Residential Lands at Coolagad, Greystones, Co. Wicklow

Infrastructure Report

Cairn Homes Properties Limited

Project number: 60641912
60641912-ACM-XX-00-RP-CE-10-0001

March 2022

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	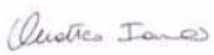		
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Revision History

Revision	Revision date	Details	Authorized	Name	Position
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1. Introduction

1.1 Background

AECOM have been appointed by Cairn Homes Properties Limited to prepare the civil infrastructure design in support of a planning application submission to An Bord Pleanála for a proposed Strategic Housing Development (SHD) on lands located in Coolagad, Greystones, Co. Wicklow.

This report will detail the pre-planning consultation, the proposed R761 upgrade works, and the existing and proposed surface water, foul sewer and watermain infrastructure for the proposed development. A separate Flood Risk Assessment has been undertaken and included under separate cover.

1.2 Existing Site

The site is located to the west of the R761 Rathdown Road, north of the Gate Lodge; north and west of Coolagad House, Temple Carrig School, Gaelscoil na gCloch Liath and Greystones Educate Together National School. The lands are bounded by Waverly Avenue and Seagreen Park residential areas to the east. Templecarrig Lower is located to the north of the lands and Kindlestown Upper to the west.

Refer to Figure 1.1.1 below for the location of the site.

Figure 1.1: Site Location (extract from Google Earth)

1.3 Site Topography

The site is steeply sloping with the terrain falling from 90mOD at the western boundary to 39mOD at the R761 Rathdown Road on the eastern side. Towards the south-western extremity of the site, it reaches the highest point of 95mOD. Most of the land slopes moderately at gradients in the range of 1:12 and 1:15 but there are steeper parts of the site with slopes of up to 1:6 which are located toward the higher side of the southern portion of the site.

The site is located to the north-east of Kindlestown Hill with a local stream originating within the site boundary providing drainage for this hill that ultimately discharges towards the east. Please refer to Section 3.1 for analysis of the catchment contributing to this stream.

It should also be noted that in addition to this stream, surveying works carried out by Enviroguide have identified some springs that are located within the site boundary, these are discussed in more detail in Section 3.2 below.

1.4 Proposed Development

The proposed development will consist of:

- 586 residential units including:
  - 351 two storey houses (207 no. 3 bed, 140 no. 4 bed, 4 no. 5 bed) comprising detached, semi-detached and terraced units
  - 203 no. apartments (65 no. 1 bed, 123 no. 2 bed, 15 no. 3 bed) provided within 6 no. blocks ranging from three to four-storey (over basement) with residential amenity facilities.
  - 32 no. duplex units within 2 no. three-storey blocks (16 no. 2 bed and 16 no. 3 bed units)
- c. 5,192 sqm of communal open space is provided to serve the proposed apartment/duplex units.
- Community building (single storey) of 392 sq.m. with 29 car parking spaces, including changing rooms and a multipurpose room.
- Creche building of 734 sq.m. with 21 car parking spaces
- A new vehicular entrance, with signalised junction and pedestrian crossings, will be provided off the R761 (Rathdown Road). The new junction will be linked to the existing signalised junction at Blacklion Manor Road / Redford Park which has a planned upgrade by Wicklow County Council. Cycle lanes will be provided along this section of the R761 on both sides. A footpath will also be provided on its western side. Car parking will be provided to the east of the R761, in the front of Redford Cemetery.
- The new access will provide a distributor road as part of the long-term objective to provide a northern access route from Greystones to the N11.
- Car and bicycle parking spaces are provided as follows:
  - 702 on curtilage car parking spaces for the houses; 206 car parking spaces at basement level and 5 at surface level for the apartments; and 32 spaces for the duplex units and 10 visitor spaces at surface level.
  - 22 motorbike parking spaces.
  - 436 resident and 118 visitor bicycle parking spaces are proposed in a mix of basement and surface levels for the apartment blocks and duplex units; 12 bicycle spaces are proposed for the creche, 12 for the community centre and 10 at the sport field.
- The development also includes site development infrastructure, a hierarchy of internal streets including bridges, cycle paths & footpaths; new watermain connection and foul and surface water drainage; the development also provides for the construction of a new public foul sewer along the R761/R762 from the site entrance as far as the R762 in front of St. Kevin's National School, Rathdown Road, Greystones.
- c.10.43ha open space to include a sport field, a MUGA, private, communal and public open spaces incorporating an existing stream, formal and informal play areas, and new boundary treatments.
- ESB substations/switchrooms, lighting, site drainage works, and all ancillary site development works above and below ground.

1.5 Ground Investigations

Ground investigations were carried out in September 2021 by Site Investigation Ltd (S.I.) (Report No. 5868), which is enclosed under separate cover.

As part of the trials, the following tests have been carried out:

- Cable Percussive Boreholes.
- Rotary Coreholes.
- Trial Pits.
- Dynamic Probes.
- Infiltration Tests.
- Groundwater monitoring.
- Permeability Tests.
- California Bearing Ration (CBR) Tests.

The soils encountered within the shallow ground of the proposed site were generally classified as sandy gravelly silty clay with cobbles and boulders while the deeper ground conditions recorded mainly cohesive clay soils, however, sand and gravel strata were also recorded at various locations across the site. No bedrock was encountered across the site.

Infiltration testing undertaken within the subject site did not record a measurable infiltration rate from the soils. It is therefore assumed that the proposed site will not be suitable for infiltration.

A number of CBR tests have been undertaken within the subject site, which have recorded bearing strengths of between 8.0% and 12.8%.

For details on groundwater vulnerability, please refer to the Hydrogeology Assessment Report by Enviroguide Consulting.

For further details on the site investigations undertaken, please refer to the S.I. Site Investigations Report No. 5868.

2. Pre-Planning Consultations

2.1 Irish Water (PCEF)

A Pre-connection enquiry has been submitted to Irish Water to estimate the impacts that the proposed development would have on the existing wastewater network. A Confirmation of Feasibility (CoF) was received from Irish Water outlining that a Wastewater Connection is feasible, subjects to infrastructure upgrades extracted below.

> *Upgrades are required in the area. A study is needed to determine the extent of upgrades required to the network and the Victor Road PS. Connection point to be determined as part of study.*

Refer to Appendix A for the Irish Water Confirmation of Feasibility.

The proposed connection point at PCEF stage was located in Redford Park as illustrated in Figure 2.1 below.

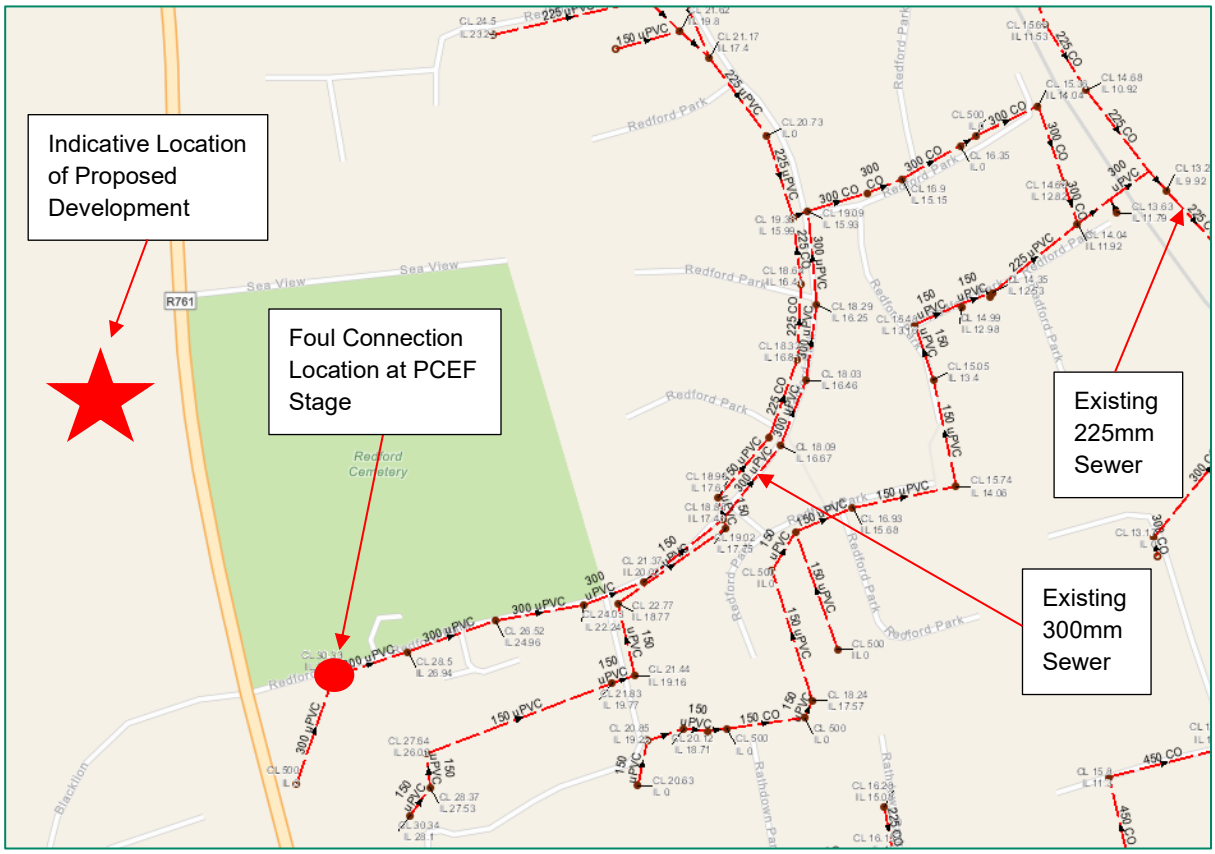

Figure 2.1: Proposed Foul Connection at PCEF Stage

Following liaison with Irish Water and Wicklow County Council, it has been noted that in the past number of years, flooding of the existing wastewater network is occurring in Redford Park.

AECOM have reviewed the existing foul water network in the area and have identified a new connection location into an existing 375mm combined sewer that flows eastwards in Victoria Road, which is currently flowing towards the existing pumping station. Refer to 2.2 for the location of the newly proposed foul water connection.

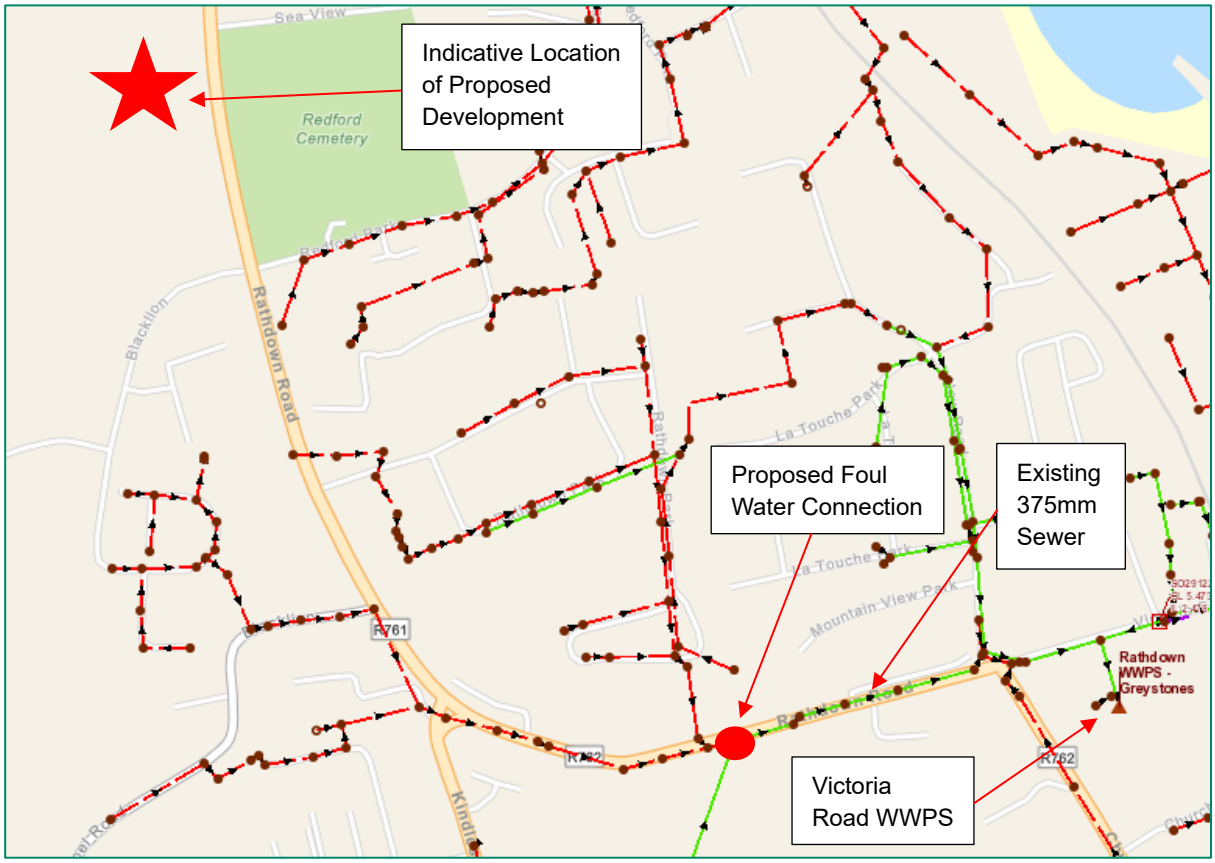

Figure 2.2: New Foul Water Connection in Victoria Road

AECOM have issued the required drawings to Irish Water to seek a Statement of Design Assessment (SODA), for the foul water and watermain networks for the proposed development. The SODA was received on the 22 of February 2022 with a corresponding CDS number of CDS20005105.

2.2 Wicklow County Council (WCC) Pre-planning Opinion

The Wicklow County Council's pre-planning opinion (ref: SHD- 20/139) dated 27th January 2021 outlined the opinions relating to the following areas.

1. Core Strategy / Housing.
2. Compliance with Zoning Objectives.
3. Density of Development.
4. Design Quality.
5. Public Open Space.
6. Private Open Space.
7. Childcare / Community.
8. Schools.
9. Phasing.
10. Roads and Accessibility.
11. Services.
12. Taking in Charge.
13. Environment Impact Assessment / Appropriate Assessment.

Please refer to Appendix B for the WCC Opinion.

The Opinion has reference the WCC internal report prepared by the Senior Executive Engineer of the Greystones Municipal District (Ruairi O'Hanlon), dated 20th January 2021 which outlines recommendations for the proposed development regarding Drainage and Road Infrastructure. Please refer to Appendix C for the full report (ref: SHDPP20139 Coolagad).

The recommendation given by the Senior Executive Engineer was a refusal and reasons are summarised below:

1. **Wastewater** – Major deficiencies within the Irish Water public sewer network of Greystones, noted in the report "*Wicklow Waste Water Network, Survey and Upgrade – Greystones, Final Report*", dated 6th July 2018 (ref: W3182-001). Upgrades to the network would be required to service the proposed development.
2. **Stormwater** – The proposed development would represent a flood hazard to the properties at downstream. Currently the stream through the site, as well as the spring sources and drainage ditches convey surface water runoff to culverts that are piped through Redford Park and Rathdown Park. This existing culvert is at limited capacity and poor quality constructed, resulting in flood event in Redford Park on several occasions. Also, consideration to be given to the surface water runoff from the Coolagad hill to the west of the site.

The above items have been reviewed by AECOM and addressed in Section 3 and Section 4 of this report.

2.3 An Bord Pleanála Pre-planning Opinion

On the 23rd February 2021, a Pre-Application Consultation meeting was held between An Bord Pleanála (ABP), the Design Team and the Local Authority (WCC) to discuss the key items for the proposed development.

In the ABP Opinion dated March 2021 (ref: ABP-308945-20), ABP have subsequently highlighted that the documents submitted as part of the Pre-Planning submission required further consideration in terms of:

1. Design and Layout
2. Water Services
3. Transportation

The issues relating to Water Services are listed below:

- *Further consideration/amendment of the design of storm water management proposals. A site-specific Flood Risk Assessment should be submitted. Further consideration of the concerns outlined in the report of Wicklow County Council Greystones Municipal District Engineer dated 20th January 2021;*
- *Further consideration / amendments of the documents as they relate to foul water drainage proposals to service the development. The documents should provide details of necessary upgrade works required to facilitate the development to include, inter alia: plans and particulars, having regard to the wastewater network constraints raised by Irish Water in their report dated 18th January 2021.*

Please note that a site-specific Flood Risk Assessment has been prepared by AECOM and submitted under separate cover. Please refer to AECOM Report 60641912-ACM-XX-00-RP-CE-10-0002 Flood Risk Assessment.

2.4 WCC Engagement post Tripartite Meeting

On the 31st August 2021, AECOM engaged with Wicklow County Council to discuss:

- Preliminary Traffic Modelling
- Current Site Layout
- Existing Drainage Onsite
- Existing Local Network Sewer Capacity

Please refer to Appendix D for minutes of the meeting.

3. Proposed Surface Water Drainage

3.1 Upstream Catchment Analysis

As part of the report forwarded by the Senior Executive Engineer of the Greystones Municipal District, in response to the Pre-Planning submission, it was highlighted:

"*Whilst all the SuDS measures employed throughout the proposed development are noted, not all sources of surface water have accurately been accounted for. Large volumes of surface water runoff are received by this site from Coolagad Hill itself. No mention of this has been included in the design other than to show a cut-off ditch along the western boundary. This cut off ditch will simply intercept and transport surface water runoff from all the lands at a higher elevation, west of the site, straight to the stream through the site, without any attenuation measures. This will vastly increase the amount and rate of runoff going to the stream as the possibility of infiltration on the subject site would now be lost. This will therefore increase the volume and flow rate of water going through the already deficient culvert through Redford and Rathdown Parks.*"

In order to provide a response to the above, AECOM have carried out a Catchment Analysis of Kindlestown Hill to:

- assess the extent of catchment whose overland flows will no longer be able to drain across the subject site due to the development;
- estimate the Qbar currently discharging into the existing stream, and;
- propose an attenuation strategy for the upstream overland flow such that discharge to the stream is limited to the existing Qbar.

3.1.1 Assessment of Contributing Catchment

To calculate the existing Qbar, it was necessary to estimate the overall contributing area that is currently discharging overland towards the western boundary of the subject site. By reviewing the Topographical Survey and the OSI information, it was possible to estimate an overall contributing area of approximately 36ha, refer to Figure 3.1 for the extent of the estimated upstream catchment area impacting the proposed development.

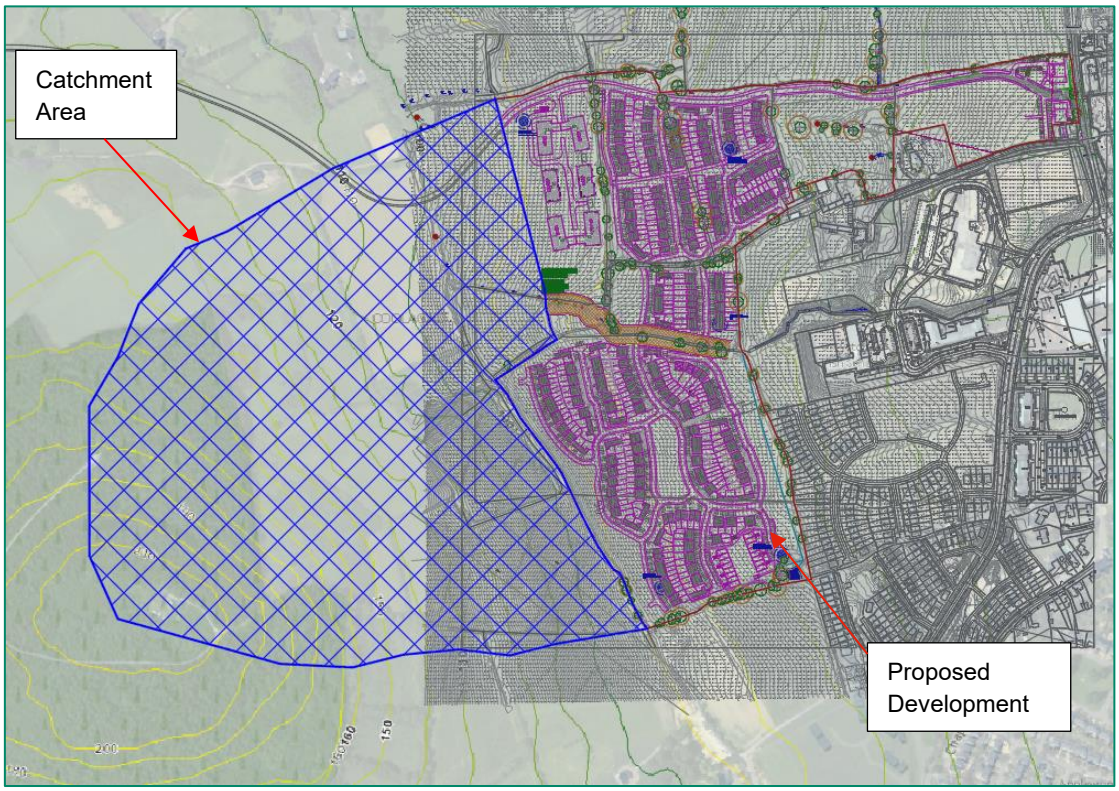

Figure 3.1: Extent of the estimated Catchment Area

From the top of Kindlestown Hill, approx. level of 210m, to the lowest level at the western boundary of the site, approx. 82m, the existing ground is sloping at approximately 1 in 5.

3.1.2 Qbar Currently Discharging to Existing Stream

As part of the proposed surface water drainage design for the development, flows from the upstream catchment will need to be intercepted and redirected to the existing stream within the subject site as they can no longer drain across the lands of the subject site. To minimise the risk of impact on downstream locations and to control the volume and flow rate of stormwater draining through the existing culvert in Redford Park and Rathdown Park, it is proposed to limit the allowable discharge rate into the stream for this upstream catchment area.

The allowable discharge rate has been determined by calculating the area which is currently draining towards the existing stream and determining its associated QBar. Refer to Figure 3.2 below for the extent of this area (highlighted in red).

The QBar for the catchment area draining to the stream was calculated using the www.uksuds.com greenfield runoff estimation tool and is 116.5 L/s for an area of 18.1ha. Please refer to Appendix E for this calculation sheet.

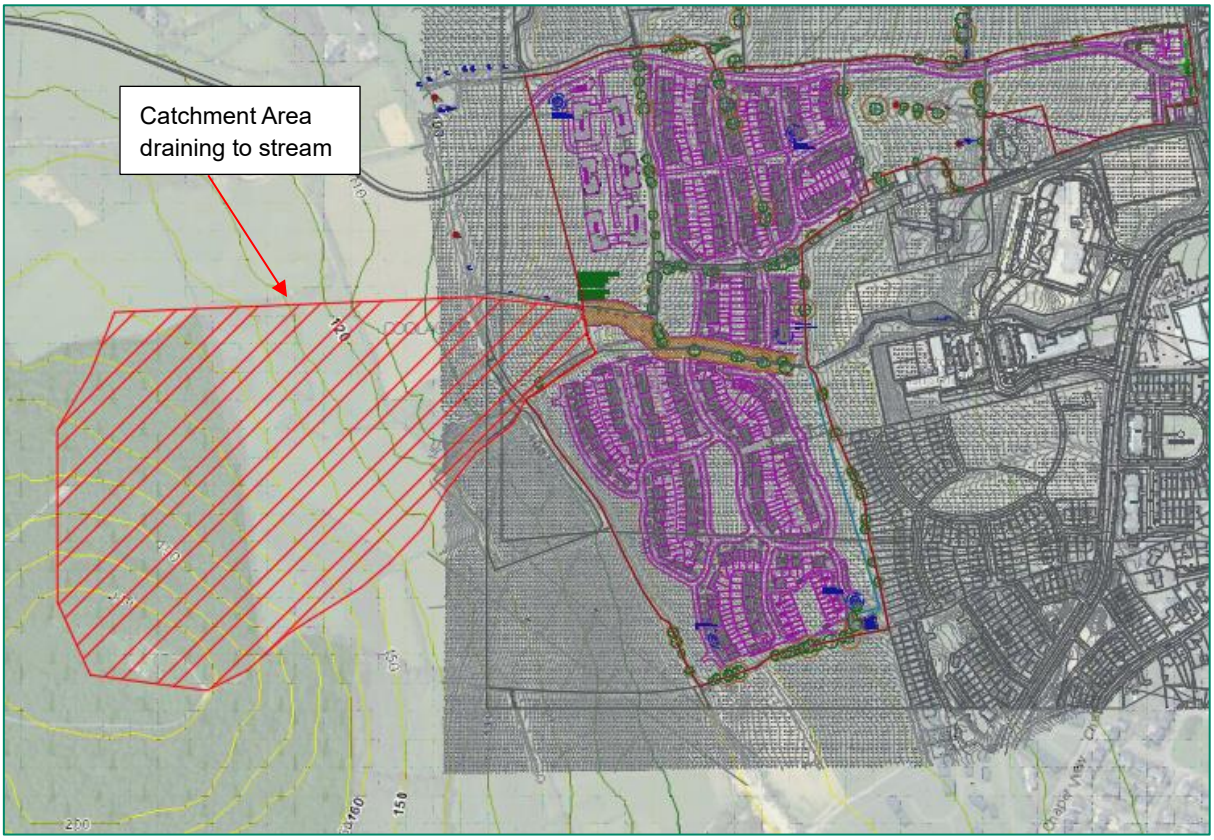

Figure 3.2: QBar Limiting Discharge Area

3.1.3 Upstream Attenuation Strategy

For the design of the proposed mitigation measures to prevent flooding occurring within the site and to minimise the risk of impact on further downstream locations, the upstream contributing catchment was broken up into 3 no. sub-catchments, refer Figure 3.3.

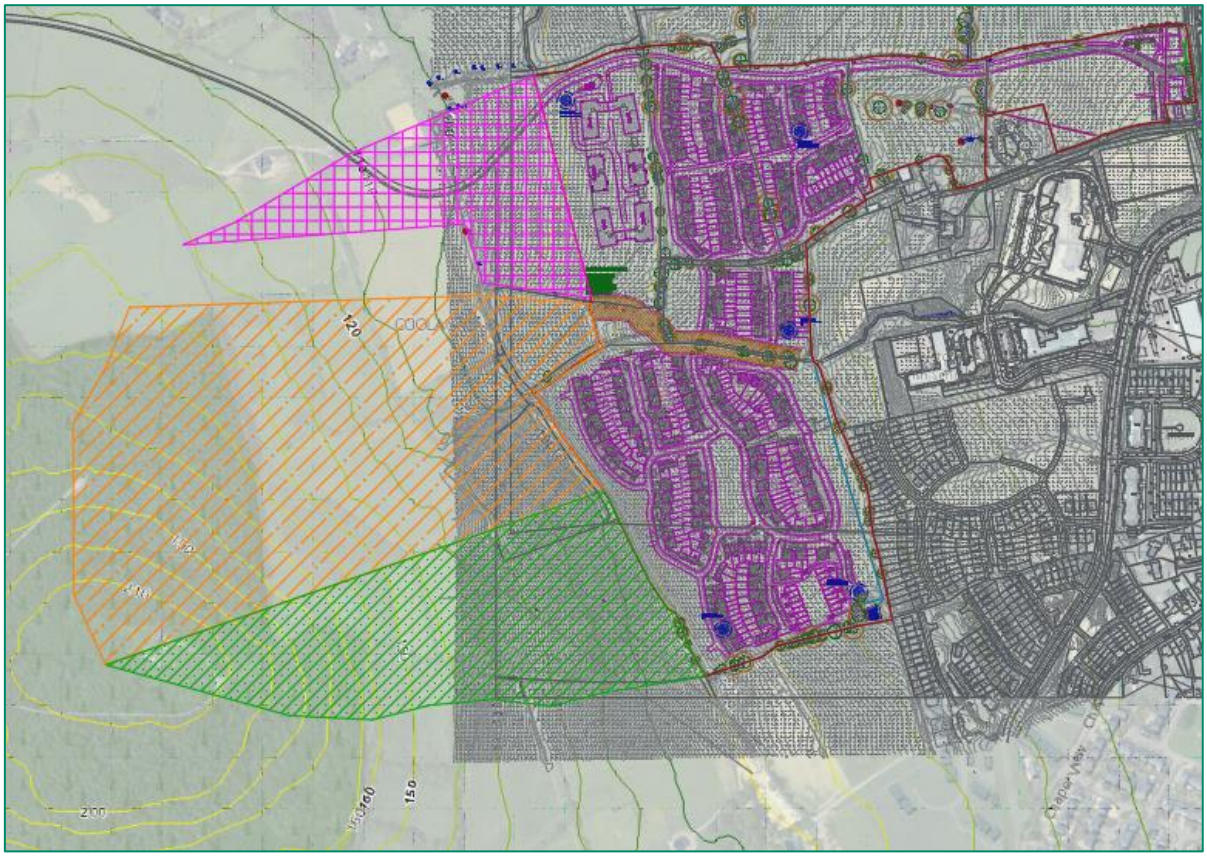

Figure 3.3: Overland Flow Sub-Catchments

It is noted that the total area of the sub-catchments does not add up to the overall contributing catchment area of 36ha with 2.9ha of this area missing from the calculations above. As can be seen in Figure 3.2 and Figure 3.3 above there is a section of the catchment that is currently draining into the existing stream that flows through the site. The estimated discharge rate from the 2.77ha land is approx. 17.8l/s.

Using the topographical information available, the allowable discharge from each of these sub-catchment areas was taken as a percentage of the total of the 3 no. areas as set out below in Table 1 below.

Table 1. Overland Flow Sub-Catchment Limiting Discharge

Highlighted Area	Area (ha)	Area as % of Total Sub-Catchment Area	Allowable QBar (L/s) from Limiting Discharge of 116.5 L/s
Magenta Area (OSC 1)	4.9	14.8	17.2
Orange Area (OSC 2)	18.6	56.2	65.5
Green Area (OSC 3)	9.6	29	33.8
Totals =	**33.1**	**100**	**116.5**

Note: OSC stands for Overland Sub Catchment

Therefore, the estimated total flow from the overland flow sub-catchment is 134.3 l/s.

It is proposed to maintain the current flow paths from the upstream catchment where possible with flows captured within swales along the western boundary of the site before discharging into proposed concrete attenuation system tank, prior to entering the existing stream or proposed site drainage. See AECOM drawing no. 60641912-ACM-XX-00-DR-CE-10-0521 & 0522 for details on the proposed overland flow catchment design.

AECOM have modelled the proposed overland flow surface water drainage network, to ensure that the discharge will be restricted to the associated greenfield runoff rate, calculated in Table 1 above, and that sufficient attenuation storage will be provided to achieve this.

The Site Investigations carried out on site have identified that the site presents a Soil Factor Type 4 (which indicated a low permeability property). Soil Factor Type 4 equates to a value of 0.47 (47%), which has been use for the QBar calculation of the overall limiting discharge (please refer to Appendix E).

The proposed storm water network has been designed using Innovyze Microdrainage software in accordance with the Greater Dublin Strategic Study (GDSDS) design guide. A model was developed using a M5-60 value of 18.000 and a Ratio R of 0.267, which is based on the Met Eireann rainfall data for the site location, please refer to Appendix F for the Met Eireann rainfall data for the subject site. A return period of 5 years was used throughout the initial sizing of the pipe networks and it should also be noted that a time of entry of 15mins was used in the calculations, due to the distance the stormwater would have to travel from the highest point on Kindlestown Hill, which steeply slopes to the western boundary of the site (approximately 500m)

The surface water network was simulated with all runoff from the upstream catchment area taken as 47% impermeable. This value is seen as suitable for a SOIL Type 4. The related SPR value is 0.47 and with the upstream catchment made-up of greenfield areas, some stormwater will infiltrate into the ground or evaporate before it reaches the western boundary of the site. The proposed attenuation systems' storage capacity and related flow control devices are set out below in Table 2 with these required to ensure no flooding occurs for the 1 in 100-year event plus 20% climate change allowance. Refer to Appendix G for the upstream catchment surface water calculations.

Table 2. Overland Flow Sub-Catchments (OSC) Storage Structures & Flow Control Devices

Area	Storage Structure	Storage Capacity (m3)	Flow Control Device	Discharge Flow (l/s)	Discharge Point
OSC 1	Pond	744.6	Weir	17.2	Existing Stream
OSC 2	Dry Swales Systems	875.8	Weir & Overflow Pipe	65.0	Existing Stream
OSC 3	Concrete Tank	2,817.5	Hydro-brake	33.8	On-site Drainage

3.1.3.1 Overland Flow Swales

Due to the topography of the site and the steep fall from land that is higher to the west, a series of swales along the western boundary is proposed to intercept any overland flows that may be generated from higher up the slope and which could potentially constitute a flood risk to the development.

The proposed swales are of various trench depths ranging from 0.925m to 1.6 m with a 1:100 base slope and are provided with 1 in 4 side slopes with the top of bank planted with a hedge to provide an additional amenity / biodiversity component, whilst also serving as an additional flow barrier / transpiration source. The swales have been proposed to flow along the topographical lines to connect into the existing watercourse, which would serve to replicate the existing flow paths.

Each of these swales have been designed through Innoyze Microdrainage with a weir flow control device to provide storage in the system during the extreme rainfall events before it enters the final attenuation system. The proposed weir will limit the flow to the next swale system to 25l/s and an additional layer of stone will be provided at the transition between the swales, in order to decrease water velocity and minimise the risk of erosion. Please refer to Figure 3.4 for typical section of the proposed overland flow swale.

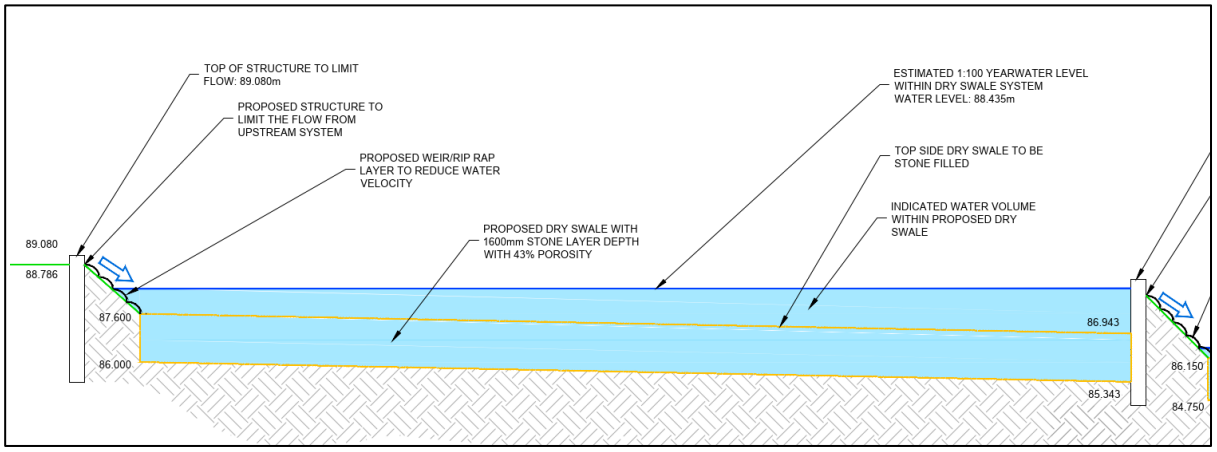

Figure 3.4: Typical section of the proposed overland flow swale

Please refer to AECOM drawing no. 60641912-ACM-XX-00-DR-CE-0527 for a full detail.

3.1.3.2 Upstream Attenuation Systems

Due to the high volumes of water which enter the site from the upstream catchment during the 1 in 100-year event the swales on their own are not sufficient to deal with these flows. Therefore, additional storage volume is required for sub-catchment Area 1 and Area 3 before the flows are discharged into the existing watercourse and site drainage. This section will detail each of the proposed attenuation systems and their flow control device for the upstream sub-catchment areas.

Overland Sub-Catchment Area 1:

The final attenuation system proposed for this area is a storage pond. This storage pond in addition to providing attenuation storage will also provide additional biodiversity to the area. This pond is designed to have a maximum Top Water Level (TWL) of 80.049m.

Using the Innoyze Microdrainage software an attenuation storage capacity of 560m^3 is required to ensure no flooding occurs on site for the 1 in 100-year event plus 20% climate change. This gives a TWL of 80.049m during this event. In the event of a heavy rainfall that will increase the modelled water level, a weir is proposed at a level of 80.100m and direct into the existing stream.

Overland Sub-Catchment Area 3:

The final attenuation system proposed for this area is a concrete attenuation tank that has been designed for the 1 in 100-year event plus 20% for climate change. The proposed tank is 3.5m deep, providing a total of 2,537m³.

The discharge from this tank into the main site drainage network will be controlled using a Hydro-brake flow control device that will limit the flows to 39 L/s.

3.2 Existing Site Surface Water Drainage

There are several springs located within the subject site and a stream which originates within the subject site and drains through the centre of the site in an easterly direction.

In October 2020, AECOM carried out a site visit to estimate the extent of the existing stream on site and to assess the existing springs onsite. The following was noted:

- One spring with water running from the north-west corner of the subject site, flowing eastwards, follows the existing hedgerows located at the northern perimeter, as far as the north-east corner of the development, and finally discharges into the existing culvert.
- Another spring was identified within the heart of the proposed open space to the north of the site. During the site visit, a high-water table was encountered. The water from the spring is currently flowing eastwards via an existing culvert. It is estimated that the culvert is discharging into an existing surface water manhole prior to discharge to the existing network, but the existing record drawings obtained for the subject area have not identified any surface water network in the area.

Further investigations were carried out on site on the 31st March 2021 by Enviroguide Consulting and further drainage infrastructure has been found within the subject site, as follows:

- A 750mm diameter culvert, approximately 6.1m long, has been identified along the existing stream that flows through the site. The culvert appears to facilitate access between the existing fields either side of the stream and is located approximately 9.9m from the eastern boundary of the subject site. Refer to Figure 3.5 below for details.

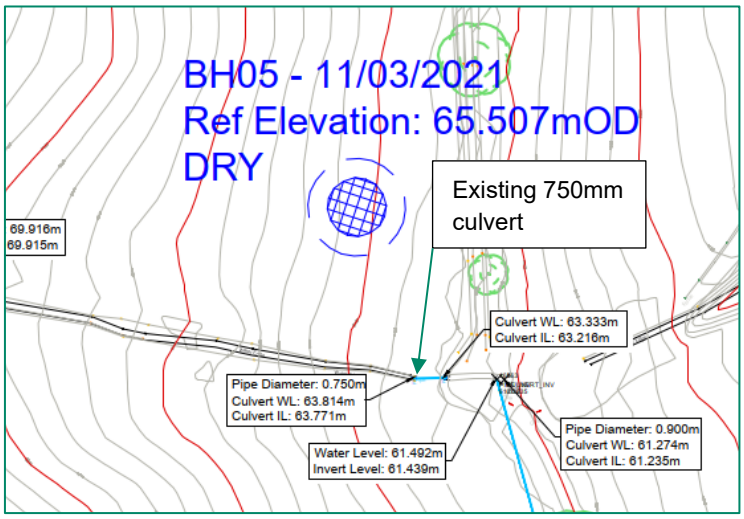

Figure 3.5: Location of the Existing 750mm Culvert

- A surface water pipe with has been identified draining from, a natural depression located in the south eastern corner of the subject site. The pipe drains in a northerly direction discharging into the existing stream, east of the abovementioned 750mm culvert section.
- There are also 2 no. culverts located in the eastern portion of the site, however their alignment and sizing are unknown. According to a neighbour, one of the culverts drains from within the subject site, at the north eastern corner of the Evans property, and drains in a south easterly direction, traversing the third party property and back into the subject site, before it exits the subject site again. It is noted that further CCTV survey will be carried out to identify the identified culverts. Please refer to Figure 3.6.

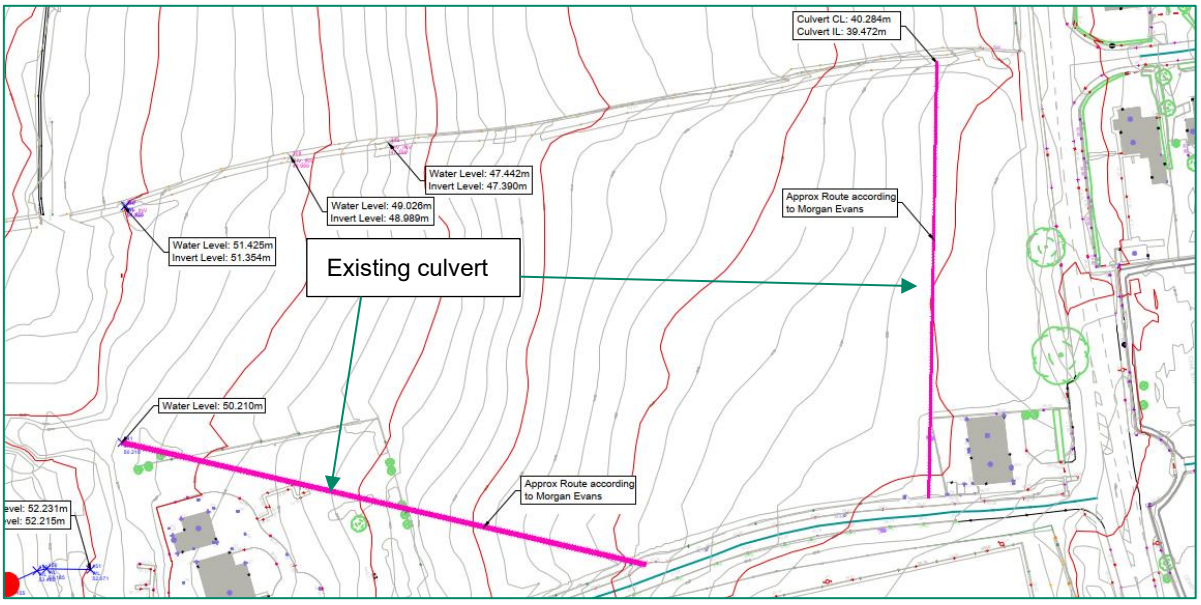

Figure 3.6: Location of the 2 Culvert Identified in the Eastern Portion of the Development

The survey, carried out on site by Enviroguide, noted the second culvert drains from the site boundary at the north eastern corner of the subject site and drains in a southerly direction, before it exits the subject site approximately 75m east of where the other unknown culvert exits the site. It is believed that this is the culvert which drains the spring located in the north-west corner of the subject site that flows along the existing hedgerow along the northern perimeter of the site.

It is unknown as to whether these 2 no. culverts link up further downstream, however it is worth noting that an existing 450mm diameter surface water pipe has been identified approximately 65m south of this location.

Refer to Appendix H for the Enviroguide Drainage Survey.

3.3 Proposed Site Surface Water Drainage

With no public record of the existing surface water networks identified within the site area or along the R761 roadway, it is proposed to maintain the current flow paths from the site and drain surface water runoff from the proposed development to either the existing stream within the site, a proposed wetland area or the existing underground pipe identified in the Enviroguide survey. Refer AECOM drawing no. 60641912-ACM-XX-00-DR-CE-10-0501 to 0506 for the proposed on-site drainage and discharge locations.

AECOM have modelled the proposed on-site surface water drainage network to ensure that the discharge will be restricted to the associated greenfield runoff rate and that sufficient attenuation storage will be provided to achieve this.

To help determine the allowable discharge rates for the different areas, the site was divided up into four main sub-catchment areas, refer Figure 3.7.

Figure 3.7: Main Site Drainage Sub-Catchment Areas

The QBar for each sub-catchment was calculated using the www.uksuds.com greenfield runoff estimation tool with a breakdown of each of these areas provided in Table 3 below.

Table 3. QBar Discharge for each Site Sub-Catchment Area

Highlighted Area (Figure 3.7)	Area (Ha)	QBar (L/s)
Magenta Area (SSC 1)	0.86	5.5
Red Area (SSC 2)	7.93	51.0
Blue Area (SSC 3)	4.79	30.8
Orange Area (SSC 4)	4.76	30.6
Total	**18.34**	**117.9**

Note: SSC stands for Site Sub-Catchment

The calculation input parameters for the QBar calculation are as follows:

- Site Area of each Sub-Catchment;
- Soil Type 4 (SPR value of 0.47); and
- The Standard Annual Average Rainfall (SAAR) of 895mm.

Based on the equation developed by the Institute of Hydrology (Report 124 "Flood Estimation for small catchments, 1994):

$QBAR_{rural} = 0.00108AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$

Where:

- $Qbar_{rural}$ is the mean annual flood flow from a rural catchment in m^3/s;
- AREA is the area of the catchment in km^2;
- SAAR is the Standard Average Annual Rainfall for the period from 1941 to 1970 (mm);
- SOIL is the soil index.

Refer to Appendix I for QBar calculation reports.

Similarly, a Soil Factor Type 4 has been considered suitable for the on-site conditions given the steeply sloping characterises of the site.

