DENIS O'SULLIVAN & ASSOCIATES
CONSULTING ENGINEERS

RESIDENTIAL DEVELOPMENT AT LEHENAGHMORE, CORK

INFRASTRUCTURE REPORT

DATE 16/06/2022

REVISION 2

JOB NO. 6159

Joyce House, Barrack Square, Ballincollig, Co. Cork
T 021 4871781 E info@dosa.ie W www.dosa.ie

DOCUMENT CONTROL

PROJECT NAME: RESIDENTIAL DEVELOPMENT AT LEHENAGHMORE, CORK

PROJECT NUMBER: 6159

REVISION	DATE	FILE NAME: RESIDENTIAL DEVELOPMENT AT LEHENAGHMORE, CORK			
0	18.01.2022	DESCRIPTION: Infrastructure Report			
			PREPARED	CHECKED	APPROVED
		INITIAL	SOD	CO'S	SOD
		DATE	18.01.2022	18.01.2022	18.01.2022
1	07.03.2022	FILE NAME: RESIDENTIAL DEVELOPMENT AT LEHENAGHMORE, CORK			
		DESCRIPTION: Infrastructure Report			
			PREPARED	CHECKED	APPROVED
		INITIAL	SOD	CO'S	SOD
		DATE	07.03.2022	07.03.2022	07.03.2022
2	16.06.2022	FILE NAME: RESIDENTIAL DEVELOPMENT AT LEHENAGHMORE, CORK			
		DESCRIPTION: Infrastructure Report			
			PREPARED	CHECKED	APPROVED
		INITIAL	SOD	SOD	SOD
		DATE	16.06.2022	16.06.2022	16.06.2022
#	Insert Date	FILE NAME:			
		DESCRIPTION: Insert description			
			PREPARED	CHECKED	APPROVED
		INITIAL	Initials	Initials	Initials
		DATE	Insert Date	Insert Date	Insert Date
#	Insert Date	FILE NAME:			
		DESCRIPTION: Insert description			
			PREPARED	CHECKED	APPROVED
		INITIAL	Initials	Initials	Initials
		DATE	Insert Date	Insert Date	Insert Date

Contents

1 *Introduction*

Denis O'Sullivan & Associates have been engaged as Consulting Engineers for the proposed development at Lehenaghmore, Cork.

The proposed development consists of the construction of 45 residential units within the vacant green field site at Lehenaghmore Cork. The overall development consists of 12no. 3 bed semi-detached, 25no. 3 bed townhouses and 8no. 2 bed townhouses.

Access to the site will be from the south west on the existing Togher Road

1.1 Objectives

Denis O'Sullivan & Associates carried out a number of site investigations and their findings have been incorporated to deal with solutions to:

- Surface Water Drainage Network
- Foul Drainage Network
- Water Supply

The foul sewer & water infrastructure associated with the proposed development were discussed with the Mr Brian O Mahony Southern Region department in Irish Water. The Confirmation of Feasibility as issued by Irish Water is included in Appendix A of this Report.

1.2 Site Location & Historical Aerial Photographs

The site is accessed from the south west on the existing Togher Road

The site is located in the townland of Lehenaghmore, Cork and is in close proximity the N27 and Cork Airport. The following Figures 1–3 show the various aerials view back to the year 2000.

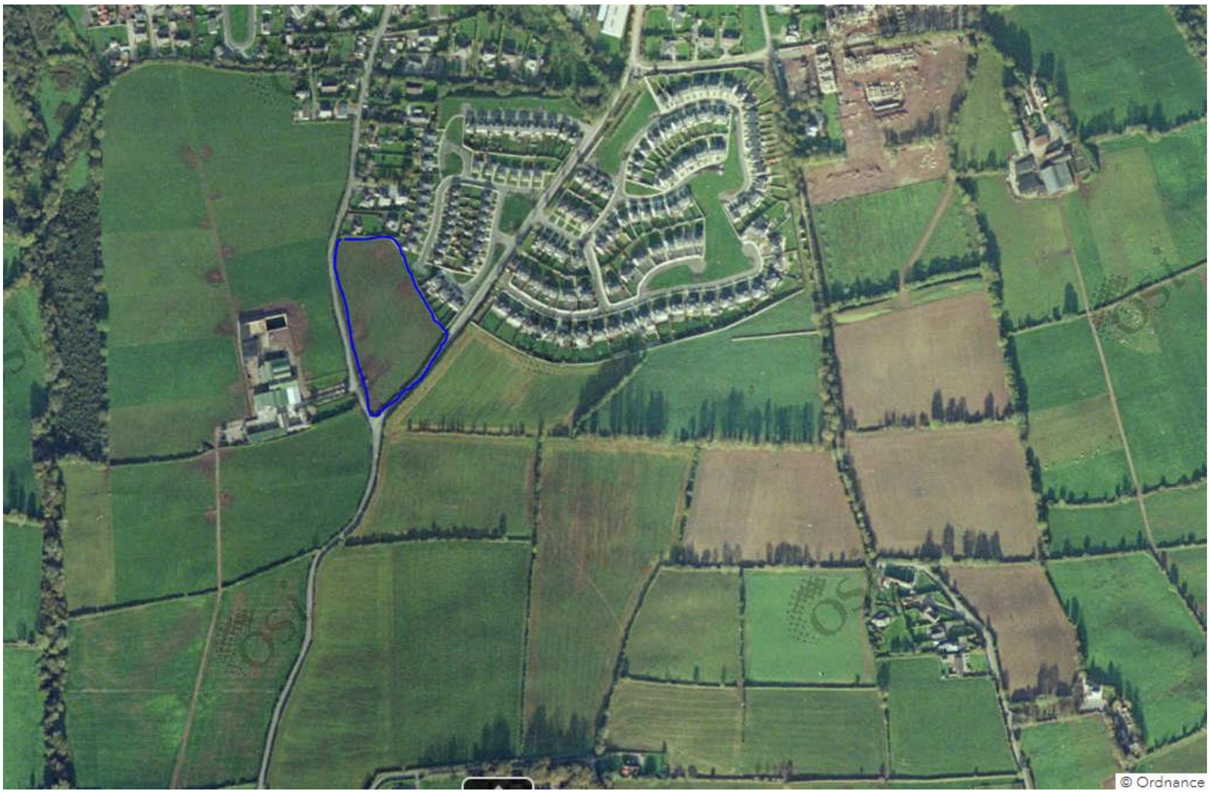


Figure 1 Aerial View 2013-2018

Figure 2 Aerial View 2005

Figure 3 Aerial View 2000

2 *Surface Water Management*

2.1 Surface Water Design

The storm water system for the development will involve a network of underground pipelines and manholes discharging to the storm sewer at the junction of Alderbrook housing development and Togher road via an attenuation system, which will be fitted with flow control devices to ensure no increase in peak flows and an oil interceptor to remove any traces of oil washed off road surfaces.

Surface water discharge rates from the proposed surface water drainage network will be controlled by a vortex flow control device (Hydrobrake or equivalent) and associated attenuation tank. Surface water discharge will also pass via a bypass fuel/oil separator (sized in accordance with permitted discharge from the site).

The proposed surface water drainage network will collect surface water runoff from the site via a piped network prior to discharging off site via the attenuation tank, flow control device and separator arrangement as noted above.

2.2 SuDS Appraisal

Stormwater attenuation and treatment measures utilising Sustainable Drainage Systems (SuDS) in addition to attenuation tanks and hydrocarbon interceptors, shall be incorporated into the proposed storm water system.

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

The applicant has considered the use of all appropriate SUDS devices as part of the site SUDS strategy.

- Underground Attenuation -below the open space area
- Flow control device (e.g. hydrobrake) - installed at the outfall manhole of each catchment
- Petrol Interceptor - installed downstream of each flow control device manhole.

The effectiveness of each SUDS / drainage mechanism proposed is outlined below

2.2.1 Tree Pits

It is also proposed, where possible to fit tree pits along the entrance road to drain and treat surface water runoff from the road network. This will allow for treatment of first flush and low flows., and high flows will discharge into the surface water network during extreme rainfall events. Rain water gullies will still be provided downstream of any tree pit to drain runoff during an extreme rainfall event.

2.2.2 Underground Attenuation

The system attenuates surface water to restrict the outflow to the equivalent of an agricultural runoff. This ensures the development will not give rise to any impact downstream of the site.

2.2.3 Flow Control Device

It is proposed to provide a hydrobrake, or similar approved, at the outfall of the surface water catchment to restrict the outflow of water from the subject site. The hydro-brakes will be fitted with a pull cord bypass and a penstock valve installed on the inlet to the manhole for maintenance purposes.

2.2.4 Petrol Interceptor

It is proposed to provide a petrol interceptor upstream of both attenuation tanks to ensure that any remaining hydro-carbons or pollutants within the runoff from trafficked areas are treated prior to outfall to the existing combined sewer. It is proposed to provide a Conder Bypass Separator Type or similar approved.

In conclusion the water quality from this catchment should be of a high quality due to the above-mentioned measures, which are applied in a treatment train to treat the water before discharge at a restricted rate to the local network.

The above measures ensure a suitable management train is provided.

2.2.5 Management Train

The management train commences with source control by the introduction of the hydrocarbon interceptors, which provide a degree of treatment before discharging to the attenuation system.

The underground attenuation offers a secondary stage of treatment, regional control, by slowing the storm water discharge down, promoting infiltration and removing additional silts which may remain in the storm water.

2.3 Surface Water Drainage Network

The surface water drainage network for the proposed development was modelled using the Microdrainage software application. The surface water pipe lengths, slopes, contributing impermeable areas, upstream invert levels, upstream cover levels and pipe diameters were entered into the model using the drawings supplied. Appendices C & D show the proposed surface water drainage network layout, pipe and manhole numbering.

2.4 Design Criteria

The proposed surface water drains have been designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS), the Department of the Environment's Recommendations for Site Development Works for Housing Areas, the Department of the Environment's Building Regulations "Technical Guidance Document Part H Drainage and Waste Water Disposal" and BS EN 752: 2008 Drain and Sewer Systems Outside Buildings.

- Return period for pipe work design — 2 years
- Return period for attenuation design — 100 years
- Soil Type — 2
- Allowable Outflow — 8.4l/sec
- Time of entry — 5 minutes
- M5 – 60 — 18.80 mm
- Ratio "r" — 0.25
- Pipe Friction (Ks) — 0.6 mm
- Minimum Velocity (based on pipe flowing full) — 1.0 m/s
- Rainfall Runoff from Roads and Footpaths — 100%
- Rainfall Runoff from Roofs — 80%
- Rainfall Runoff from Driveways — 80%
- Rainfall Runoff from Green Areas — 20%
- Rainfall Depth Factored for Climate Change (as per GDSDS) — 20%

(in accordance with GDSDS Volume 2, Chapter 6, Table 6.2 – see below)

Climate Change Category	Characteristics
River flows	20% increase in flows for all return periods up to 100 years
Sea level	400+mm rise (see Climate Change policy document for sea levels as a function of return period)
Rainfall	10% increase in depth (factor all intensities by 1.1)
	Modify time series rainfall in accordance with the GDSDS climate change policy document

Table 6.2 Climate Change Factors to be Applied to Drainage Design

The global variables required for the model were the M5-60 and Rainfall Ratio. These two factors may be read from maps contained in the Wallingford procedure. They enable the program to calculate the intensity, duration and frequency characteristics of storms.

M5-60 is the rainfall depth based on a 60-minute storm of 5 years return period. Ratio R is the ratio of the 60-minute storm to the 2-day storm for the 5-year return period events. These values are as follows:

- M5-60 = 18.80mm
- Ratio R = 0.25

Microdrainage generates design storms using the principles set out in the Flood Studies Report (NERC 1975). A summer rainfall profile was used for the design of the pipework and a winter rainfall profile was used for the design of the storm water attenuation tank to give the critical design. A summer profile gives higher rainfall intensities and results in higher runoff rates and is used to determine the required capacity of the pipework. A winter rainfall profile gives a flatter more sustained profile and results in higher runoff volumes and is used to determine the attenuation/storage requirements.

The surface water drainage network was assessed for compliance with maximum and minimum velocities, pipe length etc. The network was designed to ensure velocities in the network and pipe gradients did not exceed the maximum velocity of 4.5m/s. The minimum velocity allowed was 0.75m/s.

The design of the drainage network was assessed using events with a range of different durations to determine the critical event for each return period analysed as follows:

- 1 in 2-year return period events were used to ensure that the system did not surcharge;
- 1 in 100 year return period events were used to ensure that flooding did not occur.

The layout of the proposed storm water network is shown on the Proposed Stormwater & Foul Sewer Layout Plan Drawing No. 6159-5020.

NOTE: The surcharging indicated in the design sheets is directly upstream of the restricted outlet. For design purposes the tank has been replaced with a pipe and as a result surcharging occurs. This design approach is acceptable and in reality, there will be no surcharging.

2.5 Stormwater Attenuation Strategy

2.5.1 Pre-Development Conditions

The catchment area of this proposed development area within the overall estate is 1.7 hectares (ha). For this development, the permissible outflow is calculated using the estimation method contained in the Institute of Hydrology Report No. 124: Flood estimation for small catchments.

$$QBAR = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$$

QBAR = The Mean Annual Peak Flow (Permissible outflow in m3.sec

AREA = Area of the Catchment (site) in km^2

SAAR = Standard Annual Average Rainfall

SOIL = Soil index

As the development is smaller than 50 ha, the analysis for determining the permissible outflow uses 50 ha in the formula and linearly interpolates the flow rate value based on the ratio of the development to 50 ha. This is a statistical based method within the Microdrainage Software utilizing the Regional Flood Frequency by Catchment Characteristics to give the Index Flood (QBAR)

Design summary sheets for the QBAR value are contained in Appendix A. The Mean Annual Peak Flow (permissible outflow) was calculated for the particular design development areas. The allowable runoff estimation method utilises IH 124 and the Soil Index value taken from the Micrcodrainage Design Package mapping system gives a Soil Index of 0.3.

2.5.2 Post-Development Conditions

The stormwater management plan adopted for this particular development area within the estate involves the use of an attenuation tank located in the green area of the development.

Contributing Area	Permissible Outflow (l/sec)
Catchment Area A	8.4 l/sec
Catchment Area B	8.4l/sec

The flood peak runoff rates from the post-development grassy permeable area (Q_p grass) and the post-development impervious area (Q_p imp.) using the Rational Method (100% impermeability of hard surfaces) are calculated using Windes 10.4. The Sources Control Module of the Microdrainage Software was used to design the attenuation tank capacities. This module also provides the critical storm duration for the attenuation tank during the design process.

It should be noted that climate change has been accounted for in the design. As per volume 5 of the GDSDS a factor of 10% has been incorporated into the design.

2.6 Attenuation Tank

2.6.1 Volume of Attenuation Tank

The capacity of the attenuation tank is designed to cater for the capacity required for a 1 in 100 year ARI event. This capacity is summarised as follows:

Tank No.	Capacity (m^3)	Restricted Outlet (l/sec)
1	500	8.4 l/sec
2	300	8.4l/sec

2.7 Hydrocarbon Treatment

A petrol interceptor is a trap used to filter out hydrocarbon pollutants from rainwater runoff. It is used in construction to prevent fuel contamination of streams carrying away the runoff.

Petrol interceptors work on the premise that some hydrocarbons such as petroleum and diesel float on the top of water. The contaminated water enters the interceptor typically after flowing off roads or hardstanding areas before being deposited into the first tank inside the interceptor.

The first tank builds up a layer of the hydrocarbon as well as other scum. Typically, petrol interceptors have 3 separate tanks each connected with a dip pipe, as more liquid enters the interceptor the water enters into the second tank leaving the majority of the hydrocarbon behind as it cannot enter the dip pipe, whose opening into the second tank is below the surface.

However, some of the contaminants may by chance enter the second tank. This second tank will not build up as much of the hydrocarbon on its surface. As before, the water is pushed into the third tank and more water enters the second.

The third tank should be practically clear of any hydrocarbon floating on its surface. As a precaution, the outlet pipe is also a dip pipe. When the water leaves the third tank via the outlet pipe it should be contaminant free.

For the Catchment Area A, the hard-surfaced area that will be draining to the interceptor between SW.04 & SW.05 is approximately 3312m^2. A Conder CNSB10s/21 interceptor with a catchment capacity of 5,560m^2 will be provided. For the Catchment Area B, the hard-surfaced area that will be draining to the interceptor between SW.012 & SW.013 is approximately 4,650m^2. A Conder CNSB10s/21 interceptor with a catchment capacity of 5,560m^2 will be provided

A summary of the proposed interceptor is as per the table below.

Table 2.4 – Petrol Interceptor Details

Catchment Reference	Petrol Interceptor Make & Model	Oil Storage Capacity (l)
Catchment Area A	1 No. Conder CNSB10s/21	150 litres
Catchment Area B	1 No. Conder CNSB10s/21	150 litres

2.8 Silt Control

The proposed petrol interceptors from Conder Environmental also include a silt storage capacity in addition to the oil storage capacity that allow silt to be collected in the interceptor prior to discharge to the proposed attenuation tanks. This silt build-up can then be removed from the tanks. The amount of silt storage from the proposed petrol interceptor is outlined in Table 2.5 below.

Table 2.5 – Petrol Interceptor Silt Storage Details

Catchment Reference	Petrol Interceptor Make & Model	Silt Storage Capacity (l)
Catchment Area A	1 No. Conder CNSB10s/21	1000 litres
Catchment Area B	1 No. Conder CNSB10s/21	1000 litres

3 *Foul Sewer System*

3.1 Foul Sewer Design

A Pre-Connection Enquiry was submitted to Irish Water. The Irish Water Reference Number for this enquiry is CDS20007706. The response to this Enquiry issued on the 8th January 2021 confirmed that connection to the network was feasible without any infrastructure upgrade. There are Irish Water pipes within and in close proximity of the site boundaries as indicated in Appendix B.

The foul sewer has been designed using the System 1 and Simulation Modules of the Micro-drainage package. The foul network design addresses present day design issues and can view velocities at Full Bore, Proportional Depth and 1/3 flow.

A model of the proposed foul drainage network was built using the micro-drainage software applications. The model was analysed and amended until the results met with the design criteria specified.

The network has been designed to achieve self-cleansing velocities at 1/3 flow whilst maintaining minimum gradients. Design summary sheets are contained in Appendix F.

3.1.1 Development Breakdown

<u>45 No. Units</u>

Section 3.6 of The Irish Water Code of Practice Wastewater Infrastructure states that for the gravity sewers shall be designed to carry a minimum wastewater volume of 6 times the dry weather flow (6DWF) which is to be taken as 446 litres per dwelling

Loading = (45) (446) / (24) (60) (60) = 0.232 litres/second

6DWF = 1.39 litres/second

The layout of the proposed foul sewer network is shown on the Proposed Stormwater & Foul Sewer Layout Plan 6159-5020 & 5021.

The foul waste within the development will be collected via an internal gravity network and will discharge to the existing public foul sewer on Main Street.

All works will be in accordance with Irish Water specifications and requirements.

All works will be in accordance with Irish Water Code of Practice for Wastewater Supply & the Wastewater Infrastructure Standard Details Document Number: IW-CDS-5030-01.

4 *Water Supply*

As with the drainage network, a Pre-Connection Enquiry was submitted to Irish Water under Reference No. CDS20007706. This confirmed that connection to the network was feasible.

It is proposed to provide a 100mm internal diameter HDPE connection to tie into the existing public main located on Togher Road with associated valves and metering requirements. Internally within the development it is proposed to have a series of 100mm Ø branches and loops with associated hydrants, valves and metering requirements.

Water distribution supply to each building will be sized to cater for the requirements of those particular uses. Metered connections will be made to the main in accordance with Irish Water specifications and details.

The layout of the proposed watermain network is shown on the Proposed Watermain Layout Plan 6159-5030.

All works will be in accordance with Irish Water Code of Practice for Water Supply & the Water Infrastructure Standard Details Document Number: IW-CDS-5020-01.

5 Summary of Results

The storm water network was built and analysed using the Microdrainage Software application and were assessed for a 1 in 2-year storm & 1 in 100-year storm. A summary of the results is shown in Tables 5.1 below and in the Microdrainage outputs in the Appendices.

The global variables, pipeline and manhole schedules for both the surface water network and foul network were printed and are included in the Appendices. These show the basic pipe details such as pipe length, diameter, roughness coefficient, upstream invert, velocity, etc.

Table 5.1 Summary of Surcharge and Flooding

Attenuation Tank Reference	Storm Event	Results
Attenuation Tank	1 in 2 year	Surcharge
	1 in 100 year	Surcharge

The surcharging that occurs in the pipes highlighted in the summary of the design sheets are the pipes that have been replaced with tanks and hydrobrakes. For the purposes of design this is acceptable.

No flooding was predicted to occur for the 1 in 100-year return period event. Surcharging and flood risk occurred for a number of critical storm events but this is allowed and does not compromise the network.

Table 5.2 Outlet Control Summary

Attenuation Tank Reference	Hydrobrake Reference	Limiting Discharge (l/s)	Design Head (m)	Hydrobrake Diameter (mm)
Attenuation Tank No. 1	MD4	8.4 l/sec	2	61
Attenuation Tank No. 2	MD4	8.4 l/s	2	120

Table 5.3: Storage Tank Summary

Tank No.	Storage Type	Capacity (m^3)	Invert Level (m)	Maximum Storage Level (m)
Attenuation Tank No. 1	RC Concrete/Proprietary System	500	79.70	81.7
Attenuation Tank No. 2	RC Concrete/Proprietary System	300	72.96	74.96

The foul water network model was built and analysed using the Micro-drainage Software application and was assessed to ensure velocities maintained a self-cleansing velocity. The system will consist of an internal gravity network discharging to the existing Irish Water asset.