The proposed on-site storm water network has been designed using Innovyze Microdrainage software in accordance with the Greater Dublin Strategic Study (GDSDS) design guide. A model was developed for the proposed development using a M5-60 value of 18.000 and a Ratio R of 0.267, which is based on the Met Eireann rainfall data for the site location, please refer to Appendix F for the Met Eireann rainfall data for the subject site. A return period of 5 years was used throughout the initial sizing of the pipe networks.

The surface water network was simulated with all runoff coming from roofs and impermeable areas from the site taken as 100% impermeable and limited to the QBar rate via hydro-brake flow control devices. The proposed site attenuation storage capacities and their related QBar discharge rates are set out below in Table 4. These storage capacities are required to ensure that no flooding occurs on site for the 1 in 100-year event plus 20% climate change allowance.

Table 4. On-site Attenuation Storage Requirements

Area	Manhole Reference (Calculation Output)	Minimum Storage Capacity Required (m3)	Discharge Location	QBar (L/s)
SSC 1	S110	310	Underground Pipe	5.5
SSC 2	S86	1708	Proposed Wetland	57.1
SSC 4 & 3	S172	389	Existing Stream	55.3
Total		**2,407**		**117.9**

One additional attenuation tank will be provided within site sub-catchment 4 to provide the additional storage for the final tank for SSC 4 & 3, it should also be noted that this additional tank will collect the 33.8 L/s discharge from the overland flow catchment.

The proposed surface water drainage networks have been designed with particular attention to the flood exceedance routes, in case of rainfall events that exceed the 1:100 year storm event, with the water being directed away from buildings.

Please refer to AECOM drawing 60641912-ACM-XX-00-DR-CE-10-550.

Refer to Appendix J for the surface water network calculations.

3.3.1 Proposed SuDS (Sustainable urban Drainage Systems)

The proposed development has been assessed in relation to Sustainable Urban Drainage Systems (SuDS) in accordance with the guidelines of the Greater Dublin Strategic Study (GDSDS) and the SuDS Manual CIRIA C753. The aim of the proposed drainage system is to replicate the natural characteristics of rainfall runoff, minimising the environmental impact from rainfall events by reducing the runoff leaving the site for small rainfall events.

Refer to AECOM Drawing No. 60641912-ACM-XX-00-DR-CE-10-521 to 524 for the proposed SuDS measures which are detailed in the following sections.

3.3.1.1 Green Roof

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover/landscaping. It is proposed that extensive green roof will be provided for the apartment blocks located at the north-west of the site. The roof is likely to consist of an impermeable layer, a substrate or growing medium and a drainage layer (although not all green roofs require a drainage layer), refer to Figure 3.8 below for a section through a typical extensive green roof.

Green roofs are designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.

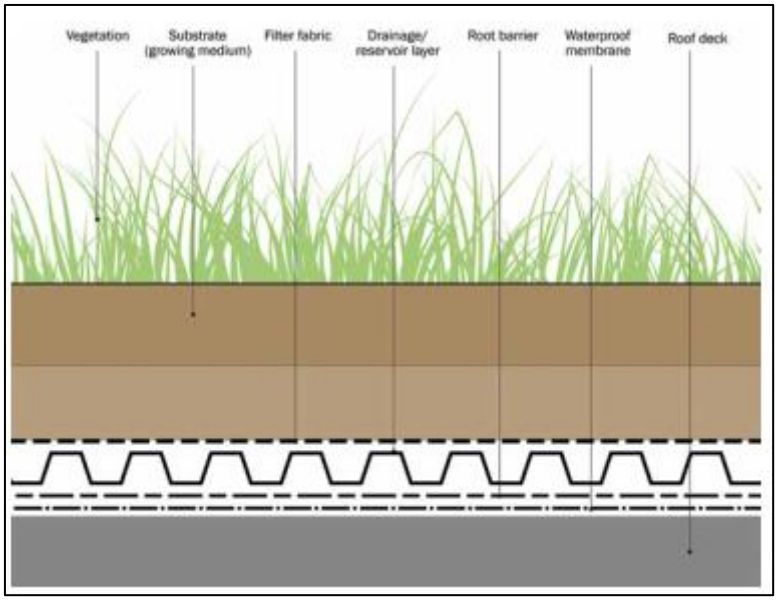

Figure 3.8: Typical Section through Extensive Green Roof (Source: CIRIA SuDS Manual C753)

3.3.1.2 Permeable Paving

Permeable paving is proposed for all the parking spaces. Porous surfacing (paving block or open graded material) which can treat rainwater, at source, and allow infiltration through to an underlying porous subbase where water can be stored within the voids of the subbase before being slowly released to the drainage collection system through natural flow via the porous medium.

These systems will allow some form of storage for small rainfall events and can result in water evaporation and adsorption in small quantities, therefore there will be less run-off from these areas in small rainfall events thus mimicking the natural response for this catchment. As well as reducing the amount of run-off from the surface, permeable paving will slow down the rate of runoff from the pavement in extreme rainfall events contributing to attenuation of flows.

In addition, permeable paving will increase the quality of water which is intercepted by the system through filtration, biodegradation, pollutant adsorption and settlement and retention of solids, also the reduction in peak flows to the outfall will enhance settlement and biodegradation of pollutants.

Refer to Figure 3.9 for an illustration of a typical permeable paving detail. Given that the proposed site is not suitable for infiltration, as discussed in Section 1.5, no infiltration has been assumed for the permeable paving systems proposed throughout the site.

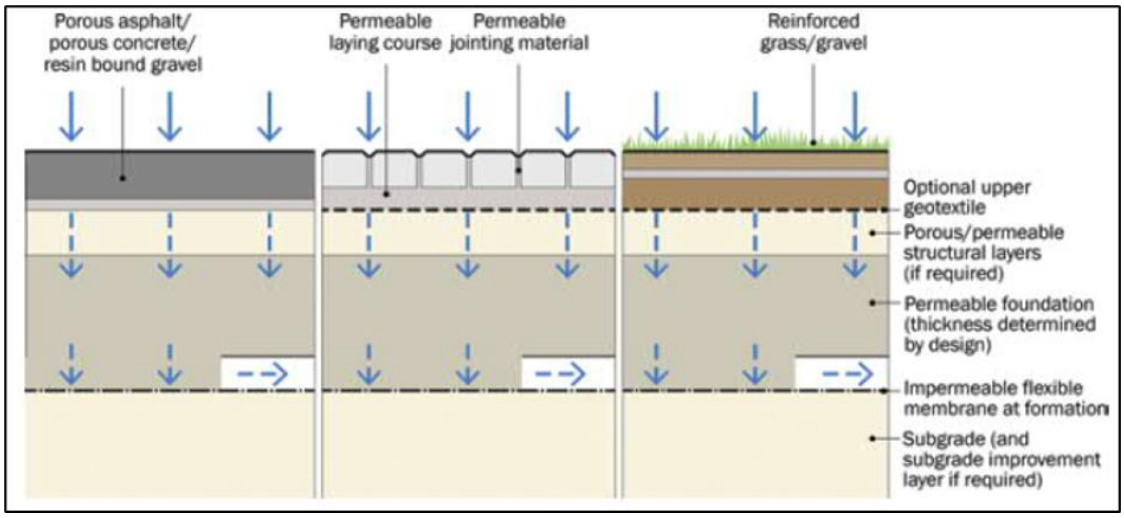

Figure 3.9: Permeable Paving System - No Infiltration (Source: CIRIA C753 SuDS Manual)

3.3.1.3 Filter Drain

Filter drains, as shown below in Figure 3.10, are shallow trenches filled with stone/gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. The stone may be contained in a simple trench lined with a geotextile, geomembrane or other impermeable liner, or within a more structural facility such a concrete trough. Filter drains can help to reduce pollutant levels in runoff by filtering out fine sediments, metals, hydrocarbons and other pollutants.

Filter drains are generally 1-2m deep, with a minimum depth of filter beneath any inflow distribution pipework and outfall collection systems of 0.5m to ensure reasonable levels of pollutant removal.

It is proposed to provide filter drains adjacent to the impermeable roads wherever possible. Given that the proposed site is not suitable for infiltration, as discussed in Section 1.5, no infiltration has been assumed for the filter drains proposed throughout the site however in dryer months it is anticipated that some infiltration will be achieved.

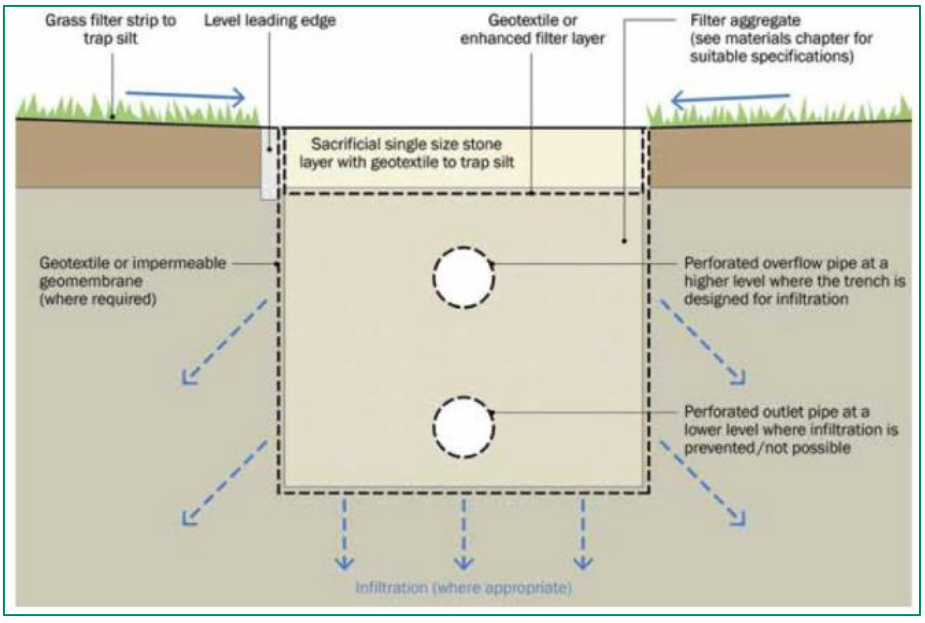

Figure 3.10: Typical Filter Drain Section (Source: CIRIA C753 The SuDS Manual)

3.3.1.4 Swale

Swales are shallow, broad and vegetated channels designed to store and/or convey runoff and remove pollutants. They may be used as conveyance structures to pass the runoff to the next stage of the treatment train and can be designed to promote infiltration where soil and groundwater conditions allow.

However, given that the proposed site is not suitable for infiltration as discussed in Section 1.5, no infiltration has been assumed for the swales proposed throughout the site. All swales will be provided with an impermeable flexible membrane to prevent infiltration.

Additional information on the proposed swales that will be used to capture the overland flows from the upper catchment and their flow control devices is provided in Section 3.1.3.1.

Figure 3.11: Various Examples of Swale Designs (Source: CIRIA C753 SuDS Manual)

3.3.1.5 Bio-Retention

The Bio-Retention proposals will provide suitable at-source interception and treatment to roof runoff. Figure 3.12 illustrates a typical bio-retention section for use adjacent to building structures. Given that the proposed site is not suitable for infiltration, as discussed in Section 1.5, no infiltration has been assumed for the bio retention systems proposed throughout the site.

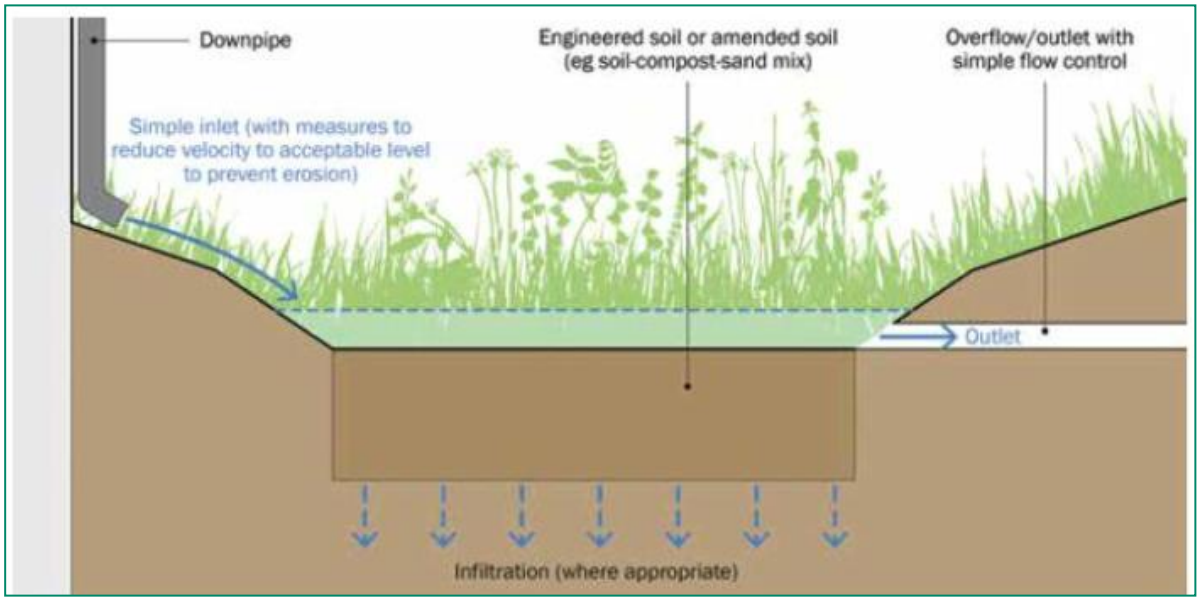

Figure 3.12: Typical Bio-Retention Section (Source: Ciria C753 The SuDS Manual)

3.3.1.6 Storage Pond

As part of the upstream attenuation strategy, a storage pond is proposed to assist in managing the discharge rate which outfalls to the existing stream. It is proposed that a pond will be provided within the landscaped area immediately south of the apartment blocks to assist in the management of overland flows. The storage pond will outfall to the existing stream at a controlled discharge rate. Furthermore, the storage pond will promote biodiversity in this area of the site.

Please refer to Section 3.1.3.2 which discusses the proposed storage pond for attenuating the overland flows in more detail

3.3.1.7 Petrol Interceptor

A Class 1 NSBE 010 bypass interceptor is proposed downstream of each of the hydrobrake systems. Petrol interceptors are widely used to avoid and prevent hazardous chemical and petroleum by-products from entering watercourses and public sewers. They should be installed close to the potential pollution source to minimise emulsification of oils and their coating of sediments.

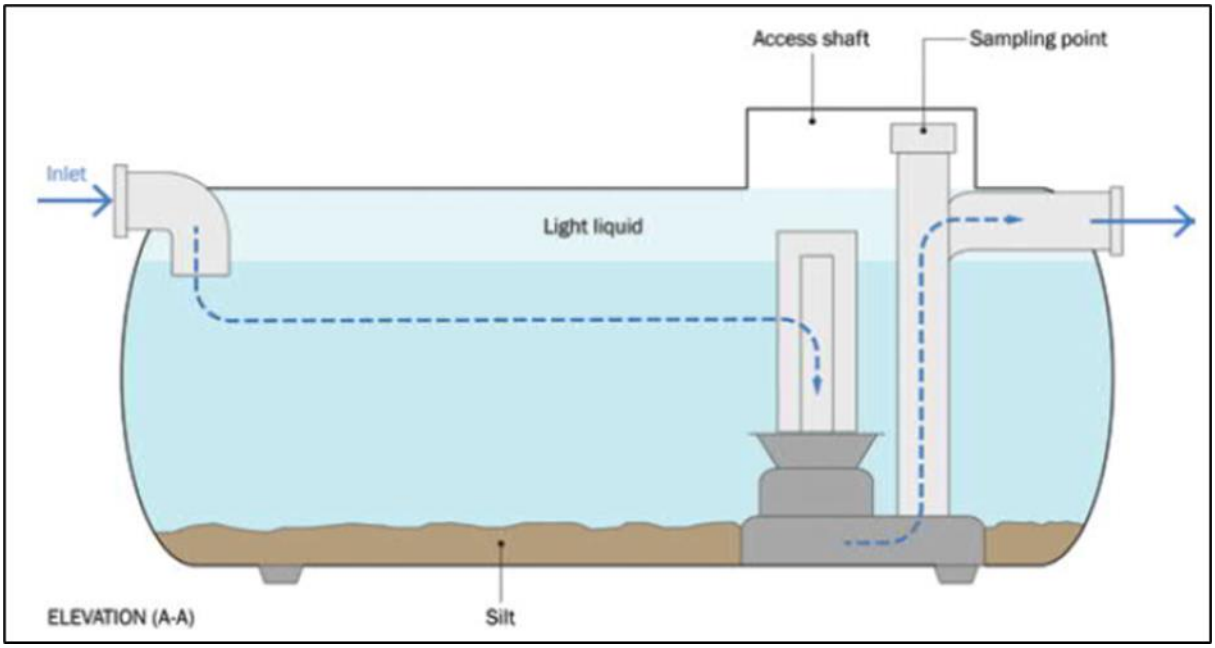

Figure 3.13: Typical Petrol Interceptor Detail (Source: CIRIA C753 SuDS Manual)

3.3.1.8 StormTech Attenuation Tanks

A series of attenuation tanks have been proposed on site to provide the required storage volume on site, prior discharging to the designed outfalls.

These will take the form of cellular storage units with approximate 56% effective storage volume and will be lined with an impermeable membrane given it has been established that the subject site is not suitable for infiltration.

The StormTech attenuation tanks proposed throughout the development, their required storage volume and the storage capacity of each tank is presented in Table 5 below.

Table 5. Proposed On-Site StormTech Attenuation Tanks

StormTech Tank & Ref. Location	Storage Provided (m^3)
Tank 1 (S110)	387.6
Tank 1a (S86)	1700
Tank 2&3 (S151)	2295
Tank 4 (S172)	652.1

Note: The StormTech Tank number is marked on AECOM Drawing No. 60641912-ACM-XX-00-DR-CE-10-0501 to 0506.

Please refer to Appendix K for StormTech tank details.

3.3.1.9 Flow Control Devices

To manage the surface water flows from the on-site network this will be primarily managed by hydro-brakes located at the discharge point of each of the attenuation tank systems, prior to the flows entering the proposed discharge points. Please refer to AECOM Drawing No. 60641912-ACM-XX-00-DR-CE-10-0501 to 0506 for the location of these points.

V-notch weirs are proposed within the swales to control the overland flow emanating from the upstream catchment. The principal function of these weirs is to throttle the discharge downstream and manage the velocity and rate of flows through the swales.

Figure 3.14 shows example of some weir flow control devices that could be implemented in the swales.

Figure 3.14: Examples of Possible Outfall Controls for the Swales

3.3.2 Water Quality Protection – Interception & Treatment

A review has been undertaken in accordance with the GDSDS to verify the required 5mm interception storage is being provided as per Sub-Criterion 1.1 from Table 6.2 GDSDS Volume 2 New Development. The provided interception volumes for each of the site sub-catchment areas are illustrated below in Table 6 to Table 8.

Where possible SuDS and interception storage will be provided at source through the permeable paving. The positioning of the attenuation tank and the quantity of interception storage provided in the tank sub-base will ensure that the interception storage presented below will capture runoff from all of the impermeable areas within the site.

Table 6. Site Sub-Catchment 1 (SSC 1) Proposed Interception Volume

Feature	Area (m2)	Interception Storage Required (m3) *	Interception Storage Provided (m3)
Roof Area	860	3.4	-
Road Area (including footways)	5766	23.1	-
Attenuation Tank **	329	-	52.6
Interception Provision =		**26.5**	**52.6**

* Based on the first 5mm of rainfall over 80% of the total impermeable area, as per the GDSDS Volume 2, New Development, Appendix E, Section E1.1.5.

** Attenuation Tank Interception provision based on the volume of stone provided within tank structure.

Table 7. Site Sub-Catchment 2 & 3a (SSC 2 & 3a) Proposed Interception Volume

Feature	Area (m2)	Interception Storage Required (m3) *	Interception Storage Provided (m3)
Roof Area	21743	87.0	-
Road Area (including footways)	15264	61.1	-
Attenuation Tank **	1260	5.0	317.5
Green Roof (Apartments) ***	2611	10.4	23.5
Interception Provision		**163.5**	**341**

* Based on the first 5mm of rainfall over 80% of the total impermeable area, as per the GDSDS Volume 2, New Development, Appendix E, Section E1.1.5

** Attenuation Tank Interception provision based on the volume of stone provided within the tank structure.

*** Interception provision based on 30mm substrate depth of extensive green roof (Bauder SB Sedum System, 30 to 40mm as specified on Bauders product data sheet, refer to Appendix L) with 30% porosity.

Table 8. Site Sub-Catchment 4 & 3b (SSC 4 & 3b) Proposed Interception Volume

Feature	Area (m2)	Interception Storage Required (m3) *	Interception Storage Provided (m3)
Roof Area	20046	80.2	-
Road Area (including footways)	14776	59.1	-
Attenuation Tank **	1956	-	466.3
Interception Provision		**139.3**	**466.3**

* Based on the first 5mm of rainfall over 80% of the total impermeable area, as per the GDSDS Volume 2, New Development, Appendix E, Section E1.1.5

** Attenuation Tank Interception provision based on the volume of stone provided within the two tank structures.

As set out in the GDSDS Table 6.3 Criterion 1 with the successful provision of 5mm of interception storage, treatment storage is not required.

3.3.3 Drainage Maintenance Inspection Checklist

Please refer to Appendix M for a typical SuDS Maintenance Inspection Checklist which includes the typical operation and maintenance requirements for the proposed SuDS measures discussed above, this is sourced from the CIRIA SuDS Manual C753.

4. Foul Water Drainage

4.1 Existing Foul Water Drainage

The existing site is greenfield at present and the existing foul drainage infrastructure is located in the R761 as indicated in the services record drawings contained in Appendix N. A Ground Penetration Radar (GPR) was carried out along the R761 (Survey ID MG38901-U), confirming the presence of the existing foul network as per the existing record drawings obtained. Please refer to Appendix N for full map of the existing record drawings obtained.

4.2 Proposed Foul Water Drainage

As discussed in Section 2.1, AECOM have reviewed the existing foul water network in the area and have identified a new connection location into the existing 375mm combined sewer that flows eastwards in Victoria Road, which is currently flowing towards the existing pumping station. Refer to Figure 2.2 for the location of the proposed foul water connection.

The proposed foul sewers have been designed in accordance with Irish Water's code of Practice for Wastewater Infrastructure and will fall by gravity into the existing 375mm combined sewer via a new 300mm pipe to be laid along the R761 and Victoria Road roadways. The proposed foul network has been modelled using Innovyze Microdrainage software and detailed calculations are enclosed in Appendix O. Refer to AECOM Drawing No. 60641912-ACM-XX-00-DR-CE-10-0501 to 0506 for the proposed drainage layout.

The estimated wastewater discharge associated with the proposed development has been based on Irish Water's Code of Practice for Wastewater Infrastructure. The design foul loading is outlined in Table 9 below.

Table 9. Estimated Foul Effluent

Use	No. of Units	Population Equivalent (PE)*	Foul Discharge (l/d)**	Dry Weather Flow (DWF) (l/s)	Peak Flow (l/s)***
Residential	619	1,672	275,880	3.19	19.14
Creche	12No. Classrooms	190	10,450	0.12	0.54
Community Building	1	5	275	0.01	0.02
Total			**286,330**	**3.32**	**19.70**

* Based on 2.7 population per house, as per the Irish Water requirements.

** Based on foul loading of 165l/p/d as per Irish Water requirement (including 10% infiltration allowance as per Irish Water recommendations).

*** Based on average peak demand factor of 3 as per Irish Water requirements (population between 1,001 – 5000)

The estimated foul water effluent generated from the site is 3.31l/s with a peak flow of 19.68l/s.

5. Water Supply

5.1 Existing Water Supply Network

There is an existing 100mm watermain running along the R761 to the east of the proposed development. Refer to Appendix N for existing record drawings.

5.2 Proposed Water Supply Network

It is proposed supply the development via a new watermain network that connects to the existing network along the R761. As part of the proposal approximately 200m of the existing 4 inch watermain is required to be upgraded up to 200mm in diameter, in line with the recommendations issued as part of the Irish Water Confirmation of Feasibility:

> *To connect this development to Irish Water's water network approx. 200m of existing 4 Inch watermain must be upsized to 200mm. The applicant will be responsible for the full cost of these upgrades.*

Please refer to Figure 5.1 for location and extent of proposed watermain upgrade.

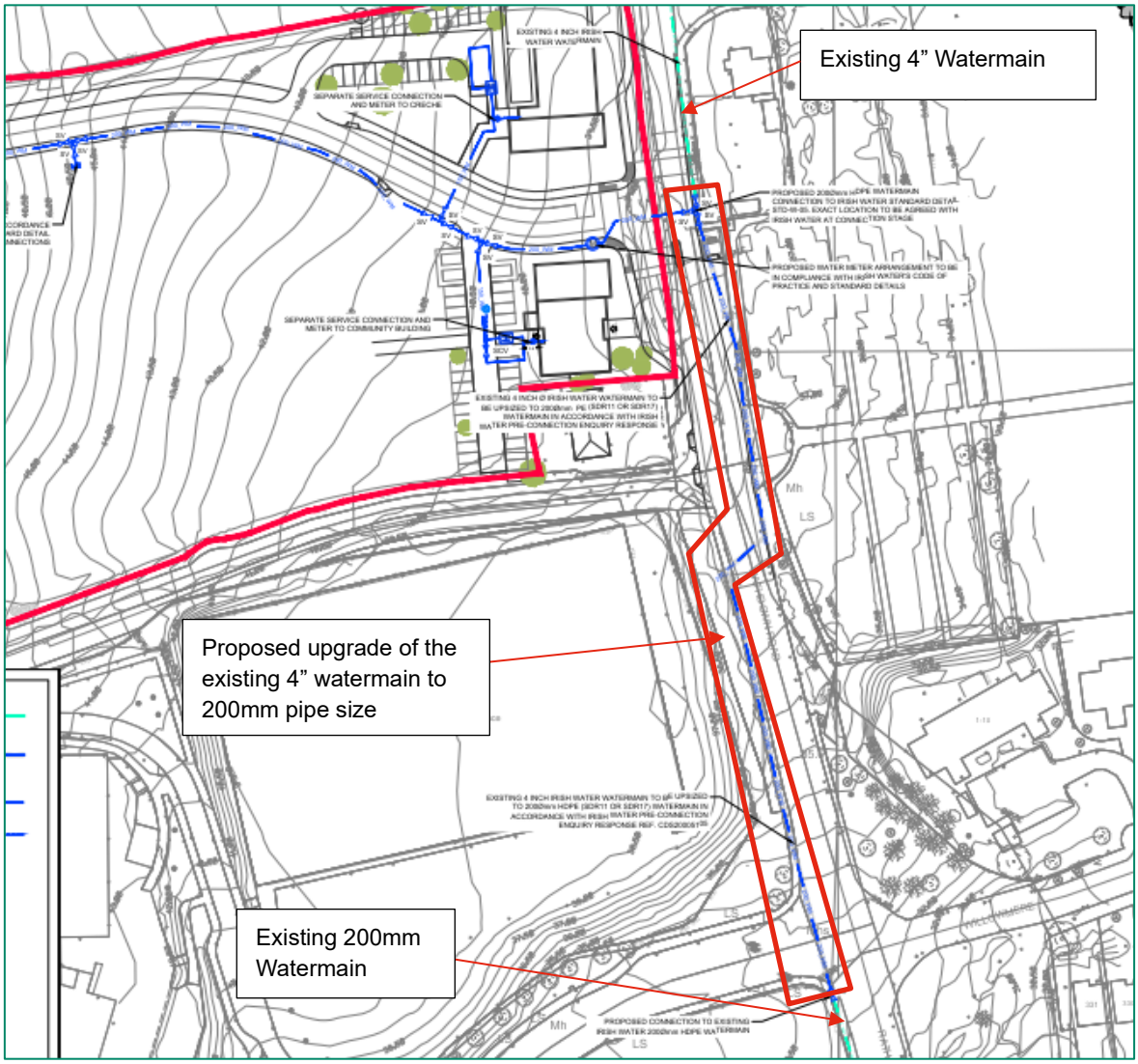

Figure 5.1: Extent of proposed upgrade works on the existing watermain (extract from AECOM drawings)

For further details on the Irish Water Confirmation of Feasibility, please refer to Appendix A.

The new internal watermain will be provided with 25mm nominal bore service connections for each of the units. The proposed watermain has been designed in accordance with Irish Water's Code of Practice for Water Infrastructure including the necessary fire hydrant and scour valve provisions. Refer to AECOM Drawing no. 60641912-ACM-XX-00-DR-CE-10-2701 to 2706 for the proposed water main layout.

The estimated water demand associated with the proposed development was based on Irish Water's Code of Practice for Water Infrastructure. The design demand is outlined below in Table 10.

Table 10. Estimated Water Demand for the Proposed Development

Use	No. Units	Population Equivalent	Flow (l/s/d)	Average Water Demand (l/s)	Peak Water Demand (l/s)
Residential	619	1,672	250.800	2.90	18.19
Creche	12 No. Classrooms	190	9,500	0.11	0.69
Community Building	1	5	250	0.01	0.02
Total			**260,300**	**3.02**	**18.90**

The estimated average water demand for the proposed development is 3.01l/s, with a peak of 18.88l/s.

Appendix A – Irish Water Confirmation of Feasibility

Matteo Iannucci

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A96T927

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Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

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

www.water.ie

7 December 2020

Re: CDS20005105 pre-connection enquiry - Subject to contract | Contract denied

Connection for Housing Development of 625 unit(s) at Coolagad, Greystones, Wicklow

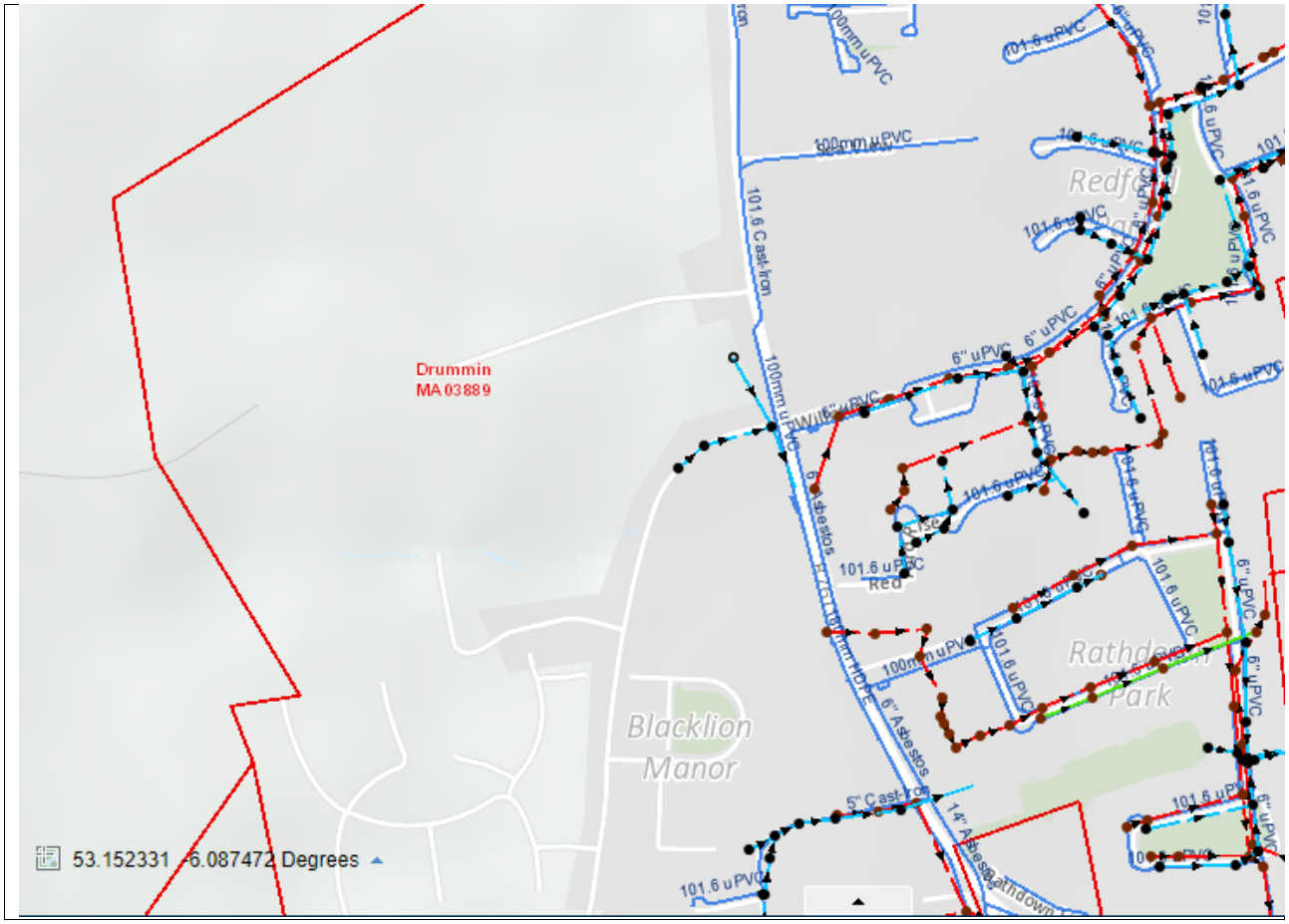
Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Coolagad, Greystones, Wicklow (the **Premises**). Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time.

SERVICE	**OUTCOME OF PRE-CONNECTION ENQUIRY** **THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.**
Water Connection	Feasible Subject to upgrades
Wastewater Connection	Feasible Subject to upgrades
SITE SPECIFIC COMMENTS	
Water Connection	To connect this development to Irish Water's water network approx. 200m of existing 4 Inch watermain must be upsized to 200mm. The applicant will be responsible for the full cost of these upgrades.
Wastewater Connection	Upgrades are required in the area. A study is needed to determine the extent of upgrades required to the network and the Victor Road PS. Connection point to be determined as part of study.

The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.

The map included below outlines the current Irish Water infrastructure adjacent to your site:



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

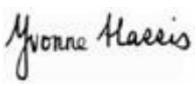
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network 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.

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.
3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

If you have any further questions, please contact Patrick O'Neill from the design team on 01 89 25250 or email patoneil@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



Yvonne Harris

Head of Customer Operations

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

www.water.ie

22 February 2022

Re: Design Submission for Coolagad, Greystones, Wicklow (the "Development") (the "Design Submission") / Connection Reference No: CDS20005105

Dear Matteo Iannucci,

Many thanks for your recent Design Submission.

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

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

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

If you have any further questions, please contact your Irish Water representative:
Name: Patrick O'Neill
Phone: 01 89 25250
Email: patoneil@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision
Foul

- COO-ACM-00-00-DR-CE-00-0501
- COO-ACM-00-00-DR-CE-00-0502
- COO-ACM-00-00-DR-CE-00-0503
- COO-ACM-00-00-DR-CE-00-0504
- COO-ACM-00-00-DR-CE-00-0505
- COO-ACM-00-00-DR-CE-00-0506
- COO-ACM-00-00-DR-CE-00-0507

Water

- COO-ACM-00-00-DR-CE-00-2701
- COO-ACM-00-00-DR-CE-00-2702
- COO-ACM-00-00-DR-CE-00-2703
- COO-ACM-00-00-DR-CE-00-2704
- COO-ACM-00-00-DR-CE-00-2705

Standard Details/Code of Practice Exemption:
Not Used

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

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

Appendix B – WCC Opinion

WICKLOW COUNTY COUNCIL,
Planning Department

REPORT BY WICKLOW COUNTY COUNCIL PURSUANT TO S.5 OF THE PLANNING AND DEVELOPMENT (HOUSING) AND RESIDENTIAL TENANCIES ACT 2016 AND THE PLANNING AND DEVELOPMENT (STRATEGIC HOUSING DEVELOPMENT) REGULATIONS 2017 OPERATIONAL FROM JULY 3RD 2017.

WCC REF:	SHD- 20/139
ABP REF:	ABP-308945-20
STAGE:	Pre-Application consultation- Planning Authority's Opinion
APPLICANT:	Cairn Homes Properties Limited.
LOCATION:	Coolagad, Greystones, Co. Wicklow.
DEVELOPMENT PROPOSAL:	***607 no. residential units***
	405 no. houses
	202 no. apartments
	Creche/ Community Space
	Active Open Space
	Public Open Space
ABP NOTIFICATION:	15th January 2021
DUE DATE:	29th January 2021.

1.0 LEGISLATIVE/ POLICY CONTEXT:

1.1 Statutory Requirements of this Report pursuant to S. 6(4)(b)

(i) Copies of all records of the consultation(s) held with the prospective applicant by the authority pursuant to s.5(2) and

(ii) The planning authority's opinion in writing (including the reasons for its opinion) of what considerations, related to proper planning and sustainable development of the area concerned, may have a bearing on the Board's decision in relation to the proposed strategic housing development having regard to the provisions of the relevant development plan or local area plan as the case may be.

And shall send to that prospective applicant copies of the records and the opinion so submitted.

1.2 Relevant Local Policy Documents:

Any development on these lands should be assessed against the policies and standards set out in the following documents:

- Wicklow County Development Plan 2016-2022
- Greystones, Delgany and Kilcoole Local Area Plan 2013-2019
- Action Area Plan AP1 – Coolagad Greystones

1.2.1 Wicklow County Development Plans 2016-2022 – Main Relevant Objectives

Chapter 2 –Vison and Core Strategy

Greystones/ Delgany – Large Growth Town II

Chapter 3 - Settlement Strategy

Role and Function

The town should aim to attract a concentration of major employment generating investment and should target investment from foreign and local sources in a mixture of 'people' and 'product' intensive industries. In addition, the town should provide for the retail needs of its population and its catchment, in the form of a mixture of both comparison and convenience retail offer. It is an objective of the NTA to upgrade the rail track south of Bray to facilitate additional rail services. An improved frequency rail service would benefit the town in terms of attracting investment.

The settlement should aim to be economically self sustaining, with a population including its catchment that is able to support facilities such as high quality secondary education service, a small hospital or Primary Health Centre type facility and comparison retail centre.

3.3 Settlement Strategy Objectives

SS1 To implement the County Wicklow Core Strategy and Settlement Strategy, having regard to the availability of services and infrastructure and in particular, to direct growth into the designated metropolitan growth centres and the large, moderate and small growth towns in the Greater Dublin hinterland area.

SS2 To facilitate service and infrastructure providers in the delivery of services and infrastructure to enable the implementation of the County Wicklow Core Strategy and Settlement Strategy.

SS3 To ensure that all settlements, as far as is practicable, develop in a self sufficient manner with population growth occurring in tandem with physical and social infrastructure and economic development. Development should support a compact urban form and the integration of land use and transport.

Chapter 4 Housing:

General

HD1 *New housing development shall be required to locate on suitably zoned or designated land in settlements, and will only be considered in the open countryside when it is for the provision of a rural dwelling to those with a housing, social or economic need to live in the open countryside.*

Design:

HD2 *New housing development, above all other criteria, shall enhance and improve the residential amenity of any location, shall provide for the highest possible standard of living of occupants and in particular, shall not reduce to an unacceptable degree the level of amenity enjoyed by existing residents in the area.*

HD3 *All new housing developments (including single and rural houses) shall achieve the highest quality of layout and design, in accordance with the standards set out in the Development and Design Standards document appended to this plan, which includes a Wicklow Single Rural Houses Design Guide.*

Social Housing:

HD4 *To implement the provisions of the Wicklow Housing Strategy and in particular, to require that 10% of all zoned land developed for residential use, or for a mixture of residential and other uses, shall be devoted to social housing.*

Density:

HD5 *In order to make best use of land resources and services, unless there are cogent reasons to the contrary, new residential development shall be expected to aim for the highest density indicated for the lands. The Council reserves the right to refuse permission for any development that is not consistent with this principle.*

Sequence / Phasing of Housing:

HD8 *Housing development shall be managed and phased to ensure that infrastructure and in particular, community infrastructure, is provided to match the need of new residents. Where specified by the Planning Authority, new significant residential or mixed use development proposals, may be required to provide a social and community facility/facilities as part of the proposed development or the developer may be required to carry out a social infrastructure audit, to determine if social and community facilities in the area are sufficient to provide for the needs of the future residents. Where deficiencies are identified, proposals will be required to either rectify the deficiency, or suitably restrict or phase the development in accordance with the capacity of existing or planned services.*

Unit Types / Sizes / Location:

HD15 *Within medium to large scale housing developments, a range of unit types / sizes shall be provided, including bungalows (this requirement does not apply to apartment only developments).*

Housing Formats:

HD17 *The maximum size of any single 'housing estate' shall be 200 units and developments that include more than 200 units should be broken into a number of smaller 'estates', which shall be differentiated from each other by the use of* ***materially*** *different design themes.*

Chapter 8 Community Development:

Childcare and Preschool Objectives:

CD22 *to facilitate the provision of childcare in a manner which is compatible with land-use and transporation policies and adheres to the principles of sustainable development*

CD24 *Where considered necessary by the Planning Authority, to require the provision of childcare facilities in all residential developments comprising 75 houses or more (including local authority and social housing schemes). In accordance with Department of Environment, Heritage & Local Government guidelines, childcare places shall be provided at a ratio of 20 places per 75 residential units, having regard to cumulative effects of permitted development, (unless it can be demonstrated that having regard to the existing geographic distribution of childcare facilities and the emerging demographic profile of the area that this level of childcare facilities is not required). Without substantial cause, it is the policy of the Planning Authority not to allow a change of use of these premises within five years.*

Leisure and Recreation Objectives

CD32 New community buildings / facilities shall be designed to facilitate a wide range of uses including active uses (e.g. basketball, badminton, gymnastics / dance, martial arts etc), meeting / club use and the operation of youth clubs and youth services.

CD33 To provide for the development of facilities that contribute to the improvement of the health and well being of the inhabitants of County Wicklow and facilitate participation in sport and recreation.

CD34 Through the local plan and Action Area Plan process to identify the need and designate suitable active open space for the provision and expansion of sport and recreation opportunities, commensurate with its needs and existing facilities, in accordance with the provisions of the Wicklow County Council Play, Sport & Recreation and Active Open Space policies.

Open Space Objectives

CD43 To require open space to be provided in tandem with new residential development (in accordance with the standards set out in the Development & Design Standards Appendix)

CD46 All open spaces shall be provided with environmentally friendly lighting in order to ensure their safe usage after day light hours (refer to 'Light pollution' section of Chapter 9 of this plan).

Chapter 9 – Infrastructure:

Cycling and Walking Objectives:

TR9 *To improve existing or provide new foot and cycleways on existing public roads, as funding allows.*

TR10 *To require all new regional and local roads to include foot and cycleways, except in cases where shared road space is provided2.*

TR11 *To facilitate the development of foot and cycleways off road (e.g. through open spaces, along established rights-of-way etc), in order to achieve the most direct route to the principal destination (be that town*

centre, schools, community facilities or transport nodes), while ensuring that personal safety, particularly at night time, is of the utmost priority.

TR12 *To encourage the provision of secure covered bicycle-parking facilities at strategic locations such as town centres, neighbourhood centres, community facilities and transport nodes.*

General Road Objectives:

TR15 Traffic Impact Assessments will be required for new developments in accordance with the thresholds set out in the 'Design Manual for Roads and Bridges' the 'Traffic & Transport Assessment Guidelines' (TII) and the Design Manual for Urban Roads and Streets (DoECLG & DoTTS).

TR16 Road Safety Audits and/or Road Safety Impact Assessments shall be required at the discretion of the Planning Authority, but shall generally be required where new road construction or a permanent change to the existing road layout is proposed.

Water Objectives

WI3 *To require new developments to connect to public water supplies where services are adequate or where they will be provided in the near future.*

Storm and Surface Water Infrastructure Objectives

WI11 Ensure the separation of foul and surface water discharges in new developments through the provision of separate networks.

WI12 Ensure the implementation of Sustainable Urban Drainage Systems (SUDS) and in particular, to ensure that all surface water generated in a new development is disposed of on-site or is attenuated and treated prior to discharge to an approved surface water system.

Solid Waste Management Objectives

WE2 To require all new developments, whether residential, community, agricultural or commercial to make provision for storage and recycling facilities (in accordance with the standards set out in Development & Design Standards of this plan).

Chapter 10 – Heritage

10.3 Natural Heritage and Landscape

Biodiversity Objectives

NH1 To ensure that the impact of new developments on biodiversity is minimised and to require measures for the protection and enhancement of biodiversity in all proposals for large developments.

Woodlands, Trees and Hedgerows Objectives

NH14 To promote the preservation of trees, groups of trees or woodlands in particular native tree species, and those trees associated with demesne planting, in the interest of amenity or the environmental, as set out in Schedule 10.08 and Map 10.08 A, B & C of this plan.

NH16 Development that requires the felling of mature trees of environmental and/or amenity value, even though they may not have a TPO in place, will be discouraged.

NH17 To discourage the felling of mature trees to facilitate development and encourage tree surgery rather than felling where possible.