Appendix A – Irish Water COF

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

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

www.water.ie

Stephen O' Grady

Joyce House
Barrack Square
Ballincollig
Co. Cork
P31KP84

8 January 2021

Re: CDS20007706 pre-connection enquiry - Subject to contract | Contract denied

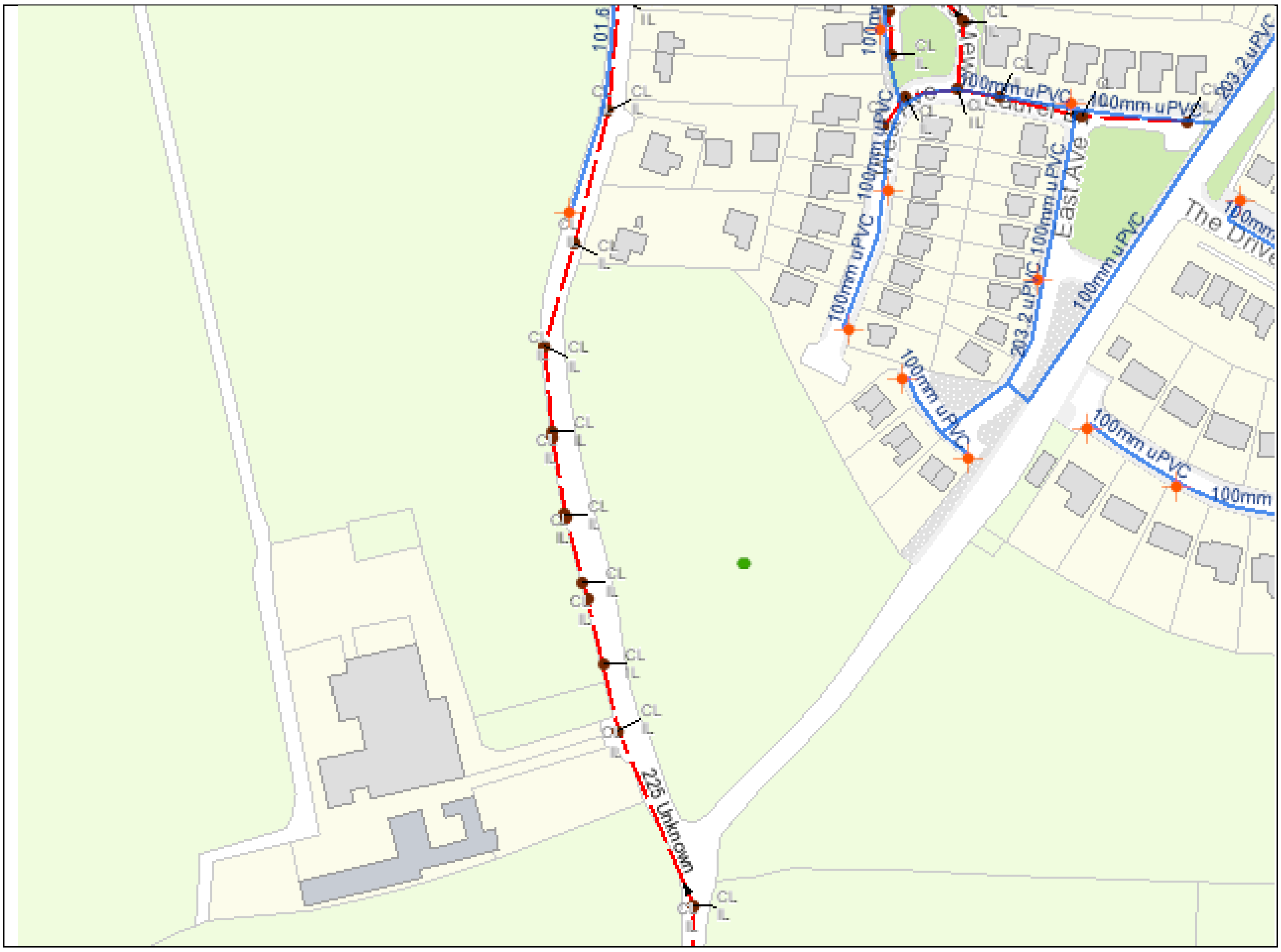
Connection for Housing Development of 50 unit(s) at Lehenaghmore, Togher, Co. Cork

Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Lehenaghmore, Togher, Co. Cork (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 without infrastructure upgrade by Irish Water
Wastewater Connection	Feasible without infrastructure upgrade by Irish Water
SITE SPECIFIC COMMENTS	
Water Connection	Connection can be made to the water main on the Togher Road approximately 20m to the North of the site. The extension of the existing network will be carried out by Irish Water at the time of connection and the cost associated with this will be included in your connection offer.
Wastewater Connection	Connection can be made to the sewer on the Togher road.
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 Brian O'Mahony from the design team on 022 52205 or email bomahony@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,

Yvonne Harris

Yvonne Harris

Head of Customer Operations

Appendix B – Allowable Runoff QBAR Values

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.790	Urban	0.000
SAAR (mm)	1149	Region Number	Ireland South

Results	**l/s**
QBAR Rural	8.4
QBAR Urban	8.4
Q100 years	15.5
Q1 year	7.1
Q2 years	8.1
Q5 years	10.0
Q10 years	11.3
Q20 years	12.6
Q25 years	13.0
Q30 years	13.4
Q50 years	14.3
Q100 years	15.5
Q200 years	16.7
Q250 years	n/a
Q1000 years	n/a

WARNING: Irish growth curves are not defined above 200 years.

Warning: It is unusual to use the IH124 method with an area < 50ha. The Interim Code of Practice recommends that the IH124 method is applied with 50ha and the resulting discharge is linearly interpolated for the required area. The ICP SUDS tab will do this automatically.

Appendix C – 1 in 2 Year Design Sheets

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)	100	Add Flow / Climate Change (%)	10
M5-60 (mm)	18.800	Minimum Backdrop Height (m)	0.200
Ratio R	0.250	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.083	4-8	0.556	8-12	0.119

Total Area Contributing (ha) = 0.758

Total Pipe Volume (m³) = 38.774

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	43.100	1.995	21.6	0.114	5.00	0.0	0.600	o	225
S1.001	22.500	1.125	20.0	0.015	0.00	0.0	0.600	o	225
S1.002	49.000	0.490	100.0	0.134	0.00	5.0	0.600	o	300
S1.003	18.000	0.108	166.7	0.000	0.00	0.0	0.600	o	300
S1.004	25.000	0.036	694.4	0.000	0.00	0.0	0.600	o	225
S1.005	15.500	0.103	150.5	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.25	87.000	0.114	0.0	0.0	1.5	2.83	112.4	17.0
S1.001	50.00	5.38	85.005	0.129	0.0	0.0	1.7	2.94	116.9	19.2
S1.002	50.00	5.52	81.300	0.000	8.4	0.0	0.8	1.57	111.1	8.4
S1.003	50.00	5.77	80.810	0.000	8.4	0.0	0.8	1.22	85.9	9.2
S1.004	50.00	5.85	80.702	0.000	8.4	0.0	0.8	0.49	19.4	8.4
S1.005	50.00	6.10	79.700	0.000	8.4	0.0	0.8	1.06	42.3	9.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.006	7.000	0.108	64.8	0.061	0.00	0.0	0.600	o	225
S2.000	12.100	1.210	10.0	0.065	5.00	0.0	0.600	o	225
S2.001	47.700	3.457	13.8	0.000	0.00	0.0	0.600	o	225
S2.002	56.400	0.376	150.0	0.129	0.00	0.0	0.600	o	225
S1.007	27.600	1.004	27.5	0.017	0.00	0.0	0.600	o	225
S1.008	33.600	1.179	28.5	0.039	0.00	0.0	0.600	o	225
S1.009	30.700	1.800	17.1	0.043	0.00	0.0	0.600	o	225
S1.010	30.700	0.146	210.3	0.089	0.00	0.0	0.600	o	375
S3.000	12.000	0.205	58.5	0.000	5.00	0.0	0.600	o	225
S3.001	36.700	1.707	21.5	0.052	0.00	0.0	0.600	o	225
S3.002	26.500	0.132	200.0	0.000	0.00	0.0	0.600	o	225
S1.011	6.300	0.038	165.8	0.000	0.00	0.0	0.600	o	375
S1.012	17.000	1.822	9.3	0.000	0.00	0.0	0.600	o	225
S1.013	8.100	0.270	30.0	0.000	0.00	0.0	0.600	o	225
S1.014	57.400	5.230	11.0	0.000	0.00	0.0	0.600	o	225
S1.015	23.400	0.140	167.1	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.006	50.00	6.17	79.597	0.061	8.4	0.0	1.7	1.63	64.7	18.3
S2.000	50.00	5.05	86.510	0.065	0.0	0.0	0.9	4.16	165.5	9.7
S2.001	50.00	5.27	84.260	0.065	0.0	0.0	0.9	3.54	140.8	9.7
S2.002	50.00	6.16	80.803	0.194	0.0	0.0	2.6	1.07	42.4	28.9
S1.007	50.00	6.35	79.489	0.272	8.4	0.0	4.5	2.51	99.6	49.8
S1.008	50.00	6.58	78.485	0.311	8.4	0.0	5.1	2.46	97.8	55.6
S1.009	50.00	6.74	77.306	0.354	8.4	0.0	5.6	3.18	126.6	62.0
S1.010	50.00	7.15	75.506	0.443	8.4	0.0	6.8	1.25	137.6	75.2
S3.000	50.00	5.12	80.200	0.000	0.0	0.0	0.0	1.71	68.1	0.0
S3.001	50.00	5.33	77.200	0.052	0.0	0.0	0.7	2.83	112.7	7.7
S3.002	50.00	5.81	75.493	0.052	0.0	0.0	0.7	0.92	36.6	7.7
S1.011	50.00	7.22	75.000	0.495	8.4	0.0	7.5	1.40	155.1	83.0
S1.012	50.00	5.07	74.962	0.000	8.4	0.0	0.8	4.31	171.3	8.4
S1.013	50.00	5.12	72.960	0.000	8.4	0.0	0.8	2.40	95.3	9.2
S1.014	50.00	5.36	72.690	0.000	8.4	0.0	0.8	3.97	157.9	9.2
S1.015	50.00	5.75	67.460	0.000	8.4	0.0	0.8	1.01	40.1	9.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.016	80.000	6.650	12.0	0.000	0.00	0.0	0.600	o	225
S1.017	80.000	5.000	16.0	0.000	0.00	0.0	0.600	o	225
S1.018	90.000	3.333	27.0	0.000	0.00	0.0	0.600	o	225
S1.019	1.000	0.002	401.8	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.016	50.00	6.10	66.650	0.000	8.4	0.0	0.8	3.79	150.8	9.2
S1.017	50.00	6.51	60.000	0.000	8.4	0.0	0.8	3.29	130.7	9.2
S1.018	50.00	7.10	55.000	0.000	8.4	0.0	0.8	2.53	100.5	9.2
S1.019	50.00	7.13	51.667	0.000	8.4	0.0	0.8	0.65	25.7	9.2

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
SSS01	88.500	1.500	1050	S1.000	87.000	225				
SSS02	86.500	1.495	1050	S1.001	85.005	225	S1.000	85.005	225	
SSS03	85.500	4.200	1200	S1.002	81.300	300	S1.001	83.880	225	2505
SSS04	83.000	2.190	1200	S1.003	80.810	300	S1.002	80.810	300	
SSS05	84.700	3.998	1200	S1.004	80.702	225	S1.003	80.702	300	
SSS06	84.400	4.700	1200	S1.005	79.700	225	S1.004	80.666	225	966
SSS07	82.400	2.803	1200	S1.006	79.597	225	S1.005	79.597	225	
SSS17	88.010	1.500	1050	S2.000	86.510	225				
SSS18	87.890	3.630	1200	S2.001	84.260	225	S2.000	85.300	225	1040
SSS19	82.300	1.497	1050	S2.002	80.803	225	S2.001	80.803	225	
SSS08	82.000	2.511	1200	S1.007	79.489	225	S1.006	79.489	225	
							S2.002	80.427	225	938
SSS09	80.000	1.515	1050	S1.008	78.485	225	S1.007	78.485	225	
SSS10	78.800	1.494	1050	S1.009	77.306	225	S1.008	77.306	225	
SSS11	77.000	1.494	1350	S1.010	75.506	375	S1.009	75.506	225	
SSS14	81.700	1.500	1050	S3.000	80.200	225				
SSS15	81.200	4.000	1200	S3.001	77.200	225	S3.000	79.995	225	2795
SSS15A	77.000	1.507	1050	S3.002	75.493	225	S3.001	75.493	225	
SSS12	77.000	2.000	1350	S1.011	75.000	375	S1.010	75.360	375	360
							S3.002	75.361	225	211
SSS013	77.100	2.138	1350	S1.012	74.962	225	S1.011	74.962	375	
SSS16	77.100	4.140	1200	S1.013	72.960	225	S1.012	73.140	225	180
SSS17	74.800	2.110	1200	S1.014	72.690	225	S1.013	72.690	225	
SSS018	70.000	2.540	1200	S1.015	67.460	225	S1.014	67.460	225	
SSS19	68.450	1.800	1200	S1.016	66.650	225	S1.015	67.320	225	670
SSS20	61.800	1.800	1200	S1.017	60.000	225	S1.016	60.000	225	
SSS21	56.900	1.900	1200	S1.018	55.000	225	S1.017	55.000	225	
SEx Sewer	53.125	1.458	1050	S1.019	51.667	225	S1.018	51.667	225	
S	53.126	1.462	300		OUTFALL		S1.019	51.664	225	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	o	225	SSS01	88.500	87.000	1.275	1050
S1.001	o	225	SSS02	86.500	85.005	1.270	1050
S1.002	o	300	SSS03	85.500	81.300	3.900	1200
S1.003	o	300	SSS04	83.000	80.810	1.890	1200
S1.004	o	225	SSS05	84.700	80.702	3.773	1200
S1.005	o	225	SSS06	84.400	79.700	4.475	1200
S1.006	o	225	SSS07	82.400	79.597	2.578	1200
S2.000	o	225	SSS17	88.010	86.510	1.275	1050
S2.001	o	225	SSS18	87.890	84.260	3.405	1200
S2.002	o	225	SSS19	82.300	80.803	1.272	1050
S1.007	o	225	SSS08	82.000	79.489	2.286	1200
S1.008	o	225	SSS09	80.000	78.485	1.290	1050
S1.009	o	225	SSS10	78.800	77.306	1.269	1050
S1.010	o	375	SSS11	77.000	75.506	1.119	1350
S3.000	o	225	SSS14	81.700	80.200	1.275	1050
S3.001	o	225	SSS15	81.200	77.200	3.775	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	43.100	21.6	SSS02	86.500	85.005	1.270	1050
S1.001	22.500	20.0	SSS03	85.500	83.880	1.395	1200
S1.002	49.000	100.0	SSS04	83.000	80.810	1.890	1200
S1.003	18.000	166.7	SSS05	84.700	80.702	3.698	1200
S1.004	25.000	694.4	SSS06	84.400	80.666	3.509	1200
S1.005	15.500	150.5	SSS07	82.400	79.597	2.578	1200
S1.006	7.000	64.8	SSS08	82.000	79.489	2.286	1200
S2.000	12.100	10.0	SSS18	87.890	85.300	2.365	1200
S2.001	47.700	13.8	SSS19	82.300	80.803	1.272	1050
S2.002	56.400	150.0	SSS08	82.000	80.427	1.348	1200
S1.007	27.600	27.5	SSS09	80.000	78.485	1.290	1050
S1.008	33.600	28.5	SSS10	78.800	77.306	1.269	1050
S1.009	30.700	17.1	SSS11	77.000	75.506	1.269	1350
S1.010	30.700	210.3	SSS12	77.000	75.360	1.265	1350
S3.000	12.000	58.5	SSS15	81.200	79.995	0.980	1200
S3.001	36.700	21.5	SSS15A	77.000	75.493	1.282	1050

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S3.002	o	225	SSS15A	77.000	75.493	1.282	1050
S1.011	o	375	SSS12	77.000	75.000	1.625	1350
S1.012	o	225	SSS013	77.100	74.962	1.913	1350
S1.013	o	225	SSS16	77.100	72.960	3.915	1200
S1.014	o	225	SSS17	74.800	72.690	1.885	1200
S1.015	o	225	SSS018	70.000	67.460	2.315	1200
S1.016	o	225	SSS19	68.450	66.650	1.575	1200
S1.017	o	225	SSS20	61.800	60.000	1.575	1200
S1.018	o	225	SSS21	56.900	55.000	1.675	1200
S1.019	o	225	SEx Sewer	53.125	51.667	1.233	1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S3.002	26.500	200.0	SSS12	77.000	75.361	1.414	1350
S1.011	6.300	165.8	SSS013	77.100	74.962	1.763	1350
S1.012	17.000	9.3	SSS16	77.100	73.140	3.735	1200
S1.013	8.100	30.0	SSS17	74.800	72.690	1.885	1200
S1.014	57.400	11.0	SSS018	70.000	67.460	2.315	1200
S1.015	23.400	167.1	SSS19	68.450	67.320	0.905	1200
S1.016	80.000	12.0	SSS20	61.800	60.000	1.575	1200
S1.017	80.000	16.0	SSS21	56.900	55.000	1.675	1200
S1.018	90.000	27.0	SEx Sewer	53.125	51.667	1.233	1050
S1.019	1.000	401.8	S	53.126	51.664	1.237	300

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)
S1.019	S	53.126	51.664	51.625	300	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Foul Sewage per hectare (l/s)	0.000
PIMP (% impervious)	100	Additional Flow - % of Total Flow	10.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.250		

Online Controls for Storm

Hydro-Brake® Manhole: SSS05, DS/PN: S1.004, Volume (m³): 5.7

Design Head (m) 2.000 Hydro-Brake® Type Md4 Invert Level (m) 80.702
Design Flow (l/s) 8.4 Diameter (mm) 88

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.7	1.200	6.6	3.000	10.5	7.000	16.0
0.200	4.5	1.400	7.1	3.500	11.3	7.500	16.5
0.300	3.8	1.600	7.6	4.000	12.1	8.000	17.1
0.400	3.9	1.800	8.1	4.500	12.8	8.500	17.6
0.500	4.3	2.000	8.5	5.000	13.5	9.000	18.1
0.600	4.7	2.200	9.0	5.500	14.2	9.500	18.6
0.800	5.4	2.400	9.3	6.000	14.8		
1.000	6.0	2.600	9.7	6.500	15.4		

Hydro-Brake® Manhole: SSS013, DS/PN: S1.012, Volume (m³): 3.6

Design Head (m) 2.000 Hydro-Brake® Type Md4 Invert Level (m) 74.962
Design Flow (l/s) 8.4 Diameter (mm) 88

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.7	1.200	6.6	3.000	10.5	7.000	16.0
0.200	4.5	1.400	7.1	3.500	11.3	7.500	16.5
0.300	3.8	1.600	7.6	4.000	12.1	8.000	17.1
0.400	3.9	1.800	8.1	4.500	12.8	8.500	17.6
0.500	4.3	2.000	8.5	5.000	13.5	9.000	18.1
0.600	4.7	2.200	9.0	5.500	14.2	9.500	18.6
0.800	5.4	2.400	9.3	6.000	14.8		
1.000	6.0	2.600	9.7	6.500	15.4		

Storage Structures for Storm

Cellular Storage Manhole: SSS05, DS/PN: S1.004

Invert Level (m) 79.900 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	250.0	0.0	2.000	250.0	0.0

Cellular Storage Manhole: SSS013, DS/PN: S1.012

Invert Level (m) 72.960 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	160.0	0.0	2.000	160.0	0.0

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

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2
Climate Change (%) 0

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
S1.000	15 Winter	2	0%					
S1.001	15 Winter	2	0%					
S1.002	1440 Winter	2	0%					
S1.003	1440 Winter	2	0%	2/960 Summer				
S1.004	1440 Winter	2	0%	2/480 Summer				
S1.005	1440 Winter	2	0%					
S1.006	15 Winter	2	0%					
S2.000	15 Winter	2	0%					
S2.001	15 Winter	2	0%					
S2.002	15 Winter	2	0%					
S1.007	15 Winter	2	0%					
S1.008	15 Winter	2	0%					
S1.009	15 Winter	2	0%					
S1.010	15 Winter	2	0%					
S3.000	60 Winter	2	0%					
S3.001	15 Winter	2	0%					
S3.002	1440 Winter	2	0%					
S1.011	1440 Winter	2	0%	2/1440 Summer				
S1.012	1440 Winter	2	0%	2/960 Winter				
S1.013	1440 Winter	2	0%					
S1.014	1440 Winter	2	0%					
S1.015	1440 Winter	2	0%					
S1.016	1440 Winter	2	0%					
S1.017	1440 Winter	2	0%					
S1.018	1440 Winter	2	0%					
S1.019	1440 Winter	2	0%					

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
S1.000	SSS01	87.064	-0.161	0.000	0.18	0.0	18.8	OK
S1.001	SSS02	85.073	-0.157	0.000	0.19	0.0	20.7	OK
S1.002	SSS03	81.510	-0.090	0.000	0.09	0.0	9.3	OK
S1.003	SSS04	81.502	0.392	0.000	0.12	0.0	9.2	SURCHARGED
S1.004	SSS05	81.497	0.570	0.000	0.35	0.0	5.4	SURCHARGED
S1.005	SSS06	79.757	-0.168	0.000	0.14	0.0	5.4	OK
S1.006	SSS07	79.663	-0.159	0.000	0.18	0.0	8.5	OK
S2.000	SSS17	86.551	-0.184	0.000	0.08	0.0	10.7	OK
S2.001	SSS18	84.302	-0.183	0.000	0.08	0.0	10.6	OK
S2.002	SSS19	80.944	-0.084	0.000	0.71	0.0	28.8	OK
S1.007	SSS08	79.592	-0.122	0.000	0.43	0.0	39.4	OK
S1.008	SSS09	78.596	-0.114	0.000	0.48	0.0	44.5	OK
S1.009	SSS10	77.409	-0.122	0.000	0.42	0.0	50.1	OK
S1.010	SSS11	75.697	-0.184	0.000	0.51	0.0	62.2	OK
S3.000	SSS14	80.200	-0.225	0.000	0.00	0.0	0.0	OK
S3.001	SSS15	77.239	-0.186	0.000	0.07	0.0	7.3	OK
S3.002	SSS15A	75.684	-0.034	0.000	0.02	0.0	0.8	OK
S1.011	SSS12	75.684	0.309	0.000	0.11	0.0	11.2	SURCHARGED
S1.012	SSS013	75.683	0.496	0.000	0.03	0.0	5.1	SURCHARGED
S1.013	SSS16	72.999	-0.186	0.000	0.07	0.0	5.1	OK
S1.014	SSS17	72.717	-0.198	0.000	0.03	0.0	5.1	OK
S1.015	SSS018	67.516	-0.169	0.000	0.14	0.0	5.1	OK
S1.016	SSS19	66.677	-0.198	0.000	0.03	0.0	5.1	OK
S1.017	SSS20	60.029	-0.196	0.000	0.04	0.0	5.1	OK
S1.018	SSS21	55.033	-0.192	0.000	0.05	0.0	5.1	OK
S1.019	SEx Sewer	51.729	-0.163	0.000	0.17	0.0	5.1	OK

Appendix D – 1 in 100 Year Design Sheets

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)	100	Add Flow / Climate Change (%)	10
M5-60 (mm)	18.800	Minimum Backdrop Height (m)	0.200
Ratio R	0.250	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.083	4-8	0.556	8-12	0.119