NH18 To encourage the preservation and enhancement of native and semi-natural woodlands, groups of trees and individual trees, as part of the development management process, and require the planting of native, and appropriate local characteristic species, in all new developments.

NH19 To encourage the retention, wherever possible, of hedgerows and other distinctive boundary treatment in the County. Where removal of a hedgerow, stone wall or other distinctive boundary treatment is unavoidable, provision of the same type of boundary will be required of similar length and set back within the site in advance of the commencement of construction works on the site (unless otherwise agreed by the Planning Authority).

Water Systems Objectives

NH23 To minimise alterations or interference with river / stream beds, banks and channels, except for reasons of overriding public health and safety (e.g. to reduce risk of flooding); a buffer of generally 10m along watercourses should be provided (or other width, as determined by the Planning Authority) free from inappropriate development, with undeveloped riparian vegetation strips, wetlands and floodplains generally being retained in as natural a state as possible. In all cases where works are being carried out, to have regard to Regional Fisheries Board "Requirements for the protection of fisheries habitat during the construction and development works at river sites"

1.2.2 Greystones-Delgany and Kilcoole Local Area Plan 2013-2019

Section 3 : Population And Housing

RES1: To adhere to the objectives of the Wicklow County Development Plan 2010-2016 in regard to population and housing as are applicable to the plan area. In the assessment of development proposals, regard shall be paid to the Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas (Cities, Towns and Villages), (DoEHLG, 2009).

RES5: On undeveloped residentially zoned land, it is an objective of the Council to provide for the development of sustainable residential communities up to a maximum density, as prescribed by the land use zoning objectives.
Densities shall be based on a typical house of 125m2 gross floor area. As such, the maximum total number of units permissible on a site shall be calculated on the basis of total gross floor area permitted over a site;

RES7: Notwithstanding the zoning objectives set out within this plan, lower density residential developments may be required at certain locations; where by virtue of environmental, topographical and service constraints, including lack of public mains infrastructure, poor road access, steep gradients, flooding issues and significant coverage of natural biodiversity; a lower density of development is preferable. This objective applies to all land zonings within the plan area.
In particular, the planning authority will limit growth in the amount of housing on lands zoned 'R2.5: Residential (2.5/ha) along Blackberry Lane, Delgany and lands zoned 'RE: Existing Residential' at Kindlestown Upper and Bellevue Demesne. In these areas housing shall generally be restricted to the development of low density single housing, subject to all matters being addressed to the satisfaction of the planning authority. On land zoned R17/R5/R22 in the Kindlestown Upper/Coolagad vicinity, the design and layout of developments shall be appropriate to the topography of sites and the necessity to ensure that there is a visual transition between these developed lands and the unzoned agricultural lands/Kindlestown Hill to the rear of the site. Regard shall be paid to the protection of the visual amenity of the area, including views of Kindlestown Hill and to the objectives of the Blacklion ACA.

RES13: There is a shortfall of affordable family-type homes (e.g. three to four bedroom houses on small to medium sized plots, generally semi-detached in nature, typically not more than 125m² in floor area) within the Greystones-Delgany area. As such, there shall be a preference for the development of these types of housing units within this plan area.

RES14: To facilitate the development of housing options for older people within the plan area.

Section 7 : Social Infrastructure

SOC13: Allow for the development of new and improved community services, for health, welfare, community, education, civic and institutional uses including schools, childcare, nursing homes, community buildings, churches, Garda station, health centre etc. on suitably zoned lands. A site shall be reserved at Charlesland for a new Garda station (see AP7: Charlesland Action Plan).

Section 8 ; Transport and Service Infrastructure.

Flooding

TS6 Notwithstanding the identification of an area as being at low or no risk of flooding, where the planning authority is of the opinion that flood risk may arise or new information has come to light that may alter the flood designation of the land, an appropriate flood risk assessment may be required to be submitted by an applicant for planning permission.

Roads and Transportation.

TS7: Promote the development of safe and accessible pedestrian and traffic routes.

TS8: To implement the objectives as set out in Table 7.1, for:

Table 7.1: Roads Objectives

RO1 Reserve a land corridor to provide for a new road from the R761 at Sea View to lands within AP1: Coolagad Action Plan. The new road shall provide local access to zoned lands within the lifetime of the plan and shall, subject to feasibility, need and design, in the long term provide a northern access route from Greystones to the N11.

Sustainable Transportation Modes

TS12: To develop the 'greenroute' network for pedestrian and/or cycling facilities. The proposed indicative 'greenroute' network is indicated on Map B. Greenroutes should be developed with a common scheme of signage and/or markings. Where feasible, proposals for development should provide for the development of these greenroutes. Proposals for the Greystones – Delgany and Kilcoole Local Area Plan 2013-2019 development of 'greenroutes' shall be subject to appropriate assessment requirements in accordance with the Habitats Directive. No development shall be permitted that would have adverse impacts (directly, indirectly or cumulatively) on the conservation objectives of Natura 2000 sites. While certain parts of the 'greenroute' network are likely to be implemented in the short term, certain parts are considered to be a more long term aspiration. Implementation of 'greenroutes' is subject to the available funding and further design and feasibility studies. Some sections may also be delivered as part of proposals for the development of zoned land.

TS13 : Lands being developed at the periphery of the developed part of zoned lands should provide for corridors lands that could be required to facilitate future population increases in future LAPs are not landlocked and can be effectively and efficiently accessed.

Section 9 : Natural and Built Heritage

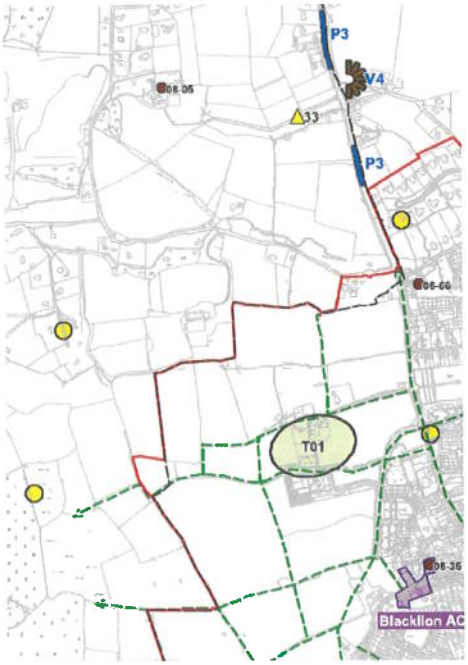
HER1: Protect and enhance the character, setting and environmental quality of natural, architectural and archaeological heritage, and in particular those features of the natural landscape and built structures that contribute to its special interest. The natural, architectural and archaeological heritage of the area shall be protected in accordance with the objectives set out in the Wicklow County Development Plan.

HER3: To protect, wherever possible, wildlife habitats that are located outside protected and designated areas, including the coast, cliffs, dunes, trees, hedgerows, drainage ditches, scrub, woodland, rock outcrops, watercourses, stone walls and other features of the natural landscape that provide wildlife corridors and which contribute to the biodiversity of the area. In the assessment of planning applications, the Council may require that such features are retained and incorporated into future development. In considering proposals for development, regard shall be paid to the Greystones-Delgany Local Biodiversity Area Study (2006). Recommendations set out in this study shall be implemented, as deemed appropriate, by the planning authority.

HER4: To protect and retain trees which contribute to the biodiversity value and the character and amenity of the area. This objective applies to the list of trees indicated in Appendix B and Map B.

HER5: To protect the biodiversity value and associated habitats of water bodies within the plan area in accordance with the objectives as set out in the Wicklow County Development Plan and Eastern River Basin District Management Plan. In considering proposals for development, regard shall be paid to the recommendations set out in Greystones- Delgany Local Biodiversity Area Study (2006). In particular, recommendations relating to the Three Trouts Stream shall be implemented, as deemed appropriate, by the planning Authority. Water bodies within the plan area include the Three Trouts Stream, the Newtown River from Newtown to Kilcoole Marsh via Druids Glen Golf Course, Kilcoole Stream (from Kilpedder to Kilcoole feeding to Kilcoole Marsh), Kilcoole Marsh (a transitional estuarine water body), the southwestern Irish Sea-Killiney Bay (coastal water body) and a number of groundwater bodies.

Extract Greystones/ Delgany & Kilcoole LAP 2013



Section 10

10.1 ACTION PLANS

Action plan areas are areas that are designated for comprehensive (not piecemeal) integrated schemes of development that allow for the sustainable, phased and managed development of the area during the plan period. Separate applications for sections of each area will not be considered until an overall action plan has been agreed in writing with the planning authority unless it can be shown that any application will not undermine the achievement of the overall objectives for that Action Area.

10.2 AP1: COOLAGAD ACTION PLAN

This Action Area is located at Templecarrig Lower, Coolagad and Kindlestown Upper, on a site approximately 34ha in size. This area shall be developed for a mix of uses including residential, community and open space, in accordance with the following:

- c. 29ha for the development of residential units.
- A minimum of 4ha of land shall be provided for active open space including public park, MUGA and playground, in accordance with the requirements of the Community and Enterprise Section of the Council.
- A community centre and/or other community facility/facilities shall be provided to serve the communities of this area. In determining requirements for community facilities, a community services audit shall be carried out and consultation shall be undertaken with the Community and Enterprise Section of the Council.
- A new road shall be provided for local access to zoned lands and shall be designed to facilitate the achievement of the long term objective to provide a northern access route from Greystones to the N11, in accordance with roads objective RO1, 'Section 7: Transport and Service Infrastructure' of this plan.
- Greenroutes shall be provided throughout the area to link residential areas with community infrastructure, schools, adjoining housing lands and the Blacklion neighbourhood centre.
- The residential amenity of existing and future adjoining properties shall be protected.
- Protection of natural and built heritage, including rivers and trees.
- In designing the development of this area attention shall be paid to reducing the visual impact of the development on views towards Kindlestown Hill, from the R761. In particular, development on lands to the west of the Blacklion Action Plan shall be of a design and layout that is appropriate to the topography of the site and the necessity to ensure there is a visual transition between these developed lands and the unzoned agricultural lands / Kindlestown Hill to the rear of the site.
- Regard shall be paid to ensuring appropriate links and transition of scale, design and layout of housing, with lands adjoining the boundary of the Action Plan, including lands within AP2: Blacklion Action Plan and lands zoned for housing to the south at Kindlestown Upper.

- Phasing shall be as follows:
  - o Phase 1: 200 units and completion of road
  - o Phase 2: 150 units and provision of open space (AOS and OS)
  - o Phase 3: 150 units and community centre/facility
  - o Phase 4: remainder of units.

Section 11 : Zoning

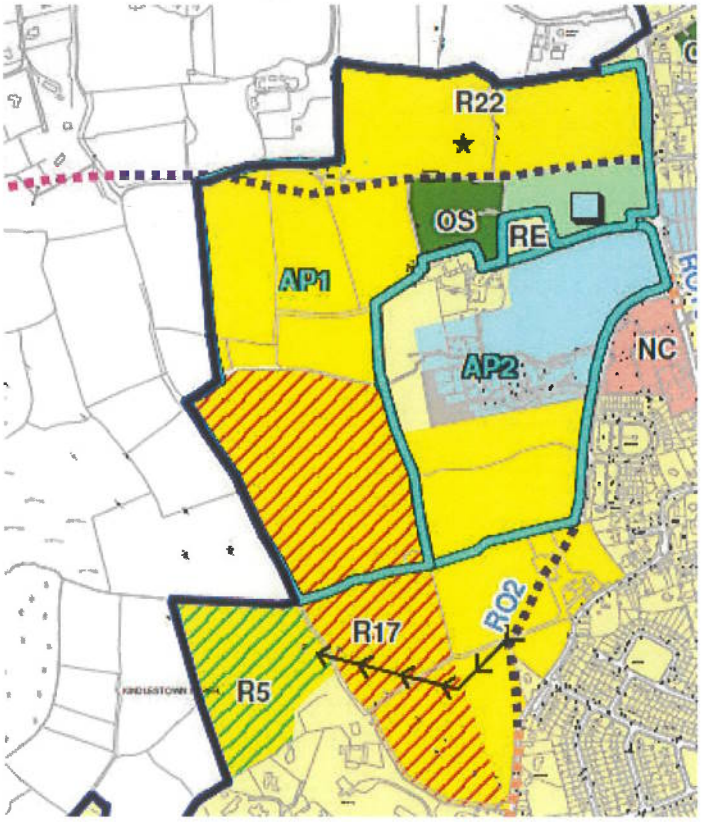
R22 –Residential: : To provide for the development of sustainable residential communities up to a maximum of 22 units per hectare and to preserve and protect residential amenity.

R17 – Residential - To provide for the development of sustainable residential communities up to a maximum density of 17 units per hectare and to preserve and protect residential amenity.

OS : Open Space : To preserve, provide for and improve public and private open space for recreational amenity and passive open space.

AOS : Active Open Space : To provide for active recreational open space.

Identified CE block within open space area to correspond with AP1 objectives. CE : Community and Education To provide for civic, community, institutional, health, educational facilities and burial grounds.



1.2.3 Agreed Action Plan

AP1-Coolagad Action Area - Agreed 16th June 2016 - See Appendix A for full details

Action Area Agreed subject to following

- Development within the Action Area complies with the requirements and objectives of the Greystones/ Delgany & Kilcoole Local Area Plan 2013
- The amendment of the phasing to include the provision of the Open Space and Active Open Space in Phase 2 prior to the occupation of 50 residential units in that phase.

2.0 BACKGROUND DATA:

2.1 Consultations under S. 247 of the Planning and Development Act 2000(as amended):

PP 20/81 : A S.247 meeting was held on the 22nd September 2020 (see Appendix B for Details)

Issues :

- Indicated to agents that preplanning previously carried out on site, agents highlighted that new layout required due to required change of densities. Increased densities are noted which are not in line with the zoning objectives in the LAP.
- Community Centre is to be provided in the later stage which would not accord with the approved Action Area.
- Noted that the site given the stream and topography restricts development layout, however it is considered that the layout has very straight lines and should review.
- Visually site is a challenge, need to justify how arrived at the proposed layout, and how that will achieve Action Area objectives.
- Issue of 10 year permission raised, indicated that this is something for the Board to assess, PA would not raise any issues but applicant will have to justify.
- Road Objective R01 for the lands is still in place.
- Need to show that the format of the junction accords with DMURS and amend the design to take account of this.
- MD Engineer had indicated to agents that there were issues in relation to carpark provision around school and graveyard, and requested them to look at the possibility of accommodating this within the site.
- Cycleway along R761- roundabout should be designed to be cycle friendly .
- Traffic in Greystones delayed by traffic lights at Redford and therefore another signalised set of lights at the junction with the R761 could create further delays. The design of the main access is particular important. Agent preference is not for roundabout.
- Stream through the site and at the northern boundary, both have issues of flooding downstream. In addition the site is an important reservoir for Coolagad Hill. Therefore any assessments of surface water needs to address both off site impacts and Coolagad Hill.
- Identified by agents that there are 2 main Surface Water catchments and design proposals provide for suds/ swales / permeable paving. It was indicated to agents that all surface water flow discharge to same stream and result in flooding of private properties downstream.
- Foul water sewer , identify difficulty with gravity sewer so may be need for pumping station, indicated that this would not be taken in charge by Council and need to show that Irish Water will take in charge.
- Watermain no real issues.
- Indicated by agents the site developed with distinct character areas, green lung of landscaped openspace, need for significant cut & fill , 15% openspace provided.

- Highlighted that the agents should review the visual impact of the development in terms of what is identified in the Greystones/Delgany LAP, particular the Action Area objectives and the particular criteria set out in the agreed Action Area.
- Stream needs to be retained as an open channel
- Access to a lot of the houses is quite linear following topography, need to justify layout progression.
- With respect to community building there is a need to engage with Community and Enterprise Section.
- A crèche would be required for the development, and contact should be made with Wicklow County Childcare in respect of any proposal , and the PA will be guided by them
- Connectivity to Waverly should be kept, the development is not taken in charge at present .
- Welcome the Openspace / east of zoned residential should push this connection to the boundary. Connections should be pedestrian/ cycle only.
- Should make sure that where connections are shown that they match up to suitable locations.

2.2 Internal Reports:

- Housing and Capital Projects
- Municipal District Engineer (Greystones)

Copies of these reports are appended to this document (Appendix C)

3.0 ASSESSMENT OF PROPOSED DEVELOPMENT (Compliance with Development Plan Policy and Design Standards):

3.1 Core Strategy/Housing:

Policy – County Development Plan 2016-2022

Chapter 2 : Core Strategy

Level 3 : Large Growth Town II : Greystones/Delgany

Indicated as :

i. Strong active growth town supporting surrounding areas located on multi modal corridor in metropolitan hinterland
ii. attractor for inward investment

Population target:

Year	2011	2022	2025	2028
Population	17,208	21,603	22,801	24,000

Housing stock: Growth Targets:

Year	2011	2022	2028	Target
Housing stock	6,637	8,321	10,138	3501

Proposed Development: 607 units
33 % of required housing stock required during the period of 2022 to 2028.

Note 2016 population 18,021, Housing Stock 2016 = 6766
Taking account of housing (under construction) 7985.
Taking account of housing under construction & Extant permissions = 8,266

OPINION :

- The quantum of residential development proposed would exceed the indicative target for 2022, but would be within the current Core Strategy Target up to 2028 as set out in the Wicklow County Development Plan 2016-2022 (currently under review).
- Draft County Development Plan 2021-2027 is expected to be on display by February/ March 2021.

3.2 Compliance with Zoning Objectives:

As set out in the Greystones-Delgany and Kilcoole Local Area Plan 2013-2019, the land use zoning objectives is as follows:

R22 –Residential: : To provide for the development of sustainable residential communities up to a maximum of 22 units per hectare and to preserve and protect residential amenity.

R17 – Residential - To provide for the development of sustainable residential communities up to a maximum density of 17 units per hectare and to preserve and protect residential amenity.

CE : Community and Education To provide for civic, community, institutional, health, educational facilities and burial grounds.

OS : Open Space : To preserve, provide for and improve public and private open space for recreational amenity and passive open space.

AOS : Active Open Space : To provide for active recreational open space.

OPINION:

- The lands in question are zoned to provide for the development of residential/ openspace with an indicative community zoning identified in the openspace, and are subject to the provisions of an Action Area as set out in the Greystones-Delgany and Kilcoole Local Area Plan 2013-2019. An Action Area was agreed in 2016, which was in line with the provisions of the LAP. It is considered that the development whilst generally in line with the location of zonings, does not accord with the zoning objectives or with the provisions of the Action Plan as set out in the Local Area Plan. The overall scale of the development, the impact on the required visual transition to the undeveloped agricultural lands, and the phasing of development would it is considered materially contravene the provisions of the Local Area Plan.

3.3 Intensity of Development:

Permitted Density varies across site northern part 22units /ha, southern 17 units/ha

Site Area (Gross)	=	24.87 ha
Site Area (net)	=	17.1ha
GFA residential	=	67,330sqm
No. of units	=	607 units
Stated density	=	35.4 u /ha

R22 Area Density		
Site Area Gross	=	10.7ha
Units	=	343

Density = 32u/ha

Based on Dwelling Equivalent 125sqm
Total SQM = 36,515sqm
Density = 27u/h

R17 Area Density
Site Area Gross = 10.1ha
Units = 264
Density = 26.13 u/ha

Based on Dwelling Equivalent 125sqm
Total SQM = 30815sqm
Density = 24.4u/h

OPINION

- The development as proposed significantly exceeds the density standards as identified in the Greystones/Delgany and Kilcoole Local Area Plan 2013 – 2019 for the lands in question. Given the location of the development on the edge of Greystones , the difficult topography and urban fringe location, the suitability of the lands for increased intensity needs to be considered carefully in light of visual impact, impacts on the amenities of adjoining housing, amenities off future residents, and topography disturbance.

3.4 Design Quality

3.4.1 Layout Design / Visual Amenity

OPINION

- The site layout provides for a large area of openspace/ active space running along the northern site boundary in line with the Action Area requirements. The layout is broken into 3 character areas, which provide for blocks of housing units some off cul-de-sac roads. There are a number of long runs of roads forming overall access to the lands. In addition there is a green lung of openspace traversing from north to south, which opens out into a larger central openspace within the southern lands located to the west of the existing Waverly development.
  The location of openspace areas is considered sufficiently spaced within the site that it would allow appropriate accessibility to the future residents
- Concern is raised with respect to the significant length of linear road, and lack of

deflection, (Street 11 to 13 & Street 10- 14). Furthermore the looping nature of some roads would allow for fast movements eg. Street 12, Street 22 Street 23). Some opportunities may exist to amend the road to avoid excessive speeding and therefore the need for ramps which are considered inappropriate.

- The topography of the lands, as is evident from drawings, is quite steep given its hillside location, this has resulted in the need for both cut and fill as part of the overall development. Any future application should be accompanied by a drawing identifying the location of cut & fill, and a clear estimation of where materials are to be reused or stored on site. The placement of materials in future openspace areas should be avoided, and neither should materials be stockpiled in significant mounds as this leads to future issues with openspace profiles etc.
- The significant difference in levels across the site results in a number of areas of concern i.e. back to back housing, relationship of housing to openspace, impacts / relationship at boundary locations. Whilst it is noted that some cross-sections have been included there are concerns that the impacts on future residents is not fully identified. Some units have as much as a 5m level difference with limited garden depths , accordingly there is a concern that the private amenity space associated with such units will be compromised , as well as potential for significant overbearance of housing on upper levels given the garden depths.
- The interface of the development with the existing rear gardens at Waverley is a concern. The submission identifies the building up of levels at this point, and this coupled with boundary wall/ retaining features would create a bunker effect to such houses. From a review the finished floor level differences will range from 6m up to 10m at points. Therefore the impact on the amenities of these houses by the proposed development needs further assessment.
- Additional and more detailed cross-sections should be submitted with any application to show in full the boundary impacts and residential amenity impact.
- Multiple cross-sections of public openspace/ green areas within the site should be provided to show the relationship of such areas to housing, road and adjoining boundaries.
- All internal retaining features required should be identified clearly and an assessment of the suitability of all landscaping proposals vis-à-vis such features should be identified.
- Further visual assessment should be provided to show the impact of the varying house levels on future vistas within the site.
- Additional views should be provided at the Blacklion junction itself (R761 & L 1026), and in proximity to school areas to fully assess the visual impact of the development.
- The indicative access to school lands are noted, however this access is only shown onto adjoining lands and it should be shown how it will access into Waverly to allow for pedestrian movements.
- Details of all boundaries are required to fully assess impacts.
- The submitted existing site assessment should include a number of highlighted contours for ease of reference.

3.4.2 Housing Type and Tenure:

- 300 three bed houses
- 105 no 4 bed houses
- 20 no.1 bed apartment units
- 116 no. 2 bed apartment units
- 66 no. 3 bed apartment units

OPINION:

- The house designs are not considered sufficiently divergent between the character areas to ensure distinct placemaking.
- The provision of a number of single storey units should be considered to ensure a suitable variety of unit types to cater for downsizing/ lifestyle changes.

3.4.3 Public Open Space

Public Open Space/ Active Open Space zoning - 4.2ha
Public Open Space forming part of residential development – 4.47ha (18% gross site area)

Required standard: The standards for Residential Public Open Space are set out in Section 6 (Community Development and Open Space) of the Development and Design Standards (Appendix 1) of the Wicklow County Development Plan 2016-2022.

In accordance with these Standards:- *public open space will normally be required at a rate of 15% of the site area – areas within the site that are not suitable for development or for recreational use must be excluded before the calculation is made;*

OPINION

- The provision of c. 18% of the overall site as public openspace would accord with the requirements of the County Development Plan 2016-2022.
- The overall location of public openspace within the development given the constraints, and having regard to its connectivity within the site is considered generally acceptable.
- All public open space areas should be designed and landscaped to ensure that they are usable (in terms of gradient etc).
- The topography of the site is such that there are significant level changes across public open space, and along boundary green areas. Full cross/ longitudinal sections of public open space/ green areas, their relationship to adjoining public roads and housing, and how they sit with respect to boundaries should be fully assessed, with the potential impacts both visually and with respect to amenity value fully set out.

3.4.4 Private Open Space

Required standard:

Within apartment developments, private and communal amenity space shall be provided in accordance with Sustainable Urban Housing: Design Standards for New Apartments: Guidelines for planning authorities' (DoECLG, 2015). Care should be taken to ensure that such places receive adequate sunlight and meet the highest safety standards. The front wall of balconies should be made from opaque material and be at least 1m in height.

Dwellings (including own door duplexes) shall generally be provided with private open space at the following minimum rates, unless otherwise specified by the Planning Authority:

House size	Minimum private open space
1-2 bedrooms	50sqm
3+ bedrooms	60-75sqm

As a general 'rule of thumb', 0.64sqm of private open space shall be provided for each 1sqm of house floor area, subject to the minimum sizes specified above.

OPINION

- The submitted details indicate that the private open space size standards identified for housing units have been met.
- Adequate private and communal open space areas would appear to be available within the apartment element of the submitted proposal.
- Given the topography of the site there is concern that areas of both private and communal space are of such a level difference that their use is compromised, and that there may be impacts in terms their usage, with the resultant effect that they may not fully meet the amenity requirements of future residents
- All areas of private open space should be suitably designed /landscaped to ensure usability particularly in terms of gradient. Given there are significant level changes between back to back housing within the development retaining features will be required to provide usable rear private open space. The location and details of all retaining structures should be identified with any application.

3.5 Childcare/ Community :

Creche 733sqm
Community Space 258sqm

OPINION

- The provision of a combined Creche and Community Centre would not it is considered accord with the Action Area Plan objectives for Coolagad as set out in the Greystones-Delgany and Kilcoole Local Area Plan 2013-2019.
- The Community Centre should be of a scale that serves both the proposed housing and the wider area, and the overall size should be arrived at on the basis of an audit of community services and needs and subject to consultation with the Community, Culture and Social Development Section of Wicklow County Council. Notwithstanding, the proposed sizing is considered inadequate to service the wider area.
- The crèche location is considered to be inappropriate being separated from the housing it will serve, and it should be relocated within the housing element of the overall lands.
- The development of the crèche and the community element as part of the final phase is considered inappropriate, and this phasing should be justified.
- The guidance of Wicklow County Childcare should be sought in respect of the overall scale of the crèche given this represents a significant sized crèche which would not be in line with County Development Plan criteria as set out in Appendix 1.
- The community space within the Creche has no identified toilet or food preparation facility which is considered necessary for its viability as a community space.

3.6 Schools

OPINION

- The capacity/ availability of schools to service this development needs further robust analysis given development permitted within Greystones area, and the timing of any development coming on-stream. There is currently a serious shortage of school places available in Greystones, with temporary buildings currently in use to offset the shortfall.

3.7 Phasing:

OPINION :

- Given the alteration from the Action Area Lan the phasing would not accord with that identified in the LAP or the Agreed Action Area.
- Further clarity is required with respect to the phasing plan ie. the plan should
  - Identify the tie in of upgrades to roads/ pedestrians facilities provision to each phase,
  - the number of units to be completed/ occupied prior to the completion of the crèche/ operation of the crèche, prior to completion of community facility and this facility should be provided earlier in the phasing.

3.8 Roads and Accessibility

The comments and particular application detail requirements are set out in the reports of the MD Engineer Greystones and the Ex Eng (Roads) Reports included in Appendix B.

3.8.1 Road Network

OPINION

The receiving environment for the proposed development is insufficient to cater for the development until such time as:

- The upgrade of the R761 Bray to Greystones Cycle route has been provided.
- The upgrade of the R761 Blacklion cycle track provision has been completed
- The Chapel Road Upgrade Scheme has been completed
- The R761 Redford Junction has been upgraded.

3.8.2 Entrance/ Road Design

OPINION

- Further technical examination is required to deal with the issues highlighted in the Municipal District Engineers Report as Attached to this Opinion.
- Location of proposed junction onto the R761 should be justified having regard to the concerns that this access is
    - *Too close to the junction with the L97612 Seaview Cottages.*
    - *Too far away from the cemetery such that funeral goers parking in the proposed car park of the development may not use the pedestrian crossing at the junction.*
- The layout should be re-examined in terms of the provision of cycle facilities
- The main access road is too straight and will lead to undesirably high speeds.
- The main access road being Road Objective RO1 of the Greystones, Delgany and Kilcoole Local Area Plan 2013-2019 should be realigned so as to be contained entirely within the site and not have a portion of it off site as shown.
- Many of the roads are too long and straight and there is concern in respect of some junction layouts.
- Entrance details are required including sightline details for the proposed junctions.
- The proposed future pedestrian access to the school at the eastern boundary joins a private property that separates the school from the development. Completion of this connection should be fully investigated.
- The feasibility of future road and footpath connections to adjoining lands should be fully designed i.e. not simply shown in plan but that they work on the vertical plane too.
- The road crossings over the stream should be by way of road bridges and not culverts in order to minimise the impact on the existing stream ecology.
- A Street Design Audit in accordance with the Design Manual for Urban Roads and Streets should be carried out. This audit along with other road audits should be brought together in a Quality Audit Report.
- Alternative route for construction traffic, as outlined in Construction Traffic Management Plan, should not be considered until such time as Chapel Road Upgrade Scheme is complete.

3.8.3 Outline Mobility Management Plan

OPINION

- Further examination of the mobility management plan should be undertaken in light of the comments raised by the Municipal District Engineer Greystones, report attached.
- The provision of a private bus service to and from the town centre at peak hours should be investigated.

3.8.4 Pedestrian Facilities, Cycle Facilities

OPINION:

- The pedestrian/ cycle facilities should be designed in accordance with the requirements of the Road Authority and the development should be phased to ensure that these facilities are provided prior to occupation of the proposed development.
- Compliance with the 'greenroute' network as set out in the Greystones/ Delgany and Kilcoole Local Area Plan 2013 should be detailed as the layout would not appear to be fully compliant with this requirement.

3.8.5 Parking:

3.8.5.1 Car parking

Required standard: County Development Plan Appendix 1 : Design and Development standards
Where on-site car parking is provided, the car parking area shall be suitably surfaced and all bays and aisles marked out with white durable material. Spaces shall meet the following size requirements

***Parking and loading dimensions* Car-Parking Bays**	5.0m x 2.5m
Disabled Parking Bay	5.0m x 2.5m + 0.9m between bays
Loading Bay	6.0m x 3.0m
Circulation Aisles	6.0m in width

Car Parking Standards

Dwelling	• 2 off street car parking spaces shall normally be required for all dwelling units over 2 bedrooms in size. For every 5 residential units provided with only 1 space, 1 visitor space shall be provided. Parking for non-residential uses shall be provided in accordance with the standards set out in Table 7.1 to follow except where a deviation from the standard has been justified.
Childcare Facilities	0.5 spaces per staff member + 1 car parking space per 10 children

Proposal: in accordance with the details submitted car parking is provided within the scheme as follows:

Houses (units)	=	810spaces
Duplex Units	=	198spaces
Apartments (units)	=	70 spaces.
Creche/ Community Space	=	22 spaces
Total	=	1100 spaces

OPINION:
- Parking facilities should be designed in accordance with the standards set out in Appendix 1 of the County Development Plan 2016-2022.
- The quantum of car parking proposed for residential units is generally acceptable.
- The parking for the Creche/ Community Space building is considered on the low site, and a justification is required for the shared usage given the community facilities are used during daytime hours.
- Parking for Active OpenSpace, and adjoining public openspace should be provided.

3.8.5.2 Bicycle parking

Required standard:

Bicycle parking standards ***Table 7.2***

Type of Development	Cycle Parking Standard
Residential units	1 space per bedroom + 1 visitor space per 2 units
Shops	1 space for every 10 car space
Supermarkets / large stores	10% of total car spaces subject to a minimum provision of 50 spaces
Offices	20% of employee numbers subject to minimum of 10 bicycle places or one bike space for every car space, whichever is the greatest.

OPINION :
- Bicycle parking/ storage generally acceptable for residential element.
- The Creche/ Community facility should be provided with bicycle parking , the statement that no cycle parking is provided in the absence of standards is inappropriate, and a combination of identified standards should be utilised.
- Cycle parking for Active OpenSpace, and adjoining public openspace should be provided.

3.9 Services:

3.9.1 Drainage/ flooding:

This Section should be read in conjunction with the internal report received from the Municipal District Engineer Greystones – See Appendix B.

OPINION

- The full flood risk assessment needs to provide a full detailed examination of the effects of the loss of green field attenuation for upstream, and effect downstream of loss of attenuation, but also the potential for the reduction in flow time (time of concentration in a sewer or stream design) i.e. a full examination with respect to the potential for peak flows reaching the downstream properties quicker . This is a key examination given that flooding has occurred downstream.
- Further technical examination is required to deal with the issues highlighted in the Municipal District Engineers Report as attached to this Opinion. In particular the location and flow of drainage ditches and outfalls should be re-surveyed and verified in order to make a proper assessment.
- Storm sewers should not be located in rear private amenity space.
- The location of the proposed cut off ditch at the south eastern boundary with Waverly development, wholly within private property, is considered inappropriate, as there is a concern its longterm retention will be compromised, by future residents incorporating this ditch into private amenity space by infilling.
- The proposed cut off ditch along the western boundary shows no measures to reduce the runoff rate to the stream.
- The existing piped spring along the south eastern boundary is shown to remain piped. This should be reopened and integrated into the open space.

3.9.2 Waste Water Treatment: Public Mains

OPINION

- Irish Water are responsible for determining the connection/ provision of public sewerage.
- Concern arises in respect of the suitability of connecting to the public foul sewer in Redford Park given recent refusals for such connections to adjoining developments i.e. Waverly and Seagreen.
- Upgrade works are identified as necessary for future connection to the public sewer, and this will require further investigation. In absence of identified upgrade works the development would be premature.
- The provision of a pumping station to offset any deficiencies is not considered appropriate, and where such were envisaged a clear commitment from Irish Water would be required confirming they would take such works in charge, as such elements would not be taken in charge by WCC.

3.9.3 Water Supply: Public Mains

OPINION
This is a matter for Irish Water

3.9.4 Street Lighting:

OPINION:

- Public lighting for the development (including all road infrastructure and public open space areas)should be designed and laid out in accordance with Wicklow County Council's Guidance Document for Public Lighting Works for Developers : Wicklow County Council : 2017 and with the requirements of the Road Authority.

3.10 Part V:

Proposal:

10% of permitted residential units -60 units
- 8 No. 2-bed Duplex (81.6 m^2);
- 8 No. 3-bed Duplex (117.4 m^2);
- 9 No. 3-bed Houses (116 m^2);
- 9 No. 1-bed Apt (49.4 m^2);
- 26 No. 2-bed Apt (78.4 m^2);

Comments of Housing and Corporate Estate: (please refer to the full report appended to this document)

- *Applicant should review the Council's Part V policy.*
- *The Part V units should be pepper potted throughout the site in groups of not more than 4.*
- *The developer should ensure that any Part V units proposed conform to the Quality Housing for Sustainable Communities Guidelines in order for the WCC to obtain funding from the Department of Housing, Local Government and Heritage. Document can be reviewed online on the Departments website.*
- *Social leasing to Approved Housing Bodies may be more appropriate for apartments without own door access, communal stairs/ halls or shared facilities.*
- *The construction should be phased so that Part V units are provided on a pro rata basis e.g. for every 10 units constructed a Part V house/ unit should be completed.*

OPINION:

- The applicants should ensure that the Part V proposal is in line with Wicklow County Council's Part V policy, and that the units offered meet the guidelines in terms of floor areas laid down in the Quality Housing for Sustainable Communities.

3.11 Taking in Charge

OPINION

- The TIC map is not acceptable due to privately owned on road parking spaces being proposed which are shown being completely surrounded by Public roads and footpath. This is not feasible or practical.

3.12 Environmental Impact Assessment/ Appropriate Assessment.

OPINION

- The submitted screening reports are noted. Some of the key impacts of the development are considered to be visual impact, loss of biodiversity, impacts on residential amenity, flooding, traffic impacts and impact on social capital.

4.0 CONCLUSION

Following consideration of the plans and particulars submitted to the Planning Authority in respect of this Section 5 consultation Process the Planning Authority is of the opinion that:

- The density of development would materially contravene the zoning objectives of the Greystones-Delgany and Kilcoole Local Area Plan 2013-2019.
- The proposed development would materially contravene the Action Area Plan AP1 provisions of the Greystones-Delgany and Kilcoole Local Area Plan 2013-2019
- The Community Facility would not accord with the requirements of Action Area Plan AP1-Coolagad, would not appear to be properly sized to meet the needs of the wider area, and should be designed to ensure it is appropriate for community usage.
- Having regard to the topography of the site and the proposed layout, it is considered that the development will have a negative impact on the amenities of existing and future residents, and will not result in an appropriate graduation between the more urban area and the rural fringe.
- The development is considered premature pending a number of upgrades to the Greystones road network
- The development is considered premature pending upgrade of the Public Sewerage Infrastructure in the area.

Disclaimer:

This document provides an outline of the Planning Authority's opinion in relation to the considerations of proper planning and sustainable development, that may have a bearing on the Board's decision in respect of this proposed strategic housing development, in accordance with the requirements of Section 6(4)(b) of the Planning and Development (Housing) and Residential Tenancies Act 2016. It is not intended as a full and detailed assessment of the plans and particulars submitted in support of the proposal.

It should be noted as detailed under Section 6 (9) of the Planning and Development (Housing) and Residential Tenancies Act 2016 that neither (a) the holding of a consultation or (b) the forming of an opinion shall prejudice the performance of the Planning Authority of any other of its functions under the Planning and Development Acts, or any other enactment and cannot be relied upon in the formal planning process or in legal proceedings.

Edel Bermingham
Sen Ex Planner

Appendix C – WCC Senior Executive Engineer's Pre-Planning Recommendation Report

To: Senior Executive Officer, Planning, Development and Environment

From: Ruairí O'Hanlon, Senior Executive Engineer, Greystones Municipal District

Date: Wednesday, 20 January 2021

Re: SHDPP20139 Coolagad

Recommendation: Refusal: The development is premature pending the improvement of services in the town of Greystones. See headings below.

Waste Water

Whilst there is adequate capacity within the Greystones Waste Water Treatment Plant there are major deficiencies within the Irish Water public sewer network of Greystones. This is highlighted in the Irish Water commissioned report 'Wicklow Waste Water Network, Survey and Upgrade – Greystones, Final Report' dated 06 July 2018 prepared by Arup Byrne Looby consultants, reference W3182-001. Upgrades to the network would be required in order to service this application site. The applicant has shown an indicative connection to the public foul sewer network at the top of Redford Park. Irish Water recently would not permit the two adjacent developments of Waverly and Seagreen to connect to their provided public foul sewer connections as provided for under their respective grants of planning permission which were to also connect to the existing foul sewer in Redford Park and compelled them to undertake an incredibly costly and disruptive alternative route. Given that no upgrades to the network have been undertaken by Irish Water in the intervening period this would indicate that Irish Water would not be in favour of the applicants proposed connection point. There are no other feasible gravity connection points in the area.

It is noted in the Pre Connection Enquiry letter from Irish Water contained within Appendix B of the Aecom Engineering Design Report that a waste water connection is feasible subject to upgrades. The letter further expands '*Upgrades are required in the area. A Study is needed to determine the extent of upgrades required to the network and the Victor (Victoria) Road PS. Connection Point to be determined as part of the study.*' These statements form Irish Water are unclear as what study is required when a there is a final study report on the Greystones Network since 2018. It is unclear as to whether the development can go ahead in the absence of such upgrades. It is alos understood from discussions with Irish Water Staff that the proposed network improvements as specified in the 2018 report would be very difficult to carry out and excessively costly and that Irish Water would like to look at alternatives.

A pumping station cannot be considered as a viable alternative for this development as the deficiencies in the Irish Water foul sewer network are all close to the Victoria Road Pumping Station as well as possibly the pumping station itself.

Storm Water

The proposed development would present as a flood hazard to of properties downstream. Currently the stream through the site, as well as the spring sources and drainage ditches convey surface water runoff to culverts that are piped through Redford Park and Rathdown Park. This existing culvert, being of limited capacity and poor quality construction, has resulted in the flooding of homes in Redford and Rathdown Parks on a number of occasions, the last time being in 2019. Whilst all the SUDS measures employed throughout the proposed development are noted, not all sources of surface water have accurately been accounted for. Large volumes of surface water runoff are received by this site from Coolagad Hill itself. No mention of this has been included in the design other than to show a cut-off ditch along the western boundary. This cut-off ditch will simply intercept and transport surface water runoff from all the lands at a higher elevation, west of the site, straight to the stream through the site, without any attenuation measures. This will vastly increase the amount and rate of runoff going to the stream as the possibility of infiltration on the subject site would now be lost. This will therefore increase the volume and flow rate of water going through the already deficient culvert through Redford and Rathdown parks. There would also be surface water runoff from the agricultural lands to the north of the proposed development contributing to the runoff from the existing site as these lands share a common drainage ditch boundary. These lands to the north have not been considered in the drainage design calculations.

Roads

The receiving environment for the proposed development is insufficient to cater for it and so it should not be permitted until such time as:

- The Greystones Transport Study has been completed so as to better inform a decision on the application site.
- The upgrade of the R761 Bray to Greystones Cycle route has been provided.
- The upgrade of the R761 Blacklion cycle track provision has been completed
- The Chapel Road Upgrade Scheme has been completed
- The R761 Redford Junction has been upgraded.

The development as shown would be poorly linked to the rest of Greystones by sustainable transport modes and given its distance from the centre of Greystones would result in a considerable increase in traffic congestion to the town centre.

Schools

Greystones and its environs are already severely deficient in school capacity with many new large scale housing developments already underway. A number of new schools are occupying temporary accommodation such as prefabs and one is occupying the local tennis club. Whilst sites are earmarked for development by the Department of Education and Skills this development is premature and would force

children in this development to travel a great distance to access schools, increasing car journey's.

Employment

There is a massive lack of employment opportunities within Greystones with a report 85 to 90 percent of the population commuting to work. In the absence of new job opportunities in Greystones the proposed development would lead to a huge increase of car journeys towards Bray along the R761 and Dublin along the N11/M11 and M50.

Comments on the Specific Design

Roads

- No DMURS Street Design Audit has been provided as required. This is in a prescribed format. A statement of compliance with DMURS is not the same thing.
- The level of detail of the proposed main access road junction with the R761 is poor.
- No cycle facilities have been provided for through the junction of the R761 with the proposed main access road.
- Justification for the location of the proposed junction of the main access road to the R761 should be provided. The Council has concerns that it is;
    - Too close to the junction with the L97612 Seaview Cottages.
    - Too far away from the cemetery such that funeral goers parking in the proposed car park of the development may not use the pedestrian crossing at the junction.
- The traffic data provided for in Section 5.2 of the Aecom Traffic and Transport Assessment is flawed. Wicklow County Council's own real time data shows differing peak hours as well as differing peak traffic volumes.
- No cycle facilities have been provided for along the main access road.
- The main access road is too straight and will lead to undesirably high speeds.
- The main access road being Road Objection RO1 of the Greystones, Delgany and Kilcoole Local Area Plan 2013-2019 should be realigned so as to be contained entirely within the site and not have a portion of it off site as shown.
- There are two future road connections shown to the north of the main access road. These should be omitted as the lands to the north are not zoned for development.
- No road or footpath widths have been shown on any drawings
- No junction radii values have been shown.
- Many of the roads are too long and straight, e.g. Street 11, which will encourage higher traffic speeds.
- The junctions of street 13 to 15 as well as streets 14 to 15 and 16 are very poor in layout which will cause confusion for drivers as to who has the right of way.
- The proposed future pedestrian access to the school at the eastern boundary joins to a private property that separates the school from the development. How is this

connection envisaged to be completed? The Council is of the opinion that the applicant should ensure this pedestrian/cyclist link can be provided with the development.

- The feasibility of future road and footpath connections to adjoining lands should be fully designed, i.e. not simply shown in plan but that they work on the vertical plane too.
- The road crossings over the stream should be by way of road bridges and not culverts in order to minimise the impact on the existing stream ecology.
- The proposed Taking in Charge drawing is not acceptable as it shows private parking spaces on public roads.

Storm Drainage

- It is unclear from the details submitted how the swales operate, i.e. how is the run off diverted to the swales.
- The proposed pond shown on the Aecom drainage drawings does not correlate with the proposed location on the architect and landscape drawings.
- The existing drainage ditch along the northern boundary is not shown on the existing drainage drawing nor is its piped outfall. It is the Council's understanding from the previous landowner that the pipe flows in a southerly direction towards the existing drainage ditch and piped outfall from the site on the shown at the south eastern corner of the site. The northern boundary drainage ditch does not, as far as the Council is aware, flow in an easterly direction across the R761 towards the cemetery as is described in Section 3.1 of the Aecom Engineering Design Report. The actual route of this outfall should be fully surveyed and verified in order to make a proper assessment.
- The proposed storm sewer section S82 to S89 is shown to be all in the rear of private residential properties with no access for the local authority for maintenance purposes. This should be redesigned so that the sewer is not in private property.
- There is also a proposed cut off ditch running the length of the south eastern boundary with the Waverly development. This entire cut off ditch is shown to be in rear gardens of private properties and so would require that residenst don't interfere with it and maintain it. This is highly unlikey and it is more likely that residents would simply fill it in to make better use of their rear garden. It would alos mean openings in side boundaries between private properties which would be highly irregular and unacceptable to residents.
- The proposed storm sewer section S105A to S105B to S105 should be rerouted so as to avoid the unnecessary stream crossing.
- The proposed cut off ditch along the western boundary shows no measures to reduce the runoff rate to the stream.
- The existing piped spring along the south eastern boundary is shown to remain piped. This should be reopened and integrated into the open space.