Total Area Contributing (ha) = 0.758

Total Pipe Volume (m³) = 38.774

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	43.100	1.995	21.6	0.114	5.00	0.0	0.600	o	225
S1.001	22.500	1.125	20.0	0.015	0.00	0.0	0.600	o	225
S1.002	49.000	0.490	100.0	0.134	0.00	5.0	0.600	o	300
S1.003	18.000	0.108	166.7	0.000	0.00	0.0	0.600	o	300
S1.004	25.000	0.036	694.4	0.000	0.00	0.0	0.600	o	225
S1.005	15.500	0.103	150.5	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.25	87.000	0.114	0.0	0.0	1.5	2.83	112.4	17.0
S1.001	50.00	5.38	85.005	0.129	0.0	0.0	1.7	2.94	116.9	19.2
S1.002	50.00	5.52	81.300	0.000	8.4	0.0	0.8	1.57	111.1	8.4
S1.003	50.00	5.77	80.810	0.000	8.4	0.0	0.8	1.22	85.9	9.2
S1.004	50.00	5.85	80.702	0.000	8.4	0.0	0.8	0.49	19.4	8.4
S1.005	50.00	6.10	79.700	0.000	8.4	0.0	0.8	1.06	42.3	9.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.006	7.000	0.108	64.8	0.061	0.00	0.0	0.600	o	225
S2.000	12.100	1.210	10.0	0.065	5.00	0.0	0.600	o	225
S2.001	47.700	3.457	13.8	0.000	0.00	0.0	0.600	o	225
S2.002	56.400	0.376	150.0	0.129	0.00	0.0	0.600	o	225
S1.007	27.600	1.004	27.5	0.017	0.00	0.0	0.600	o	225
S1.008	33.600	1.179	28.5	0.039	0.00	0.0	0.600	o	225
S1.009	30.700	1.800	17.1	0.043	0.00	0.0	0.600	o	225
S1.010	30.700	0.146	210.3	0.089	0.00	0.0	0.600	o	375
S3.000	12.000	0.205	58.5	0.000	5.00	0.0	0.600	o	225
S3.001	36.700	1.707	21.5	0.052	0.00	0.0	0.600	o	225
S3.002	26.500	0.132	200.0	0.000	0.00	0.0	0.600	o	225
S1.011	6.300	0.038	165.8	0.000	0.00	0.0	0.600	o	375
S1.012	17.000	1.822	9.3	0.000	0.00	0.0	0.600	o	225
S1.013	8.100	0.270	30.0	0.000	0.00	0.0	0.600	o	225
S1.014	57.400	5.230	11.0	0.000	0.00	0.0	0.600	o	225
S1.015	23.400	0.140	167.1	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.006	50.00	6.17	79.597	0.061	8.4	0.0	1.7	1.63	64.7	18.3
S2.000	50.00	5.05	86.510	0.065	0.0	0.0	0.9	4.16	165.5	9.7
S2.001	50.00	5.27	84.260	0.065	0.0	0.0	0.9	3.54	140.8	9.7
S2.002	50.00	6.16	80.803	0.194	0.0	0.0	2.6	1.07	42.4	28.9
S1.007	50.00	6.35	79.489	0.272	8.4	0.0	4.5	2.51	99.6	49.8
S1.008	50.00	6.58	78.485	0.311	8.4	0.0	5.1	2.46	97.8	55.6
S1.009	50.00	6.74	77.306	0.354	8.4	0.0	5.6	3.18	126.6	62.0
S1.010	50.00	7.15	75.506	0.443	8.4	0.0	6.8	1.25	137.6	75.2
S3.000	50.00	5.12	80.200	0.000	0.0	0.0	0.0	1.71	68.1	0.0
S3.001	50.00	5.33	77.200	0.052	0.0	0.0	0.7	2.83	112.7	7.7
S3.002	50.00	5.81	75.493	0.052	0.0	0.0	0.7	0.92	36.6	7.7
S1.011	50.00	7.22	75.000	0.495	8.4	0.0	7.5	1.40	155.1	83.0
S1.012	50.00	5.07	74.962	0.000	8.4	0.0	0.8	4.31	171.3	8.4
S1.013	50.00	5.12	72.960	0.000	8.4	0.0	0.8	2.40	95.3	9.2
S1.014	50.00	5.36	72.690	0.000	8.4	0.0	0.8	3.97	157.9	9.2
S1.015	50.00	5.75	67.460	0.000	8.4	0.0	0.8	1.01	40.1	9.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.016	80.000	6.650	12.0	0.000	0.00	0.0	0.600	o	225
S1.017	80.000	5.000	16.0	0.000	0.00	0.0	0.600	o	225
S1.018	90.000	3.333	27.0	0.000	0.00	0.0	0.600	o	225
S1.019	1.000	0.002	401.8	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.016	50.00	6.10	66.650	0.000	8.4	0.0	0.8	3.79	150.8	9.2
S1.017	50.00	6.51	60.000	0.000	8.4	0.0	0.8	3.29	130.7	9.2
S1.018	50.00	7.10	55.000	0.000	8.4	0.0	0.8	2.53	100.5	9.2
S1.019	50.00	7.13	51.667	0.000	8.4	0.0	0.8	0.65	25.7	9.2

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
SSS01	88.500	1.500	1050	S1.000	87.000	225				
SSS02	86.500	1.495	1050	S1.001	85.005	225	S1.000	85.005	225	
SSS03	85.500	4.200	1200	S1.002	81.300	300	S1.001	83.880	225	2505
SSS04	83.000	2.190	1200	S1.003	80.810	300	S1.002	80.810	300	
SSS05	84.700	3.998	1200	S1.004	80.702	225	S1.003	80.702	300	
SSS06	84.400	4.700	1200	S1.005	79.700	225	S1.004	80.666	225	966
SSS07	82.400	2.803	1200	S1.006	79.597	225	S1.005	79.597	225	
SSS17	88.010	1.500	1050	S2.000	86.510	225				
SSS18	87.890	3.630	1200	S2.001	84.260	225	S2.000	85.300	225	1040
SSS19	82.300	1.497	1050	S2.002	80.803	225	S2.001	80.803	225	
SSS08	82.000	2.511	1200	S1.007	79.489	225	S1.006	79.489	225	
							S2.002	80.427	225	938
SSS09	80.000	1.515	1050	S1.008	78.485	225	S1.007	78.485	225	
SSS10	78.800	1.494	1050	S1.009	77.306	225	S1.008	77.306	225	
SSS11	77.000	1.494	1350	S1.010	75.506	375	S1.009	75.506	225	
SSS14	81.700	1.500	1050	S3.000	80.200	225				
SSS15	81.200	4.000	1200	S3.001	77.200	225	S3.000	79.995	225	2795
SSS15A	77.000	1.507	1050	S3.002	75.493	225	S3.001	75.493	225	
SSS12	77.000	2.000	1350	S1.011	75.000	375	S1.010	75.360	375	360
							S3.002	75.361	225	211
SSS013	77.100	2.138	1350	S1.012	74.962	225	S1.011	74.962	375	
SSS16	77.100	4.140	1200	S1.013	72.960	225	S1.012	73.140	225	180
SSS17	74.800	2.110	1200	S1.014	72.690	225	S1.013	72.690	225	
SSS018	70.000	2.540	1200	S1.015	67.460	225	S1.014	67.460	225	
SSS19	68.450	1.800	1200	S1.016	66.650	225	S1.015	67.320	225	670
SSS20	61.800	1.800	1200	S1.017	60.000	225	S1.016	60.000	225	
SSS21	56.900	1.900	1200	S1.018	55.000	225	S1.017	55.000	225	
SEx Sewer	53.125	1.458	1050	S1.019	51.667	225	S1.018	51.667	225	
S	53.126	1.462	300		OUTFALL		S1.019	51.664	225	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	o	225	SSS01	88.500	87.000	1.275	1050
S1.001	o	225	SSS02	86.500	85.005	1.270	1050
S1.002	o	300	SSS03	85.500	81.300	3.900	1200
S1.003	o	300	SSS04	83.000	80.810	1.890	1200
S1.004	o	225	SSS05	84.700	80.702	3.773	1200
S1.005	o	225	SSS06	84.400	79.700	4.475	1200
S1.006	o	225	SSS07	82.400	79.597	2.578	1200
S2.000	o	225	SSS17	88.010	86.510	1.275	1050
S2.001	o	225	SSS18	87.890	84.260	3.405	1200
S2.002	o	225	SSS19	82.300	80.803	1.272	1050
S1.007	o	225	SSS08	82.000	79.489	2.286	1200
S1.008	o	225	SSS09	80.000	78.485	1.290	1050
S1.009	o	225	SSS10	78.800	77.306	1.269	1050
S1.010	o	375	SSS11	77.000	75.506	1.119	1350
S3.000	o	225	SSS14	81.700	80.200	1.275	1050
S3.001	o	225	SSS15	81.200	77.200	3.775	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	43.100	21.6	SSS02	86.500	85.005	1.270	1050
S1.001	22.500	20.0	SSS03	85.500	83.880	1.395	1200
S1.002	49.000	100.0	SSS04	83.000	80.810	1.890	1200
S1.003	18.000	166.7	SSS05	84.700	80.702	3.698	1200
S1.004	25.000	694.4	SSS06	84.400	80.666	3.509	1200
S1.005	15.500	150.5	SSS07	82.400	79.597	2.578	1200
S1.006	7.000	64.8	SSS08	82.000	79.489	2.286	1200
S2.000	12.100	10.0	SSS18	87.890	85.300	2.365	1200
S2.001	47.700	13.8	SSS19	82.300	80.803	1.272	1050
S2.002	56.400	150.0	SSS08	82.000	80.427	1.348	1200
S1.007	27.600	27.5	SSS09	80.000	78.485	1.290	1050
S1.008	33.600	28.5	SSS10	78.800	77.306	1.269	1050
S1.009	30.700	17.1	SSS11	77.000	75.506	1.269	1350
S1.010	30.700	210.3	SSS12	77.000	75.360	1.265	1350
S3.000	12.000	58.5	SSS15	81.200	79.995	0.980	1200
S3.001	36.700	21.5	SSS15A	77.000	75.493	1.282	1050

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S3.002	o	225	SSS15A	77.000	75.493	1.282	1050
S1.011	o	375	SSS12	77.000	75.000	1.625	1350
S1.012	o	225	SSS013	77.100	74.962	1.913	1350
S1.013	o	225	SSS16	77.100	72.960	3.915	1200
S1.014	o	225	SSS17	74.800	72.690	1.885	1200
S1.015	o	225	SSS018	70.000	67.460	2.315	1200
S1.016	o	225	SSS19	68.450	66.650	1.575	1200
S1.017	o	225	SSS20	61.800	60.000	1.575	1200
S1.018	o	225	SSS21	56.900	55.000	1.675	1200
S1.019	o	225	SEx Sewer	53.125	51.667	1.233	1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S3.002	26.500	200.0	SSS12	77.000	75.361	1.414	1350
S1.011	6.300	165.8	SSS013	77.100	74.962	1.763	1350
S1.012	17.000	9.3	SSS16	77.100	73.140	3.735	1200
S1.013	8.100	30.0	SSS17	74.800	72.690	1.885	1200
S1.014	57.400	11.0	SSS018	70.000	67.460	2.315	1200
S1.015	23.400	167.1	SSS19	68.450	67.320	0.905	1200
S1.016	80.000	12.0	SSS20	61.800	60.000	1.575	1200
S1.017	80.000	16.0	SSS21	56.900	55.000	1.675	1200
S1.018	90.000	27.0	SEx Sewer	53.125	51.667	1.233	1050
S1.019	1.000	401.8	S	53.126	51.664	1.237	300

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)
S1.019	S	53.126	51.664	51.625	300	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Foul Sewage per hectare (l/s)	0.000
PIMP (% impervious)	100	Additional Flow - % of Total Flow	10.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.250		

Online Controls for Storm

Hydro-Brake® Manhole: SSS05, DS/PN: S1.004, Volume (m³): 5.7

Design Head (m) 2.000 Hydro-Brake® Type Md4 Invert Level (m) 80.702
Design Flow (l/s) 8.4 Diameter (mm) 88

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	2.7	1.200	6.6	3.000	10.5	7.000	16.0
0.200	4.5	1.400	7.1	3.500	11.3	7.500	16.5
0.300	3.8	1.600	7.6	4.000	12.1	8.000	17.1
0.400	3.9	1.800	8.1	4.500	12.8	8.500	17.6
0.500	4.3	2.000	8.5	5.000	13.5	9.000	18.1
0.600	4.7	2.200	9.0	5.500	14.2	9.500	18.6
0.800	5.4	2.400	9.3	6.000	14.8		
1.000	6.0	2.600	9.7	6.500	15.4		

Hydro-Brake® Manhole: SSS013, DS/PN: S1.012, Volume (m³): 3.6

Design Head (m) 2.000 Hydro-Brake® Type Md4 Invert Level (m) 74.962
Design Flow (l/s) 8.4 Diameter (mm) 88

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	2.7	1.200	6.6	3.000	10.5	7.000	16.0
0.200	4.5	1.400	7.1	3.500	11.3	7.500	16.5
0.300	3.8	1.600	7.6	4.000	12.1	8.000	17.1
0.400	3.9	1.800	8.1	4.500	12.8	8.500	17.6
0.500	4.3	2.000	8.5	5.000	13.5	9.000	18.1
0.600	4.7	2.200	9.0	5.500	14.2	9.500	18.6
0.800	5.4	2.400	9.3	6.000	14.8		
1.000	6.0	2.600	9.7	6.500	15.4		

Storage Structures for Storm

Cellular Storage Manhole: SSS05, DS/PN: S1.004

Invert Level (m) 79.900 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	250.0	0.0	2.000	250.0	0.0

Cellular Storage Manhole: SSS013, DS/PN: S1.012

Invert Level (m) 72.960 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	160.0	0.0	2.000	160.0	0.0

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

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 100
Climate Change (%) 0

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
S1.000	15 Winter	100	0%					
S1.001	15 Winter	100	0%					
S1.002	15 Winter	100	0%	100/15 Summer				
S1.003	1440 Winter	100	0%	100/15 Summer				
S1.004	1440 Winter	100	0%	100/360 Summer				
S1.005	15 Winter	100	0%	100/15 Winter				
S1.006	15 Winter	100	0%	100/15 Summer				
S2.000	15 Winter	100	0%					
S2.001	15 Winter	100	0%					
S2.002	15 Winter	100	0%	100/15 Summer				
S1.007	15 Winter	100	0%	100/15 Summer				
S1.008	15 Winter	100	0%	100/15 Summer				
S1.009	15 Winter	100	0%	100/15 Summer				
S1.010	1440 Winter	100	0%	100/15 Summer				
S3.000	60 Winter	100	0%					
S3.001	15 Winter	100	0%					
S3.002	1440 Winter	100	0%	100/960 Winter				
S1.011	1440 Winter	100	0%	100/15 Summer				
S1.012	1440 Winter	100	0%	100/480 Winter				
S1.013	1440 Winter	100	0%					
S1.014	1440 Winter	100	0%					
S1.015	1440 Winter	100	0%					
S1.016	1440 Winter	100	0%					
S1.017	1440 Winter	100	0%					
S1.018	1440 Winter	100	0%					
S1.019	1440 Winter	100	0%					

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
S1.000	SSS01	87.102	-0.123	0.000	0.42	0.0	45.2	OK
S1.001	SSS02	85.116	-0.114	0.000	0.48	0.0	51.1	OK
S1.002	SSS03	81.782	0.182	0.000	1.04	0.0	109.1	SURCHARGED
S1.003	SSS04	81.694	0.584	0.000	0.17	0.0	12.5	SURCHARGED
S1.004	SSS05	81.688	0.761	0.000	0.39	0.0	6.0	SURCHARGED
S1.005	SSS06	79.937	0.012	0.000	0.06	0.0	2.3	SURCHARGED
S1.006	SSS07	79.938	0.116	0.000	0.53	0.0	24.6	SURCHARGED
S2.000	SSS17	86.575	-0.160	0.000	0.18	0.0	25.8	OK
S2.001	SSS18	84.327	-0.158	0.000	0.19	0.0	25.5	OK
S2.002	SSS19	81.808	0.780	0.000	1.76	0.0	71.9	SURCHARGED
S1.007	SSS08	79.922	0.208	0.000	0.97	0.0	90.0	SURCHARGED
S1.008	SSS09	78.971	0.261	0.000	1.09	0.0	100.4	SURCHARGED
S1.009	SSS10	77.589	0.058	0.000	0.96	0.0	113.6	SURCHARGED
S1.010	SSS11	76.275	0.394	0.000	0.14	0.0	16.6	SURCHARGED
S3.000	SSS14	80.200	-0.225	0.000	0.00	0.0	0.0	OK
S3.001	SSS15	77.269	-0.156	0.000	0.21	0.0	22.1	OK
S3.002	SSS15A	76.270	0.552	0.000	0.04	0.0	1.4	SURCHARGED
S1.011	SSS12	76.270	0.895	0.000	0.18	0.0	18.0	SURCHARGED
S1.012	SSS013	76.268	1.081	0.000	0.05	0.0	6.9	SURCHARGED
S1.013	SSS16	73.006	-0.179	0.000	0.09	0.0	6.9	OK
S1.014	SSS17	72.721	-0.194	0.000	0.05	0.0	6.9	OK
S1.015	SSS018	67.526	-0.159	0.000	0.19	0.0	6.9	OK
S1.016	SSS19	66.681	-0.194	0.000	0.05	0.0	6.9	OK
S1.017	SSS20	60.034	-0.191	0.000	0.05	0.0	6.9	OK
S1.018	SSS21	55.039	-0.186	0.000	0.07	0.0	6.9	OK
S1.019	SEx Sewer	51.740	-0.152	0.000	0.23	0.0	6.9	OK

Appendix E – Foul Sewer Design Sheets

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 (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	444.00	Maximum Backdrop Height (m)	1.500
Persons per House	1.00	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 Inverts

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
F1.000	53.400	2.015	26.5	0.000	7	0.0	1.500	o	225
F1.001	22.500	3.335	6.7	0.000	0	0.0	1.500	o	225
F1.002	46.000	0.807	57.0	0.000	8	0.0	1.500	o	225
F2.000	12.100	0.212	57.1	0.000	0	2.0	1.500	o	225
F2.001	28.500	0.950	30.0	0.000	4	0.0	1.500	o	225
F2.002	57.800	2.102	27.5	0.000	6	0.0	1.500	o	225
F2.003	3.000	0.060	50.0	0.000	0	0.0	1.500	o	225
F1.003	21.500	0.420	51.2	0.000	3	0.0	1.500	o	225
F3.000	56.500	0.377	150.0	0.000	7	0.0	1.500	o	225

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ DWF (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	86.650	0.000	0.0	7	0.0	9	0.44	2.23	88.9	0.2
F1.001	84.635	0.000	0.0	7	0.0	6	0.70	4.43	176.3	0.2
F1.002	81.300	0.000	0.0	15	0.0	14	0.44	1.52	60.5	0.5
F2.000	86.160	0.000	2.0	0	0.0	28	0.69	1.52	60.5	2.0
F2.001	84.260	0.000	2.0	4	0.0	25	0.88	2.10	83.5	2.1
F2.002	83.310	0.000	2.0	10	0.0	25	0.93	2.19	87.2	2.3
F2.003	81.208	0.000	2.0	10	0.0	29	0.76	1.63	64.6	2.3
F1.003	80.493	0.000	2.0	28	0.0	33	0.81	1.61	63.8	2.9
F3.000	80.450	0.000	0.0	7	0.0	13	0.25	0.94	37.2	0.2

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
F1.004	26.800	1.914	14.0	0.000	0	0.0	1.500	o	225
F1.005	31.400	1.200	26.2	0.000	0	0.0	1.500	o	225
F1.006	31.900	1.800	17.7	0.000	0	0.0	1.500	o	225
F1.007	54.700	1.563	35.0	0.000	6	0.0	1.500	o	225
F4.000	12.000	0.080	150.0	0.000	0	0.0	1.500	o	225
F4.001	37.200	2.480	15.0	0.000	4	0.0	1.500	o	225
F1.008	13.600	1.046	13.0	0.000	0	0.0	1.500	o	225
F1.009	25.000	1.923	13.0	0.000	0	0.0	1.500	o	225
F1.010	1.000	0.004	230.3	0.000	0	0.0	1.500	o	225

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.004	80.073	0.000	2.0	35	0.0	25	1.29	3.08	122.3	3.1
F1.005	78.159	0.000	2.0	35	0.0	29	1.04	2.25	89.4	3.1
F1.006	76.959	0.000	2.0	35	0.0	26	1.19	2.73	108.7	3.1
F1.007	75.159	0.000	2.0	41	0.0	32	0.96	1.94	77.3	3.3
F4.000	79.850	0.000	0.0	0	0.0	0	0.00	0.94	37.2	0.0
F4.001	77.200	0.000	0.0	4	0.0	6	0.44	2.97	118.2	0.1
F1.008	73.596	0.000	2.0	45	0.0	25	1.36	3.19	127.0	3.4
F1.009	72.550	0.000	2.0	45	0.0	25	1.36	3.19	127.0	3.4
F1.010	70.627	0.000	2.0	45	0.0	51	0.50	0.75	30.0	3.4

Manhole Schedules for Foul - Main

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
FFS01	88.250	1.600	1050	F1.000	86.650	225				
FFS02	86.650	2.015	1200	F1.001	84.635	225	F1.000	84.635	225	
FFS03	85.500	4.200	1200	F1.002	81.300	225	F1.001	81.300	225	
FFS11	88.010	1.850	1200	F2.000	86.160	225				
FFS12	87.890	3.630	1200	F2.001	84.260	225	F2.000	85.948	225	1688
FFS13	84.800	1.490	1050	F2.002	83.310	225	F2.001	83.310	225	
FFS14	83.000	1.792	1200	F2.003	81.208	225	F2.002	81.208	225	
FFS04	83.000	2.507	1200	F1.003	80.493	225	F1.002	80.493	225	
							F2.003	81.148	225	655
FFS15	82.300	1.850	1200	F3.000	80.450	225				
FFS05	82.000	1.927	1200	F1.004	80.073	225	F1.003	80.073	225	
							F3.000	80.073	225	
FFS06	80.000	1.841	1200	F1.005	78.159	225	F1.004	78.159	225	
FFS07	78.800	1.841	1200	F1.006	76.959	225	F1.005	76.959	225	
FFS08	77.000	1.841	1200	F1.007	75.159	225	F1.006	75.159	225	
FFS16	81.700	1.850	1200	F4.000	79.850	225				
FFS17	81.200	4.000	1200	F4.001	77.200	225	F4.000	79.770	225	2570
FFS09	77.000	3.404	1200	F1.008	73.596	225	F1.007	73.596	225	
							F4.001	74.720	225	1124
FFS10	74.800	2.250	1200	F1.009	72.550	225	F1.008	72.550	225	
FEx sewer	72.430	1.803	1200	F1.010	70.627	225	F1.009	70.627	225	
F	72.430	1.807	225		OUTFALL		F1.010	70.623	225	