Waste Water

- The proposed foul sewer F67 to F68 should be rerouted to avoid an unnecessary stream crossing.
- Should a connection into the Redford Park foul sewer be permitted by Irish Water it should be done so on the existing 300mm diameter pipe on the north western side

of the Redford Junction and the sewer from the site should be laid along the western edge of the R761 and not down the centre of it as shown.

Outline Mobility Management Plan

- Section 7.2 states that it will be an objective to discourage private car as a means of travel to and from the development. Given the location of the development at the far extents of the town of Greystones and the poor linkages provided by the development, the development itself would result in nothing else other than increased private car use within the town and surrounding area.
- Many of the initiatives suggested place too much merit on their potential success:
    - *Provide umbrellas to residents of the apartment blocks on wet days. How realistic and sustainable an approach is this*. Why do household residents not also receive these?
    - *Establish a resident Bicycle User Group*. This is completely dependent on uptake of residents.
    - *Advertising the Bike to Work Scheme*. Given that the likelihood is that the majority if not all of the working residents will either be working towards the Dublin area or at home and not in Greystones this scheme is unlikely to be of use.
    - *Encourage establishment of a cycling club/society*. This is much the same as point b above and is wholly dependent on the uptake of residents.
    - *Install good quality cycle parking provision on site*. Whilst this initiative is welcome the detail of these is not provided nor are the locations shown on any drawings. Bike parking for residents should be in a covered and secure lockup only accessible by residents. Visitor bike parking should be covered.
    - *Provision of public transport maps and timetable in prominent locations on site. Information should be kept up to date. This information could also be available online*. This information is already available online and through mobile apps by the relevant public transport providers.
    - *Publicise real time passenger information apps and websites.* Transport for Ireland website and app is widely publicised nationally already.
    - *Publicise door-to-door multi modal journey planner website.* Transport for Ireland website and app is widely publicised.
    - *Encouragement of residents and visitors of the development to use other modes of travel other than private car.* Very high level idealistic initiative but how is this proposed to be done, lacking in any credible detail.
    - *Where it is necessary for car use to travel to and from work, residents and staff (of the apartment blocks) should be made aware of other people who are either within close proximity of their homes (for staff) or on their route into work (for residents).* Again a good notional idea but how will this be put into practice taking into consideration data protection?
- As part of any Mobility Management Plan targets should be set and legally imposable financial penalties should be created for the developer for any targets not met.
- The developer should be conditioned to provide a private bus service to and from the town centre, i.e. the train station at peak periods.

Outline Construction Traffic Management Plan

- Section 8.4 proposes a route and an alternative route. The alternative route proposed should in no way be considered feasible. An alternative route may be feasible in the future pending the completion of the Chapel Road Upgrade Scheme.

Appendix D – WCC Meeting Minutes

31/08/2021 - WCC Roads Dept. Meeting

Tuesday, August 31, 2021 9:31 AM

Project
Coolagad SHD Development by Cairn Homes PLC

Date & Time
31/08/2021 – 11am to 11:30am

Purpose
To discuss the preliminary traffic modelling for the Coolagad SHD development along with the current site layout and other keys items.

Attendees

- Declan O'Brien – WCC – Roads Dept
- Ruairi O'Hanlon – WCC – Senior Executive Engineer
- Laura Shaughnessy – AECOM – PM – Civil
- Kyle McKinnon – AECOM – Traffic
- Zac Cave – AECOM – Traffic

Red text is edits by WCC.

No.	Items Discussed	Action
	Preliminary Traffic Modelling	
1	AECOM outlined that the **preliminary traffic modelling** has indicated that the redford junction exceed capacity due to the development. The modelling assumes that all 600 units would come online in 2023. One key issue the AM flow coming from Redford Park into the Redford junction. All other roads coming into the junction are also very busy.	Note
2	WCC advised that the design of **upgrades to the Redford junction** (adjacent Lidl) are currently being undertaken by a WCC design team. The upgrade will incorporate a new type of junction layout, one of the first of its kind in Ireland, which the NTA are planning on adopting in the National Cycle Manual.	WCC to obtain latest most preferred junction design for the Redford junction upgrade, including any traffic modelling/analysis and share with AECOM for coordination and consideration in the Coolagad SHD planning submission.
3	WCC queried whether **linking the two sets of lights** at the existing Redford junction and the new Coolagad SHD signalised junction at the entrance, had been considered. AECOM had advised that linking the light was not yet considered.	AECOM to investigate linking the two sets of lights in the traffic analysis to determine if it would be of any benefit to traffic movements and junction capacity.
4	As AECOM has considered that all 600 units would come online all at once in 2023, it was queries as to whether implementing a **phased approach** would be acceptable to WCC whereby impact would be accessed based on the different phasing. The phasing would need to be agreed with Cairn and appropriate timelines applied for each phase. WCC did not have any objection to this proposal.	AECOM to review traffic impacts based on a phased approach.
5	The WCC development plan includes provision for a **proposed link roadway to the N11**, a portion of which is proposed for the Coolagad SHD development, located along the north of the development site. AECOM queried whether this link roadway could be considered for future stages. WCC advised that the link road to the N11 would not be built any time soon. However, this does not mean that the new road and junction onto the R761 should not be designed to cater for the connection to the N11. It would only be prudent to include in all designs the final scenario of a connection to the N11.	Note
	Current Site Layout	
6	AECOM presented the **current site layout and new junction layout**, and noted that the layout is subject to change and that any comments from WCC on the layout would be welcomed now such that they can be incorporated in to the final planning submission.	WCC to review the current site layout and junction layout and provide comments to AECOM.
7	AECOM queried whether WCC would accept **parallel parking along the new access roadway**, at the entrance to the development, immediately after the creche and community building. WCC expressed that this option should be avoided if possible as it would not be preferred.	Note
8	AECOM outlined that **cycle lanes** will be provided along the R761 from the new junction to the Redford junction. Cycle lanes will also be provided along either side of the new access roadway within the development up to the roadway connection to the proposed apartments.	AECOM to coordinated the new cycle lanes along the R761 with the proposed Redford junction upgrades, following receipt of design from WCC.
9	Regarding the **internal roadway layout**, WCC advised that they do not want to see any vertical traffic calming measures. Calming measures should be by way of horizontal deflection. WCC advised that as this is a green field site, traffic calming measures should be by way of applying DMURS first principles to the layout of the estate as opposed to creating a layout and adding in DMURS elements for existing roads afterwards. WCC is aware that the topography of the site poses challenges in this regard. Vertical deflections are to be avoided.	AECOM to review internal roadway layout and implement appropriate traffic calming measures where possible.
10	WCC queried if the **stream roadway crossings** could be reduced to 1 crossing but providing a **pedestrian and cyclist crossing** instead. AECOM advised that if one road crossing were to be deleted, then it would be the western crossing as it is close to the existing archaeological site, and all services are being brought across the steam via the eastern roadway crossing. WCC reiterated that all stream crossing are to be via bridge crossings.	AECOM to liaise with Cairn, the Architect and Landscape Architect regarding the deletion of one of the roadway crossings, and the provision of a pedestrian and cycle bridge in lieu.
11	WCC queried whether the **green routes in the local area** have been considered in the site layout. These include walking routes up to Kindlestown hill, the proposed site layout should ensure that walking routes are not cut off by the back yards for the proposed units. The green route are not necessarily through woodlands, some are through existing cul-de-sacs such as Waverley Avenue and Seagreen Park. **Pedestrian connections** should be allowed for in the site layout, including provision for connection to the existing school.	AECOM to investigate and review site layout in coordination with the local green routes for the area. AECOM to allow for connections to the neighbouring cul-de-sacs and the existing school. And the undeveloped site to the south. Connections need to consider vertical alignment as well as horizontal alignment.
	Existing Drainage Onsite	
12	AECOM queried whether WCC were aware of the **existing storage pond** located in the south eastern corner of the site. WCC advised that they were of the understanding that the storage pond was installed by the farmer as the area is subject to flash flooding due to run off from Kindlestown hill. AECOM noted that the pond has an outfall pipe that reticulated to the existing stream. WCC noted that perhaps this was installed by the Waverley development, but were unsure.	Further investigation is required regarding the purpose of the existing storage pond and whether it has been design for a particular upstream catchment.
	Existing Local Network Sewer Capacity	
13	AECOM noted that they have been struggling to obtain the referenced **sewer capacity study** that has been referenced in the WCC Opinion. WCC advised that they are not at liberty to issue the report to AECOM without permission from Irish Water.	AECOM to seek Irish Water's permission for WCC to release the report.

Appendix E – Q_{BAR} Calculations for Upstream Catchments

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Jamie Cullen
Site name:	Limiting QBar Discharge
Site location:	Coolagad, Co. Wicklow

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

Site Details

Latitude:	53.15054° N
Longitude:	6.0966° W
Reference:	1394428075
Date:	Jan 26 2022 14:35

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 18.1

Methodology

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

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	1056	895
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	141.37	116.49
1 in 1 year (l/s):	120.16	99.02
1 in 30 years (l/s):	301.12	248.13
1 in 100 year (l/s):	368.97	304.05
1 in 200 years (l/s):	404.32	333.17

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions. The results from this tool are estimations of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix F – Met Eireann Rainfall Data

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 327507, Northing: 212796,

	Interval		Years											
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	3.0,	4.1,	4.7,	5.6,	6.2,	6.7,	8.3,	10.0,	11.1,	12.7,	14.1,	15.2,	16.9,	18.2,	19.2,	N/A ,
10 mins	4.1,	5.7,	6.6,	7.8,	8.7,	9.4,	11.5,	13.9,	15.5,	17.7,	19.7,	21.2,	23.5,	25.3,	26.8,	N/A ,
15 mins	4.8,	6.7,	7.7,	9.2,	10.2,	11.0,	13.5,	16.4,	18.2,	20.8,	23.1,	24.9,	27.7,	29.8,	31.5,	N/A ,
30 mins	6.4,	8.8,	10.0,	11.9,	13.1,	14.1,	17.2,	20.6,	22.8,	26.0,	28.7,	30.8,	34.1,	36.6,	38.6,	N/A ,
1 hours	8.5,	11.4,	13.0,	15.3,	16.8,	18.0,	21.7,	25.9,	28.6,	32.3,	35.6,	38.1,	41.9,	44.9,	47.3,	N/A ,
2 hours	11.2,	14.9,	16.9,	19.7,	21.6,	23.0,	27.6,	32.6,	35.8,	40.3,	44.1,	47.1,	51.6,	55.1,	57.9,	N/A ,
3 hours	13.2,	17.4,	19.6,	22.8,	24.9,	26.5,	31.7,	37.2,	40.8,	45.8,	50.1,	53.3,	58.3,	62.1,	65.2,	N/A ,
4 hours	14.8,	19.5,	21.9,	25.3,	27.6,	29.4,	34.9,	41.0,	44.8,	50.1,	54.7,	58.2,	63.6,	67.6,	70.9,	N/A ,
6 hours	17.4,	22.7,	25.5,	29.4,	32.0,	33.9,	40.1,	46.8,	51.1,	57.0,	62.1,	65.9,	71.8,	76.2,	79.8,	N/A ,
9 hours	20.5,	26.6,	29.6,	34.1,	37.0,	39.2,	46.1,	53.6,	58.3,	64.8,	70.4,	74.7,	81.1,	85.9,	89.9,	N/A ,
12 hours	23.0,	29.7,	33.0,	37.8,	41.0,	43.4,	50.9,	58.9,	64.0,	71.0,	77.0,	81.5,	88.4,	93.5,	97.8,	N/A ,
18 hours	27.1,	34.6,	38.4,	43.9,	47.4,	50.1,	58.4,	67.4,	73.0,	80.7,	87.3,	92.3,	99.8,	105.4,	110.0,	N/A ,
24 hours	30.4,	38.7,	42.8,	48.7,	52.5,	55.4,	64.5,	74.1,	80.2,	88.4,	95.5,	100.8,	108.8,	114.8,	119.7,	136.3,
2 days	38.8,	48.4,	53.2,	59.9,	64.3,	67.5,	77.7,	88.3,	95.0,	104.0,	111.6,	117.4,	125.9,	132.4,	137.6,	155.1,
3 days	45.6,	56.3,	61.6,	69.0,	73.8,	77.3,	88.3,	99.8,	107.0,	116.6,	124.8,	130.9,	139.9,	146.7,	152.2,	170.6,
4 days	51.6,	63.3,	69.0,	77.0,	82.1,	85.9,	97.6,	109.9,	117.5,	127.6,	136.2,	142.6,	152.2,	159.3,	165.0,	184.2,
6 days	62.2,	75.5,	81.9,	90.8,	96.5,	100.8,	113.8,	127.3,	135.6,	146.7,	156.1,	163.0,	173.3,	181.0,	187.2,	207.7,
8 days	71.7,	86.3,	93.3,	103.1,	109.3,	113.9,	128.0,	142.6,	151.5,	163.4,	173.4,	180.8,	191.8,	200.0,	206.5,	228.3,
10 days	80.4,	96.2,	103.8,	114.3,	121.0,	125.9,	141.0,	156.5,	166.0,	178.6,	189.1,	197.0,	208.5,	217.1,	224.0,	246.8,
12 days	88.6,	105.5,	113.6,	124.8,	131.8,	137.1,	153.0,	169.4,	179.4,	192.6,	203.7,	211.9,	224.0,	233.0,	240.2,	263.9,
16 days	103.8,	122.7,	131.7,	144.1,	151.9,	157.7,	175.2,	193.1,	204.0,	218.4,	230.4,	239.2,	252.3,	262.0,	269.7,	295.2,
20 days	118.0,	138.7,	148.5,	162.0,	170.4,	176.7,	195.6,	214.8,	226.5,	241.9,	254.7,	264.2,	278.1,	288.3,	296.6,	323.6,
25 days	134.8,	157.5,	168.2,	182.9,	192.1,	198.9,	219.3,	240.0,	252.6,	269.1,	282.9,	293.0,	307.8,	318.8,	327.5,	356.2,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

M5-60 = 18mm
RATIO R = 0.267
SAAR = 895mm

Appendix G – Upstream Catchment Surface Water Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm Overland Flows

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.267	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	75	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm Overland Flows

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	4.027	0.040	100.0	0.601	15.00	0.0	0.600	o	600	Pipe/Conduit	
S1.001	38.137	0.381	100.1	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	3.680	0.037	100.0	1.069	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	65.739	0.657	100.1	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	5.117	0.051	100.0	0.390	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.005	53.073	0.531	99.9	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.006	3.652	0.037	100.0	0.079	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.007	12.389	0.124	99.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	4.427	0.044	100.6	0.173	15.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	32.062	0.321	99.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	6.582	0.066	99.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	40.78	15.03	88.500	0.601	0.0	0.0	0.0	2.44	688.6	66.4
S1.001	40.45	15.26	87.620	0.000	25.0	0.0	0.0	2.43	688.2	25.0
S1.002	40.42	15.29	86.500	1.069	25.0	0.0	0.0	2.44	688.6	142.1
S1.003	40.20	15.45	86.000	0.000	25.0	0.0	0.0	2.43	688.4	25.0
S1.004	40.15	15.49	85.000	0.390	25.0	0.0	0.0	2.44	688.6	67.4
S1.005	40.31	15.36	84.750	0.000	25.0	0.0	0.0	2.44	688.8	25.0
S1.006	40.28	15.39	83.500	0.079	25.0	0.0	0.0	2.44	688.6	33.6
S1.007	40.63	15.13	82.500	0.000	25.0	0.0	0.0	1.57	111.2	25.0
S2.000	40.75	15.05	81.500	0.173	0.0	0.0	0.0	1.57	110.8	19.1
S2.001	40.35	15.34	81.250	0.000	25.0	0.0	0.0	1.57	111.2	25.0
S1.008	40.25	15.41	79.680	0.000	50.0	0.0	0.0	1.57	111.3	50.0

Network Design Table for Storm Overland Flows

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.009	10.648	0.106	100.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.010	47.999	0.050	960.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	3.878	0.059	65.7	1.054	15.00	0.0	0.600	o	600	Pipe/Conduit	
S3.001	33.590	0.336	100.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.002	21.955	0.219	100.3	0.583	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.003	5.025	0.077	65.3	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.004	9.259	0.093	99.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.005	5.122	0.078	65.7	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.006	8.856	0.089	99.5	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.007	5.477	0.089	61.5	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.008	15.062	0.151	99.7	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.009	5.872	0.089	66.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.010	12.306	0.123	100.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.011	6.360	0.096	66.3	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.012	8.467	0.085	99.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.013	4.544	0.069	65.9	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.014	10.169	0.102	99.7	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.015	3.374	0.051	66.2	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.016	7.671	0.077	99.6	1.536	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.017	7.671	0.077	99.6	0.898	0.00	0.0	0.600	o	600	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.009	40.10	15.52	78.700	0.000	50.0	0.0	0.0	1.57	111.1	50.0
S1.010	38.71	16.60	78.594	0.000	19.9	0.0	0.0	0.50	35.3	19.9
S3.000	40.78	15.02	92.250	1.054	0.0	0.0	0.0	3.01	850.2	116.4
S3.001	40.50	15.23	91.500	0.000	25.0	0.0	0.0	2.44	688.7	25.0
S3.002	40.61	15.15	90.000	0.000	25.0	0.0	0.0	2.43	687.7	25.0
S3.003	40.57	15.18	89.781	0.000	25.0	0.0	0.0	3.02	853.3	25.0
S3.004	40.73	15.06	89.704	0.000	25.0	0.0	0.0	2.44	690.1	25.0
S3.005	40.69	15.09	89.000	0.000	25.0	0.0	0.0	3.01	850.6	25.0
S3.006	40.73	15.06	88.250	0.000	25.0	0.0	0.0	2.44	690.3	25.0
S3.007	40.69	15.09	87.500	0.000	25.0	0.0	0.0	3.11	878.8	25.0
S3.008	40.67	15.10	86.250	0.000	25.0	0.0	0.0	2.44	689.5	25.0
S3.009	40.63	15.14	85.500	0.000	25.0	0.0	0.0	3.00	848.6	25.0
S3.010	40.70	15.08	84.000	0.000	25.0	0.0	0.0	2.43	688.4	25.0
S3.011	40.65	15.12	82.750	0.000	25.0	0.0	0.0	3.00	846.8	25.0
S3.012	40.73	15.06	81.600	0.000	25.0	0.0	0.0	2.44	689.9	25.0
S3.013	40.70	15.08	81.000	0.000	25.0	0.0	0.0	3.00	849.4	25.0
S3.014	40.72	15.07	80.250	0.000	25.0	0.0	0.0	2.44	689.6	25.0
S3.015	40.69	15.09	79.500	0.000	25.0	0.0	0.0	3.00	847.4	25.0
S3.016	40.74	15.05	79.000	0.000	25.0	0.0	0.0	2.44	689.9	25.0
S3.017	40.74	15.05	78.900	0.000	25.0	0.0	0.0	2.44	689.9	25.0

Network Design Table for Storm Overland Flows

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S4.000	3.226	0.049	65.8	0.000	15.00	0.0	0.600	o	600	Pipe/Conduit	
S4.001	11.599	0.116	100.0	1.385	0.00	0.0	0.600	o	600	Pipe/Conduit	
S4.002	11.708	0.117	100.1	0.686	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.018	7.816	0.158	49.5	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
S3.019	32.631	0.100	326.3	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
S5.000	3.623	0.055	66.0	1.213	15.00	0.0	0.600	o	600	Pipe/Conduit	
S5.001	51.039	0.510	100.1	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S5.002	3.333	0.051	65.4	0.892	0.00	0.0	0.600	o	600	Pipe/Conduit	
S5.003	20.704	0.207	100.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S5.004	17.646	0.176	100.3	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S5.005	3.258	0.049	66.5	0.778	0.00	0.0	0.600	o	600	Pipe/Conduit	
S5.006	27.197	0.272	100.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S5.007	10.230	0.102	100.3	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S6.000	3.579	0.054	66.0	0.000	15.00	0.0	0.600	o	600	Pipe/Conduit	
S6.001	31.188	0.312	100.0	0.582	0.00	0.0	0.600	o	600	Pipe/Conduit	
S6.002	41.201	0.412	100.0	0.660	0.00	0.0	0.600	o	600	Pipe/Conduit	
S6.003	5.530	0.084	65.8	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S5.008	7.902	0.120	65.9	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S4.000	40.79	15.02	79.750	0.000	0.0	0.0	0.0	3.00	849.5	0.0
S4.001	40.70	15.08	79.500	0.000	25.0	0.0	0.0	2.44	688.6	25.0
S4.002	40.70	15.08	79.000	0.000	25.0	0.0	0.0	2.43	688.3	25.0
S3.018	40.65	15.12	78.000	0.000	50.0	0.0	0.0	3.73	1335.5	50.0
S3.019	40.30	15.38	77.300	0.000	65.0	0.0	0.0	1.45	517.2	65.0
S5.000	40.79	15.02	92.260	1.213	0.0	0.0	0.0	3.00	848.4	134.0
S5.001	40.33	15.35	92.000	0.000	25.0	0.0	0.0	2.43	688.3	25.0
S5.002	40.31	15.37	91.400	0.892	25.0	0.0	0.0	3.02	852.6	122.3
S5.003	40.62	15.14	91.000	0.000	25.0	0.0	0.0	2.44	688.5	25.0
S5.004	40.65	15.12	90.250	0.000	25.0	0.0	0.0	2.43	687.7	25.0
S5.005	40.62	15.14	89.500	0.778	25.0	0.0	0.0	2.99	845.3	110.6
S5.006	40.56	15.19	88.750	0.000	25.0	0.0	0.0	2.44	688.6	25.0
S5.007	40.72	15.07	87.500	0.000	25.0	0.0	0.0	2.43	687.6	25.0
S6.000	40.79	15.02	87.000	0.000	0.0	0.0	0.0	3.00	848.4	0.0
S6.001	40.52	15.21	86.750	0.000	25.0	0.0	0.0	2.44	688.7	25.0
S6.002	40.42	15.28	86.250	0.000	25.0	0.0	0.0	2.44	688.6	25.0
S6.003	40.38	15.31	85.750	0.000	25.0	0.0	0.0	3.00	849.5	25.0
S5.008	40.32	15.36	84.600	0.000	50.0	0.0	0.0	3.00	849.4	50.0

Network Design Table for Storm Overland Flows

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S5.009	9.596	0.098	97.9	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.000	3.958	0.060	66.0	0.654	15.00	0.0	0.600	o	600	Pipe/Conduit	
S7.001	9.839	0.098	100.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.002	4.033	0.061	66.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.003	41.749	0.417	100.1	1.178	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.004	41.927	0.419	100.1	1.138	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.005	5.539	0.027	205.1	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.006	71.978	0.360	199.9	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.007	26.944	0.135	199.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.008	22.847	0.114	200.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.009	45.914	0.459	100.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.010	69.481	0.695	100.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S5.010	7.445	0.266	28.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S5.011	3.896	0.139	28.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.012	3.896	0.195	20.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.013	14.633	0.523	28.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.014	15.344	0.548	28.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S5.009	40.23	15.42	83.500	0.000	50.0	0.0	0.0	2.46	695.9	50.0
S7.000	40.78	15.02	92.300	0.654	0.0	0.0	0.0	3.00	848.4	72.3
S7.001	40.72	15.07	92.000	0.000	25.0	0.0	0.0	2.43	687.2	25.0
S7.002	40.69	15.09	91.000	0.000	25.0	0.0	0.0	3.00	848.4	25.0
S7.003	40.42	15.29	90.500	0.000	25.0	0.0	0.0	2.43	688.2	25.0
S7.004	40.42	15.29	90.000	0.000	15.0	0.0	0.0	2.43	688.4	15.0
S7.005	40.34	15.34	89.500	0.000	15.0	0.0	0.0	1.70	479.7	15.0
S7.006	39.42	16.04	89.473	0.000	15.0	0.0	0.0	1.72	485.9	15.0
S7.007	39.09	16.30	88.500	0.000	15.0	0.0	0.0	1.72	486.4	15.0
S7.008	38.81	16.52	88.365	0.000	15.0	0.0	0.0	1.72	485.8	15.0
S7.009	38.43	16.84	86.100	0.000	15.0	0.0	0.0	2.44	688.5	15.0
S7.010	37.87	17.31	84.600	0.000	15.0	0.0	0.0	2.44	688.6	15.0
S5.010	40.78	15.03	80.900	0.000	40.0	0.0	0.0	4.61	1304.8	40.0
S5.011	40.75	15.05	80.634	0.000	40.0	0.0	0.0	2.98	210.7	40.0
S5.012	40.72	15.07	79.600	0.000	40.0	0.0	0.0	3.53	249.6	40.0
S5.013	40.61	15.15	77.800	0.000	40.0	0.0	0.0	2.98	210.9	40.0
S5.014	40.49	15.23	76.000	0.000	40.0	0.0	0.0	2.98	210.8	40.0

Free Flowing Outfall Details for Storm Overland Flows

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.010	SNorthern Outfall	80.000	78.544	77.600	0	0

Free Flowing Outfall Details for Storm Overland Flows

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S3.019	SSourthern Outfall	79.000	77.200	77.200	0	0

Free Flowing Outfall Details for Storm Overland Flows

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S5.014	SSite Outfall	77.025	75.452	74.595	0	0

Simulation Criteria for Storm Overland Flows

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	0.850	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	30	Number of Storage Structures	33	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.267		

Online Controls for Storm Overland Flows

Weir Manhole: S1A, DS/PN: S1.001, Volume (m³): 6.0

Discharge Coef 0.544 Width (m) 0.050 Invert Level (m) 89.147

Weir Manhole: S2A, DS/PN: S1.003, Volume (m³): 7.7

Discharge Coef 0.544 Width (m) 0.150 Invert Level (m) 88.203

Weir Manhole: S3A, DS/PN: S1.005, Volume (m³): 6.1

Discharge Coef 0.544 Width (m) 0.150 Invert Level (m) 86.194

Weir Manhole: S4A, DS/PN: S1.007, Volume (m³): 7.9

Discharge Coef 0.544 Width (m) 0.150 Invert Level (m) 84.812

Weir Manhole: S5A, DS/PN: S2.001, Volume (m³): 4.1

Discharge Coef 0.544 Width (m) 0.025 Invert Level (m) 82.208

Weir Manhole: S8, DS/PN: S1.010, Volume (m³): 6.7

Discharge Coef 0.544 Width (m) 0.055 Invert Level (m) 80.100

Weir Manhole: S9A, DS/PN: S3.001, Volume (m³): 6.9

Discharge Coef 0.544 Width (m) 0.185 Invert Level (m) 93.363

Weir Manhole: S9B, DS/PN: S3.002, Volume (m³): 17.5

Discharge Coef 0.544 Width (m) 0.250 Invert Level (m) 92.761

Weir Manhole: S10A, DS/PN: S3.004, Volume (m³): 7.8

Discharge Coef 0.544 Width (m) 0.240 Invert Level (m) 91.809

Weir Manhole: S11A, DS/PN: S3.006, Volume (m³): 6.5

Discharge Coef 0.544 Width (m) 0.235 Invert Level (m) 89.837

Weir Manhole: S12A, DS/PN: S3.008, Volume (m³): 6.6

Discharge Coef 0.544 Width (m) 0.225 Invert Level (m) 87.836

Weir Manhole: S13A, DS/PN: S3.010, Volume (m³): 7.0

Discharge Coef 0.544 Width (m) 0.200 Invert Level (m) 85.703

Weir Manhole: S14A, DS/PN: S3.012, Volume (m³): 6.2

Discharge Coef 0.544 Width (m) 0.190 Invert Level (m) 82.911

Weir Manhole: S15A, DS/PN: S3.014, Volume (m³): 4.9

Discharge Coef 0.544 Width (m) 0.165 Invert Level (m) 81.283

Weir Manhole: S16A, DS/PN: S3.016, Volume (m³): 5.8

Discharge Coef 0.544 Width (m) 0.450 Invert Level (m) 79.500

Weir Manhole: S16B, DS/PN: S3.017, Volume (m³): 7.3

Discharge Coef 0.544 Width (m) 0.455 Invert Level (m) 79.750

Weir Manhole: S17A, DS/PN: S4.001, Volume (m³): 5.3

Discharge Coef 0.544 Width (m) 0.500 Invert Level (m) 80.500

Weir Manhole: S17B, DS/PN: S4.002, Volume (m³): 10.1

Discharge Coef 0.544 Width (m) 0.300 Invert Level (m) 79.825

Complex Manhole: S19, DS/PN: S3.019, Volume (m³): 11.6

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0326-6500-1200-6500
Design Head (m)	1.200
Design Flow (l/s)	65.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	326
Invert Level (m)	77.300
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	65.0	Kick-Flo®	0.921	57.2
Flush-Flo™	0.503	65.0	Mean Flow over Head Range	-	52.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.7	0.800	61.6	2.000	83.2	4.000	116.6	7.000	153.3
0.200	33.3	1.000	59.5	2.200	87.2	4.500	123.5	7.500	158.5
0.300	59.2	1.200	65.0	2.400	90.9	5.000	130.0	8.000	163.6
0.400	64.3	1.400	70.0	2.600	94.5	5.500	136.2	8.500	168.6
0.500	65.0	1.600	74.7	3.000	101.3	6.000	142.1	9.000	173.3
0.600	64.5	1.800	79.1	3.500	109.3	6.500	147.8	9.500	178.0

Weir Manhole: S20A, DS/PN: S5.001, Volume (m³): 5.0

Discharge Coef 0.544 Width (m) 0.225 Invert Level (m) 93.159

Weir Manhole: S21A, DS/PN: S5.003, Volume (m³): 4.3

Discharge Coef 0.544 Width (m) 0.375 Invert Level (m) 91.925

Weir Manhole: S21B, DS/PN: S5.004, Volume (m³): 9.5

Discharge Coef 0.544 Width (m) 0.350 Invert Level (m) 91.300

Weir Manhole: S22A, DS/PN: S5.006, Volume (m³): 5.1

Discharge Coef 0.544 Width (m) 0.450 Invert Level (m) 89.973

Weir Manhole: S22B, DS/PN: S5.007, Volume (m³): 13.0

Discharge Coef 0.544 Width (m) 0.450 Invert Level (m) 89.196

Weir Manhole: S23A, DS/PN: S6.001, Volume (m³): 5.0

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 87.750

Weir Manhole: S23B, DS/PN: S6.002, Volume (m³): 14.0

Discharge Coef 0.544 Width (m) 0.500 Invert Level (m) 87.650

Weir Manhole: S27A, DS/PN: S7.001, Volume (m³): 5.3

Discharge Coef 0.544 Width (m) 0.300 Invert Level (m) 93.240

Weir Manhole: S28A, DS/PN: S7.003, Volume (m³): 8.6

Discharge Coef 0.544 Width (m) 0.600 Invert Level (m) 92.700

Weir Manhole: S28B, DS/PN: S7.004, Volume (m³): 19.2

Discharge Coef 0.544 Width (m) 0.320 Invert Level (m) 92.600

Hydro-Brake® Optimum Manhole: S35, DS/PN: S5.010, Volume (m³): 31.8

Unit Reference	MD-SHE-0213-3380-3500-3380
Design Head (m)	3.500
Design Flow (l/s)	33.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	213
Invert Level (m)	80.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.500	33.8	Kick-Flo®	1.899	25.2
Flush-Flo™	0.917	32.3	Mean Flow over Head Range	-	28.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.2	0.800	32.2	2.000	25.8	4.000	36.0	7.000	47.2
0.200	20.7	1.000	32.3	2.200	27.1	4.500	38.1	7.500	48.8
0.300	26.5	1.200	31.9	2.400	28.2	5.000	40.1	8.000	50.4
0.400	28.8	1.400	31.0	2.600	29.3	5.500	42.0	8.500	51.9
0.500	30.3	1.600	29.5	3.000	31.4	6.000	43.8	9.000	53.3
0.600	31.3	1.800	27.0	3.500	33.8	6.500	45.6	9.500	54.8

Storage Structures for Storm Overland Flows

Dry Swale Manhole: S1A, DS/PN: S1.001

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	87.620	Cap Volume Depth (m)	0.000
Trench Height (m)	1.527	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	38.1		

Dry Swale Manhole: S2A, DS/PN: S1.003

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	86.000	Cap Volume Depth (m)	0.000
Trench Height (m)	1.000	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	65.7		

Dry Swale Manhole: S3A, DS/PN: S1.005

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	84.750	Cap Volume Depth (m)	0.000
Trench Height (m)	1.444	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	53.1		

Dry Swale Manhole: S4A, DS/PN: S1.007

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Invert Level (m)	83.000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Height (m)	1.000
Safety Factor	2.0	Trench Width (m)	3.5
Porosity	1.00	Trench Length (m)	12.4

Dry Swale Manhole: S4A, DS/PN: S1.007

Trench Infiltration Side (m/hr)	0.00000	Cap Volume Depth (m)	0.000
Trench Porosity	0.43	Cap Infiltration Depth (m)	0.000
Side Slope (1:X)	4.0	Include Swale Volume	Yes
Slope (1:X)	100.0		

Dry Swale Manhole: S5A, DS/PN: S2.001

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	81.250	Cap Volume Depth (m)	0.000
Trench Height (m)	0.958	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	32.1		

Tank or Pond Manhole: S8, DS/PN: S1.010

Invert Level (m) 78.594

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	300.0	1.500	450.0	1.501	550.0

Dry Swale Manhole: S9A, DS/PN: S3.001

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	91.500	Cap Volume Depth (m)	0.000
Trench Height (m)	1.200	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	33.6		

Dry Swale Manhole: S9B, DS/PN: S3.002

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.5
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	21.9
Safety Factor	2.0	Trench Infiltration Side (m/hr)	0.00000
Porosity	1.00	Trench Porosity	0.43
Invert Level (m)	90.000	Side Slope (1:X)	4.0
Trench Height (m)	1.000	Slope (1:X)	100.0

Dry Swale Manhole: S9B, DS/PN: S3.002

Cap Volume Depth (m) 0.000 Include Swale Volume Yes
Cap Infiltration Depth (m) 0.000

Dry Swale Manhole: S10A, DS/PN: S3.004

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	89.750	Cap Volume Depth (m)	0.000
Trench Height (m)	1.000	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	9.3		

Dry Swale Manhole: S11A, DS/PN: S3.006

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	88.250	Cap Volume Depth (m)	0.000
Trench Height (m)	1.000	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	8.9		

Dry Swale Manhole: S12A, DS/PN: S3.008

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	86.250	Cap Volume Depth (m)	0.000
Trench Height (m)	1.586	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	15.1		

Dry Swale Manhole: S13A, DS/PN: S3.010

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	2.0
Infiltration Coefficient Side (m/hr)	0.00000	Porosity	1.00

Dry Swale Manhole: S13A, DS/PN: S3.010

Invert Level (m)	84.000	Side Slope (1:X)	4.0
Trench Height (m)	1.200	Slope (1:X)	100.0
Trench Width (m)	3.5	Cap Volume Depth (m)	0.000
Trench Length (m)	12.3	Cap Infiltration Depth (m)	0.000
Trench Infiltration Side (m/hr)	0.00000	Include Swale Volume	Yes
Trench Porosity	0.43		

Dry Swale Manhole: S14A, DS/PN: S3.012

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	81.600	Cap Volume Depth (m)	0.000
Trench Height (m)	1.311	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	8.5		

Dry Swale Manhole: S15A, DS/PN: S3.014

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	80.250	Cap Volume Depth (m)	0.000
Trench Height (m)	1.033	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	10.2		

Dry Swale Manhole: S16A, DS/PN: S3.016

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	79.000	Cap Volume Depth (m)	0.000
Trench Height (m)	1.330	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	7.7		

Dry Swale Manhole: S16B, DS/PN: S3.017

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	78.900	Cap Volume Depth (m)	0.000
Trench Height (m)	1.207	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	7.7		

Dry Swale Manhole: S17A, DS/PN: S4.001

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	79.500	Cap Volume Depth (m)	0.000
Trench Height (m)	1.317	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	11.6		

Dry Swale Manhole: S17B, DS/PN: S4.002

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	79.000	Cap Volume Depth (m)	0.000
Trench Height (m)	1.000	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	11.7		

Dry Swale Manhole: S19, DS/PN: S3.019

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Length (m)	60.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Safety Factor	2.0	Trench Porosity	0.45
Porosity	1.00	Side Slope (1:X)	4.0
Invert Level (m)	77.300	Slope (1:X)	100.0
Trench Height (m)	1.000	Cap Volume Depth (m)	0.000
Trench Width (m)	3.5	Cap Infiltration Depth (m)	0.000

Dry Swale Manhole: S19, DS/PN: S3.019

Include Swale Volume Yes

Dry Swale Manhole: S20A, DS/PN: S5.001

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	92.000	Cap Volume Depth (m)	0.000
Trench Height (m)	1.159	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	51.0		

Dry Swale Manhole: S21A, DS/PN: S5.003

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	91.000	Cap Volume Depth (m)	0.000
Trench Height (m)	0.925	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	20.7		

Dry Swale Manhole: S21B, DS/PN: S5.004

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	90.250	Cap Volume Depth (m)	0.000
Trench Height (m)	1.050	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	17.6		

Dry Swale Manhole: S22A, DS/PN: S5.006

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000	Invert Level (m)	88.750
Safety Factor	2.0	Trench Height (m)	1.223

Dry Swale Manhole: S22A, DS/PN: S5.006

Trench Width (m)	3.5	Slope (1:X)	100.0
Trench Length (m)	27.2	Cap Volume Depth (m)	0.000
Trench Infiltration Side (m/hr)	0.00000	Cap Infiltration Depth (m)	0.000
Trench Porosity	0.43	Include Swale Volume	Yes
Side Slope (1:X)	4.0		

Dry Swale Manhole: S22B, DS/PN: S5.007

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	87.500	Cap Volume Depth (m)	0.000
Trench Height (m)	1.696	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	10.2		

Dry Swale Manhole: S23A, DS/PN: S6.001

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	86.750	Cap Volume Depth (m)	0.000
Trench Height (m)	1.174	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	31.2		

Dry Swale Manhole: S23B, DS/PN: S6.002

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	86.250	Cap Volume Depth (m)	0.000
Trench Height (m)	1.000	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	41.2		

Dry Swale Manhole: S27A, DS/PN: S7.001

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Dry Swale Manhole: S27A, DS/PN: S7.001

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	92.000	Cap Volume Depth (m)	0.000
Trench Height (m)	1.240	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	9.8		

Dry Swale Manhole: S28A, DS/PN: S7.003

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	90.500	Cap Volume Depth (m)	0.000
Trench Height (m)	1.500	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	41.7		

Dry Swale Manhole: S28B, DS/PN: S7.004

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.43
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	90.000	Cap Volume Depth (m)	0.000
Trench Height (m)	1.200	Cap Infiltration Depth (m)	0.000
Trench Width (m)	3.5	Include Swale Volume	Yes
Trench Length (m)	41.9		

Filter Drain Manhole: S30, DS/PN: S7.006

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.700
Safety Factor	2.0	Number of Pipes	1
Porosity	0.45	Slope (1:X)	100.0
Invert Level (m)	91.000	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	45.0		

Filter Drain Manhole: S31, DS/PN: S7.007

Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.45
Infiltration Coefficient Side (m/hr)	0.00000	Invert Level (m)	88.500
Safety Factor	2.0	Trench Width (m)	1.0

Filter Drain Manhole: S31, DS/PN: S7.007

Trench Length (m)	28.0	Slope (1:X)	100.0
Pipe Diameter (m)	0.300	Cap Volume Depth (m)	0.000
Pipe Depth above Invert (m)	0.700	Cap Infiltration Depth (m)	0.000
Number of Pipes	1		

Filter Drain Manhole: S34, DS/PN: S7.010

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.300
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.700
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	100.0
Invert Level (m)	84.600	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	32.0		

Tank or Pond Manhole: S35, DS/PN: S5.010

Invert Level (m) 80.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	805.0	3.500	805.0	3.501	0.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm Overland Flows

Simulation Criteria

Areal Reduction Factor	0.850	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	30	Number of Storage Structures	33	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.267
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	180 Winter	100	+20%	1/240 Winter				89.642	0.542
S1.001	S1A	180 Winter	100	+20%	1/15 Summer				89.640	1.420
S1.002	S2	960 Winter	100	+20%	1/60 Winter				88.437	1.337
S1.003	S2A	960 Winter	100	+20%	1/15 Summer				88.435	1.835
S1.004	S3	960 Winter	100	+20%	1/240 Winter				86.460	0.860
S1.005	S3A	960 Winter	100	+20%	1/60 Winter				86.457	1.107
S1.006	S4	960 Winter	100	+20%	1/2160 Winter				85.081	0.981
S1.007	S4A	960 Winter	100	+20%	1/15 Summer				85.079	2.279
S2.000	S5	480 Winter	100	+20%	1/180 Winter				82.442	0.642
S2.001	S5A	480 Winter	100	+20%	1/15 Winter				82.440	0.890
S1.008	S6	2880 Winter	100	+20%	1/10080 Winter				80.475	0.495
S1.009	S7	4320 Winter	100	+20%	1/4320 Winter				80.435	1.435
S1.010	S8	4320 Winter	100	+20%	1/4320 Winter				80.423	1.529
S3.000	S9	180 Winter	100	+20%	1/60 Summer				93.704	0.854
S3.001	S9A	180 Winter	100	+20%	1/15 Summer				93.699	1.599
S3.002	S9B	720 Winter	100	+20%	1/15 Summer				92.976	2.376
S3.003	S10	960 Winter	100	+20%	1/2880 Winter				92.018	1.637
S3.004	S10A	960 Winter	100	+20%	1/2880 Winter				92.015	1.711
S3.005	S11	960 Winter	100	+20%	1/4320 Winter				90.038	0.438
S3.006	S11A	960 Winter	100	+20%	1/4320 Winter				90.035	1.185
S3.007	S12	720 Winter	100	+20%					88.100	0.000
S3.008	S12A	960 Winter	100	+20%	1/5760 Winter				88.033	1.183
S3.009	S13	1440 Winter	100	+20%					85.903	-0.197

Summary of Critical Results by Maximum Level (Rank 1) for Storm Overland Flows

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.18			55.9	SURCHARGED	
S1.001	S1A	0.000	0.05			29.5	SURCHARGED	
S1.002	S2	0.000	0.16			49.7	SURCHARGED	
S1.003	S2A	0.000	0.05			28.5	SURCHARGED	
S1.004	S3	0.000	0.10			34.7	SURCHARGED	
S1.005	S3A	0.000	0.06			34.3	SURCHARGED	
S1.006	S4	0.000	0.12			35.4	SURCHARGED	
S1.007	S4A	0.000	0.40			35.1	SURCHARGED	
S2.000	S5	0.000	0.13			8.2	SURCHARGED	
S2.001	S5A	0.000	0.05			4.8	SURCHARGED	
S1.008	S6	0.000	0.47			30.4	SURCHARGED	
S1.009	S7	0.000	0.30			24.2	SURCHARGED	
S1.010	S8	0.000	0.52			17.2	SURCHARGED	
S3.000	S9	0.000	0.29			99.6	SURCHARGED	
S3.001	S9A	0.000	0.11			61.4	SURCHARGED	
S3.002	S9B	0.000	0.09			42.3	SURCHARGED	
S3.003	S10	0.000	0.12			39.9	SURCHARGED	
S3.004	S10A	0.000	0.11			37.7	SURCHARGED	
S3.005	S11	0.000	0.11			36.7	SURCHARGED	
S3.006	S11A	0.000	0.10			35.7	SURCHARGED	
S3.007	S12	0.000	0.09			32.5	OK	
S3.008	S12A	0.000	0.08			32.4	SURCHARGED	
S3.009	S13	0.000	0.09			31.1	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm Overland Flows

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S3.010	S13A	1440 Winter	100	+20%	1/5760 Winter				85.894	1.294
S3.011	S14	1440 Winter	100	+20%					83.112	-0.238
S3.012	S14A	1440 Winter	100	+20%	1/7200 Winter				83.105	0.905
S3.013	S15	1440 Winter	100	+20%					81.506	-0.094
S3.014	S15A	1440 Winter	100	+20%	1/7200 Winter				81.494	0.644
S3.015	S16	15 Winter	100	+20%	1/15 Summer				80.782	0.682
S3.016	S16A	15 Winter	100	+20%	1/15 Summer				80.782	1.182
S3.017	S16B	30 Winter	100	+20%	1/15 Summer				80.621	1.121
S4.000	S17	30 Winter	100	+20%	1/15 Summer				81.149	0.799
S4.001	S17A	30 Winter	100	+20%	1/15 Summer				81.149	1.049
S4.002	S17B	30 Winter	100	+20%	1/15 Summer				80.795	1.195
S3.018	S18	240 Winter	100	+20%	1/30 Winter				80.297	1.622
S3.019	S19	180 Winter	100	+20%	1/15 Winter				80.209	2.234
S5.000	S20	60 Winter	100	+20%	1/30 Summer				93.697	0.837
S5.001	S20A	60 Winter	100	+20%	1/15 Summer				93.681	1.081
S5.002	S21	60 Winter	100	+20%	1/30 Summer				92.463	0.463
S5.003	S21A	60 Winter	100	+20%	1/15 Summer				92.432	0.832
S5.004	S21B	60 Winter	100	+20%	1/60 Summer				91.819	0.969
S5.005	S22	120 Winter	100	+20%	1/120 Winter				90.552	0.452
S5.006	S22A	120 Winter	100	+20%	1/15 Summer				90.480	1.130
S5.007	S22B	120 Winter	100	+20%	1/60 Winter				89.703	1.603
S6.000	S23	120 Winter	100	+20%	1/60 Summer				88.078	0.478
S6.001	S23A	120 Winter	100	+20%	1/30 Summer				88.078	0.728
S6.002	S23B	60 Winter	100	+20%	1/30 Summer				87.910	1.060
S6.003	S24	120 Winter	100	+20%					85.985	-0.365
S5.008	S25	120 Winter	100	+20%					85.200	0.000
S5.009	S26	2160 Winter	100	+20%	100/60 Winter				84.401	0.301
S7.000	S27	30 Winter	100	+20%	1/15 Summer				93.640	0.740
S7.001	S27A	30 Winter	100	+20%	1/15 Summer				93.631	1.031
S7.002	S28	360 Summer	100	+20%	1/30 Summer				93.066	1.466
S7.003	S28A	480 Winter	100	+20%	1/15 Summer				93.056	1.956
S7.004	S28B	360 Winter	100	+20%	1/15 Summer				92.896	2.296
S7.005	S29	360 Winter	100	+20%					89.746	-0.354
S7.006	S30	360 Winter	100	+20%					89.654	-0.419
S7.007	S31	360 Winter	100	+20%					88.698	-0.402
S7.008	S32	360 Winter	100	+20%					88.569	-0.396
S7.009	S33	360 Winter	100	+20%					86.253	-0.447
S7.010	S34	360 Winter	100	+20%					84.749	-0.451
S5.010	S35	2160 Winter	100	+20%	30/180 Winter				84.398	2.898
S5.011	S36	2160 Winter	100	+20%					80.758	-0.176
S5.012	S37	2160 Winter	100	+20%					79.713	-0.187
S5.013	S38	2160 Winter	100	+20%					77.889	-0.211
S5.014	S39	2160 Winter	100	+20%					76.088	-0.212

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S3.010	S13A	0.000	0.08			27.9	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Storm Overland Flows

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S3.011	S14	0.000	0.08			28.1	OK	
S3.012	S14A	0.000	0.08			28.0	SURCHARGED	
S3.013	S15	0.000	0.08			27.2	OK	
S3.014	S15A	0.000	0.08			27.0	SURCHARGED	
S3.015	S16	0.000	0.02			8.1	SURCHARGED	
S3.016	S16A	0.000	1.13		11	393.9	SURCHARGED	
S3.017	S16B	0.000	1.72		11	597.1	SURCHARGED	
S4.000	S17	0.000	0.01			2.8	SURCHARGED	
S4.001	S17A	0.000	0.97		17	338.1	SURCHARGED	
S4.002	S17B	0.000	1.34		10	463.7	SURCHARGED	
S3.018	S18	0.000	0.73			368.4	SURCHARGED	
S3.019	S19	0.000	0.24		138	65.0	SURCHARGED	
S5.000	S20	0.000	0.59			206.5	SURCHARGED	
S5.001	S20A	0.000	0.24		46	144.1	SURCHARGED	
S5.002	S21	0.000	0.70			241.6	SURCHARGED	
S5.003	S21A	0.000	0.51		36	230.6	SURCHARGED	
S5.004	S21B	0.000	0.53		46	222.2	SURCHARGED	
S5.005	S22	0.000	0.81			282.3	SURCHARGED	
S5.006	S22A	0.000	0.53		76	277.0	SURCHARGED	
S5.007	S22B	0.000	0.79			275.5	SURCHARGED	
S6.000	S23	0.000	0.00			0.8	SURCHARGED	
S6.001	S23A	0.000	0.11			64.0	SURCHARGED	
S6.002	S23B	0.000	0.19			113.2	SURCHARGED	
S6.003	S24	0.000	0.33			113.3	OK	
S5.008	S25	0.000	1.11			386.0	OK	
S5.009	S26	0.000	0.21			73.6	SURCHARGED	
S7.000	S27	0.000	0.38			130.4	SURCHARGED	
S7.001	S27A	0.000	0.36			124.8	SURCHARGED	
S7.002	S28	0.000	0.15			53.5	SURCHARGED	
S7.003	S28A	0.000	0.15			90.5	SURCHARGED	
S7.004	S28B	0.000	0.15			87.8	SURCHARGED	
S7.005	S29	0.000	0.36			87.9	OK	
S7.006	S30	0.000	0.20		138	87.8	OK	
S7.007	S31	0.000	0.24		132	87.8	OK	
S7.008	S32	0.000	0.25			87.7	OK	
S7.009	S33	0.000	0.15			87.7	OK	
S7.010	S34	0.000	0.14		138	87.8	OK	
S5.010	S35	0.000	0.07			33.8	SURCHARGED	
S5.011	S36	0.000	0.36			33.8	OK	
S5.012	S37	0.000	0.31			33.8	OK	
S5.013	S38	0.000	0.19			33.8	OK	
S5.014	S39	0.000	0.19			33.8	OK	

Appendix H – Enviroguide Consulting Drainage Survey

713527.027

728489.064

727069.558

712392.050

N

W E

S

BH03 - 11/03/2021
Ref Elevation: 82.677mOD
GW Elevation: 85.898mOD

BH06 - 11/03/2021
Ref Elevation: 64.994mOD
GW Elevation: 63.874mOD

PW01 - 11/03/2021
Ref Elevation:
78.584mOD
GW Elevation:
78.584mOD

BH05 - 11/03/2021
Ref Elevation: 65.507mOD
DRY

BH04 - 11/03/2021
Ref Elevation: 67.147mOD
GW Elevation: 63.017mOD

BH02 - 11/03/2021
Ref Elevation: 82.677mOD
DRY

Legend:

- Borehole
- Private Well
- Spring

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OSI ENGINEERS IRELAND

CLIENT: Cairn Homes Limited			
LOCATION: Coolagad, Greystones, Wicklow			
DRAWING TITLE: Proposed Site Levels			
SCALE: 1 : 2000 @ A1	**DATE:** 31 / 03 / 2021	**DRN BY:** RH	**DRG NO:** P-01

Appendix I – Q_{BAR} Calculations for Site Catchments

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Jamie Cullen
Site name:	Phase 1 C & R
Site location:	Coolagad, Wicklow

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

Site Details

Latitude:	53.15076° N
Longitude:	6.09158° W
Reference:	499192043
Date:	Nov 12 2021 09:24

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.86

Methodology

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

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	1065	895
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	6.78	5.54
1 in 1 year (l/s):	5.77	4.7
1 in 30 years (l/s):	14.45	11.79
1 in 100 year (l/s):	17.71	14.45
1 in 200 years (l/s):	19.4	15.83

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Jamie Cullen
Site name:	Drainage Sub-Catchment 2
Site location:	Coolagad, Wicklow

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

Site Details

Latitude:	53.15131° N
Longitude:	6.09157° W
Reference:	3553771525
Date:	Nov 23 2021 11:16

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 7.93

Methodology

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

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	1065	895
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	62.55	51.04
1 in 1 year (l/s):	53.17	43.38
1 in 30 years (l/s):	133.24	108.71
1 in 100 year (l/s):	163.27	133.21
1 in 200 years (l/s):	178.91	145.97

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Jamie Cullen
Site name:	Drainage Sub-Catchment 3
Site location:	Coolagad, Wicklow

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

Site Details

Latitude:	53.15131° N
Longitude:	6.09157° W
Reference:	2762511376
Date:	Nov 23 2021 11:18

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 4.79

Methodology

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

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	1065	895
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	37.79	30.83
1 in 1 year (l/s):	32.12	26.2
1 in 30 years (l/s):	80.48	65.67
1 in 100 year (l/s):	98.62	80.46
1 in 200 years (l/s):	108.07	88.17

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Jamie Cullen
Site name:	Drainage Sub-Catchment 4
Site location:	Coolagad, Wicklow

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

Site Details

Latitude:	53.15131° N
Longitude:	6.09157° W
Reference:	2581471233
Date:	Nov 23 2021 11:19

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 4.76

Methodology

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

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	1065	895
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	37.55	30.64
1 in 1 year (l/s):	31.92	26.04
1 in 30 years (l/s):	79.98	65.25
1 in 100 year (l/s):	98	79.96
1 in 200 years (l/s):	107.39	87.62

Appendix J – Surface Water Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	20
Ratio R	0.267	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	75	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm at outfall SNorthern_Pond_Outfall (pipe S1.012)

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	1.676	4-8	2.823	8-12	0.020

Total Area Contributing (ha) = 4.519

Total Pipe Volume (m³) = 238.898

Time Area Diagram at outfall SCreche_Outfall (pipe S15.014)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.429	4-8	0.348

Total Area Contributing (ha) = 0.778

Total Pipe Volume (m³) = 33.266

Time Area Diagram at outfall SSteam_Outfall (pipe S20.023)

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.419	4-8	2.716	8-12	0.540

Total Area Contributing (ha) = 3.676

Total Pipe Volume (m³) = 164.151

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

Network Design Table for Storm

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	13.954	0.279	50.0	0.099	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	28.857	0.577	50.0	0.139	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	31.738	0.757	41.9	0.184	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.003	12.311	0.213	57.8	0.006	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.000	31.117	0.506	61.5	0.230	4.00	0.0	0.600	o	375	Pipe/Conduit	
S2.001	12.191	0.250	48.8	0.005	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.000	60.143	2.005	30.0	0.195	4.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	30.690	0.205	150.0	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
S4.001	33.092	1.655	20.0	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.002	27.282	1.364	20.0	0.057	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.003	22.169	1.108	20.0	0.044	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.004	7.676	0.384	20.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.005	7.676	0.384	20.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	34.941	0.339	103.0	0.106	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.002	15.137	0.151	100.0	0.033	0.00	0.0	0.600	o	375	Pipe/Conduit	
S5.000	43.159	0.719	60.0	0.087	4.00	0.0	0.600	o	225	Pipe/Conduit	
S5.001	10.124	0.506	20.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.002	10.577	0.529	20.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.003	14.171	0.709	20.0	0.043	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	71.01	4.13	69.376	0.099	0.0	0.0	5.1	1.85	73.7	30.4
S1.001	69.81	4.34	69.022	0.238	0.0	0.0	12.0	2.23	157.5	71.9
S1.002	68.80	4.53	68.370	0.422	0.0	0.0	21.0	2.81	309.8	125.8
S1.003	68.35	4.62	67.613	0.428	0.0	0.0	21.1	2.39	263.7	126.9
S2.000	70.46	4.22	68.155	0.230	0.0	0.0	11.7	2.31	255.6	70.2
S2.001	70.02	4.30	67.649	0.235	0.0	0.0	11.9	2.60	287.2	71.4
S3.000	69.40	4.42	74.065	0.195	0.0	0.0	9.8	2.40	95.3	58.6
S4.000	69.06	4.48	81.000	0.066	0.0	0.0	3.3	1.07	42.4	19.7
S4.001	68.09	4.67	79.000	0.101	0.0	0.0	5.0	2.94	116.9	29.7
S4.002	67.31	4.82	77.345	0.158	0.0	0.0	7.7	2.94	116.9	45.9
S4.003	66.69	4.95	75.981	0.201	0.0	0.0	9.7	2.94	116.9	58.2
S4.004	66.48	4.99	74.872	0.201	0.0	0.0	9.7	2.94	116.9	58.2
S4.005	66.27	5.04	73.900	0.201	0.0	0.0	9.7	2.94	116.9	58.2
S3.001	64.76	5.36	71.910	0.502	0.0	0.0	23.5	1.79	197.2	141.0
S3.002	64.14	5.50	71.571	0.535	0.0	0.0	24.8	1.81	200.1	148.7
S5.000	69.36	4.43	74.723	0.087	0.0	0.0	4.3	1.69	67.3	26.1
S5.001	69.05	4.48	73.850	0.087	0.0	0.0	4.3	2.94	116.8	26.1
S5.002	68.73	4.54	72.400	0.087	0.0	0.0	4.3	2.94	116.9	26.1
S5.003	68.32	4.62	71.871	0.130	0.0	0.0	6.4	2.94	116.9	38.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S3.003	38.973	1.299	30.0	0.013	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.004	32.140	1.071	30.0	0.012	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	37.545	0.799	47.0	0.013	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	37.916	0.807	47.0	0.014	0.00	0.0	0.600	o	450	Pipe/Conduit	
S6.000	35.216	0.880	40.0	0.255	4.00	0.0	0.600	o	300	Pipe/Conduit	
S6.001	25.469	0.509	50.0	0.100	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	12.877	0.191	67.5	0.008	0.00	0.0	0.600	o	600	Pipe/Conduit	
S7.000	50.033	0.486	102.9	0.158	4.00	0.0	0.600	o	225	Pipe/Conduit	
S7.001	10.452	0.105	100.0	0.051	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	44.404	0.658	67.5	0.107	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.008	29.389	0.435	67.6	0.085	0.00	0.0	0.600	o	600	Pipe/Conduit	
S8.000	24.961	1.248	20.0	0.056	4.00	0.0	0.600	o	225	Pipe/Conduit	
S8.001	25.195	1.260	20.0	0.031	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.002	24.719	1.236	20.0	0.031	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.003	25.197	1.260	20.0	0.033	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.004	24.937	1.247	20.0	0.034	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.005	24.967	1.248	20.0	0.031	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.006	27.114	1.356	20.0	0.032	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.007	24.820	1.241	20.0	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.003	63.29	5.70	71.012	0.678	0.0	0.0	31.0	3.32	366.5	186.0
S3.004	62.51	5.88	69.000	0.690	0.0	0.0	31.1	2.88	203.6	186.9
S1.004	61.66	6.09	67.000	1.366	0.0	0.0	60.8	2.97	472.7	365.1
S1.005	60.83	6.31	64.978	1.380	0.0	0.0	60.8	2.97	472.7	365.1
S6.000	70.39	4.24	65.415	0.255	0.0	0.0	13.0	2.49	176.2	77.7
S6.001	69.35	4.43	64.535	0.354	0.0	0.0	17.8	2.23	157.5	106.5
S1.006	60.55	6.38	63.726	1.743	0.0	0.0	76.2	2.97	838.9	457.3
S7.000	68.19	4.65	64.325	0.158	0.0	0.0	7.8	1.29	51.2	46.7
S7.001	67.63	4.76	63.764	0.209	0.0	0.0	10.2	1.57	111.1	61.4
S1.007	59.62	6.63	62.440	2.059	0.0	0.0	88.7	2.97	839.0	532.0
S1.008	59.03	6.79	60.250	2.144	0.0	0.0	91.4	2.97	838.5	548.3
S8.000	70.92	4.14	85.800	0.056	0.0	0.0	2.8	2.94	116.9	17.1
S8.001	70.12	4.28	83.700	0.086	0.0	0.0	4.4	2.94	116.9	26.2
S8.002	69.36	4.42	81.160	0.117	0.0	0.0	5.9	2.94	116.9	35.2
S8.003	68.61	4.57	78.880	0.150	0.0	0.0	7.5	2.94	116.9	44.7
S8.004	67.88	4.71	76.570	0.184	0.0	0.0	9.0	2.94	116.9	54.2
S8.005	67.17	4.85	74.260	0.215	0.0	0.0	10.4	2.94	116.9	62.6
S8.006	66.42	5.00	72.680	0.248	0.0	0.0	11.9	2.94	116.9	71.2
S8.007	65.75	5.14	70.960	0.277	0.0	0.0	13.2	2.94	116.9	78.9

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S8.008	25.046	1.252	20.0	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.009	24.933	1.247	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.010	25.061	1.253	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.011	24.970	1.249	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.012	24.879	1.244	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.013	19.108	0.955	20.0	0.022	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.014	11.381	0.111	102.5	0.015	0.00	0.0	0.600	o	375	Pipe/Conduit	
S8.015	27.104	0.263	103.0	0.075	0.00	0.0	0.600	o	375	Pipe/Conduit	
S8.016	35.588	0.178	200.0	0.085	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.009	38.349	0.568	67.5	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S9.000	49.684	0.248	200.0	0.137	4.00	0.0	0.600	o	300	Pipe/Conduit	
S10.000	43.928	0.879	50.0	0.046	4.00	0.0	0.600	o	225	Pipe/Conduit	
S10.001	43.810	0.626	70.0	0.081	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.002	43.612	0.545	80.0	0.048	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.003	22.708	0.227	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.004	35.759	1.788	20.0	0.054	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.005	21.984	1.099	20.0	0.064	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.006	13.889	0.694	20.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S11.000	19.031	0.095	200.0	0.037	4.00	0.0	0.600	o	225	Pipe/Conduit	
S11.001	11.025	0.055	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S8.008	65.10	5.29	69.400	0.306	0.0	0.0	14.4	2.94	116.9	86.4
S8.009	64.46	5.43	67.820	0.337	0.0	0.0	15.7	2.94	116.9	94.0
S8.010	63.83	5.57	66.223	0.367	0.0	0.0	16.9	2.94	116.9	101.4
S8.011	63.23	5.71	64.700	0.396	0.0	0.0	18.1	2.94	116.9	108.6
S8.012	62.64	5.85	63.120	0.426	0.0	0.0	19.3	2.94	116.9	115.7
S8.013	62.26	5.94	61.552	0.448	0.0	0.0	20.2	3.53	249.6	120.9
S8.014	61.84	6.05	60.522	0.463	0.0	0.0	20.7	1.79	197.6	124.2
S8.015	60.84	6.30	60.411	0.538	0.0	0.0	23.7	1.79	197.2	141.9
S8.016	59.30	6.72	60.073	0.623	0.0	0.0	26.7	1.43	228.1	160.2
S1.009	58.27	7.01	57.500	2.767	0.0	0.0	116.4	2.97	838.8	698.7
S9.000	67.68	4.75	71.380	0.137	0.0	0.0	6.7	1.11	78.3	40.3
S10.000	69.52	4.39	84.425	0.046	0.0	0.0	2.3	1.85	73.7	13.8
S10.001	67.12	4.86	83.546	0.127	0.0	0.0	6.1	1.57	62.2	36.8
S10.002	64.77	5.36	82.921	0.175	0.0	0.0	8.2	1.46	58.2	49.0
S10.003	63.50	5.65	82.375	0.175	0.0	0.0	8.2	1.31	52.0	49.0
S10.004	62.65	5.85	81.800	0.228	0.0	0.0	10.3	2.94	116.9	62.0
S10.005	62.14	5.98	79.000	0.293	0.0	0.0	13.1	2.94	116.9	78.8
S10.006	61.82	6.05	74.817	0.293	0.0	0.0	13.1	2.94	116.8	78.8
S11.000	69.79	4.34	73.795	0.037	0.0	0.0	1.9	0.92	36.6	11.2
S11.001	68.73	4.54	73.700	0.037	0.0	0.0	1.9	0.92	36.6	11.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S10.007	9.285	0.046	200.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S10.008	9.285	0.310	30.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S9.001	44.306	0.886	50.0	0.074	0.00	0.0	0.600	o	375	Pipe/Conduit	
S12.000	25.600	0.128	200.0	0.110	4.00	0.0	0.600	o	225	Pipe/Conduit	
S12.001	28.384	0.142	199.9	0.060	0.00	0.0	0.600	o	300	Pipe/Conduit	
S12.002	15.292	0.382	40.0	0.045	0.00	0.0	0.600	o	300	Pipe/Conduit	
S9.002	25.099	0.627	40.0	0.017	0.00	0.0	0.600	o	375	Pipe/Conduit	
S9.003	26.959	0.674	40.0	0.018	0.00	0.0	0.600	o	375	Pipe/Conduit	
S9.004	7.574	0.189	40.1	0.004	0.00	0.0	0.600	o	375	Pipe/Conduit	
S13.000	29.163	0.483	60.4	0.170	4.00	0.0	0.600	o	225	Pipe/Conduit	
S13.001	12.432	0.600	20.7	0.039	0.00	0.0	0.600	o	225	Pipe/Conduit	
S9.005	11.610	0.415	28.0	0.025	0.00	0.0	0.600	o	375	Pipe/Conduit	
S9.006	14.990	0.535	28.0	0.009	0.00	0.0	0.600	o	375	Pipe/Conduit	
S14.000	52.669	0.293	180.0	0.297	4.00	0.0	0.600	o	375	Pipe/Conduit	
S14.001	17.406	0.087	200.0	0.109	0.00	0.0	0.600	o	375	Pipe/Conduit	
S14.002	21.962	0.110	199.7	0.016	0.00	0.0	0.600	o	375	Pipe/Conduit	
S9.007	16.150	0.404	40.0	0.018	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.008	23.215	0.580	40.0	0.019	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S10.007	61.34	6.17	73.495	0.330	0.0	0.0	14.6	1.28	141.1	87.6
S10.008	61.16	6.22	72.000	0.330	0.0	0.0	14.6	3.32	366.8	87.6
S9.001	60.06	6.51	71.057	0.541	0.0	0.0	23.5	2.57	283.6	140.8
S12.000	69.15	4.46	71.730	0.110	0.0	0.0	5.5	0.92	36.6	32.9
S12.001	66.97	4.89	71.527	0.169	0.0	0.0	8.2	1.11	78.3	49.1
S12.002	66.48	4.99	71.385	0.214	0.0	0.0	10.3	2.49	176.2	61.8
S9.002	59.52	6.65	70.170	0.773	0.0	0.0	33.2	2.87	317.2	199.3
S9.003	58.96	6.81	68.800	0.791	0.0	0.0	33.7	2.87	317.2	202.0
S9.004	58.80	6.86	68.000	0.795	0.0	0.0	33.8	2.87	316.9	202.6
S13.000	70.10	4.29	68.286	0.170	0.0	0.0	8.6	1.69	67.0	51.7
S13.001	69.71	4.36	67.803	0.210	0.0	0.0	10.6	2.89	114.8	63.3
S9.005	58.61	6.91	67.053	1.030	0.0	0.0	43.6	3.44	379.5	261.5
S9.006	58.35	6.98	66.638	1.039	0.0	0.0	43.8	3.44	379.5	262.7
S14.000	68.17	4.65	67.000	0.297	0.0	0.0	14.6	1.35	148.8	87.7
S14.001	67.03	4.88	66.707	0.406	0.0	0.0	19.6	1.28	141.1	117.8
S14.002	65.66	5.16	65.800	0.422	0.0	0.0	20.0	1.28	141.2	120.0
S9.007	58.07	7.07	65.615	1.479	0.0	0.0	62.0	3.22	512.5	372.2
S9.008	57.66	7.19	65.000	1.498	0.0	0.0	62.4	3.22	512.3	374.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S9.009	8.940	0.224	39.9	0.016	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.010	12.810	0.320	40.0	0.028	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.011	19.773	0.494	40.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.012	27.720	0.693	40.0	0.090	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.013	24.891	0.622	40.0	0.068	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.014	15.748	0.394	40.0	0.017	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.015	24.834	0.432	57.5	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.016	28.311	0.492	57.5	0.035	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.010	28.861	0.289	99.9	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
S1.011	56.376	0.282	199.9	0.000	0.00	0.0	0.600	o	825	Pipe/Conduit	
S1.012	15.995	0.080	199.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S15.000	24.958	1.248	20.0	0.049	4.00	0.0	0.600	o	225	Pipe/Conduit	
S15.001	24.838	1.242	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.002	25.238	1.262	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.003	24.923	1.246	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.004	25.056	1.253	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.005	24.869	1.243	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.006	25.121	1.256	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.007	24.928	1.246	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.008	25.068	1.253	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.009	24.989	1.249	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.010	24.903	1.245	20.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.011	25.922	1.296	20.0	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S9.009	57.50	7.23	64.420	1.514	0.0	0.0	62.9	3.23	513.0	377.3
S9.010	57.28	7.30	64.196	1.543	0.0	0.0	63.8	3.22	512.5	382.9
S9.011	56.95	7.40	63.500	1.543	0.0	0.0	63.8	3.22	512.3	382.9
S9.012	56.49	7.55	63.006	1.633	0.0	0.0	66.6	3.22	512.5	399.7
S9.013	56.08	7.67	61.800	1.701	0.0	0.0	68.9	3.22	512.3	413.3
S9.014	55.83	7.76	60.600	1.717	0.0	0.0	69.2	3.22	512.7	415.4
S9.015	55.36	7.91	59.500	1.717	0.0	0.0	69.2	2.69	427.1	415.4
S9.016	54.88	8.07	57.500	1.752	0.0	0.0	69.4	2.96	640.1	416.6
S1.010	54.37	8.24	54.800	4.519	0.0	0.0	177.5	2.80	1237.3	1064.7
S1.011	53.11	8.69	54.000	4.519	0.0	0.0	177.5	2.10	1120.6	1064.7
S1.012	70.67	4.19	53.200	0.000	57.1	0.0	9.5	1.43	228.1	57.1
S15.000	70.92	4.14	59.000	0.049	0.0	0.0	2.5	2.94	116.9	15.0
S15.001	70.13	4.28	57.400	0.079	0.0	0.0	4.0	2.94	116.9	23.9
S15.002	69.36	4.43	56.158	0.108	0.0	0.0	5.4	2.94	116.9	32.6
S15.003	68.61	4.57	54.490	0.139	0.0	0.0	6.9	2.94	116.9	41.2
S15.004	67.88	4.71	53.244	0.168	0.0	0.0	8.3	2.94	116.9	49.5
S15.005	67.17	4.85	51.600	0.199	0.0	0.0	9.6	2.94	116.8	57.8
S15.006	66.48	4.99	50.150	0.228	0.0	0.0	11.0	2.94	116.9	65.8
S15.007	65.81	5.13	48.544	0.258	0.0	0.0	12.3	2.94	116.9	73.7
S15.008	65.15	5.28	47.000	0.288	0.0	0.0	13.6	2.94	116.9	81.4
S15.009	64.51	5.42	45.500	0.319	0.0	0.0	14.8	2.94	116.8	89.1
S15.010	63.88	5.56	44.000	0.348	0.0	0.0	16.1	2.94	116.9	96.4
S15.011	63.25	5.71	42.120	0.376	0.0	0.0	17.2	2.94	116.9	103.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S15.012	42.716	0.407	105.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S16.000	32.654	1.633	20.0	0.061	4.00	0.0	0.600	o	225	Pipe/Conduit	
S17.000	32.979	0.330	100.0	0.055	4.00	0.0	0.600	o	300	Pipe/Conduit	
S18.000	31.983	1.599	20.0	0.054	4.00	0.0	0.600	o	225	Pipe/Conduit	
S18.001	22.019	0.220	100.0	0.099	0.00	0.0	0.600	o	225	Pipe/Conduit	
S18.002	17.442	0.174	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S16.001	11.512	0.058	200.0	0.010	0.00	0.0	0.600	o	375	Pipe/Conduit	
S19.000	34.401	0.430	80.0	0.050	4.00	0.0	0.600	o	225	Pipe/Conduit	
S19.001	13.131	0.058	226.4	0.073	0.00	0.0	0.600	o	300	Pipe/Conduit	
S16.002	24.568	0.246	100.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S15.013	29.639	0.148	200.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S15.014	20.664	0.103	200.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S20.000	39.207	1.307	30.0	0.109	4.00	0.0	0.600	o	225	Pipe/Conduit	
S20.001	33.432	0.836	40.0	0.079	0.00	0.0	0.600	o	225	Pipe/Conduit	
S20.002	34.254	0.856	40.0	0.079	0.00	0.0	0.600	o	225	Pipe/Conduit	
S20.003	33.368	0.834	40.0	0.067	0.00	0.0	0.600	o	300	Pipe/Conduit	
S20.004	13.120	0.164	80.0	0.008	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S15.012	61.36	6.17	40.500	0.376	0.0	0.0	17.2	1.53	108.5	103.2
S16.000	70.67	4.19	40.355	0.061	0.0	0.0	3.1	2.94	116.9	18.6
S17.000	69.77	4.35	37.134	0.055	0.0	0.0	2.8	1.57	111.1	16.5
S18.000	70.70	4.18	40.570	0.054	0.0	0.0	2.7	2.94	116.9	16.5
S18.001	69.16	4.46	38.971	0.152	0.0	0.0	7.6	1.31	52.0	45.7
S18.002	68.00	4.68	38.751	0.152	0.0	0.0	7.6	1.31	52.0	45.7
S16.001	67.25	4.83	36.729	0.278	0.0	0.0	13.5	1.28	141.1	81.0
S19.000	69.54	4.39	38.363	0.050	0.0	0.0	2.5	1.46	58.2	15.1
S19.001	68.43	4.60	37.858	0.123	0.0	0.0	6.1	1.04	73.6	36.6
S16.002	66.15	5.06	36.672	0.402	0.0	0.0	19.2	1.81	200.1	115.1
S15.013	60.04	6.51	36.351	0.778	0.0	0.0	33.7	1.43	228.1	202.4
S15.014	69.63	4.37	36.203	0.000	5.5	0.0	0.9	0.92	36.6	5.5
S20.000	70.19	4.27	82.748	0.109	0.0	0.0	5.5	2.40	95.3	33.2
S20.001	68.74	4.54	81.441	0.188	0.0	0.0	9.3	2.07	82.5	56.1
S20.002	67.34	4.82	80.605	0.267	0.0	0.0	13.0	2.07	82.5	77.9
S20.003	66.25	5.04	79.674	0.334	0.0	0.0	16.0	2.49	176.2	96.0
S20.004	65.67	5.16	78.840	0.342	0.0	0.0	16.2	1.76	124.4	97.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S20.005	13.767	0.172	80.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S20.006	16.674	0.208	80.2	0.082	0.00	0.0	0.600	o	300	Pipe/Conduit	
S20.007	14.091	0.176	80.0	0.038	0.00	0.0	0.600	o	375	Pipe/Conduit	
S20.008	38.094	0.476	80.0	0.081	0.00	0.0	0.600	o	375	Pipe/Conduit	
S20.009	21.125	0.264	80.0	0.030	0.00	0.0	0.600	o	375	Pipe/Conduit	
S20.010	40.642	0.508	80.0	0.059	0.00	0.0	0.600	o	375	Pipe/Conduit	
S21.000	34.143	0.759	45.0	0.098	4.00	0.0	0.600	o	225	Pipe/Conduit	
S21.001	26.297	0.584	45.0	0.071	0.00	0.0	0.600	o	225	Pipe/Conduit	
S21.002	36.579	0.813	45.0	0.069	0.00	0.0	0.600	o	225	Pipe/Conduit	
S20.011	16.180	0.162	99.9	0.028	0.00	33.8	0.600	o	450	Pipe/Conduit	
S20.012	37.616	0.376	100.0	0.063	0.00	0.0	0.600	o	450	Pipe/Conduit	
S20.013	13.537	0.135	100.3	0.042	0.00	0.0	0.600	o	450	Pipe/Conduit	
S20.014	11.926	0.119	100.2	0.029	0.00	0.0	0.600	o	450	Pipe/Conduit	
S22.000	40.440	0.809	50.0	0.175	4.00	0.0	0.600	o	225	Pipe/Conduit	
S22.001	30.075	0.752	40.0	0.118	0.00	0.0	0.600	o	300	Pipe/Conduit	
S22.002	41.642	1.388	30.0	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	
S22.003	24.821	0.124	200.2	0.135	0.00	0.0	0.600	o	375	Pipe/Conduit	
S23.000	15.910	0.159	100.1	0.075	4.00	0.0	0.600	o	225	Pipe/Conduit	
S23.001	49.976	0.250	199.9	0.165	0.00	0.0	0.600	o	300	Pipe/Conduit	
S23.002	44.958	0.225	199.8	0.135	0.00	0.0	0.600	o	375	Pipe/Conduit	
S23.003	17.966	0.090	200.0	0.038	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S20.005	65.06	5.29	78.676	0.342	0.0	0.0	16.2	1.76	124.4	97.4
S20.006	64.35	5.45	78.504	0.425	0.0	0.0	19.7	1.76	124.2	118.4
S20.007	63.84	5.57	78.221	0.463	0.0	0.0	21.3	2.03	223.9	128.0
S20.008	62.52	5.88	78.045	0.544	0.0	0.0	24.5	2.03	223.9	147.3
S20.009	61.81	6.05	77.569	0.573	0.0	0.0	25.6	2.03	223.9	153.6
S20.010	60.51	6.39	77.305	0.633	0.0	0.0	27.6	2.03	223.9	165.9
S21.000	70.09	4.29	79.699	0.098	0.0	0.0	4.9	1.96	77.8	29.7
S21.001	68.88	4.52	78.940	0.168	0.0	0.0	8.4	1.96	77.7	50.3
S21.002	67.29	4.83	78.356	0.238	0.0	0.0	11.6	1.96	77.7	69.3
S20.011	60.01	6.52	76.722	0.898	33.8	0.0	45.7	2.03	323.6	274.1
S20.012	58.89	6.83	75.500	0.961	33.8	0.0	47.7	2.03	323.3	285.9
S20.013	58.50	6.94	74.500	1.003	33.8	0.0	49.2	2.03	322.9	294.9
S20.014	58.16	7.04	73.900	1.032	33.8	0.0	50.1	2.03	323.0	300.8
S22.000	69.69	4.36	74.367	0.175	0.0	0.0	8.8	1.85	73.7	52.8
S22.001	68.62	4.56	73.483	0.293	0.0	0.0	14.5	2.49	176.3	87.2
S22.002	67.39	4.81	72.731	0.341	0.0	0.0	16.6	2.88	203.7	99.5
S22.003	65.83	5.13	71.268	0.476	0.0	0.0	22.6	1.28	141.0	135.7
S23.000	70.57	4.20	71.842	0.075	0.0	0.0	3.8	1.31	52.0	22.9
S23.001	66.66	4.95	71.608	0.240	0.0	0.0	11.6	1.11	78.3	69.3
S23.002	63.96	5.54	71.283	0.375	0.0	0.0	17.3	1.28	141.2	103.9
S23.003	62.96	5.78	71.058	0.413	0.0	0.0	18.8	1.28	141.1	112.8

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S23.004	46.635	0.233	200.2	0.100	0.00	0.0	0.600	o	375	Pipe/Conduit	
S23.005	31.604	0.158	200.0	0.073	0.00	0.0	0.600	o	450	Pipe/Conduit	
S22.004	20.500	0.103	200.0	0.039	0.00	0.0	0.600	o	525	Pipe/Conduit	
S22.005	4.875	0.024	200.0	0.015	0.00	0.0	0.600	o	525	Pipe/Conduit	
S20.015	26.958	0.110	244.5	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
S20.016	19.929	0.146	136.5	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
S24.000	67.064	0.335	200.2	0.220	4.00	0.0	0.600	o	300	Pipe/Conduit	
S24.001	11.776	0.118	99.8	0.053	0.00	0.0	0.600	o	300	Pipe/Conduit	
S24.002	35.179	0.352	99.9	0.120	0.00	0.0	0.600	o	300	Pipe/Conduit	
S24.003	57.583	1.799	32.0	0.120	0.00	0.0	0.600	o	300	Pipe/Conduit	
S24.004	29.535	0.148	199.6	0.066	0.00	0.0	0.600	o	450	Pipe/Conduit	
S24.005	34.479	0.210	164.2	0.085	0.00	0.0	0.600	o	450	Pipe/Conduit	
S25.000	28.303	0.347	81.6	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
S24.006	12.882	0.135	95.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S20.017	50.353	0.213	236.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S20.018	27.121	0.157	172.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S20.019	31.315	0.313	100.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S20.020	24.446	0.244	100.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S20.021	23.346	0.233	100.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S23.004	60.53	6.38	70.968	0.513	0.0	0.0	22.4	1.28	141.0	134.7
S23.005	59.18	6.75	70.660	0.586	0.0	0.0	25.1	1.43	228.1	150.3
S22.004	58.41	6.97	70.427	1.101	0.0	0.0	46.5	1.58	342.1	278.7
S22.005	58.23	7.02	70.325	1.116	0.0	0.0	46.9	1.58	342.1	281.7
S20.015	57.26	7.31	70.150	2.149	33.8	0.0	95.6	1.67	598.1	573.7
S20.016	56.78	7.46	70.040	2.149	33.8	0.0	95.6	2.24	802.2	573.7
S24.000	66.40	5.01	77.449	0.220	0.0	0.0	10.5	1.11	78.3	63.3
S24.001	65.80	5.13	76.500	0.273	0.0	0.0	13.0	1.57	111.3	78.0
S24.002	64.11	5.51	75.650	0.393	0.0	0.0	18.2	1.57	111.2	109.3
S24.003	62.64	5.85	75.298	0.513	0.0	0.0	23.2	2.79	197.1	139.4
S24.004	61.26	6.19	73.349	0.580	0.0	0.0	25.7	1.44	228.3	153.9
S24.005	59.88	6.56	73.201	0.665	0.0	0.0	28.7	1.58	251.9	172.5
S25.000	69.90	4.33	74.420	0.066	0.0	0.0	3.3	1.45	57.6	20.0
S24.006	59.51	6.66	72.991	0.731	0.0	0.0	31.4	2.08	331.1	188.4
S20.017	67.30	4.82	69.894	0.000	55.0	0.0	9.2	1.02	72.0	55.0
S20.018	65.48	5.20	69.681	0.000	55.0	0.0	11.0	1.19	84.4	66.0
S20.019	63.99	5.53	69.524	0.000	55.0	0.0	11.0	1.57	111.1	66.0
S20.020	62.88	5.79	68.500	0.000	55.0	0.0	11.0	1.57	111.0	66.0
S20.021	61.87	6.04	66.500	0.000	55.0	0.0	11.0	1.57	111.0	66.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S26.000	23.786	0.238	100.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
S26.001	29.968	0.300	99.9	0.133	0.00	0.0	0.600	o	225	Pipe/Conduit	
S26.002	24.986	0.250	100.0	0.047	0.00	0.0	0.600	o	225	Pipe/Conduit	
S26.003	18.946	0.189	100.0	0.054	0.00	0.0	0.600	o	300	Pipe/Conduit	
S26.004	30.292	0.303	100.0	0.063	0.00	0.0	0.600	o	300	Pipe/Conduit	
S26.005	20.918	0.209	100.0	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	
S26.006	28.988	0.290	100.0	0.085	0.00	0.0	0.600	o	375	Pipe/Conduit	
S26.007	14.252	0.143	100.0	0.038	0.00	0.0	0.600	o	375	Pipe/Conduit	
S27.000	47.901	1.198	40.0	0.125	4.00	0.0	0.600	o	225	Pipe/Conduit	
S27.001	18.521	0.185	100.1	0.014	0.00	0.0	0.600	o	225	Pipe/Conduit	
S27.002	54.211	0.542	100.0	0.095	0.00	0.0	0.600	o	300	Pipe/Conduit	
S27.003	40.688	0.407	100.0	0.095	0.00	0.0	0.600	o	300	Pipe/Conduit	
S26.008	13.533	0.335	40.4	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S26.009	5.404	0.054	100.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S26.010	30.795	0.308	100.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S26.011	9.587	0.096	100.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S20.022	53.966	0.540	99.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S20.023	15.181	0.152	100.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S26.000	70.02	4.30	69.051	0.000	0.0	0.0	0.0	1.31	52.0	0.0
S26.001	68.00	4.69	68.813	0.133	0.0	0.0	6.5	1.31	52.0	39.2
S26.002	66.42	5.00	68.513	0.180	0.0	0.0	8.6	1.31	52.0	51.8
S26.003	65.48	5.20	68.188	0.234	0.0	0.0	11.1	1.57	111.1	66.3
S26.004	64.03	5.53	67.300	0.297	0.0	0.0	13.7	1.57	111.2	82.5
S26.005	63.08	5.75	66.997	0.345	0.0	0.0	15.7	1.57	111.1	94.4
S26.006	61.98	6.01	66.713	0.430	0.0	0.0	19.3	1.81	200.1	115.5
S26.007	61.46	6.14	66.423	0.468	0.0	0.0	20.8	1.81	200.1	124.6
S27.000	69.57	4.38	68.900	0.125	0.0	0.0	6.3	2.08	82.5	37.7
S27.001	68.33	4.62	67.625	0.139	0.0	0.0	6.8	1.31	52.0	41.0
S27.002	65.52	5.20	67.365	0.234	0.0	0.0	11.1	1.57	111.1	66.3
S27.003	63.59	5.63	66.823	0.329	0.0	0.0	15.1	1.57	111.2	90.6
S26.008	61.15	6.22	66.280	0.797	0.0	0.0	35.2	2.86	315.6	211.0
S26.009	60.97	6.27	65.870	0.797	0.0	0.0	35.2	2.03	323.3	211.0
S26.010	60.02	6.52	65.816	0.797	0.0	0.0	35.2	2.03	323.4	211.0
S26.011	59.73	6.60	65.508	0.797	0.0	0.0	35.2	2.03	323.3	211.0
S20.022	68.58	4.57	65.000	0.000	55.3	0.0	9.2	1.57	111.2	55.3
S20.023	67.76	4.73	64.460	0.000	55.3	0.0	11.1	1.57	111.1	66.4

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.012	SNorthern_Pond_Outfall	56.500	53.120	53.000	0	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S15.014	SCreche_Outfall	40.500	36.100	0.000	0	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S20.023	SSteam_Outfall	65.630	64.308	63.800	0	0

Simulation Criteria for Storm

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 4 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.267		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S86, DS/PN: S1.012, Volume (m³): 34.8

Unit Reference	MD-SHE-0311-5700-1000-5700
Design Head (m)	1.000
Design Flow (l/s)	57.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	311
Invert Level (m)	53.200
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	57.0	Kick-Flo®	0.797	51.1
Flush-Flo™	0.467	56.9	Mean Flow over Head Range	-	45.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.4	1.200	62.2	3.000	97.0	7.000	146.7
0.200	31.9	1.400	67.0	3.500	104.6	7.500	151.8
0.300	54.7	1.600	71.5	4.000	111.6	8.000	156.6
0.400	56.6	1.800	75.7	4.500	118.2	8.500	161.3
0.500	56.9	2.000	79.7	5.000	124.5	9.000	165.9
0.600	56.1	2.200	83.4	5.500	130.4	9.500	170.4
0.800	51.2	2.400	87.0	6.000	136.1		
1.000	57.0	2.600	90.5	6.500	141.5		

Hydro-Brake® Optimum Manhole: S110, DS/PN: S15.014, Volume (m³): 10.5

Unit Reference	MD-SHE-0096-5500-2000-5500
Design Head (m)	2.000
Design Flow (l/s)	5.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	96
Invert Level (m)	36.203
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.5	Kick-Flo®	0.857	3.7
Flush-Flo™	0.418	4.7	Mean Flow over Head Range	-	4.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Hydro-Brake® Optimum Manhole: S110, DS/PN: S15.014, Volume (m³): 10.5

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.1	1.200	4.3	3.000	6.6	7.000	9.9
0.200	4.3	1.400	4.7	3.500	7.1	7.500	10.2
0.300	4.6	1.600	4.9	4.000	7.6	8.000	10.6
0.400	4.7	1.800	5.2	4.500	8.0	8.500	10.9
0.500	4.6	2.000	5.5	5.000	8.4	9.000	11.2
0.600	4.5	2.200	5.7	5.500	8.8	9.500	11.5
0.800	4.0	2.400	6.0	6.000	9.2		
1.000	4.0	2.600	6.2	6.500	9.6		

Hydro-Brake® Optimum Manhole: S151, DS/PN: S20.017, Volume (m³): 17.4

Unit Reference	MD-SHE-0279-5500-3000-5500
Design Head (m)	3.000
Design Flow (l/s)	55.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	279
Invert Level (m)	69.894
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	55.0	Kick-Flo®	1.839	43.4
Flush-Flo™	0.864	55.0	Mean Flow over Head Range	-	47.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.7	1.200	53.9	3.000	55.0	7.000	82.9
0.200	28.7	1.400	52.4	3.500	59.3	7.500	85.8
0.300	46.1	1.600	49.6	4.000	63.2	8.000	88.5
0.400	49.8	1.800	44.8	4.500	66.9	8.500	91.2
0.500	52.2	2.000	45.2	5.000	70.4	9.000	93.7
0.600	53.7	2.200	47.4	5.500	73.8	9.500	96.2
0.800	54.9	2.400	49.4	6.000	76.9		
1.000	54.8	2.600	51.3	6.500	80.0		