PIPELINE SCHEDULES for Foul - Main

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
F1.000	o	225	FFS01	88.250	86.650	1.375	1050
F1.001	o	225	FFS02	86.650	84.635	1.790	1200
F1.002	o	225	FFS03	85.500	81.300	3.975	1200
F2.000	o	225	FFS11	88.010	86.160	1.625	1200
F2.001	o	225	FFS12	87.890	84.260	3.405	1200
F2.002	o	225	FFS13	84.800	83.310	1.265	1050
F2.003	o	225	FFS14	83.000	81.208	1.567	1200
F1.003	o	225	FFS04	83.000	80.493	2.282	1200
F3.000	o	225	FFS15	82.300	80.450	1.625	1200
F1.004	o	225	FFS05	82.000	80.073	1.702	1200
F1.005	o	225	FFS06	80.000	78.159	1.616	1200
F1.006	o	225	FFS07	78.800	76.959	1.616	1200
F1.007	o	225	FFS08	77.000	75.159	1.616	1200
F4.000	o	225	FFS16	81.700	79.850	1.625	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
F1.000	53.400	26.5	FFS02	86.650	84.635	1.790	1200
F1.001	22.500	6.7	FFS03	85.500	81.300	3.975	1200
F1.002	46.000	57.0	FFS04	83.000	80.493	2.282	1200
F2.000	12.100	57.1	FFS12	87.890	85.948	1.717	1200
F2.001	28.500	30.0	FFS13	84.800	83.310	1.265	1050
F2.002	57.800	27.5	FFS14	83.000	81.208	1.567	1200
F2.003	3.000	50.0	FFS04	83.000	81.148	1.627	1200
F1.003	21.500	51.2	FFS05	82.000	80.073	1.702	1200
F3.000	56.500	150.0	FFS05	82.000	80.073	1.702	1200
F1.004	26.800	14.0	FFS06	80.000	78.159	1.616	1200
F1.005	31.400	26.2	FFS07	78.800	76.959	1.616	1200
F1.006	31.900	17.7	FFS08	77.000	75.159	1.616	1200
F1.007	54.700	35.0	FFS09	77.000	73.596	3.179	1200
F4.000	12.000	150.0	FFS17	81.200	79.770	1.205	1200

PIPELINE SCHEDULES for Foul - Main

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
F4.001	o	225	FFS17	81.200	77.200	3.775	1200
F1.008	o	225	FFS09	77.000	73.596	3.179	1200
F1.009	o	225	FFS10	74.800	72.550	2.025	1200
F1.010	o	225	FEx sewer	72.430	70.627	1.578	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
F4.001	37.200	15.0	FFS09	77.000	74.720	2.055	1200
F1.008	13.600	13.0	FFS10	74.800	72.550	2.025	1200
F1.009	25.000	13.0	FEx sewer	72.430	70.627	1.578	1200
F1.010	1.000	230.3	F	72.430	70.623	1.582	225

Free Flowing Outfall Details for Foul - Main

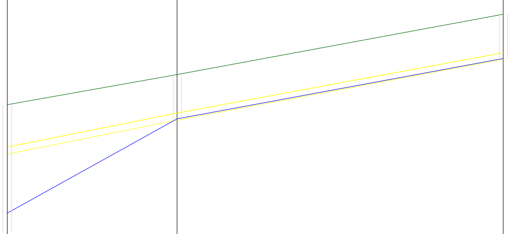
Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.010	F	72.430	70.623	70.630	225	0

Simulation Criteria for Foul - Main

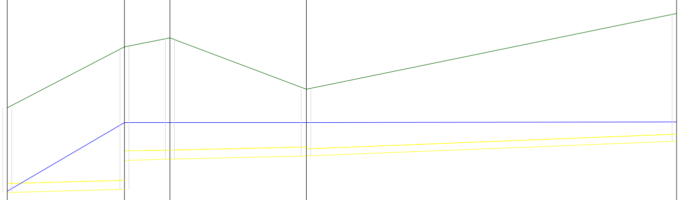
Volumetric Runoff Coeff	0.750	Foul Sewage per hectare (l/s)	0.000
PIMP (% impervious)	100	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Appendix F – Storm Water Longitudinal Sections



MH Name	SSS03		SSS02		SSS01
Hor Scale 1000 Ver Scale 250 Datum (m) 79.000					
PN		S1.001		S1.000	
Dia (mm)		225		225	
Slope (1:X)		20.0		21.6	
Cover Level (m)	85.500		86.500		88.500
Invert Level (m)	83.880		85.005 85.005		87.000
Length (m)		22.500		43.100	

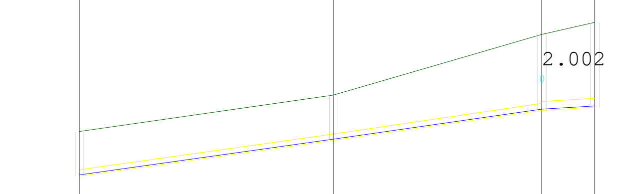


MH Name	SSS07		SSS06				SSS04		SSS03
Hor Scale 1000 Ver Scale 250 Datum (m) 77.000									
PN		S1.005				S1.003		S1.002	
Dia (mm)		300				300		225	
Slope (1:X)		150.0				166.7		100.0	
Cover Level (m)	82.400		84.400		84.700		83.000		85.500
Invert Level (m)	79.597		79.700		80.702 80.702		80.810 80.810		81.300
Length (m)		15.500				18.000		49.000	

Hor Scale 1000

Ver Scale 250

Datum (m) 74.000

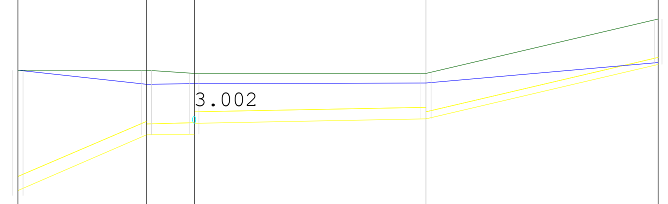


MH Name	SSS10		SSS09		SSS08	
PN		S1.008		S1.007		
Dia (mm)		225		225		
Slope (1:X)		28.5		27.5		
Cover Level (m)	78.800		80.000		82.000	82.400
Invert Level (m)	77.306		78.485 78.485		79.489	79.597
Length (m)		33.600		27.600		

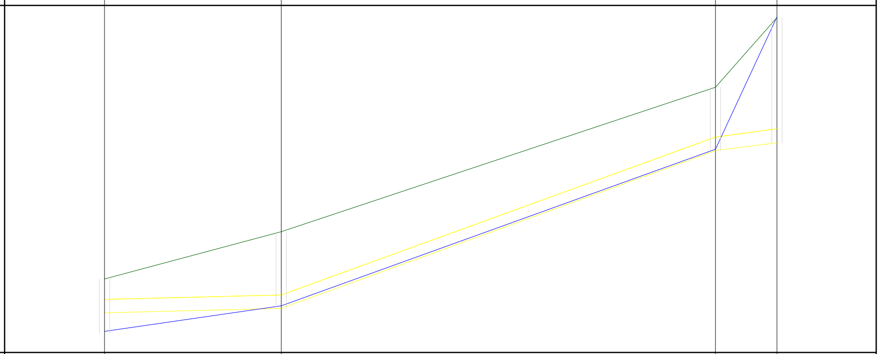
Hor Scale 1000

Ver Scale 250

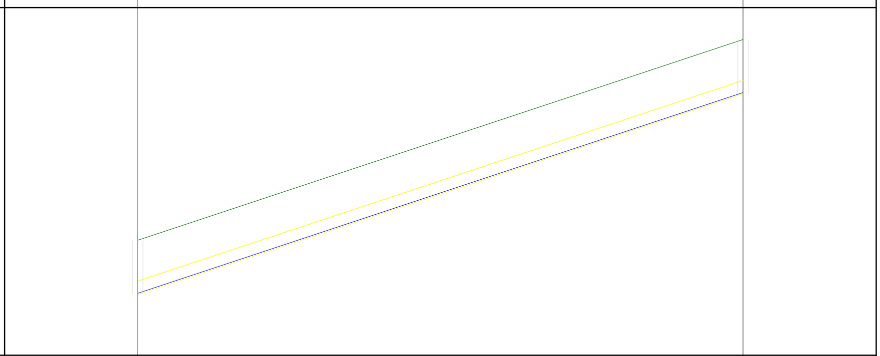
Datum (m) 70.000



MH Name	SSS16		SSS013			SSS11		SSS10
PN		S1.012			S1.010		S1.009	
Dia (mm)		450			375		225	
Slope (1:X)		9.3			210.3		17.1	
Cover Level (m)	77.100		77.100	77.000		77.000		78.800
Invert Level (m)	73.140		74.962	75.000 75.360		75.506 75.506		77.306
Length (m)		17.000			30.700		30.700	

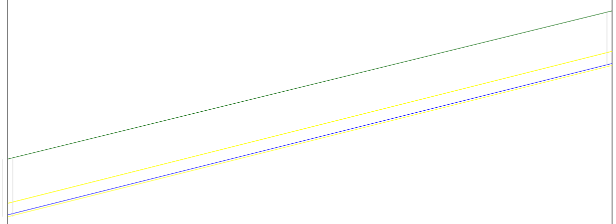


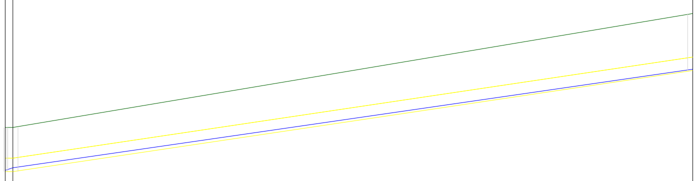
MH Name	SSS19	SSS018		SSS17	
Hor Scale 1000 Ver Scale 250 Datum (m) 66.000					
PN		S1.015	S1.014		
Dia (mm)		450	450		
Slope (1:X)		167.1	11.0		
Cover Level (m)	68.450	70.000	74.800	77.100	
Invert Level (m)		67.320 67.460	67.460 72.690	72.690 72.960	
Length (m)		23.400	57.400		

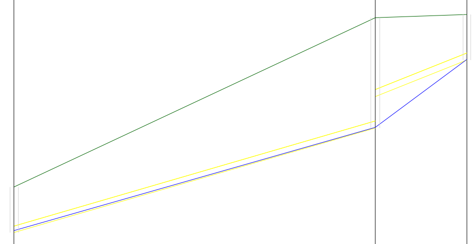


MH Name	SSS20	SSS19	
Hor Scale 1000 Ver Scale 250 Datum (m) 58.000			
PN		S1.016	
Dia (mm)		450	
Slope (1:X)		12.0	
Cover Level (m)	61.800	68.450	
Invert Level (m)		60.000 66.650	
Length (m)		80.000	

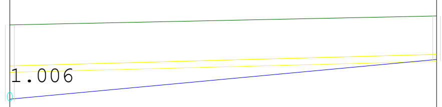
Denis O'Sullivan & Associates		Page 4
Unit 5, Joyce House Barrack Square Ballincollig, Co. Cork		
Date 19/01/2022 11:06 File STORM SEWER.MDX	Designed By SODonoghue Checked By	
Micro Drainage	Network W.12.4	

MH Name	SSS21		SSS20	
Hor Scale 1000 Ver Scale 250 Datum (m) 53.000				
PN		S1.017		
Dia (mm)		450		
Slope (1:X)		16.0		
Cover Level (m)	56.900		61.800	
Invert Level (m)	55.000		60.000	
Length (m)		80.000		

MH Name	S		SSS21	
Hor Scale 1000 Ver Scale 250 Datum (m) 49.000				
PN		S1.018		
Dia (mm)		450		
Slope (1:X)		27.0		
Cover Level (m)	53.126		56.900	
Invert Level (m)	51.667		55.000	
Length (m)		90.000		