Hydro-Brake® Optimum Manhole: S172, DS/PN: S20.022, Volume (m³): 6.4

Unit Reference	MD-SHE-0297-5530-1850-5530
Design Head (m)	1.850
Design Flow (l/s)	55.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	297
Invert Level (m)	65.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Hydro-Brake® Optimum Manhole: S172, DS/PN: S20.022, Volume (m³): 6.4

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	55.2	Kick-Flo®	1.269	46.0
Flush-Flo™	0.585	55.2	Mean Flow over Head Range	-	47.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.1	1.200	48.7	3.000	69.7	7.000	105.2
0.200	30.5	1.400	48.2	3.500	75.1	7.500	108.8
0.300	51.3	1.600	51.4	4.000	80.1	8.000	112.3
0.400	53.8	1.800	54.4	4.500	84.8	8.500	115.7
0.500	54.9	2.000	57.3	5.000	89.3	9.000	118.9
0.600	55.2	2.200	60.0	5.500	93.5	9.500	122.1
0.800	54.3	2.400	62.5	6.000	97.6		
1.000	52.6	2.600	65.0	6.500	101.5		

Storage Structures for Storm

Cellular Storage Manhole: SS85A, DS/PN: S1.011

Invert Level (m) 54.800 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	650.0	0.0	2.001	0.0	0.0
2.000	650.0	0.0			

Cellular Storage Manhole: S86, DS/PN: S1.012

Invert Level (m) 53.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1000.0	0.0	1.851	0.0	0.0
1.850	1000.0	0.0			

Cellular Storage Manhole: S110, DS/PN: S15.014

Invert Level (m) 36.203 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	323.0	0.0	2.001	0.0	0.0
2.000	323.0	0.0			

Cellular Storage Manhole: S151, DS/PN: S20.017

Invert Level (m) 69.894 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.45
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1700.0	0.0	3.001	0.0	0.0
3.000	1700.0	0.0			

Cellular Storage Manhole: S172, DS/PN: S20.022

Invert Level (m) 65.000 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.47
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	750.0	0.0	1.851	0.0	0.0
1.850	750.0	0.0			

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 4 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.267
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Summer	100	+20%					69.492	-0.109
S1.001	S2	15 Summer	100	+20%					69.184	-0.138
S1.002	S3	15 Summer	100	+20%					68.563	-0.182
S1.003	S4	15 Summer	100	+20%					67.869	-0.119
S2.000	S5	15 Winter	100	+20%					68.306	-0.224
S2.001	S6	15 Summer	100	+20%					67.817	-0.207
S3.000	S7	15 Winter	100	+20%					74.207	-0.083
S4.000	S8	15 Winter	100	+20%					81.121	-0.104
S4.001	S9	15 Summer	100	+20%					79.086	-0.139
S4.002	S10	15 Winter	100	+20%					77.457	-0.113
S4.003	S11	15 Winter	100	+20%					76.112	-0.094
S4.004	S12	15 Summer	100	+20%					75.023	-0.074
S4.005	S13	15 Summer	100	+20%					74.051	-0.074
S3.001	S14	15 Winter	100	+20%					72.275	-0.010
S3.002	S15	15 Winter	100	+20%	100/15 Summer				71.974	0.028
S5.000	S16	15 Winter	100	+20%					74.830	-0.118
S5.001	S17	15 Summer	100	+20%					73.935	-0.140
S5.002	S18	15 Summer	100	+20%					72.486	-0.139
S5.003	S19	15 Winter	100	+20%					71.974	-0.122
S3.003	S20	15 Winter	100	+20%					71.235	-0.152
S3.004	S21	15 Winter	100	+20%	100/15 Summer				69.759	0.459
S1.004	S22	15 Winter	100	+20%	100/15 Summer				67.499	0.049
S1.005	S23	15 Winter	100	+20%	100/15 Summer				65.495	0.067
S6.000	S24	15 Winter	100	+20%					65.571	-0.144
S6.001	S25	15 Winter	100	+20%					64.770	-0.065
S1.006	S26	15 Winter	100	+20%	100/15 Summer				64.400	0.074
S7.000	S27	15 Winter	100	+20%	100/15 Summer				64.600	0.050

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.52			33.6	OK	
S1.001	S2	0.000	0.57			80.7	OK	
S1.002	S3	0.000	0.52			143.3	OK	
S1.003	S4	0.000	0.80			145.0	OK	
S2.000	S5	0.000	0.34			78.0	OK	
S2.001	S6	0.000	0.41			80.1	OK	
S3.000	S7	0.000	0.72			65.8	OK	
S4.000	S8	0.000	0.56			22.4	OK	
S4.001	S9	0.000	0.31			34.1	OK	
S4.002	S10	0.000	0.49			53.2	OK	
S4.003	S11	0.000	0.63			67.7	OK	
S4.004	S12	0.000	0.77			66.9	OK	
S4.005	S13	0.000	0.76			66.3	OK	
S3.001	S14	0.000	0.92			163.1	OK	
S3.002	S15	0.000	1.13			171.8	SURCHARGED	
S5.000	S16	0.000	0.46			29.4	OK	
S5.001	S17	0.000	0.30			29.4	OK	
S5.002	S18	0.000	0.30			29.3	OK	
S5.003	S19	0.000	0.43			43.5	OK	
S3.003	S20	0.000	0.65			216.0	OK	
S3.004	S21	0.000	1.18			219.8	SURCHARGED	
S1.004	S22	0.000	1.04			432.1	SURCHARGED	
S1.005	S23	0.000	1.03			431.0	SURCHARGED	
S6.000	S24	0.000	0.53			86.4	OK	
S6.001	S25	0.000	0.84			118.9	OK	
S1.006	S26	0.000	1.24			543.8	SURCHARGED	
S7.000	S27	0.000	1.03			50.8	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S7.001	S28	15 Winter	100	+20%					63.975	-0.089
S1.007	S29	15 Summer	100	+20%					62.882	-0.158
S1.008	S30	15 Winter	100	+20%					60.850	0.000
S8.000	S31	15 Winter	100	+20%					85.863	-0.162
S8.001	S32	15 Winter	100	+20%					83.779	-0.146
S8.002	S33	15 Summer	100	+20%					81.255	-0.130
S8.003	S34	15 Summer	100	+20%					78.990	-0.115
S8.004	S35	15 Summer	100	+20%					76.694	-0.101
S8.005	S36	15 Winter	100	+20%					74.396	-0.089
S8.006	S37	15 Winter	100	+20%					72.829	-0.076
S8.007	S38	15 Summer	100	+20%					71.123	-0.062
S8.008	S39	15 Summer	100	+20%					69.576	-0.049
S8.009	S40	15 Winter	100	+20%	100/15 Summer				68.121	0.076
S8.010	S41	15 Winter	100	+20%	100/15 Summer				66.673	0.225
S8.011	S42	15 Winter	100	+20%	100/15 Summer				65.244	0.319
S8.012	S43	15 Winter	100	+20%	100/15 Summer				63.726	0.381
S8.013	S44	15 Winter	100	+20%					61.718	-0.134
S8.014	S45	15 Winter	100	+20%					60.822	-0.075
S8.015	S46	15 Winter	100	+20%					60.683	-0.103
S8.016	S47	15 Winter	100	+20%					60.400	-0.123
S1.009	S48	15 Summer	100	+20%	100/15 Summer				58.343	0.243
S9.000	S49	15 Winter	100	+20%					71.553	-0.127
S10.000	S50	15 Winter	100	+20%					84.496	-0.154
S10.001	S51	15 Winter	100	+20%					83.689	-0.083
S10.002	S52	15 Winter	100	+20%	100/15 Summer				83.164	0.019
S10.003	S53	15 Winter	100	+20%	100/15 Summer				82.652	0.051
S10.004	S54	15 Winter	100	+20%					81.929	-0.096
S10.005	S55	15 Winter	100	+20%					79.158	-0.067
S10.006	S56	15 Winter	100	+20%					74.979	-0.063
S11.000	S57	15 Winter	100	+20%					73.891	-0.129
S11.001	S58	15 Winter	100	+20%					73.813	-0.112
S10.007	S59	15 Winter	100	+20%					73.790	-0.080
S10.008	S60	15 Winter	100	+20%					72.178	-0.197
S9.001	S61	15 Winter	100	+20%					71.276	-0.155
S12.000	S62	15 Winter	100	+20%	100/15 Summer				71.970	0.015
S12.001	S63	15 Winter	100	+20%					71.730	-0.097
S12.002	S64	15 Winter	100	+20%					71.530	-0.155
S9.002	S65	15 Winter	100	+20%					70.442	-0.104
S9.003	S66	15 Winter	100	+20%					69.092	-0.083
S9.004	S67	15 Winter	100	+20%	100/15 Summer				68.566	0.191
S13.000	S68	15 Winter	100	+20%					68.456	-0.055
S13.001	S69	15 Summer	100	+20%					67.945	-0.083
S9.005	S70	15 Winter	100	+20%	100/15 Summer				67.741	0.313
S9.006	S71	15 Winter	100	+20%	100/15 Summer				67.135	0.121
S14.000	S72	15 Winter	100	+20%					67.238	-0.137
S14.001	S73	15 Winter	100	+20%	100/15 Winter				67.085	0.003
S14.002	S74	15 Winter	100	+20%	100/15 Summer				66.662	0.487
S9.007	S75	15 Winter	100	+20%	100/15 Summer				66.558	0.493
S9.008	S76	15 Winter	100	+20%	100/15 Summer				66.013	0.563
S9.009	S77	15 Winter	100	+20%	30/15 Summer				65.441	0.571
S9.010	S78	15 Winter	100	+20%	100/15 Summer				64.877	0.231
S9.011	S79	15 Winter	100	+20%	100/15 Summer				64.012	0.062
S9.012	S80	15 Winter	100	+20%					63.386	-0.070
S9.013	S81	15 Winter	100	+20%	100/15 Winter				62.296	0.046
S9.014	S82	15 Winter	100	+20%	100/15 Summer				61.251	0.201

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S7.001	S28	0.000	0.82			66.5	OK	
S1.007	S29	0.000	0.88			637.9	OK	
S1.008	S30	0.000	1.00			664.2	OK	
S8.000	S31	0.000	0.17			18.8	OK	
S8.001	S32	0.000	0.27			29.2	OK	
S8.002	S33	0.000	0.37			39.8	OK	
S8.003	S34	0.000	0.47			51.0	OK	
S8.004	S35	0.000	0.58			62.4	OK	
S8.005	S36	0.000	0.67			72.6	OK	
S8.006	S37	0.000	0.77			83.0	OK	
S8.007	S38	0.000	0.85			91.8	OK	
S8.008	S39	0.000	0.93			100.4	OK	
S8.009	S40	0.000	1.03			110.9	SURCHARGED	
S8.010	S41	0.000	1.07			114.9	SURCHARGED	
S8.011	S42	0.000	1.11			119.1	SURCHARGED	
S8.012	S43	0.000	1.14			123.3	SURCHARGED	
S8.013	S44	0.000	0.59			126.5	OK	
S8.014	S45	0.000	0.99			129.3	OK	
S8.015	S46	0.000	0.86			148.8	OK	
S8.016	S47	0.000	0.87			174.5	OK	
S1.009	S48	0.000	1.17			829.4	SURCHARGED	
S9.000	S49	0.000	0.61			44.8	OK	
S10.000	S50	0.000	0.22			15.4	OK	
S10.001	S51	0.000	0.71			42.0	OK	
S10.002	S52	0.000	0.98			54.2	SURCHARGED	
S10.003	S53	0.000	1.13			53.7	SURCHARGED	
S10.004	S54	0.000	0.61			67.7	OK	
S10.005	S55	0.000	0.81			86.7	OK	
S10.006	S56	0.000	0.85			86.8	OK	
S11.000	S57	0.000	0.38			12.5	OK	
S11.001	S58	0.000	0.39			12.1	OK	
S10.007	S59	0.000	0.97			99.4	OK	
S10.008	S60	0.000	0.46			99.5	OK	
S9.001	S61	0.000	0.64			165.5	OK	
S12.000	S62	0.000	1.05			35.6	SURCHARGED	
S12.001	S63	0.000	0.77			54.7	OK	
S12.002	S64	0.000	0.46			68.8	OK	
S9.002	S65	0.000	0.87			239.1	OK	
S9.003	S66	0.000	0.88			242.7	OK	
S9.004	S67	0.000	1.44			244.3	SURCHARGED	
S13.000	S68	0.000	0.92			57.7	OK	
S13.001	S69	0.000	0.72			70.9	OK	
S9.005	S70	0.000	1.22			308.1	SURCHARGED	
S9.006	S71	0.000	1.08			308.9	SURCHARGED	
S14.000	S72	0.000	0.71			97.4	OK	
S14.001	S73	0.000	1.08			124.3	SURCHARGED	
S14.002	S74	0.000	1.00			120.4	SURCHARGED	
S9.007	S75	0.000	1.17			420.3	SURCHARGED	
S9.008	S76	0.000	0.99			420.1	SURCHARGED	
S9.009	S77	0.000	1.58			421.8	SURCHARGED	
S9.010	S78	0.000	1.33			424.4	SURCHARGED	
S9.011	S79	0.000	1.08			426.0	SURCHARGED	
S9.012	S80	0.000	1.00			435.5	OK	
S9.013	S81	0.000	1.03			443.1	SURCHARGED	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S9.014	S82	0.000	1.25			442.8	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S9.015	S83	15 Winter	100	+20%	100/15 Summer				60.172	0.222
S9.016	S84	15 Winter	100	+20%					57.873	-0.152
S1.010	S85	15 Winter	100	+20%	30/15 Winter				55.876	0.326
S1.011	SS85A	240 Winter	100	+20%	100/15 Summer				55.001	0.176
S1.012	S86	240 Winter	100	+20%	30/15 Summer				54.991	1.341
S15.000	S87	15 Winter	100	+20%					59.059	-0.166
S15.001	S88	15 Winter	100	+20%					57.476	-0.149
S15.002	S89	15 Summer	100	+20%					56.249	-0.134
S15.003	S90	15 Summer	100	+20%					54.594	-0.121
S15.004	S91	15 Summer	100	+20%					53.361	-0.108
S15.005	S92	15 Winter	100	+20%					51.729	-0.096
S15.006	S93	15 Winter	100	+20%					50.292	-0.083
S15.007	S94	15 Summer	100	+20%					48.699	-0.070
S15.008	S95	15 Summer	100	+20%					47.168	-0.057
S15.009	S96	15 Winter	100	+20%					45.683	-0.042
S15.010	S97	15 Winter	100	+20%	100/15 Summer				44.356	0.131
S15.011	S98	15 Winter	100	+20%	100/15 Summer				42.682	0.337
S15.012	S99	15 Winter	100	+20%	100/15 Summer				40.950	0.150
S16.000	S100	15 Winter	100	+20%					40.421	-0.159
S17.000	S101	600 Winter	100	+20%	100/180 Winter				37.641	0.207
S18.000	S102	15 Winter	100	+20%					40.631	-0.164
S18.001	S103	15 Winter	100	+20%	100/15 Summer				39.230	0.034
S18.002	S104	15 Winter	100	+20%	100/15 Summer				38.984	0.009
S16.001	S105	600 Winter	100	+20%	100/60 Winter				37.641	0.537
S19.000	S106	15 Winter	100	+20%					38.449	-0.139
S19.001	S107	15 Winter	100	+20%					38.042	-0.116
S16.002	S108	600 Winter	100	+20%	100/60 Winter				37.640	0.594
S15.013	S109	600 Winter	100	+20%	30/120 Summer				37.639	0.838
S15.014	S110	600 Winter	100	+20%	1/60 Winter				37.637	1.209
S20.000	S111	15 Winter	100	+20%					82.848	-0.125
S20.001	S112	15 Winter	100	+20%					81.597	-0.069
S20.002	S113	15 Winter	100	+20%	100/15 Summer				81.002	0.172
S20.003	S114	15 Winter	100	+20%					79.853	-0.121
S20.004	S115	15 Winter	100	+20%	100/15 Summer				79.251	0.112
S20.005	S116	15 Winter	100	+20%	100/15 Summer				79.072	0.096
S20.006	S117	15 Winter	100	+20%	100/15 Summer				78.891	0.087
S20.007	S118	15 Winter	100	+20%					78.485	-0.111
S20.008	S119	15 Winter	100	+20%					78.297	-0.123
S20.009	S120	15 Winter	100	+20%					77.848	-0.096
S20.010	S121	15 Winter	100	+20%					77.652	-0.028
S21.000	S122	15 Winter	100	+20%					79.805	-0.119
S21.001	S123	15 Summer	100	+20%					79.092	-0.073
S21.002	S124	15 Winter	100	+20%	100/15 Summer				78.659	0.078
S20.011	S125	15 Winter	100	+20%	100/15 Summer				77.261	0.089
S20.012	S126	15 Winter	100	+20%	100/15 Summer				75.996	0.046
S20.013	S127	15 Summer	100	+20%	30/15 Summer				75.123	0.173
S20.014	S128	15 Winter	100	+20%	30/15 Summer				74.549	0.199
S22.000	S129	15 Winter	100	+20%					74.526	-0.066
S22.001	S130	15 Winter	100	+20%					73.654	-0.129
S22.002	S131	15 Winter	100	+20%					72.900	-0.131
S22.003	S132	15 Winter	100	+20%	100/15 Summer				71.717	0.074
S23.000	S133	15 Winter	100	+20%					71.983	-0.084
S23.001	S134	15 Winter	100	+20%	100/15 Summer				71.934	0.026
S23.002	S135	15 Winter	100	+20%	100/15 Winter				71.689	0.031
S23.003	S136	15 Winter	100	+20%	100/15 Summer				71.571	0.138

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S9.015	S83	0.000	1.24			443.7	SURCHARGED	
S9.016	S84	0.000	0.84			447.4	OK	
S1.010	S85	0.000	1.49			1250.9	SURCHARGED	
S1.011	SS85A	0.000	0.35		68	328.5	SURCHARGED	
S1.012	S86	0.000	0.45		208	56.5	SURCHARGED	
S15.000	S87	0.000	0.15			16.6	OK	
S15.001	S88	0.000	0.25			26.7	OK	
S15.002	S89	0.000	0.34			36.8	OK	
S15.003	S90	0.000	0.44			47.0	OK	
S15.004	S91	0.000	0.53			57.0	OK	
S15.005	S92	0.000	0.62			67.0	OK	
S15.006	S93	0.000	0.71			76.5	OK	
S15.007	S94	0.000	0.79			85.5	OK	
S15.008	S95	0.000	0.88			94.4	OK	
S15.009	S96	0.000	0.97			104.5	OK	
S15.010	S97	0.000	1.05			113.6	SURCHARGED	
S15.011	S98	0.000	1.11			120.0	SURCHARGED	
S15.012	S99	0.000	1.18			119.8	SURCHARGED	
S16.000	S100	0.000	0.19			20.6	OK	
S17.000	S101	0.000	0.02			2.1	SURCHARGED	
S18.000	S102	0.000	0.17			18.2	OK	
S18.001	S103	0.000	1.05			49.9	SURCHARGED	
S18.002	S104	0.000	1.05			48.8	SURCHARGED	
S16.001	S105	0.000	0.09			10.1	SURCHARGED	
S19.000	S106	0.000	0.31			16.9	OK	
S19.001	S107	0.000	0.69			41.7	OK	
S16.002	S108	0.000	0.08			14.2	SURCHARGED	
S15.013	S109	0.000	0.15			28.4	SURCHARGED	
S15.014	S110	0.000	0.14		650	4.7	SURCHARGED	
S20.000	S111	0.000	0.41			37.0	OK	
S20.001	S112	0.000	0.82			63.5	OK	
S20.002	S113	0.000	1.10			85.1	SURCHARGED	
S20.003	S114	0.000	0.65			105.1	OK	
S20.004	S115	0.000	1.04			105.1	SURCHARGED	
S20.005	S116	0.000	1.04			106.6	SURCHARGED	
S20.006	S117	0.000	1.19			126.2	SURCHARGED	
S20.007	S118	0.000	0.82			135.5	OK	
S20.008	S119	0.000	0.78			157.1	OK	
S20.009	S120	0.000	0.87			164.2	OK	
S20.010	S121	0.000	0.88			178.4	OK	
S21.000	S122	0.000	0.45			33.1	OK	
S21.001	S123	0.000	0.79			57.1	OK	
S21.002	S124	0.000	1.05			77.0	SURCHARGED	
S20.011	S125	0.000	1.29			293.0	SURCHARGED	
S20.012	S126	0.000	1.08			307.7	SURCHARGED	
S20.013	S127	0.000	1.51			311.8	SURCHARGED	
S20.014	S128	0.000	1.67			325.4	SURCHARGED	
S22.000	S129	0.000	0.84			59.1	OK	
S22.001	S130	0.000	0.62			99.1	OK	
S22.002	S131	0.000	0.61			114.9	OK	
S22.003	S132	0.000	1.29			157.0	SURCHARGED	
S23.000	S133	0.000	0.54			24.7	OK	
S23.001	S134	0.000	1.04			76.5	SURCHARGED	
S23.002	S135	0.000	0.84			109.1	SURCHARGED	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S23.003	S136	0.000	0.96			111.5	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S23.004	S137	15 Winter	100	+20%	100/15 Summer				71.506
S23.005	S138	600 Winter	100	+20%	100/15 Summer				71.429
S22.004	S139	600 Winter	100	+20%	100/15 Summer				71.427
S22.005	S140	600 Winter	100	+20%	30/600 Winter				71.425
S20.015	S141	600 Winter	100	+20%	30/360 Winter				71.424
S20.016	S142	600 Winter	100	+20%	30/180 Winter				71.417
S24.000	S143	15 Winter	100	+20%					77.688
S24.001	S144	15 Summer	100	+20%	100/15 Summer				76.814
S24.002	S145	15 Winter	100	+20%	100/15 Summer				76.153
S24.003	S146	15 Winter	100	+20%					75.516
S24.004	S147	15 Winter	100	+20%					73.689
S24.005	S148	15 Winter	100	+20%					73.558
S25.000	S149	15 Winter	100	+20%					74.521
S24.006	S150	15 Winter	100	+20%					73.402
S20.017	S151	600 Winter	100	+20%	1/60 Summer				71.410
S20.018	S152	2880 Winter	100	+20%					69.871
S20.019	S153	2880 Winter	100	+20%					69.681
S20.020	S154	960 Winter	100	+20%					68.660
S20.021	S155	2880 Winter	100	+20%	100/1440 Summer				67.262
S26.000	S156	15 Summer	1	+0%					69.051
S26.001	S157	15 Winter	100	+20%					69.029
S26.002	S158	15 Winter	100	+20%	100/15 Summer				68.810
S26.003	S159	15 Winter	100	+20%					68.384
S26.004	S160	15 Winter	100	+20%					67.556
S26.005	S161	15 Winter	100	+20%	100/15 Summer				67.314
S26.006	S162	2880 Winter	100	+20%					67.009
S26.007	S163	2880 Winter	100	+20%	100/15 Summer				67.124
S27.000	S164	15 Winter	100	+20%					69.017
S27.001	S165	15 Winter	100	+20%					67.811
S27.002	S166	15 Winter	100	+20%					67.560
S27.003	S167	15 Winter	100	+20%					67.112
S26.008	S168	2880 Winter	100	+20%	100/15 Summer				67.142
S26.009	S169	2880 Winter	100	+20%	30/960 Winter				67.155
S26.010	S170	2880 Winter	100	+20%	30/960 Winter				67.167
S26.011	S171	2880 Winter	100	+20%	30/360 Winter				67.168
S20.022	S172	2880 Winter	100	+20%	1/120 Winter				67.167
S20.023	S173	2160 Winter	100	+20%					64.632

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S23.004	S137	0.163	0.000	0.99			128.0	SURCHARGED	
S23.005	S138	0.318	0.000	0.11			22.1	SURCHARGED	
S22.004	S139	0.475	0.000	0.16			40.3	SURCHARGED	
S22.005	S140	0.575	0.000	0.22			39.8	SURCHARGED	
S20.015	S141	0.599	0.000	0.24			113.3	SURCHARGED	
S20.016	S142	0.702	0.000	0.23			112.9	SURCHARGED	
S24.000	S143	-0.061	0.000	1.00			74.6	OK	
S24.001	S144	0.014	0.000	1.05			90.5	SURCHARGED	
S24.002	S145	0.203	0.000	1.24			127.2	SURCHARGED	
S24.003	S146	-0.082	0.000	0.87			161.9	OK	
S24.004	S147	-0.110	0.000	0.91			178.8	OK	
S24.005	S148	-0.093	0.000	0.89			195.6	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S25.000	S149	-0.124	0.000	0.42			22.4	OK	
S24.006	S150	-0.039	0.000	1.00			207.1	OK	
S20.017	S151	1.216	0.000	0.81		550	54.9	SURCHARGED	
S20.018	S152	-0.110	0.000	0.72			54.9	OK	
S20.019	S153	-0.143	0.000	0.54			54.9	OK	
S20.020	S154	-0.140	0.000	0.56			54.9	OK	
S20.021	S155	0.462	0.000	0.56			54.9	SURCHARGED	
S26.000	S156	-0.225	0.000	0.00			0.0	OK	
S26.001	S157	-0.009	0.000	0.86			41.5	OK	
S26.002	S158	0.072	0.000	1.15			55.1	SURCHARGED	
S26.003	S159	-0.104	0.000	0.74			71.1	OK	
S26.004	S160	-0.044	0.000	0.89			89.9	OK	
S26.005	S161	0.017	0.000	1.05			102.5	SURCHARGED	
S26.006	S162	-0.079	0.000	0.03			5.5	OK	
S26.007	S163	0.326	0.000	0.04			6.0	SURCHARGED	
S27.000	S164	-0.108	0.000	0.53			42.2	OK	
S27.001	S165	-0.039	0.000	1.00			46.5	OK	
S27.002	S166	-0.105	0.000	0.72			75.9	OK	
S27.003	S167	-0.011	0.000	0.98			101.4	OK	
S26.008	S168	0.486	0.000	0.05			10.3	SURCHARGED	
S26.009	S169	0.834	0.000	0.06			10.3	SURCHARGED	
S26.010	S170	0.901	0.000	0.04			10.3	SURCHARGED	
S26.011	S171	1.210	0.000	0.06			10.1	SURCHARGED	
S20.022	S172	1.867	0.000	0.54		936	55.3	SURCHARGED	
S20.023	S173	-0.128	0.000	0.61			56.8	OK	

Appendix K – StormTech Attenuation Tanks

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

SiteASSIST™
FOR STORMTECH INSTRUCTIONS, DOWNLOAD THE INSTALLATION APP

TANK 1 S110

COOLAGAD SHD, CO. WICKLOW

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS, AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED, AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER, 2) MAXIMUM PERMANENT (75-YR) COVER LOAD, AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, A) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN., B) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLOURS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUB-GRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 6" (150 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE WELL GRADED BETWEEN ¾" AND 2" (20-50 mm).
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUB-SURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILISED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

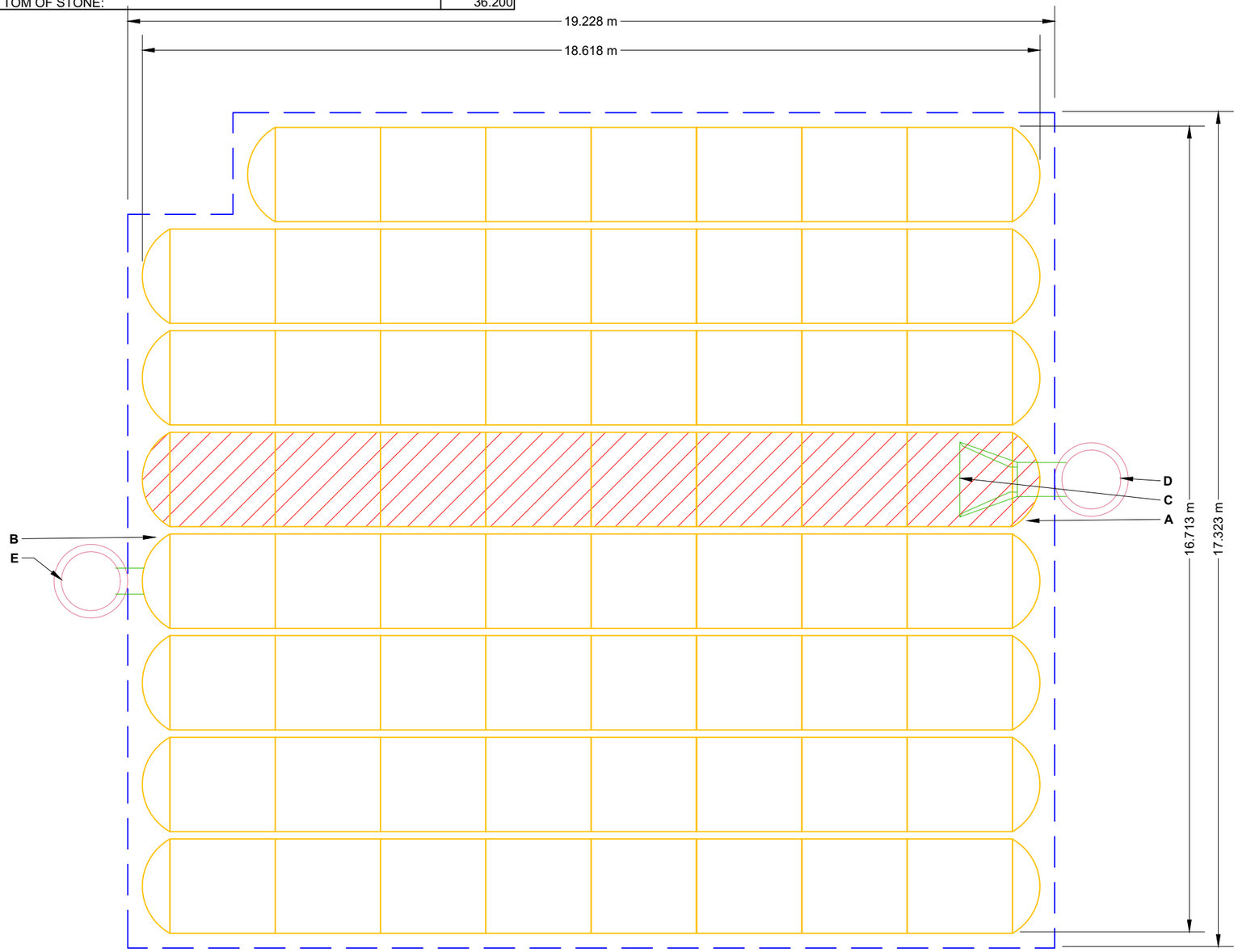
CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

ISOLATOR ROW PLUS COMPONENTS SHOWN ON THIS DESIGN MAY NOT BE AVAILABLE IN THE SPECIFIED PROJECT REGION. PLEASE CONTACT YOUR LOCAL ADS REPRESENTATIVE OR E-MAIL ADSINTERNATIONAL@ADS-PIPE.COM FOR FURTHER INFORMATION

PROPOSED LAYOUT		PROPOSED ELEVATIONS	
63	STORMTECH MC-3500 CHAMBERS	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	40.181
16	STORMTECH MC-3500 END CAPS	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	38.353
460	STONE ABOVE (mm)	TOP OF STONE:	38.203
400	STONE BELOW (mm)	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	38.200
40	STONE VOID	MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	38.200
385.4	INSTALLED SYSTEM VOLUME (m^3) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	38.200
		TOP OF MC-3500 CHAMBER:	37.743
		600 mm ISOLATOR ROW PLUS INVERT:	36.652
		450 mm BOTTOM CONNECTION INVERT:	36.645
328.5	SYSTEM AREA (m^2)	BOTTOM OF MC-3500 CHAMBER:	36.600
73.1	SYSTEM PERIMETER (m)	BOTTOM OF STONE:	36.200

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	600 mm BOTTOM CORED END CAP, PART#: MC3500IEPP24BC / TYP OF ALL 600 mm BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	52 mm	
PREFABRICATED END CAP	B	450 mm BOTTOM CORED END CAP, PART#: MC3500IEPP18BC / TYP OF ALL 450 mm BOTTOM CONNECTIONS	45 mm	
FLAMP	C	INSTALL FLAMP ON 600 mm ACCESS PIPE / PART#: MC350024RAMP (TYP 2 PLACES)		
CONCRETE STRUCTURE	D	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		
CONCRETE STRUCTURE	E	OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS)		113 L/s OUT



ISOLATOR ROW PLUS (SEE DETAIL)

NO WOVEN GEOTEXTILE

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

TANK 1 S110

COOLAGAD SHD, CO. WICKLOW

DRAWN: JC

CHECKED: N/A

DATE:

PROJECT #:

DATE	DRW	CHK	DESCRIPTION

4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

SCALE = 1 : 100

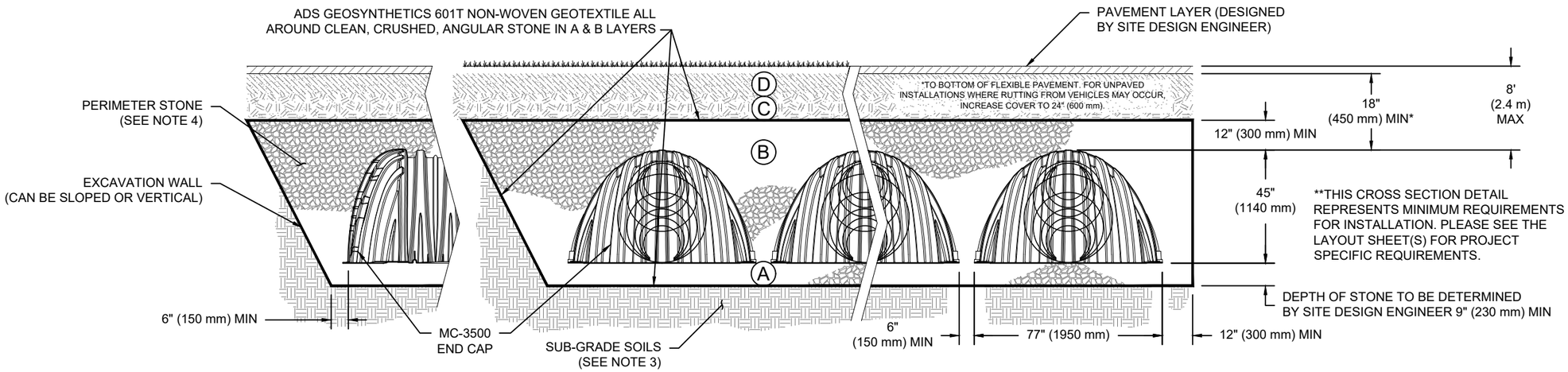
StormTech®
Chamber System

888-892-2694 | WWW.STORMTECH.COM

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUB-BASE MAY BE PART OF THE 'D' LAYER.	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUB-GRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUB-BASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUB-BASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUB-GRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUB-BASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUB-GRADE SOILS, AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, A) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN., B) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23°, AND C) CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLOURS.

TANK 1 S110
COOLAGAD SHD, CO. WICKLOW
DATE: DRAWN: JC CHECKED: N/A
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

StormTech® Chamber System
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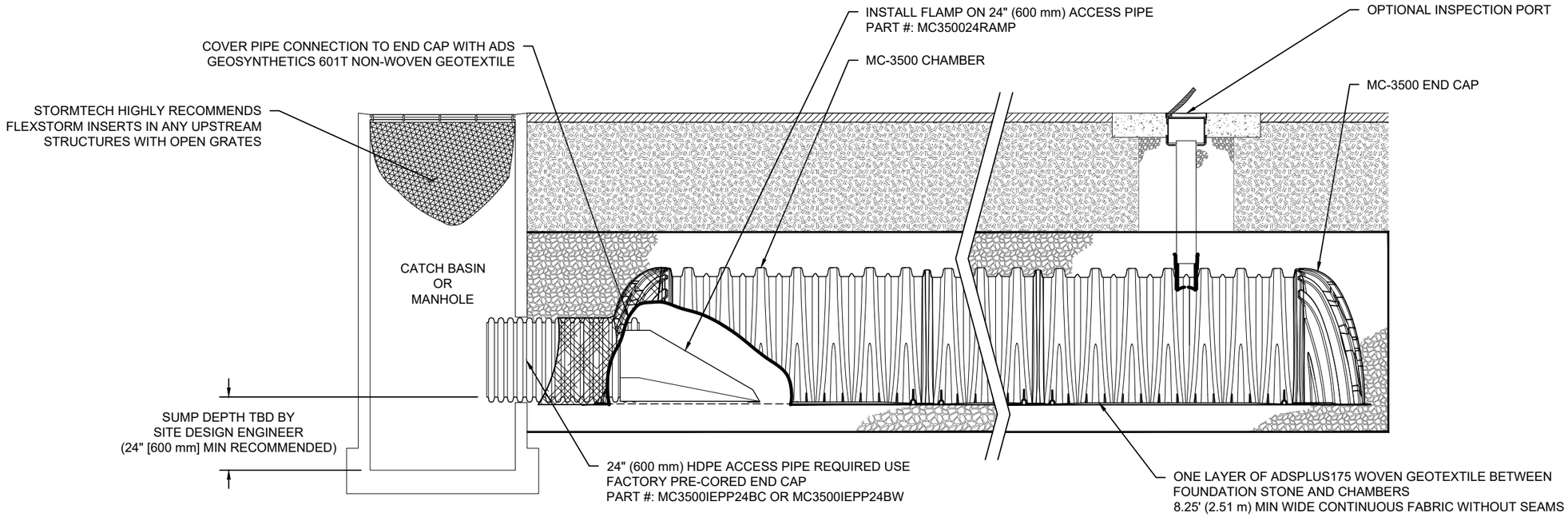
1-800-733-7473



MC-3500 ISOLATOR ROW PLUS DETAIL

NTS

ISOLATOR ROW PLUS COMPONENTS SHOWN ON THIS DESIGN MAY NOT BE AVAILABLE IN THE SPECIFIED PROJECT REGION. PLEASE CONTACT YOUR LOCAL ADS REPRESENTATIVE OR E-MAIL ADSINTERNATIONAL@ADS-PIPE.COM FOR FURTHER INFORMATION

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH-WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

TANK 1 S110
COOLAGAD SHD, CO. WICKLOW
DATE:
DRAWN: JC
PROJECT #:
CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

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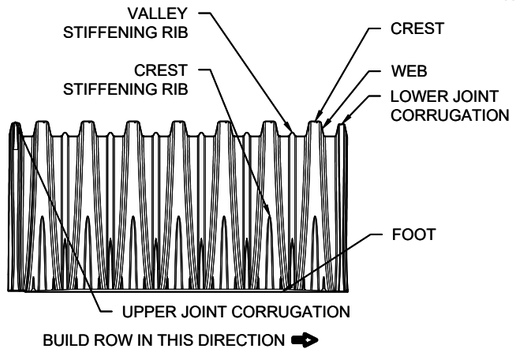
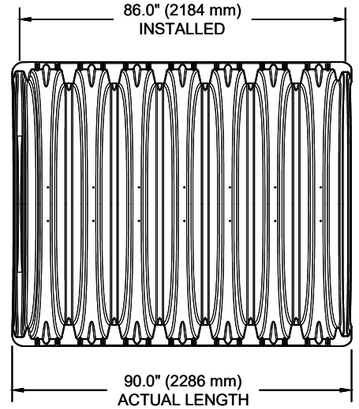
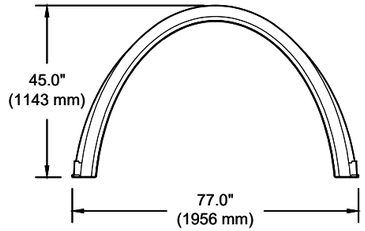
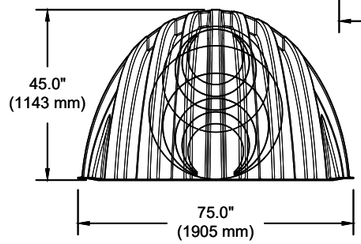
MC-3500 TECHNICAL SPECIFICATION

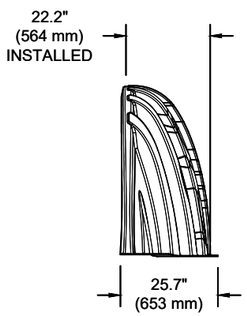
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	175.0 CUBIC FEET	(4.96 m³)
WEIGHT	134 lbs.	(60.8 kg)

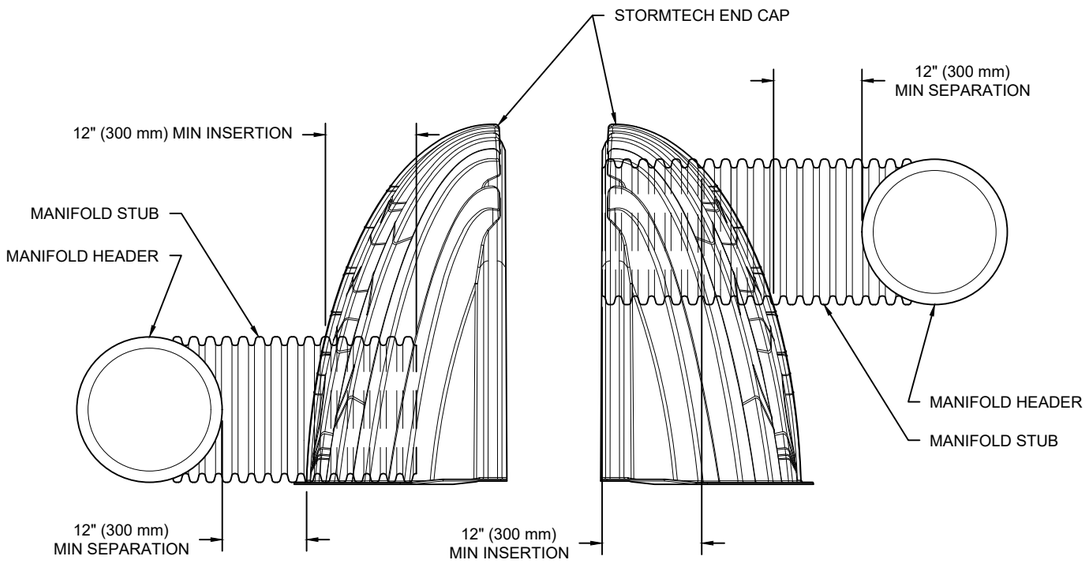
NOMINAL END CAP SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	45.1 CUBIC FEET	(1.28 m³)
WEIGHT	49 lbs.	(22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" SPACING BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

MC-SERIES END CAP INSERTION DETAIL

NTS

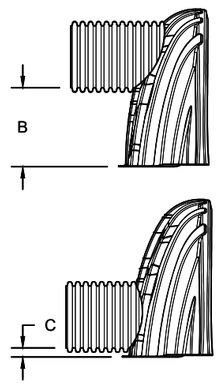


NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

TANK 1 S110
COOLAGAD SHD, CO. WICKLOW
DATE:
DRAWN: JC
PROJECT #:
CHECKED: N/A

DESCRIPTION	CHK	DRW	DATE

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Chamber System
888-892-2694 | WWW.STORMTECH.COM
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473
ADS.

Resolute Group

1A Moyne Road,
Baldoyle,
Dublin 13
Tel: 01-4853184
e-mail: sales@resolutegroup.ie
www.resolutegroup.ie

Vat no. 3689429RH
Company Reg. No. 671068

Tank 1a – height from outlet/excavation to TWL is 2.395m

Proposed levels:

Outlet/Excavation – 56.00m

TWL – 58.395m

Minimum cover level over our system – 58.545m

Maximum cover level over the system – 61.725m

Resolute Group

INPUTS

Project Name	Coolagad SHD Tank 1a
Project Reference	JN220050
Date	25-Jan-22
Designer	LP
Liner	Permeable
Chamber Model	MC3500
Required Storage Volume	1700 m^3
Stone Porosity	43%
Excavation Batter	60 °
Stone Above Chambers	0.63 m
Stone Foundation Depth	0.62 m
Chamber Seperation	0.3 m
Spacing at Sides	0.79 m
Spacing at Ends	0.78 m
No. of Rows	11
No. of Chambers per Row	19.1
Manholes - 1500mm dia.	1
Isolator Rows	1

RESULTS

System Volume and Bed Size

Installed Storage Volume	1700.5 m^3
Height per Chamber	1.143
Width per Chamber	1.960
Length per Chamber	2.184
Depth of System	2.393 m
Tank Overall Installed Width at Base	26.1 m
Tank Overall Installed Length at Base	44.4 m
Area of Dig at Base of System	1161 m^2
Area of Dig at Top of System	1364 m^2

System Components

Chambers	210.1
Endcaps	22
Amount of Stone Required (m3)	2377 m^3
Amount of Stone Required (tonne)	3612 m^3
Volume of excavation (not including top-fill)	3021 m^3

v1-11/20

STORMTECH MC-3500 CHAMBER

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots, thus maximizing land usage for private (commercial) and public applications. StormTech chambers can also be used in conjunction with Green Infrastructure, thus enhancing the performance and extending the service life of these practices.

STORMTECH MC-3500 CHAMBER
(not to scale)

Nominal Chamber Specifications

Size (L x W x H)
90" x 77" x 45"
2,286 mm x 1,956 mm x 1,143 mm

Chamber Storage
109.9 ft³ (3.11 m³)

Min. Installed Storage*
175.0 ft³ (4.96 m³)

Weight
134 lbs (60.8 kg)

Shipping
15 chambers/pallet
7 end caps/pallet
7 pallets/truck

*Assumes a minimum of 12" (300 mm) of stone above, 9" (230 mm) of stone below chambers, 6" (150 mm) of stone between chambers/end caps and 40% stone porosity.

STORMTECH MC-3500 END CAP
(not to scale)

Nominal End Cap Specifications

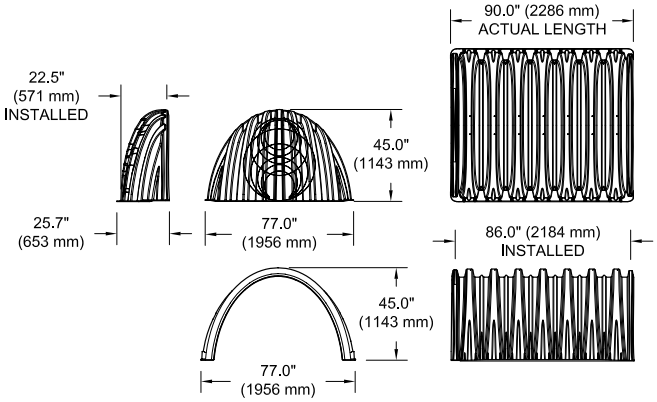
Size (L x W x H)
26.5" x 71" x 45.1"
673 mm x 1,803 mm x 1,145 mm

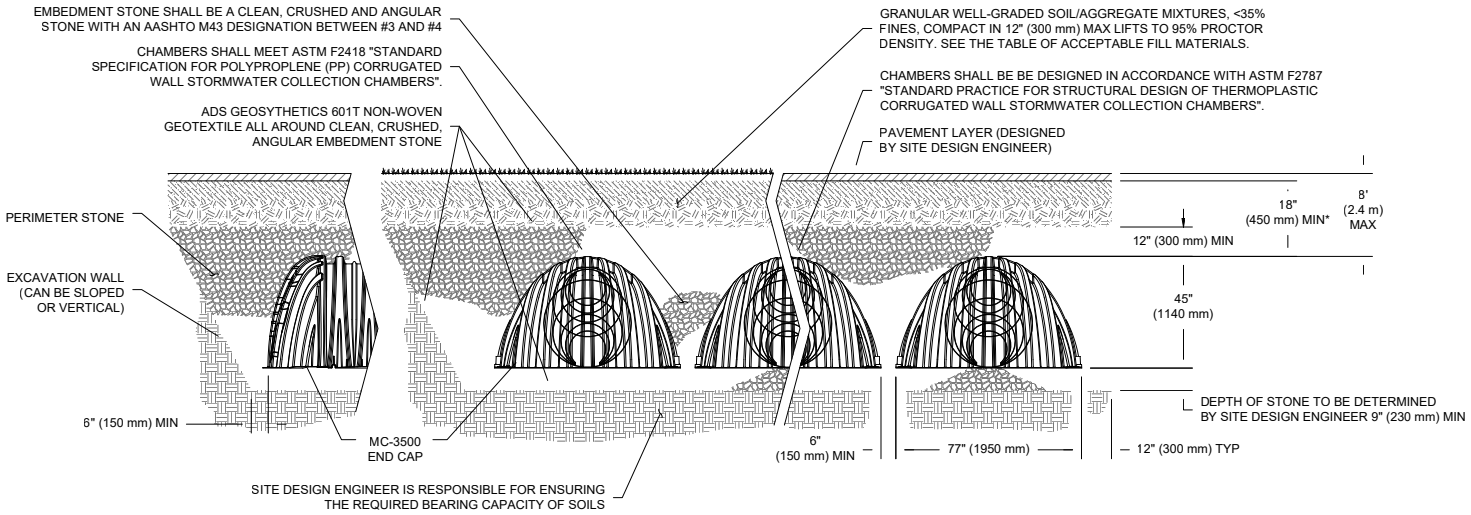
End Cap Storage
14.9 ft³ (0.42 m³)

Min. Installed Storage*
45.1ft ³ (1.28 m³)

Weight
49 lbs (22.2 kg)

*Assumes a minimum of 12" (300 mm) of stone above, 9" (230 mm) of stone below, 6" (150 mm) of stone perimeter, 6" (150 mm) of stone between chambers/end caps and 40% stone porosity.





*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24" (600 mm).

MC-3500 CHAMBER SPECIFICATION

STORAGE VOLUME PER CHAMBER FT³ (M³)

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Foundation Depth in. (mm)			
		9" (230 mm)	12" (300 mm)	15" (375 mm)	18" (450 mm)
MC-3500 Chamber	109.9 (3.11)	175.0 (4.96)	179.9 (5.09)	184.9 (5.24)	189.9 (5.38)
MC-3500 End Cap	14.9 (.42)	45.1 (1.28)	46.6 (1.32)	48.3 (1.37)	49.9 (1.41)

Note: Assumes 6" (150 mm) row spacing, 40% stone porosity, 12" (300 mm) stone above and includes the bare chamber/end cap volume.

AMOUNT OF STONE PER CHAMBER

ENGLISH TONS (yds³)	Stone Foundation Depth			
	9"	12"	15"	18"
MC-3500 Chamber	8.5 (6.0)	9.1 (6.5)	9.7 (6.9)	10.4 (7.4)
MC-3500 End Cap	3.9 (2.8)	4.1 (2.9)	4.3 (3.1)	4.5 (3.2)
METRIC KILOGRAMS (m³)	**230 mm**	**300 mm**	**375 mm**	**450 mm**
MC-3500 Chamber	7711 (4.6)	8255 (5.0)	8800 (5.3)	9435 (5.7)
MC-3500 End Cap	3538 (2.1)	3719 (2.2)	3901 (2.4)	4082 (2.5)

Note: Assumes 12" (300 mm) of stone above and 6" (150 mm) row spacing and 6" (150 mm) of perimeter stone in front of end caps.

VOLUME EXCAVATION PER CHAMBER YD³ (M³)

	Stone Foundation Depth			
	9" (230 mm)	12" (300 mm)	15" (375mm)	18" (450 mm)
MC-3500 Chamber	11.9 (9.1)	12.4 (9.5)	12.8(9.8)	13.3 (10.2)
MC-3500 End Cap	4.0 (3.1)	4.1 (3.2)	4.3 (3.3)	4.4 (3.4)

Note: Assumes 6" (150 mm) of separation between chamber rows and 24" (600 mm) of cover. The volume of excavation will vary as depth of cover increases.

Working on a project?
Visit us at www.stormtech.com
and utilize the StormTech Design Tool

For more information on the StormTech MC-3500 Chamber and other ADS products, please contact our Customer Service Representatives at 1-800-821-6710

*THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS®*

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Resolute Group

1A Moyne Road,
Baldoyle,
Dublin 13
Tel: 01-4853184
e-mail: sales@resolutegroup.ie
www.resolutegroup.ie

Vat no. 3689429RH
Company Reg. No. 671068

Combined tanks 2&3 – height from outlet/excavation to TWL is 2.995m

Proposed levels:

Outlet/Excavation – 69.894m

TWL – 72.889m

Minimum cover level over our system – 73.189m

Maximum cover level over the system – 76.099m

Resolute Group

INPUTS

Project Name	Coolagad SHD Tank 2&3	
Project Reference	JN220050	
Date	25-Jan-22	
Designer	LP	
Liner	Permeable	
Chamber Model	MC4500	
Required Storage Volume	2295	m^3
Stone Porosity	43%	
Excavation Batter	60	°
Stone Above Chambers	0.75	m
Stone Foundation Depth	0.72	m
Chamber Seperation	0.42	m
Spacing at Sides	1.03	m
Spacing at Ends	1.04	m
No. of Rows	5	
No. of Chambers per Row	57	
Manholes - 1500mm dia.	1	
Isolator Rows	1	

RESULTS

System Volume and Bed Size

Installed Storage Volume	2294.7	m^3
Height per Chamber	1.525	
Width per Chamber	2.540	
Length per Chamber	1.230	
Depth of System	2.995	m
Tank Overall Installed Width at Base	16.4	m
Tank Overall Installed Length at Base	73.8	m
Area of Dig at Base of System	1212	m^2
Area of Dig at Top of System	1536	m^2

System Components

Chambers	285	
Endcaps	10	
Amount of Stone Required (m3)	3269	m^3
Amount of Stone Required (tonne)	4968	m^3
Volume of excavation (not including top-fill)	4116	m^3

v1-11/20

MC-4500 CHAMBER

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots, thus maximizing land usage for private (commercial) and public applications. StormTech chambers can also be used in conjunction with Green Infrastructure, thus enhancing the performance and extending the service life of these practices.

STORMTECH MC-4500 CHAMBER
(not to scale)

Nominal Chamber Specifications

Size (L x W x H)
52” x 100” x 60”
1321 mm x 2540 mm x 1524 mm

Chamber Storage
106.5 ft^3 (3.01 m^3)

Min. Installed Storage*
162.6 ft^3 (4.60 m^3)

Weight
Nominal 125 lbs (56.7 kg)

Shipping
7 chambers/pallet
5 end caps/pallet
11 pallets/truck

*Assumes a minimum of 12” (300 mm) of stone above, 9” (230 mm) of stone below chambers, 9” (230 mm) of stone between chambers/end caps and 40% stone porosity.

STORMTECH MC-4500 END CAP
(not to scale)

Nominal End Cap Specifications

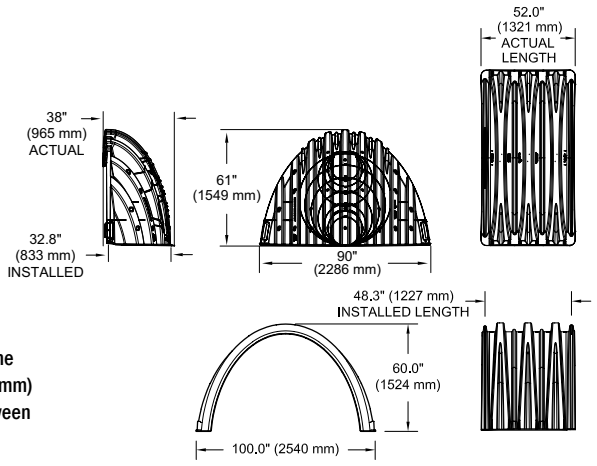
Size (L x W x H)
38” x 90” x 61”
965 mm x 2286 mm x 1549 mm

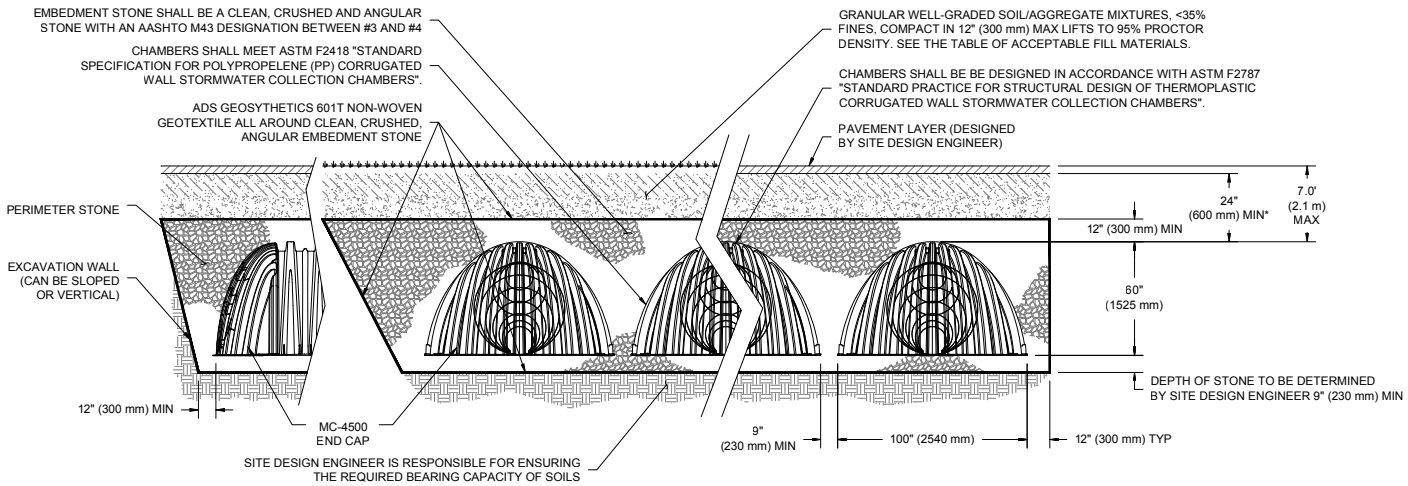
End Cap Storage
39.5 ft^3 (1.12 m^3)

Min. Installed Storage*
115.3 ft^3 (3.26 m^3)

Weight
Nominal 90.0 lbs (40.8 kg)

*Assumes a minimum of 12” (300 mm) of stone above, 9” (230 mm) of stone below, 12” (300 mm) of stone perimeter, 9” (230 mm) of stone between chambers/end caps and 40% stone porosity.





*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 30" (750 mm).

MC-4500 CHAMBER SPECIFICATIONS

STORAGE VOLUME PER CHAMBER FT³ (M³)

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Foundation Depth in. (mm)			
		9" (230 mm)	12" (300 mm)	15" (375 mm)	18" (450 mm)
MC-4500 Chamber	106.5 (3.01)	162.6 (4.60)	166.3 (4.71)	169.9 (4.81)	173.6 (4.91)
MC-4500 End Cap	39.5 (1.12)	115.3 (3.26)	118.6 (3.36)	121.9 (3.45)	125.2 (3.54)

Note: Assumes 9" (230 mm) row spacing, 40% stone porosity, 12" (300 mm) stone above and includes the bare chamber/end cap volume. End cap volume assumes 12" (300 mm) stone perimeter in front of end cap.

AMOUNT OF STONE PER CHAMBER

ENGLISH TONS (yds³)	Stone Foundation Depth			
	9"	12"	15"	18"
MC-4500 Chamber	7.4 (5.2)	7.8 (5.5)	8.3 (5.9)	8.8 (6.2)
MC-4500 End Cap	9.8 (7.0)	10.2 (7.3)	10.6 (7.6)	11.1 (7.9)
METRIC KILOGRAMS (m³)	230 mm	300 mm	375 mm	450 mm
MC-4500 Chamber	6713 (4.0)	7076 (4.2)	7529 (4.5)	7983 (4.7)
MC-4500 End Cap	8890 (5.3)	9253 (5.5)	9616 (5.8)	10069 (6.0)

Note: Assumes 12" (300 mm) of stone above and 9" (230 mm) row spacing and 12" (300 mm) of perimeter stone in front of end caps.

VOLUME EXCAVATION PER CHAMBER YD³ (M³)

	Stone Foundation Depth			
	9" (230 mm)	12" (300 mm)	15" (375mm)	18" (450 mm)
MC-4500 Chamber	10.5 (8.0)	10.8 (8.3)	11.2 (8.5)	11.5 (8.8)
MC-4500 End Cap	9.7 (7.4)	10.0 (7.6)	10.3 (7.9)	10.6 (8.1)

Note: Assumes 9" (230 mm) of separation between chamber rows, 12" (300 mm) of perimeter in front of the end caps, and 24" (600 mm) of cover. The volume of excavation will vary as depth of cover increases.

Working on a project?
Visit us at www.stormtech.com
and utilize the StormTech Design Tool

For more information on the StormTech MC-4500 Chamber and other ADS products, please contact our Customer Service Representatives at 1-800-821-6710

Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

SiteASSIST™
FOR STORMTECH INSTRUCTIONS, DOWNLOAD THE INSTALLATION APP

TANK 4 S172

COOLAGAD SHD, CO. WICKLOW

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS, AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED, AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER, 2) MAXIMUM PERMANENT (75-YR) COVER LOAD, AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, A) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN., B) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLOURS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUB-GRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 6" (150 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE WELL GRADED BETWEEN ¾" AND 2" (20-50 mm).
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUB-SURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILISED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

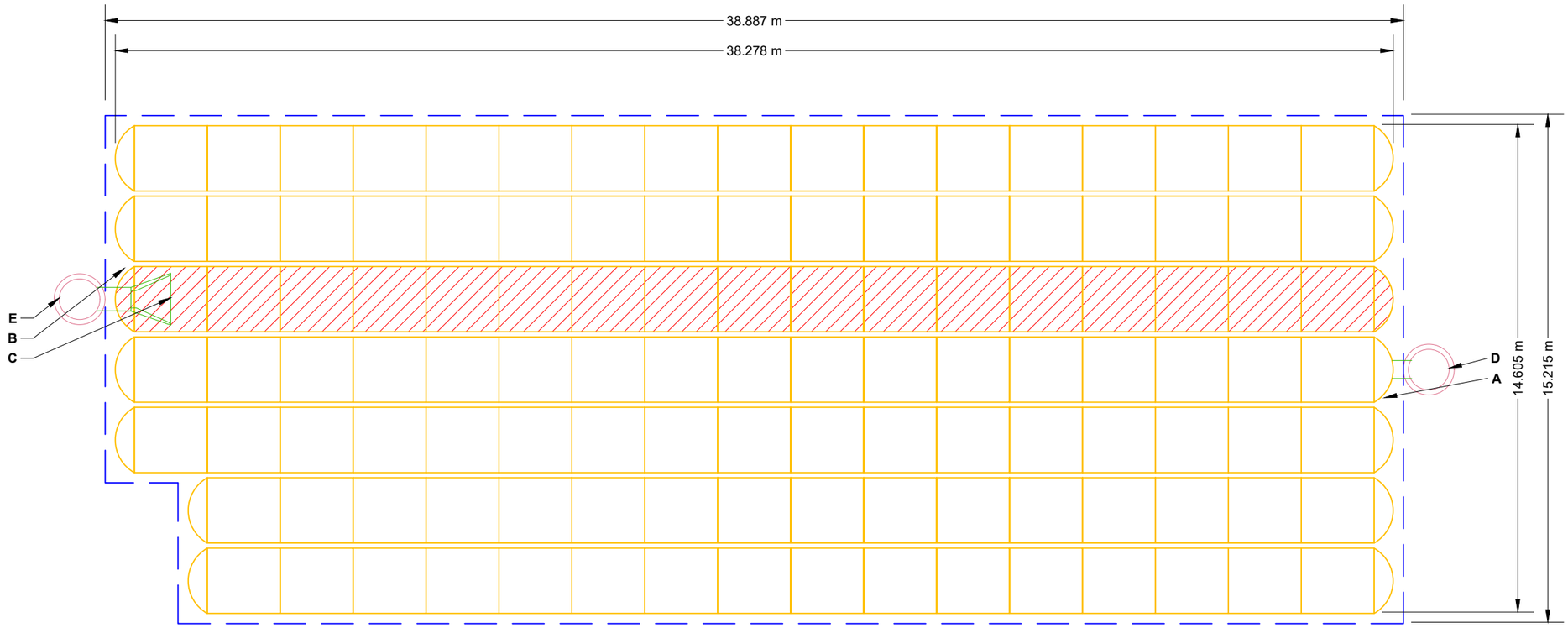
CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

ISOLATOR ROW PLUS COMPONENTS SHOWN ON THIS DESIGN MAY NOT BE AVAILABLE IN THE SPECIFIED PROJECT REGION. PLEASE CONTACT YOUR LOCAL ADS REPRESENTATIVE OR E-MAIL ADSINTERNATIONAL@ADS-PIPE.COM FOR FURTHER INFORMATION

PROPOSED LAYOUT		PROPOSED ELEVATIONS	
117	STORMTECH MC-3500 CHAMBERS	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	68.932
14	STORMTECH MC-3500 END CAPS	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	67.103
360	STONE ABOVE (mm)	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	66.950
350	STONE BELOW (mm)	MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	66.950
40	STONE VOID	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	66.950
654.1	INSTALLED SYSTEM VOLUME (m^3) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)	TOP OF STONE:	66.853
		TOP OF MC-3500 CHAMBER:	66.493
		600 mm ISOLATOR ROW PLUS INVERT:	65.402
		450 mm BOTTOM CONNECTION INVERT:	65.395
582.4	SYSTEM AREA (m^2)	BOTTOM OF MC-3500 CHAMBER:	65.350
108.2	SYSTEM PERIMETER (m)	BOTTOM OF STONE:	65.000

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	450 mm BOTTOM CORED END CAP, PART#: MC3500IEPP18BC / TYP OF ALL 450 mm BOTTOM CONNECTIONS	45 mm	
PREFABRICATED END CAP	B	600 mm BOTTOM CORED END CAP, PART#: MC3500IEPP24BC / TYP OF ALL 600 mm BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	52 mm	
FLAMP	C	INSTALL FLAMP ON 600 mm ACCESS PIPE / PART#: MC350024RAMP (TYP 2 PLACES)		
CONCRETE STRUCTURE	D	OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS)		113 L/s OUT
CONCRETE STRUCTURE	E	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		



ISOLATOR ROW PLUS (SEE DETAIL)

NO WOVEN GEOTEXTILE

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

TANK 4 S172
COOLAGAD SHD, CO. WICKLOW
DRAWN: JC
CHECKED: N/A
DATE:
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

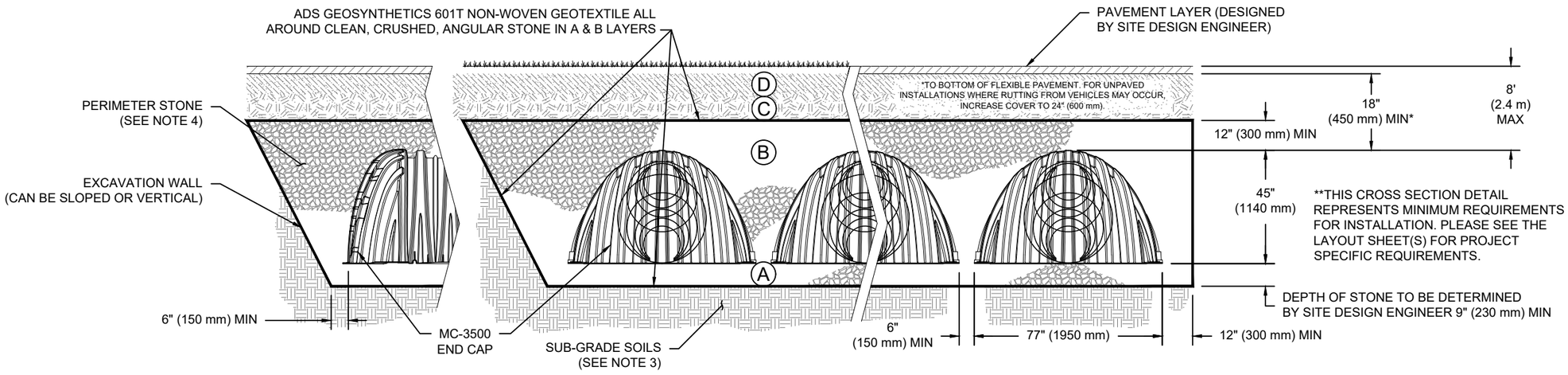
ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

SCALE = 1 : 150

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUB-BASE MAY BE PART OF THE 'D' LAYER.	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUB-GRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUB-BASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUB-BASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUB-GRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUB-BASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

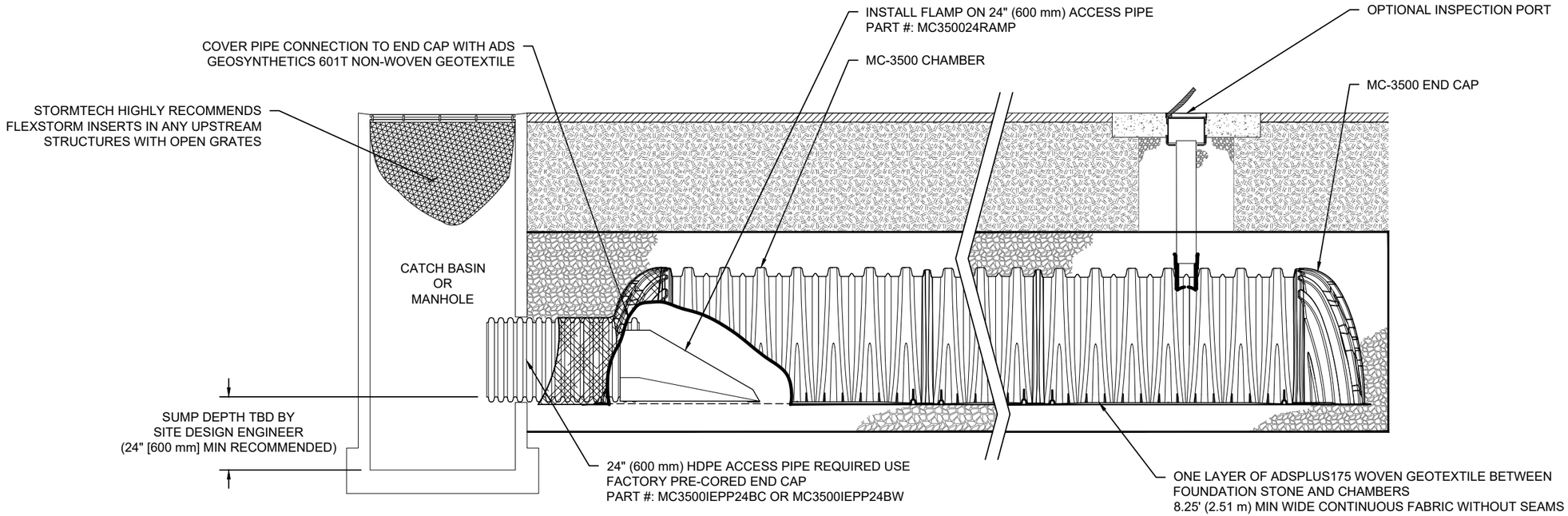
1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUB-GRADE SOILS, AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, A) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN., B) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23°, AND C) CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLOURS.

TANK 4 S172
COOLAGAD SHD, CO. WICKLOW
DATE: DRAWN: JC CHECKED: N/A
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM



MC-3500 ISOLATOR ROW PLUS DETAIL

NTS

ISOLATOR ROW PLUS COMPONENTS SHOWN ON THIS DESIGN MAY NOT BE AVAILABLE IN THE SPECIFIED PROJECT REGION. PLEASE CONTACT YOUR LOCAL ADS REPRESENTATIVE OR E-MAIL ADSINTERNATIONAL@ADS-PIPE.COM FOR FURTHER INFORMATION

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH-WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

TANK 4 S172
COOLAGAD SHD, CO. WICKLOW
DATE:
DRAWN: JC
PROJECT #:
CHECKED: N/A

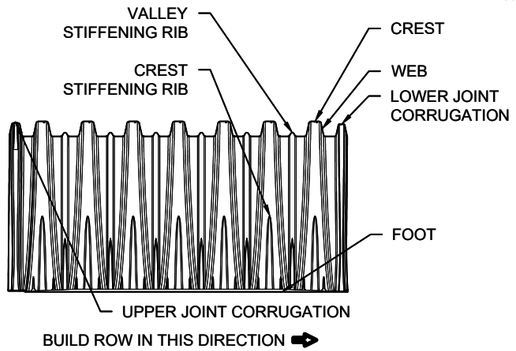
DESCRIPTION	CHK	DRW	DATE

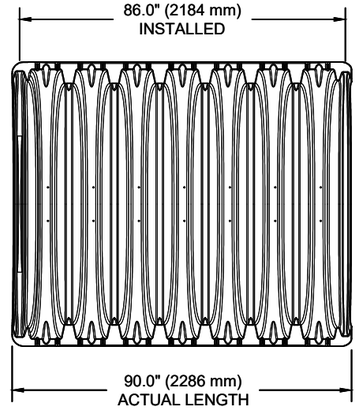
ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

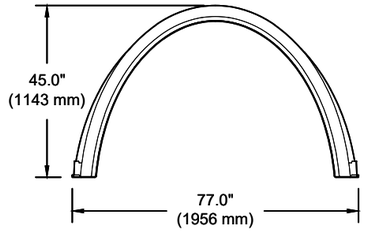
StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

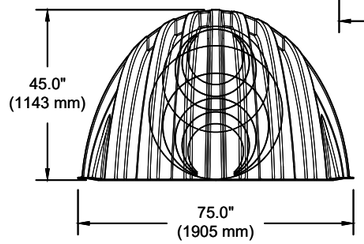
MC-3500 TECHNICAL SPECIFICATION

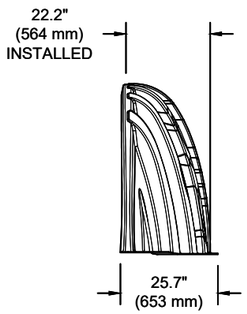
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	175.0 CUBIC FEET	(4.96 m³)
WEIGHT	134 lbs.	(60.8 kg)

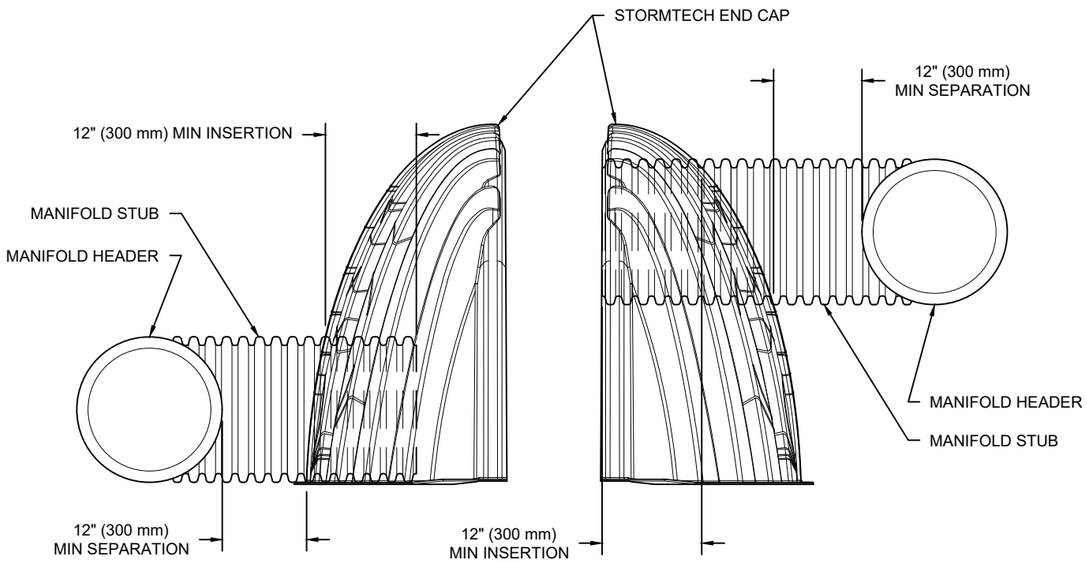
NOMINAL END CAP SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	45.1 CUBIC FEET	(1.28 m³)
WEIGHT	49 lbs.	(22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" SPACING BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

MC-SERIES END CAP INSERTION DETAIL

NTS

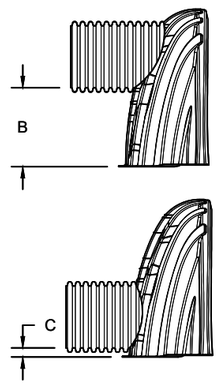


NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

TANK 4 S172
COOLAGAD SHD, CO. WICKLOW
DATE: DRAWN: JC CHECKED: N/A
PROJECT #:

DESCRIPTION	CHK	DRW	DATE

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Isolator® Row O&M Manual

THE MOST ADVANCED NAME IN WATER MANAGEMENT SOLUTIONS™

ADS®

THE ISOLATOR® ROW

INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160LP, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160LP, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

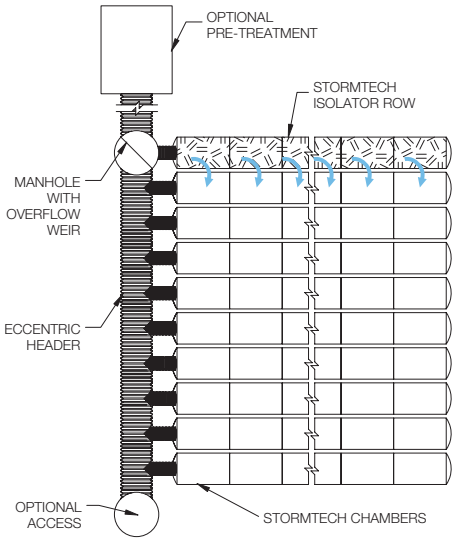
The Isolator Row is typically designed to capture the “first flush” and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

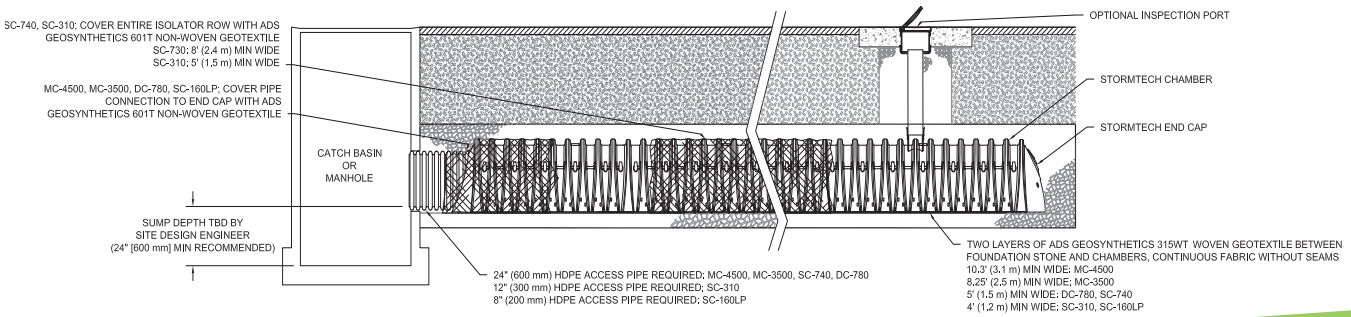
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



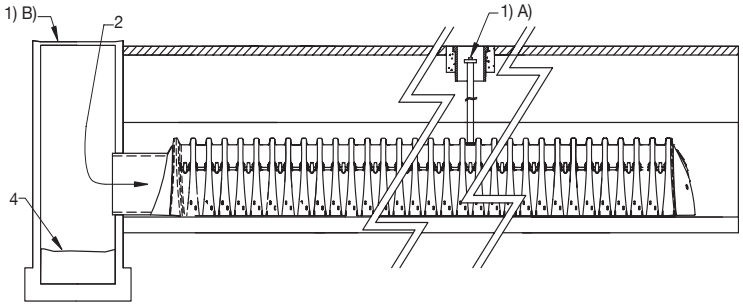
ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1
Inspect Isolator Row for sediment.
- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

STEP 2
Clean out Isolator Row using the JetVac process.
- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

STEP 3
Replace all caps, lids and covers, record observations and actions.

STEP 4
Inspect & clean catch basins and manholes upstream of the StormTech system.



SAMPLE MAINTENANCE LOG

Date	Stadia Rod Readings		Sediment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

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Appendix L – Extensive Green Roof Details

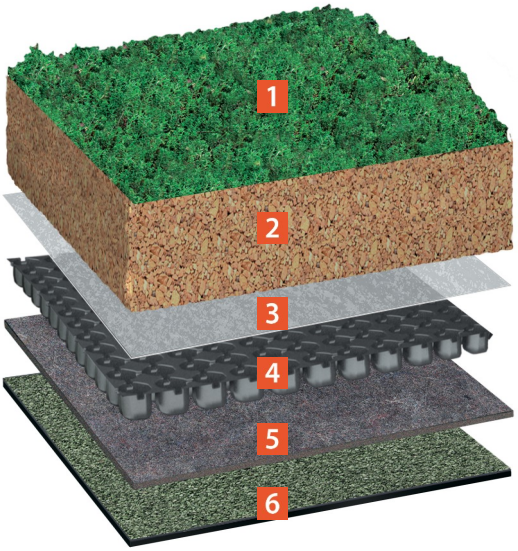
Revision: November 2020 V2

SYSTEM SUMMARY

Bauder Sedum on Extensive Substrate System

Sedum blanket green roof solution

Sedum is an ideal species for green roofs. It is both frost resistant and drought tolerant and requires little nutrient and minimal maintenance. Laying Bauder's mature SB sedum blanket on 80mm bed of extensive substrate gives the system the rooting depth and water retention to make it the most resilient of green roof finishes.



Product	Description	thickness	weight
1 Bauder SB Sedum Blanket *	Typically sown with 17 species of sedums and grown by Bauder for around 12 months before it is harvested.	30-40mm	24.0Kg/m²
2 Bauder Extensive Substrate	A lightweight, low nutrient growing material tested to BS8616 and manufactured to meet both GRO and	80mm	96Kg/m²
3 Bauder Filter Fleece	Filtration layer that prevents substrate fines from washing into the drainage and water storage layer.	1mm	0.13Kg/m²
4 Bauder DSE 20 Drainage Layer	A 20mm drainage board, holding 7.4 ltr/m2. It is manufactured from 100% recycled HDPE	20mm	8.6Kg/m² (water filled)
5 Bauder FSM 600 Protection Layer	Is 100% recycled Polyester and polypropylene fibre mix protection layer to prevent mechanical damage to the underlying waterproofing.	4mm	3.6Kg/m²
6 Underlying Waterproofing System	Various options for Bituminous Membrane, Hot Melt, Single-ply or Cold applied liquid systems.	N/A	N/A
Green Roof System Build up (fully saturated, excludes waterproofing)		**135-145mm**	**134Kg/m²**

*Bauder also produce Wildflower and seeded solutions

When to specify

Where an immediate vegetated finish is required on completion. Bauder SB sedum blanket gives instant ground cover and a low maintenance solution. Ideal for very exposed roof environment.

Please note: All green roofs require water during times of drought. Bauder recommend that the watering and maintenance of this roof is considered and addressed during its design.

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Appendix M – Maintenance Inspection Checklist

- a plan clearly showing the extent of the adopted area along with easements and rights of way for access to carry out maintenance. If other parties are responsible for different parts of a scheme, this should be clearly shown on the plan.
- the access that is required to each surface water management component for maintenance purposes and a plan for the safe and sustainable removal and disposal of waste periodically arising from the drainage system
- a review of the work to be undertaken, based on regular day-to-day maintenance, occasional tasks and remedial work. Details of the likely maintenance requirements for each SuDS element are provided in this Manual. Maintenance requirements for proprietary systems should be provided by the manufacturer or supplier.
- the maintenance specification – detailing the materials to be used and the standard of work required. A specification should describe how the work should be carried out and should contain clauses giving general instructions to the maintenance contractor.
- the maintenance schedule of work – itemising the tasks to be undertaken and the frequency at which they should be performed so that an acceptable long-term performance standard is secured. This schedule can then be priced and checked on site, and it can form the basis of an inspection log where appropriate. The schedule should be a living document because it may change, where inspections advise changes to the scheme maintenance requirements.
- contact sheet and any extra guidance notes – eg action plan for dealing with accidental spillages
- photographic records of the inspections. This can pick up long-term changes that might not be apparent on a single visit, especially where inspections are carried out by different members of staff.

Note: An example of a Maintenance Plan is available in Box B.2.

B.8.3 Maintenance inspection checklist

This checklist is a generic list that can be added to, or have items removed from it, to suit a particular site. The exact content of the checklist will depend on the combination of different SuDS components used in a scheme. Checklists should be selected based on the combination of elements in the drainage system to provide a bespoke inspection report.

The objective of this checklist is to:

- confirm that appropriate routine maintenance of the system is being undertaken
- confirm that the system is continuing to operate effectively
- identify any remedial works required
- provide a consistent record of the condition and performance of the system.

It is not a checklist of maintenance items, which is covered in Chapters 11 to 23 of this manual (Table B.24). It is a checklist to facilitate consistent inspection of the condition of the system. It can be used by any organisation responsible for the long-term maintenance of the SuDS system as a recording process, or by a subcontracted organisation as part of their client reporting procedures.

Inspections should comply with all relevant health and safety legislation (The Management of Health and Safety at Work Regulations 1999) including the development of risk assessments for working close to or in water.

Inspections should ideally be carried out monthly (and no less than three-monthly), at the same time as other routine maintenance activities.

TABLE B.24 Where to find information on maintenance activities and frequencies

Component	Ref (within this manual)
Green roofs	Section 12.12
Infiltration systems	Section 13.12
Proprietary systems	Section 14.12
Filter strips	Section 15.12
Filter drains	Section 16.12
Swales	Section 17.12
Bioretention systems	Section 18.12
Trees	Section 19.12
Pervious pavements	Section 20.14
Attenuation storage tanks	Section 21.13
Detention basins	Section 22.12
Ponds and wetlands	Section 23.12

TABLE B.25 SuDS maintenance inspection checklist

General information			
Site ID			
Site location and co-ordinates (GIS if appropriate)			
Elements forming the SuDS scheme		Approved drawing reference(s)	
Inspection frequency		Approved specification reference	
Type of development		Specific purpose of any parts of the scheme (eg biodiversity, wildlife and visual aspects)	

Inspection date								
	Details	Y/N	Action required	Date completed	Details	Y/N	Action required	Date Completed
General inspection items								
Is there any evidence of erosion, channelling, ponding (where not desirable) or other poor hydraulic performance?								
Is there any evidence of accidental spillages, oils, poor water quality, odours or nuisance insects?								
Have any health and safety risks been identified to either the public or maintenance operatives?								
Is there any deterioration in the surface of permeable or porous surfaces (eg rutting, spreading of blocks or signs of ponding water)?								
Silt/sediment accumulation								
Is there any sediment accumulation at inlets (or other defined accumulation zones such as the surface of filter drains or infiltration basins and within proprietary devices)? If yes, state depth (mm) and extent. Is removal required? If yes, state waste disposal requirements and confirm that all waste management requirements have been complied with (consult environmental regulator)								

continued...

continued from...

TABLE B.25 SuDS maintenance inspection checklist

Inspection date								
	Details	Y/N	Action required	Date completed	Details	Y/N	Action required	Date Completed
Is surface clogging visible (potentially problematic where water has to soak into the underlying construction or ground (eg underdrained swale or infiltration basin)?								
Does permeable or porous surfacing require sweeping to remove silt?								
System blockages and litter build-up								
Is there evidence of litter accumulation in the system? If yes, is this a blockage risk?								
Is there any evidence of any other clogging or blockage of outlets or drainage paths?								
Vegetation								
Is the vegetation condition satisfactory (density, weed growth, coverage etc)? (Check against approved planting regime.)								
Does any part of the system require weeding, pruning or mowing? (Check against maintenance frequency stated in approved design.)								
Is there any evidence of invasive species becoming established? If yes, state action required								
Infrastructure								
Are any check dams or weirs in good condition?								
Is there evidence of any accidental damage to the system (eg wheel ruts?)								
Is there any evidence of cross connections or other unauthorised inflows?								
Is there any evidence of tampering with the flow controls?								

continued...

continued from...

TABLE B.25 SuDS maintenance inspection checklist

Inspection date								
	Details	Y/N	Action required	Date completed	Details	Y/N	Action required	Date Completed
Are there any other matters that could affect the performance of the system in relation to the design objectives for hydraulic, water quality, biodiversity and visual aspects? (Specify.)								
Other observations								
Information appended (eg photos)								
Suitability of current maintenance regime								
Continue as current Increase maintenance Decrease maintenance								
Next inspection								
Proposed date for next inspection								

Correct application of the waterproof membrane is essential to the viability of the green roof. Quality control must be assured through the use of certified roofing procedures and an electronic water leakage test immediately following membrane application to ensure that the surface is impermeable.

Temporary ballasting of individual components may be required during construction to prevent uplift due to wind. The growing medium should be protected from over-compaction during construction, and mulch, mat or other measures to control erosion of the growing medium should be maintained until 90% vegetation coverage is achieved. The growing medium and separation fabric should be isolated from sedimentation during construction.

Safe access is required for construction of the green roof, and also for all activities in areas beneath the roof. Ideally, the roof should be installed when no follow-on trades need access to the roof after installation, in order to reduce the risk of damage.

- Further detail on construction activities and the programming of construction activities is provided in **Chapter 31**.
- Generic health and safety guidance is presented in **Chapter 36**.

A construction phase health and safety plan is required under the Construction (Design and Management) Regulations (CDM) 2015. This should ensure that all construction risks have been identified and eliminated/reduced and/or controlled where appropriate.

12.12 OPERATION AND MAINTENANCE REQUIREMENTS

Intensive green roofs are likely to require regular inspection and maintenance. Grassed areas may require mowing weekly or fortnightly, plant beds may require weeding on a weekly or fortnightly basis during the growing season, and wildflower meadows may require annual mowing with the cuttings removed. Extensive green roofs should normally only require biannual or annual visits to remove litter, check fire breaks and drains and, in some cases, remove unwanted invasive plants. The most maintenance is generally required during the establishment stage (12 to 15 months), and this should usually be made the responsibility of the green roof provider. Maintenance contractors with specialist training in green roof care should be used, where possible.

Table 12.5 provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required. Actual requirements will depend on the planting, the desired aesthetic and visual effect and the biodiversity objectives for the system. Maintenance specifications and schedules should therefore be specified for any individual green roof.

If mechanical systems are located on the roof, then spill prevention measures should be exercised to ensure that roof runoff is not contaminated. The mechanical system area should be bunded and provided with separate drainage.

All maintenance actions carried out at roof level must be in full compliance with the appropriate health and safety regulations, and particularly those specifically dealing with working at height. Training and guidance information on operating and maintaining the roof should be provided to all property owners and tenants. Safety fastenings will be required for personnel working on the roof.

Access routes to the roof should be designed and maintained to be safe and efficient, and walkways should always be kept clear of obstructions. Secure points for harness attachments should be provided when access near to the roof edges is required.

Specific maintenance needs of the green roof should be monitored and maintenance schedules adjusted to suit requirements.

TABLE 12.5 Operation and maintenance requirements for green roofs

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

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in **Chapter 32**.

CDM 2015 requires designers to ensure that all maintenance risks have been identified and eliminated, reduced or controlled where appropriate. This information will be required as part of the health and safety file.

▶ Generic health and safety guidance is presented in **Chapter 36**.

16.11 CONSTRUCTION REQUIREMENTS

Filter drains should be protected before completion and stabilisation of the upstream development areas. They should not be used for drainage of construction sites, where untreated runoff is likely to contain large amounts of silt, debris and other pollutants, as this will cause rapid clogging of the systems.

All trench excavations should follow construction best practice and be supported, if required. No personnel should be allowed to enter an unsupported trench deeper than 1.2 m. Trench supports should be designed to guarantee the safety of those working in the trench. Support may also be needed for shallower trenches in weak ground.

Filter drain formations should be flat or to a shallow grade to reduce the risk of ponding and negative filter gradients. Geotextile and stone fill should be clean before construction. Backfill should be placed in 100–150 mm layers and lightly compacted as required.

All geotextiles should be wrapped and secured to prevent gravel or stone from clogging with sediments.

The drain-down time after a storm should be observed after completion or modification of the facility to confirm that the desired drain time has been obtained (BRE, 1991).

- Further detail on construction activities and the programming of construction activities is provided in Chapter 31.

A construction phase health and safety plan is required under the Construction (Design and Management) Regulations (CDM) 2015. This should ensure that all construction risks have been identified, eliminated, reduced and/or controlled where appropriate.

- Generic health and safety guidance is presented in Chapter 36.

16.12 OPERATION AND MAINTENANCE REQUIREMENTS

Filter drains will require regular maintenance to ensure continuing operation to design performance standards, and all designers should provide detailed specifications and frequencies for the required maintenance activities along with likely machinery requirements and typical annual costs – within the Maintenance Plan. The treatment performance of filter drains is dependent on maintenance, and robust management plans will be required to ensure that maintenance is carried out in the long term. Different designs will have different operation and maintenance requirements, but this section gives some generic guidance.

Regular inspection and maintenance is important for the effective operation of filter drains as designed. Maintenance responsibility for a filter drain should always be placed with an appropriate organisation. Adequate access should always be provided to the filter drain for inspection and maintenance. If filter drains are implemented within private property, owners should be educated on their routine maintenance needs, and should understand the long-term Maintenance Plan and any legally binding maintenance agreement.

Litter (including leaf litter) and debris removal should be undertaken as part of general landscape maintenance for the site and before any other SuDS management task. All litter should be removed from site.

Table 16.1 provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

TABLE 16.1 Operation and maintenance requirements for filter drains

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Sediments excavated from upstream pre-treatment devices that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate waste management protocols and compliance with legislation. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For industrial site runoff, sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on site, if there is an appropriate safe and acceptable location to do so. Any damage due to sediment removal or erosion should be repaired and immediately reseeded or planted.

▶ Further detail on waste management is provided in Chapter 32.

Maintenance Plans and schedules should be developed during the design phase. Specific maintenance needs of the filter drain should be monitored and maintenance schedules adjusted to suit requirements.

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in Chapter 32.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

▶ Generic health and safety guidance is presented in Chapter 36.

If sediment from construction work accumulates on a swale it should be cleared and the swale fully rehabilitated before the drainage system is adopted by the organisation carrying out the maintenance.

The swale should be planted at a time of year when successful plant establishment without irrigation is most likely (noting that temporary irrigation may still be required if the period is especially dry). Freshly seeded areas should be stabilised with appropriate temporary or permanent soil stabilisation methods, such as erosion control matting or blankets. If more than 30% of the planted area is bare after four weeks, reseeding or replanting should be considered to achieve 90% coverage.

Figure 17.16 Swale during construction showing coir matting used to protect soils from erosion before the establishment of vegetation, University of York (courtesy Arup)

▶ Further detail on construction activities and the programming of construction activities is provided in Chapter 31.

A construction phase health and safety plan is required under the Construction (Design and Management) Regulations (CDM) 2015. This should ensure that all construction risks have been identified, eliminated, reduced and/or controlled where appropriate.

▶ Generic health and safety guidance is provided in Chapter 36.

17.12 OPERATION AND MAINTENANCE REQUIREMENTS

Swales will require regular maintenance to ensure continuing operation to design performance standards, and all designers should provide detailed specifications and frequencies for the required maintenance activities along with likely machinery requirements and typical annual costs – within the Maintenance Plan. The treatment performance of swales is dependent on maintenance, and robust management plans will be required to ensure maintenance is carried out in the long term. Different designs will have different operation and maintenance requirements, but this section gives some generic guidance.

Maintenance of swales is relatively straightforward for landscape contractors, and typically there should only be a small amount of extra work (if any) required for a swale over and above what is necessary for standard public open space. Provided that landscape management is already required at site, swale maintenance should have marginal cost implications. However, regular inspection and maintenance are important for the effective operation of swales as designed. Maintenance responsibility for a swale should always be placed with an appropriate organisation. If swales are implemented within private property, owners should be educated on their routine maintenance needs, and should understand the long-term Maintenance Plan and any legally binding maintenance agreement.

Adequate access should be provided to all swale areas for inspection and maintenance, including for appropriate equipment and vehicles. Litter and debris removal should be undertaken as part of general landscape maintenance for the site and before any other SuDS management task. All litter should be removed from site.

The major maintenance requirement for dry swales is mowing. Mowing should ideally retain grass lengths of 75–150 mm across the main “treatment” surface, to assist in filtering pollutants and retaining sediments and to reduce the risk of flattening during runoff events. However, longer vegetation lengths, where appropriate, are not considered to pose a significant risk to functionality.

Grass clippings should be disposed of either off site or outside the area of the swale, to remove nutrients and pollutants. For wet swales, mowing of wetland vegetation is not required. However, harvesting of very dense vegetation may be desirable in the autumn after plant die-back, to prevent the discharge of excess organic material into receiving waters. All vegetation management activities should take account of the need to maximise biosecurity and prevent the spread of invasive species.

Figure 17.17 Grass cutting of roadside swale, Stirlingshire (courtesy Abertay University)

Occasionally sediment will need to be removed (eg once deposits exceed 25 mm in depth), although this can be minimised by ensuring that upstream areas are stabilised and by incorporating effective pre-treatment devices. Available evidence from monitoring studies indicates that small distributed infiltration practices such as swales do not contaminate underlying soils, even after more than 10 years of operation (TRCA, 2008). Sediments excavated from a swale that receives runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For runoff from busy streets with high vehicle traffic, sediment testing will be essential. Any damage due to sediment removal or erosion should be repaired and immediately reseeded or planted.

▶ Further detail on waste management is provided in **Chapter 33**.

Table 17.1 provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance Plans and schedules should be developed during the design phase. Specific maintenance needs of the swales should be monitored, and maintenance schedules adjusted to suit requirements.

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in **Chapter 32**.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

▶ Generic health and safety guidance is provided in **Chapter 36**.

TABLE 17.1 Operation and maintenance requirements for swales

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

20.14 OPERATION AND MAINTENANCE REQUIREMENTS

Regular inspection and maintenance is important for the effective operation of pervious pavements. Maintenance responsibility for a pervious pavement and its surrounding area should be placed with an appropriate responsible organisation. Before handing over the pavement to the client, it should be inspected for clogging, litter, weeds and water ponding, and all failures should be rectified. After handover, the pavement should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

Pervious pavements need to be regularly cleaned of silt and other sediments to preserve their infiltration capacity. Extensive experience suggests that sweeping once per year should be sufficient to maintain an acceptable infiltration rate on most sites. However, in some instances, more or less sweeping may be required and the frequency should be adjusted to suit site-specific circumstances and should be informed by inspection reports.

A brush and suction cleaner (which can be a lorry-mounted device or a smaller precinct sweeper) should be used for regular sweeping. Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material. Any lost material should be replaced. It is also possible to clean the surface using lightweight rotating brush cleaners combined with power spraying using hot water, as shown in **Figure 20.30**. This is done every two years at the site shown.

If the surface has clogged then a more specialist sweeper with water jetting and oscillating and rotating brushes may be required, especially for porous asphalt surfaces, to restore the surface infiltration rate to an acceptable level. The specialist equipment should be adjusted so that it does not strip binder from the aggregate in the asphalt.

Figure 20.30 Deep cleaning a supermarket car park, Dundee (courtesy Abertay University)

The likely design life of grass reinforcement will be dictated by trafficking and is likely to be about 20 years if designed correctly. For concrete block permeable paving the design life should be no different from standard paving, assuming that an effective maintenance regime is in place to minimise risks of infiltration clogging. Porous asphalt will lose strength and begin to fatigue due to oxidation of the binder. This is likely to occur slightly faster in porous asphalt than normal asphalt, so the design life will be reduced slightly. Porous concrete should have a similar design life to a normal concrete slab.

The reconstruction of failed areas of concrete block pavement should be less costly and disruptive than the rehabilitation of continuous concrete or asphalt porous surfaces due to the reduced area that is likely to be affected. Materials removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and may need to be disposed of as controlled waste. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

▶ Guidance on waste management is provided in **Chapter 33**.

Table 20.15 provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance Plans and schedules should be prepared during the design phase. Specific maintenance needs of the pervious pavement should be monitored, and maintenance schedules adjusted to suit requirements.

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in **Chapter 32**.

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy) and therefore, if litter management is already required at site, this should have marginal cost implications.

Generally, pervious pavements require less frequent gritting in winter to prevent ice formation. There is also less risk of ice formation after snow melt, as the melt water drains directly into the underlying sub-base and does not have chance to refreeze. A slight frost may occur more frequently on the surface of pervious pavements compared to adjacent impermeable surfaces, but this is only likely to last for a few hours. It does not happen in all installations and, if necessary, this can be dealt with by application of salt. It is not likely to pose a hazard to vehicle movements.

- Generic health and safety guidance is presented in **Chapter 36**.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

Heavy vibrating rollers are definitely not recommended around plastic pipes or tanks due to the high pressures that they can generate. Thin layers with smaller plant are recommended. DfT (2009) should be referred to for guidance for plant and methods for achieving compaction. The manufacturers' recommendations usually limit plant size above geocellular units to no more than 2300 kg/m width. However, the loading resulting from this will still need to be checked in the design. If such plant is to be used adjacent to the units, the resulting compaction pressures need to be checked.

Any arch or flexible pipe structures depend on the even resistance provided from soil or aggregate on both sides of the arch/pipe for their structural capacity. Even slight differences in the level of filling on each side of the arch/pipe as it progresses could potentially cause uneven deflections and increase the stress within the structure above design values. Close supervision during backfilling is therefore vital. The backfill around geocellular tanks should also be brought up evenly around all sides.

Bedding directly below a concrete pipe should have minimal compaction. The fill at the side of the pipe should be well compacted to a level 300 mm above the crown of the pipe. Only light compaction should be applied to the backfill directly over the crown of the pipe to a point 300 mm above it. With reasonable workmanship and supervision, the bedding factors used in the design should be relatively conservative.

21.12.6 Wrapping

All storage tanks should be watertight in accordance with the relevant standards. Geocellular and similar structures using geomembranes to hold water should be sealed in accordance with waterproofing standards (ie welded joints rather than adhesive taped) and the integrity of the seal checked on site through the use of non-destructive testing, to ensure that it is leak-proof. Advice on appropriate integrity and seam tests for geomembranes, that could be adapted for testing membranes around storage tanks, is provided in Mallett *et al* (2014). Care needs to be taken during installation to protect against damage of both the tank structure and the geotextile and the geomembrane wrapping. Follow-on trades can also cause damage and put the integrity and performance of the structure at risk.

21.13 OPERATION AND MAINTENANCE REQUIREMENTS

Regular inspection and maintenance is required to ensure the effective long-term operation of below-ground storage systems. Maintenance responsibility for systems should be placed with a responsible organisation. **Table 21.3** provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance Plans and schedules should be developed during the design phase, and will be specific to the type of tank that is adopted. Specific maintenance needs of the system should be monitored, and maintenance schedules adjusted to suit requirements. Further detail on the preparation of maintenance specifications and schedules of work is given in **Chapter 32**.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

- Generic health and safety guidance is provided in **Chapter 36**.

TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

21.14 REFERENCES

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23.11 CONSTRUCTION REQUIREMENTS

The bottom and side slopes of the pond, including any benches, should be carefully prepared to ensure that they are structurally sound. Any embankments should be checked to ensure that they meet their design criteria. The preparation should also ensure that the basin will satisfactorily retain the surface water runoff without significant erosion damage.

Backfilling against inlet and outlet structures needs to be controlled so as to minimise settlement and erosion. The soils used to finish the side slopes of the pond above the retained level need to be suitably fertile, porous and of sufficient depth to ensure healthy vegetation growth. If an impermeable liner is used, care should be taken to ensure that it is not damaged during construction.

There are various materials available to help prevent erosion while allowing plants to establish (Section 29.4.3). Ideally, planting would be planned over a number of years so that the rate of establishment can be monitored and densities adjusted accordingly.

Ponds can only be used to manage construction runoff where there is provision made for their complete rehabilitation to original design formation levels before handover. Planting schemes should be delayed until full rehabilitation has been undertaken.

Further detail on construction activities and the programming of construction activities is provided in Chapter 31. Generic health and safety guidance is provided in Chapter 36. A construction phase health and safety plan is required under CDM 2015. This should ensure that all construction risks have been identified, eliminated, reduced and/or controlled where appropriate.

23.12 OPERATION AND MAINTENANCE REQUIREMENTS

Ponds and wetlands will require regular maintenance to ensure continuing operation to design performance standards, and all designers should provide detailed specifications and frequencies for the required maintenance activities, along with likely machinery requirements and typical annual costs – within the Maintenance Plan. The treatment performance of ponds and wetlands is dependent on maintenance, and robust management plans will be required to ensure maintenance is carried out in the long term. Different designs will have different operation and maintenance requirements, but this section gives some generic guidance.

Maintenance of ponds is relatively straightforward for landscape contractors, and typically there should only be a small amount of extra work required for a SuDS pond or wetland feature over and above what is necessary for standard public open space.

Regular inspection and maintenance is important for the effective operation of ponds as designed. Maintenance responsibility for a pond and its surrounding area should always be placed with a responsible organisation. Litter and debris removal should be undertaken as part of general landscape maintenance for the site and before any other SuDS management task. All litter should be removed from site.

Any invasive maintenance work such as silt or vegetation removal is only required intermittently, but it should be planned to be sympathetic to the requirements of wildlife in a pond. Care should be taken to avoid disturbance to nesting birds during the breeding season and habitats of target species (eg great crested newt and water voles) at critical times. The window for carrying out maintenance to achieve this is usually towards the end of the growing season (typically September/October), although this will vary with species). Invasive silt and vegetation removal should only be carried out to limited areas at any one time (25–30% of the pond area on one occasion each year to minimise the impact on biodiversity. Plant management, to achieve particular desired habitat effects, should be clearly specified in a maintenance schedule.

Site vegetation should be trimmed as necessary to keep the pond free of leaves and to maintain the aesthetic appearance of the site. Slope areas that have become bare should be re-vegetated and any eroded areas should be regraded before replanting.

Maintenance access (or "easement") should be provided to the pond from a public or private road. An assessment should be made at the planning stage regarding the maintenance and associated access requirements. Ideally, access should be at least 3.5 m wide, have a maximum cross fall of 1 in 7, and be sufficiently robust to withstand maintenance equipment and vehicles. However, temporary access routes for infrequent operations could be considered where permanent routes are not appropriate. The access should extend to any forebay, safety and aquatic benches, inlet and outlet infrastructure. Consideration should be given as to whether maintenance vehicles will need to turn around. Wherever possible SuDS ponds and wetlands should be designed so that special machinery is not required to undertake maintenance.

Table 23.1 provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required. Consideration should be given to the need to control risks to biosecurity during maintenance operations and guidance is provided in Chapter 29.

Sediments excavated from ponds or forebays that receive runoff from residential or standard road and roof areas should be safely disposed of in accordance with current waste management legislation. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Chemical testing of the sediment may be required, before sediment excavation, to determine its classification and appropriate disposal methods. For industrial site runoff, sediment testing will be essential. In the majority of cases on low-risk sites with source control and a Management Train, it will be acceptable to distribute the sediment on site, if there is an appropriate safe and acceptable location to do so. Further detail on waste management is provided in Chapter 33. If ponds are to be drawn down, care should be taken to prevent downstream discharge of sediments and anoxic water. The environmental regulator should be notified before such activities.

New ponds may become rapidly dominated by invasive native plants, particularly common bulrush (Typha latifolia). As it is not desirable for all new ponds to be bulrush dominated, it should be ensured that in the first five years, while vegetation is establishing, certain plant growth is controlled. After this time, ponds can usually be allowed to develop naturally recognising that, unless the margins are occasionally managed, they are likely to become dominated by trees and shrubs.

Eutrophication of SuDS ponds can occur during the summer months. This is best alleviated by controlling the nutrient source or providing a continuous baseflow to the pond. Unless eutrophication is severe, aeration can be used as a stop-gap measure to save aquatic animal species and reduce risks to receiving waters. However, the addition of barley straw bales, dredging or rendering the nutrients inactive by chemical means can also be successful.

Maintenance Plans and schedules should be developed during the design phase. Specific maintenance needs of the pond should be monitored, and maintenance schedules adjusted to suit requirements. Further detail on the preparation of maintenance specifications and schedules of work is given in Chapter 32.

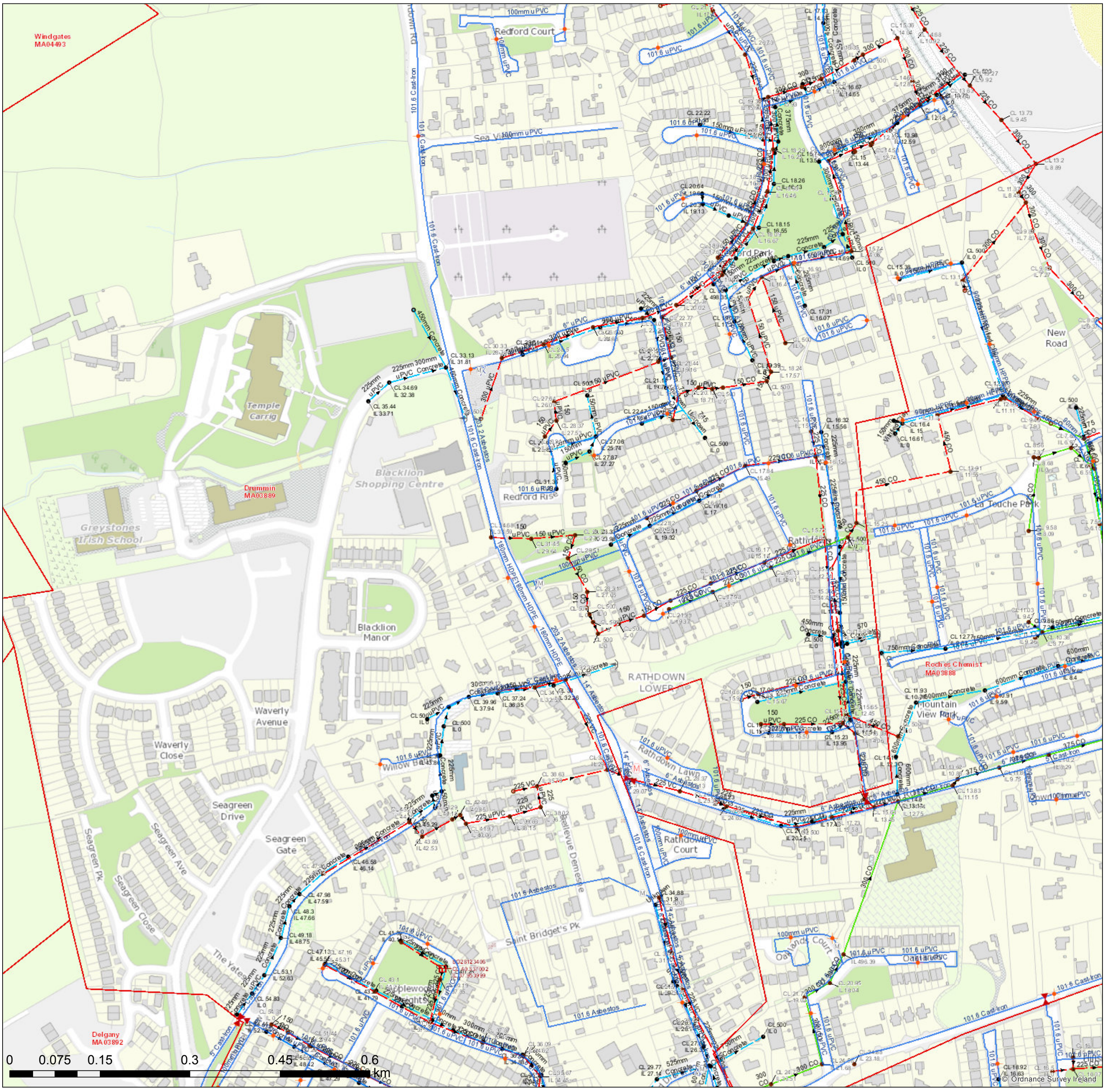
Generic health and safety guidance is provided in Chapter 36. CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

TABLE 23.1 Operation and maintenance requirements for ponds and wetlands

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check any mechanical devices, eg penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay.	Every 1–5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25–50 years
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair / rehabilitate inlets, outlets and overflows.	As required

Appendix N – Existing Record Drawings

Irish Water Web Map



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

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Appendix O – Foul Water Calculations

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	20
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.000
Flow Per Person (l/per/day)	165.00	Maximum Backdrop Height (m)	0.000
Persons per House	2.70	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	31.298	0.782	40.0	0.000	17	0.0	1.500	o	150	Pipe/Conduit	
F1.001	13.128	0.088	150.0	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F1.002	24.782	0.620	40.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F1.003	24.900	1.132	22.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	
F1.004	17.399	0.580	30.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F1.005	19.335	0.879	22.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F1.006	39.831	1.992	20.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F2.000	23.523	0.235	100.1	0.000	10	0.0	1.500	o	150	Pipe/Conduit	
F2.001	25.459	0.364	70.0	0.000	7	0.0	1.500	o	150	Pipe/Conduit	
F2.002	7.911	0.079	100.0	0.000	2	0.0	1.500	o	150	Pipe/Conduit	
F2.003	12.714	0.064	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F1.007	10.242	0.051	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	74.580	0.000	0.0	17	0.1	17	0.58	1.39	24.5	0.6
F1.001	73.723	0.000	0.0	21	0.1	23	0.37	0.94	37.2	0.8
F1.002	73.635	0.000	0.0	27	0.2	19	0.63	1.82	72.3	1.0
F1.003	73.016	0.000	0.0	30	0.2	17	0.80	2.45	97.6	1.1
F1.004	71.884	0.000	0.0	32	0.2	19	0.74	2.10	83.5	1.2
F1.005	71.304	0.000	0.0	34	0.2	18	0.84	2.45	97.5	1.3
F1.006	70.425	0.000	0.0	36	0.2	18	0.88	2.57	102.3	1.3
F2.000	68.844	0.000	0.0	10	0.1	16	0.36	0.88	15.5	0.4
F2.001	68.609	0.000	0.0	17	0.1	19	0.48	1.05	18.5	0.6
F2.002	68.245	0.000	0.0	19	0.1	22	0.44	0.88	15.5	0.7
F2.003	68.091	0.000	0.0	21	0.1	24	0.33	0.81	32.2	0.8
F1.007	68.028	0.000	0.0	59	0.4	40	0.46	0.81	32.2	2.2

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.008	21.503	0.108	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F1.009	16.687	0.083	200.0	0.000	1	0.0	1.500	o	225	Pipe/Conduit	
F1.010	31.203	0.156	200.0	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F1.011	7.565	0.038	200.0	0.000	1	0.0	1.500	o	225	Pipe/Conduit	
F1.012	27.450	0.137	200.0	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F1.013	19.700	0.099	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F1.014	12.588	0.063	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F1.015	43.709	0.219	200.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F1.016	13.459	0.067	200.0	0.000	1	0.0	1.500	o	225	Pipe/Conduit	
F1.017	11.594	0.058	200.0	0.000	1	0.0	1.500	o	225	Pipe/Conduit	
F3.000	43.944	0.732	60.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	
F1.018	32.416	0.162	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F1.019	16.983	0.085	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F1.020	45.399	0.454	100.0	0.000	16	0.0	1.500	o	150	Pipe/Conduit	
F1.021	17.315	0.087	200.0	0.000	8	0.0	1.500	o	225	Pipe/Conduit	
F1.022	23.177	0.116	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F4.000	24.747	0.825	30.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F4.001	27.351	0.912	30.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F4.002	42.330	0.423	100.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.008	67.976	0.000	0.0	61	0.4	40	0.46	0.81	32.2	2.3
F1.009	67.869	0.000	0.0	62	0.4	41	0.47	0.81	32.2	2.3
F1.010	67.785	0.000	0.0	66	0.4	42	0.48	0.81	32.2	2.5
F1.011	67.629	0.000	0.0	67	0.4	42	0.48	0.81	32.2	2.5
F1.012	67.592	0.000	0.0	71	0.4	44	0.49	0.81	32.2	2.6
F1.013	67.454	0.000	0.0	73	0.5	44	0.49	0.81	32.2	2.7
F1.014	67.356	0.000	0.0	75	0.5	45	0.50	0.81	32.2	2.8
F1.015	67.293	0.000	0.0	81	0.5	46	0.51	0.81	32.2	3.0
F1.016	67.074	0.000	0.0	82	0.5	47	0.51	0.81	32.2	3.0
F1.017	67.007	0.000	0.0	83	0.5	47	0.51	0.81	32.2	3.1
F3.000	69.204	0.000	0.0	3	0.0	8	0.29	1.13	20.0	0.1
F1.018	66.949	0.000	0.0	88	0.5	48	0.52	0.81	32.2	3.3
F1.019	66.787	0.000	0.0	90	0.6	49	0.52	0.81	32.2	3.3
F1.020	66.702	0.000	0.0	106	0.7	52	0.73	0.88	15.5	3.9
F1.021	66.173	0.000	0.0	114	0.7	55	0.56	0.81	32.2	4.2
F1.022	66.087	0.000	0.0	114	0.7	55	0.56	0.81	32.2	4.2
F4.000	79.747	0.000	0.0	4	0.0	8	0.40	1.60	28.3	0.1
F4.001	78.922	0.000	0.0	8	0.0	11	0.50	1.60	28.3	0.3
F4.002	78.010	0.000	0.0	12	0.1	18	0.38	0.88	15.5	0.4

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F5.000	42.873	0.536	80.0	0.000	2	0.0	1.500	o	150	Pipe/Conduit	
F4.003	14.304	0.715	20.0	0.000	1	0.0	1.500	o	150	Pipe/Conduit	
F4.004	39.833	1.992	20.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F4.005	10.133	0.507	20.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F4.006	17.808	0.890	20.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F4.007	10.442	0.348	30.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F4.008	13.378	0.206	65.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F4.009	15.609	0.078	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F4.010	19.883	0.099	200.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	
F4.011	16.029	0.080	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F4.012	24.091	0.120	200.0	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F4.013	18.366	0.092	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F4.014	16.894	0.084	200.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	
F4.015	13.537	0.068	200.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	
F6.000	34.554	0.864	40.0	0.000	6	0.0	1.500	o	150	Pipe/Conduit	
F6.001	26.032	0.651	40.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F6.002	27.095	0.774	35.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	
F6.003	27.364	0.684	40.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	
F6.004	23.475	0.587	40.0	0.000	2	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F5.000	78.016	0.000	0.0	2	0.0	7	0.23	0.98	17.3	0.1
F4.003	77.480	0.000	0.0	15	0.1	14	0.71	1.97	34.7	0.6
F4.004	76.765	0.000	0.0	19	0.1	15	0.76	1.97	34.7	0.7
F4.005	74.773	0.000	0.0	19	0.1	15	0.76	1.97	34.7	0.7
F4.006	74.192	0.000	0.0	21	0.1	14	0.74	2.57	102.3	0.8
F4.007	73.301	0.000	0.0	23	0.1	16	0.66	2.10	83.5	0.9
F4.008	72.953	0.000	0.0	23	0.1	20	0.51	1.43	56.7	0.9
F4.009	72.747	0.000	0.0	25	0.2	27	0.35	0.81	32.2	0.9
F4.010	72.669	0.000	0.0	28	0.2	28	0.37	0.81	32.2	1.0
F4.011	72.570	0.000	0.0	30	0.2	29	0.37	0.81	32.2	1.1
F4.012	72.490	0.000	0.0	34	0.2	31	0.39	0.81	32.2	1.3
F4.013	72.369	0.000	0.0	36	0.2	31	0.40	0.81	32.2	1.3
F4.014	72.277	0.000	0.0	39	0.2	33	0.41	0.81	32.2	1.4
F4.015	72.193	0.000	0.0	42	0.3	34	0.42	0.81	32.2	1.6
F6.000	82.771	0.000	0.0	6	0.0	10	0.41	1.39	24.5	0.2
F6.001	81.907	0.000	0.0	10	0.1	13	0.49	1.39	24.5	0.4
F6.002	81.256	0.000	0.0	13	0.1	14	0.55	1.48	26.2	0.5
F6.003	80.482	0.000	0.0	16	0.1	16	0.57	1.39	24.5	0.6
F6.004	79.798	0.000	0.0	18	0.1	17	0.59	1.39	24.5	0.7

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F6.005	12.242	0.306	40.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F6.006	11.995	0.300	40.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F7.000	35.918	0.463	77.6	0.000	6	0.0	1.500	o	150	Pipe/Conduit	
F7.001	16.060	0.268	60.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	
F7.002	17.039	0.114	150.0	0.000	2	0.0	1.500	o	150	Pipe/Conduit	
F6.007	22.688	0.113	200.0	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F6.008	16.419	0.410	40.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F8.000	65.066	0.325	200.0	0.000	20	0.0	1.500	o	225	Pipe/Conduit	
F8.001	11.434	0.057	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F8.002	37.895	0.211	180.0	0.000	8	0.0	1.500	o	225	Pipe/Conduit	
F6.009	55.561	2.778	20.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F9.000	5.537	0.092	60.0	0.000	2	0.0	1.500	o	150	Pipe/Conduit	
F9.001	29.780	0.496	60.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F9.002	24.232	0.404	60.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	
F9.003	23.171	0.290	80.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F9.004	10.520	0.175	60.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F6.005	79.211	0.000	0.0	18	0.1	17	0.59	1.39	24.5	0.7
F6.006	78.905	0.000	0.0	18	0.1	17	0.59	1.39	24.5	0.7
F7.000	78.212	0.000	0.0	6	0.0	12	0.33	1.00	17.6	0.2
F7.001	77.749	0.000	0.0	9	0.1	14	0.41	1.13	20.0	0.3
F7.002	77.481	0.000	0.0	11	0.1	19	0.32	0.71	12.6	0.4
F6.007	77.293	0.000	0.0	33	0.2	30	0.38	0.81	32.2	1.2
F6.008	77.179	0.000	0.0	33	0.2	21	0.67	1.82	72.3	1.2
F8.000	77.554	0.000	0.0	20	0.1	24	0.33	0.81	32.2	0.7
F8.001	77.229	0.000	0.0	22	0.1	25	0.34	0.81	32.2	0.8
F8.002	77.172	0.000	0.0	30	0.2	28	0.39	0.85	34.0	1.1
F6.009	76.000	0.000	0.0	63	0.4	24	1.05	2.57	102.3	2.3
F9.000	74.552	0.000	0.0	2	0.0	7	0.25	1.13	20.0	0.1
F9.001	74.460	0.000	0.0	6	0.0	11	0.36	1.13	20.0	0.2
F9.002	73.963	0.000	0.0	9	0.1	14	0.41	1.13	20.0	0.3
F9.003	73.560	0.000	0.0	13	0.1	17	0.42	0.98	17.3	0.5
F9.004	73.270	0.000	0.0	13	0.1	16	0.46	1.13	20.0	0.5

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F6.010	26.163	0.654	40.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F6.011	7.284	0.091	80.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F4.016	22.473	0.112	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F4.017	47.825	0.239	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F4.018	14.502	0.073	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F4.019	38.513	0.193	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F4.020	30.728	0.154	200.0	0.000	10	0.0	1.500	o	225	Pipe/Conduit	
F4.021	28.778	0.144	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F4.022	16.585	0.083	200.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F10.000	52.173	1.043	50.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F10.001	14.671	0.419	35.0	0.000	2	0.0	1.500	o	150	Pipe/Conduit	
F10.002	23.950	0.479	50.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F10.003	20.053	0.401	50.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F10.004	41.870	0.209	200.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F11.000	29.530	1.477	20.0	0.000	203	0.0	1.500	o	225	Pipe/Conduit	
F10.005	31.762	0.318	99.9	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F10.006	40.575	0.902	45.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F6.010	73.020	0.000	0.0	76	0.5	30	0.87	1.82	72.3	2.8
F6.011	72.365	0.000	0.0	76	0.5	36	0.69	1.28	51.1	2.8
F4.016	72.125	0.000	0.0	118	0.7	56	0.57	0.81	32.2	4.4
F4.017	72.013	0.000	0.0	118	0.7	56	0.57	0.81	32.2	4.4
F4.018	71.774	0.000	0.0	118	0.7	56	0.57	0.81	32.2	4.4
F4.019	71.701	0.000	0.0	118	0.7	56	0.57	0.81	32.2	4.4
F4.020	71.509	0.000	0.0	128	0.8	58	0.58	0.81	32.2	4.8
F4.021	71.355	0.000	0.0	130	0.8	59	0.58	0.81	32.2	4.8
F4.022	71.211	0.000	0.0	132	0.8	59	0.58	0.81	32.2	4.9
F10.000	74.100	0.000	0.0	8	0.0	13	0.42	1.24	21.9	0.3
F10.001	73.057	0.000	0.0	10	0.1	13	0.51	1.48	26.2	0.4
F10.002	72.638	0.000	0.0	14	0.1	16	0.50	1.24	21.9	0.5
F10.003	72.159	0.000	0.0	14	0.1	16	0.50	1.24	21.9	0.5
F10.004	71.683	0.000	0.0	20	0.1	24	0.33	0.81	32.2	0.7
F11.000	73.200	0.000	0.0	203	1.3	41	1.50	2.57	102.3	7.5
F10.005	71.473	0.000	0.0	227	1.4	66	0.88	1.15	45.7	8.4
F10.006	71.155	0.000	0.0	229	1.4	54	1.17	1.71	68.1	8.5

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F4.023	21.469	0.537	40.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F4.024	31.724	1.586	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F12.000	12.220	0.489	25.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F12.001	29.145	0.729	40.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F12.002	34.075	0.454	75.0	0.000	12	0.0	1.500	o	225	Pipe/Conduit	
F12.003	13.546	0.068	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F12.004	50.776	0.254	200.0	0.000	15	0.0	1.500	o	225	Pipe/Conduit	
F12.005	38.686	0.193	200.0	0.000	12	0.0	1.500	o	225	Pipe/Conduit	
F12.006	8.229	0.041	200.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	
F4.025	16.307	0.544	30.0	0.000	1	0.0	1.500	o	300	Pipe/Conduit	
F4.026	11.841	0.197	60.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F4.027	7.244	0.220	33.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.023	13.178	0.458	28.8	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.024	14.449	0.458	31.5	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.025	12.098	0.512	23.7	0.000	2	0.0	1.500	o	300	Pipe/Conduit	
F1.026	14.659	0.512	28.6	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.027	37.826	0.189	200.1	0.000	5	0.0	1.500	o	300	Pipe/Conduit	
F1.028	27.102	0.136	200.0	0.000	6	0.0	1.500	o	300	Pipe/Conduit	
F1.029	8.957	0.045	200.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F4.023	70.178	0.000	0.0	361	2.2	60	1.35	2.20	155.3	13.4
F4.024	69.200	0.000	0.0	361	2.2	50	1.72	3.11	219.7	13.4
F12.000	69.391	0.000	0.0	4	0.0	8	0.42	1.76	31.1	0.1
F12.001	68.902	0.000	0.0	12	0.1	14	0.52	1.39	24.5	0.4
F12.002	68.098	0.000	0.0	24	0.1	21	0.49	1.33	52.7	0.9
F12.003	67.644	0.000	0.0	24	0.1	26	0.35	0.81	32.2	0.9
F12.004	67.576	0.000	0.0	39	0.2	33	0.41	0.81	32.2	1.4
F12.005	67.322	0.000	0.0	51	0.3	37	0.44	0.81	32.2	1.9
F12.006	67.129	0.000	0.0	54	0.3	38	0.45	0.81	32.2	2.0
F4.025	67.013	0.000	0.0	416	2.6	59	1.55	2.54	179.3	15.4
F4.026	66.469	0.000	0.0	416	2.6	71	1.22	1.79	126.7	15.4
F4.027	66.272	0.000	0.0	416	2.6	61	1.51	2.42	170.9	15.4
F1.023	65.896	0.000	0.0	530	3.3	66	1.70	2.59	183.1	19.7
F1.024	65.438	0.000	0.0	530	3.3	68	1.64	2.47	174.8	19.7
F1.025	64.980	0.000	0.0	532	3.3	63	1.82	2.86	202.0	19.8
F1.026	64.468	0.000	0.0	532	3.3	66	1.70	2.60	183.5	19.8
F1.027	63.956	0.000	0.0	537	3.3	110	0.85	0.98	69.2	19.9
F1.028	63.767	0.000	0.0	543	3.4	111	0.85	0.98	69.2	20.2
F1.029	63.632	0.000	0.0	543	3.4	111	0.85	0.98	69.2	20.2

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F13.000	33.877	0.678	50.0	0.000	11	0.0	1.500	o	150	Pipe/Conduit	
F13.001	38.858	0.777	50.0	0.000	7	0.0	1.500	o	150	Pipe/Conduit	
F13.002	5.168	0.065	80.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F1.030	49.020	2.228	22.0	0.000	8	0.0	1.500	o	300	Pipe/Conduit	
F1.031	18.623	0.847	22.0	0.000	4	0.0	1.500	o	300	Pipe/Conduit	
F1.032	10.870	0.136	80.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F14.000	52.434	2.497	21.0	0.000	8	0.0	1.500	o	225	Pipe/Conduit	
F14.001	14.139	0.707	20.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F14.002	19.757	0.198	99.8	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F14.003	53.178	0.355	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F14.004	10.588	0.071	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.033	28.838	0.144	200.0	0.000	3	0.0	1.500	o	300	Pipe/Conduit	
F1.034	35.273	0.176	200.0	0.000	3	0.0	1.500	o	300	Pipe/Conduit	
F1.035	33.334	0.392	85.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.036	39.726	1.986	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.037	29.803	1.490	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.038	30.301	1.515	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.039	39.996	2.000	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F13.000	65.560	0.000	0.0	11	0.1	14	0.47	1.24	21.9	0.4
F13.001	64.882	0.000	0.0	18	0.1	18	0.55	1.24	21.9	0.7
F13.002	64.105	0.000	0.0	18	0.1	20	0.46	0.98	17.3	0.7
F1.030	63.587	0.000	0.0	569	3.5	64	1.90	2.96	209.4	21.1
F1.031	61.359	0.000	0.0	573	3.5	64	1.91	2.96	209.4	21.3
F1.032	60.512	0.000	0.0	573	3.5	89	1.20	1.55	109.6	21.3
F14.000	63.450	0.000	0.0	8	0.0	9	0.53	2.51	99.8	0.3
F14.001	60.750	0.000	0.0	10	0.1	10	0.58	2.57	102.3	0.4
F14.002	60.043	0.000	0.0	10	0.1	15	0.34	1.15	45.7	0.4
F14.003	59.845	0.000	0.0	10	0.1	16	0.29	0.94	37.2	0.4
F14.004	59.490	0.000	0.0	10	0.1	16	0.29	0.94	37.2	0.4
F1.033	59.345	0.000	0.0	586	3.6	115	0.87	0.98	69.2	21.8
F1.034	59.201	0.000	0.0	589	3.6	116	0.87	0.98	69.2	21.9
F1.035	59.024	0.000	0.0	589	3.6	92	1.19	1.50	106.4	21.9
F1.036	58.632	0.000	0.0	589	3.6	64	1.99	3.11	219.7	21.9
F1.037	56.000	0.000	0.0	589	3.6	64	1.99	3.11	219.7	21.9
F1.038	54.200	0.000	0.0	589	3.6	64	1.99	3.11	219.7	21.9
F1.039	52.400	0.000	0.0	589	3.6	64	1.99	3.11	219.7	21.9

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.040	69.874	3.494	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.041	59.997	3.000	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.042	19.806	0.861	23.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.043	49.929	2.496	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.044	35.094	1.755	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.045	39.472	0.877	45.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.046	41.092	1.326	31.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.047	79.049	2.080	38.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.048	25.840	0.129	200.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.049	84.423	0.422	200.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.050	86.288	0.431	200.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.051	44.620	0.223	200.1	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.052	66.829	0.334	200.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.053	89.419	0.447	200.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.054	36.561	0.340	107.5	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.055	43.130	0.216	200.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.056	9.687	0.170	57.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.057	88.889	4.444	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.058	56.181	2.554	22.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.059	56.181	2.341	24.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.060	86.717	4.336	20.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.061	49.232	2.141	23.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.040	49.500	0.000	0.0	589	3.6	64	1.99	3.11	219.7	21.9
F1.041	45.300	0.000	0.0	589	3.6	64	1.99	3.11	219.7	21.9
F1.042	42.000	0.000	0.0	589	3.6	66	1.89	2.90	204.8	21.9
F1.043	41.139	0.000	0.0	589	3.6	64	1.99	3.11	219.7	21.9
F1.044	38.643	0.000	0.0	589	3.6	64	1.99	3.11	219.7	21.9
F1.045	36.888	0.000	0.0	589	3.6	78	1.49	2.07	146.3	21.9
F1.046	36.011	0.000	0.0	589	3.6	71	1.70	2.50	176.4	21.9
F1.047	34.686	0.000	0.0	589	3.6	75	1.58	2.25	159.3	21.9
F1.048	32.605	0.000	0.0	589	3.6	116	0.87	0.98	69.2	21.9
F1.049	32.476	0.000	0.0	589	3.6	116	0.87	0.98	69.2	21.9
F1.050	32.054	0.000	0.0	589	3.6	116	0.87	0.98	69.2	21.9
F1.051	31.623	0.000	0.0	589	3.6	116	0.87	0.98	69.2	21.9
F1.052	31.400	0.000	0.0	589	3.6	116	0.87	0.98	69.2	21.9
F1.053	31.065	0.000	0.0	589	3.6	116	0.87	0.98	69.2	21.9
F1.054	30.618	0.000	0.0	589	3.6	98	1.09	1.34	94.5	21.9
F1.055	30.278	0.000	0.0	589	3.6	116	0.87	0.98	69.2	21.9
F1.056	30.063	0.000	0.0	589	3.6	83	1.37	1.84	130.0	21.9
F1.057	29.893	0.000	0.0	589	3.6	64	1.99	3.11	219.7	21.9
F1.058	25.449	0.000	0.0	589	3.6	65	1.93	2.96	209.4	21.9
F1.059	22.895	0.000	0.0	589	3.6	67	1.87	2.84	200.5	21.9
F1.060	19.420	0.000	0.0	589	3.6	64	1.99	3.11	219.7	21.9
F1.061	15.084	0.000	0.0	589	3.6	66	1.89	2.90	204.8	21.9

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.061	FEX_FMH_CHAPEL ROAD	32.350	12.943	12.740	225	0

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