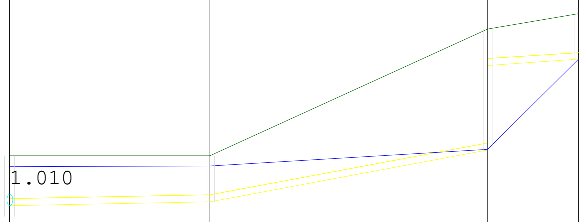


MH Name	SSS19	SSS18	SSS17	
Hor Scale 1000 Ver Scale 250 Datum (m) 79.000				
PN		S2.001	S2.000	
Dia (mm)		225	225	
Slope (1:X)		13.8	10.0	
Cover Level (m)	82.300	87.890	88.010	
Invert Level (m)		80.803 / 84.260	85.300 / 86.510	
Length (m)		47.700	12.100	

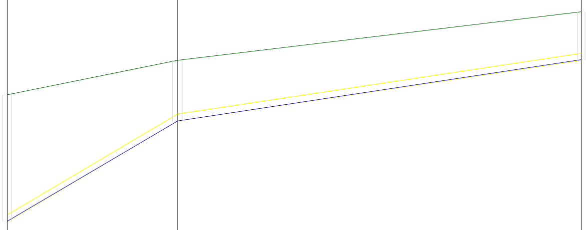


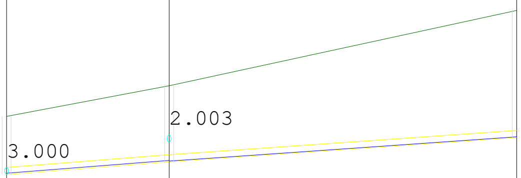
MH Name	SSS08	SSS19	
Hor Scale 1000 Ver Scale 250 Datum (m) 75.000			
PN		S2.002	
Dia (mm)		225	
Slope (1:X)		150.0	
Cover Level (m)	82.000	82.300	
Invert Level (m)		80.427 / 80.803	
Length (m)		56.400	

MH Name	SSS12	SSS15A	SSS15		
Hor Scale 1000 Ver Scale 250 Datum (m) 73.000					
PN		S3.002	S3.001		
Dia (mm)		225	225		
Slope (1:X)		200.0	21.5		
Cover Level (m)	77.000	77.000	81.200	81.700	
Invert Level (m)		75.361 75.493	75.493 77.200	79.995 80.200	
Length (m)		26.500	36.700		



Appendix G – Foul Sewer Longitudinal Sections

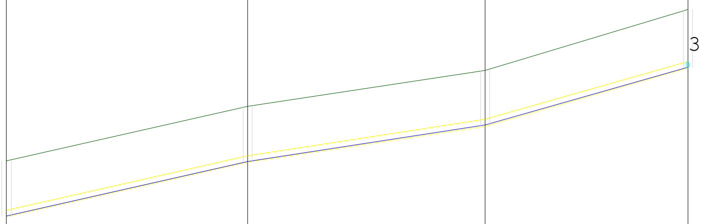
MH Name	FFS03	FFS02	FFS01	
Hor Scale 1000 Ver Scale 250 Datum (m) 79.000				
PN		F1.001	F1.000	
Dia (mm)		225	225	
Slope (1:X)		6.7	26.5	
Cover Level (m)	85.500	86.650	88.250	
Invert Level (m)		81.300 / 84.635	84.635 / 86.650	
Length (m)		22.500	53.400	

MH Name	FFS05	FFS04	FFS03	
Hor Scale 1000 Ver Scale 250 Datum (m) 77.000				
PN		F1.003	F1.002	
Dia (mm)		225	225	
Slope (1:X)		51.2	57.0	
Cover Level (m)	82.000	83.000	85.500	
Invert Level (m)		80.073 / 80.493	80.493 / 81.300	
Length (m)		21.500	46.000	

Hor Scale 1000

Ver Scale 250

Datum (m) 73.000

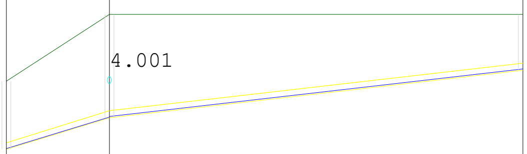


MH Name	FFS08	FFS07	FFS06	FFS05	
PN		F1.006	F1.005	F1.004	
Dia (mm)		225	225	225	
Slope (1:X)		17.7	26.2	14.0	
Cover Level (m)	77.000	78.800	80.000	82.000	
Invert Level (m)		75.159 76.959	76.959 78.159	78.159 80.073	
Length (m)		31.900	31.400	26.800	

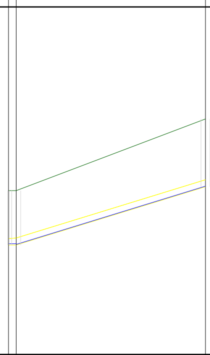
Hor Scale 1000

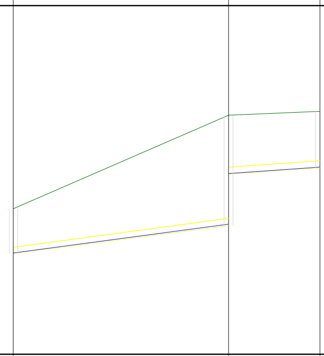
Ver Scale 250

Datum (m) 69.000

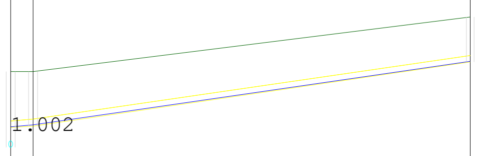


MH Name	FFS10	FFS09	FFS08	
PN		F1.008	F1.007	
Dia (mm)		225	225	
Slope (1:X)		13.0	35.0	
Cover Level (m)	74.800	77.000	77.000	
Invert Level (m)		72.550 73.596	73.596 75.159	
Length (m)		13.600	54.700	

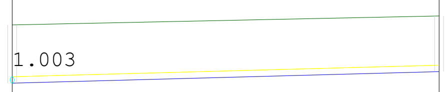
MH Name	F	FFS10	
Hor Scale 1000 Ver Scale 250 Datum (m) 67.000			
PN		F1.009	
Dia (mm)		225	
Slope (1:X)		13.0	
Cover Level (m)	72.430	74.800	
Invert Level (m)	70.627	72.550	
Length (m)		25.000	

MH Name	FFS13	FFS12	FFS11	
Hor Scale 1000 Ver Scale 250 Datum (m) 80.000				
PN		F2.001	F2.000	
Dia (mm)		225	225	
Slope (1:X)		30.0	57.1	
Cover Level (m)	84.800	87.890	88.010	
Invert Level (m)	83.310	84.260 85.948	86.160	
Length (m)		28.500	12.100	

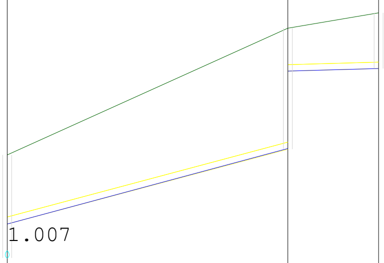
MH Name	FFS04	FFS13
Hor Scale 1000 Ver Scale 250 Datum (m) 77.000		
PN	F2.002	
Dia (mm)	225	
Slope (1:X)	27.5	
Cover Level (m)	83.000	84.800
Invert Level (m)	81.208	83.310
Length (m)	57.800	



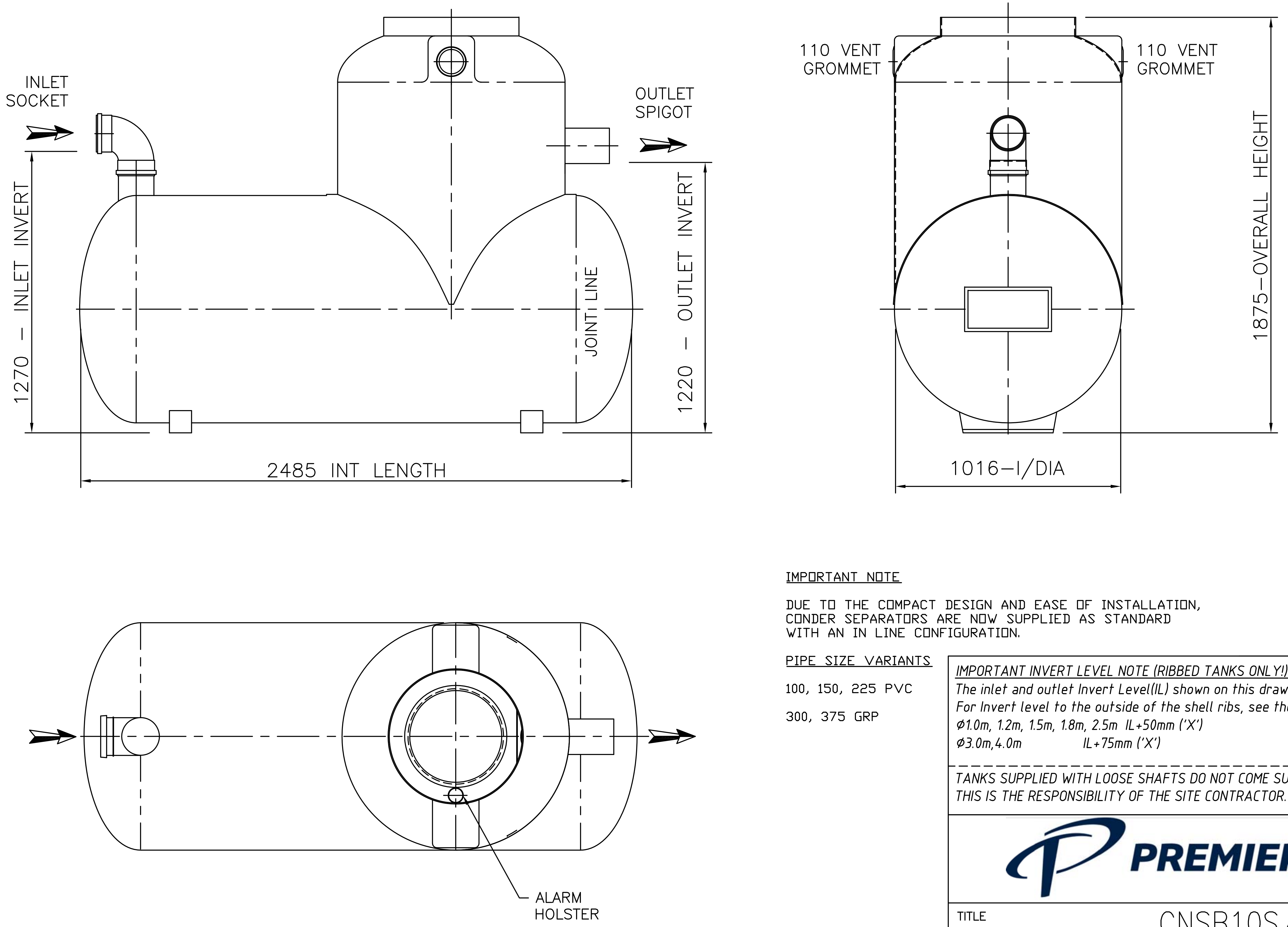
MH Name	FFS05	FFS15
Hor Scale 1000 Ver Scale 250 Datum (m) 75.000		
PN	F3.000	
Dia (mm)	225	
Slope (1:X)	150.0	
Cover Level (m)	82.000	82.300
Invert Level (m)	80.073	80.450
Length (m)	56.500	



MH Name	FFS09	FFS17		
Hor Scale 1000 Ver Scale 250 Datum (m) 72.000				
PN		F4.001		
Dia (mm)		225		
Slope (1:X)		15.0		
Cover Level (m)	77.000	81.200	81.700	
Invert Level (m)		74.720 77.200	79.770 79.850	
Length (m)		37.200		



Appendix H - Petrol Interceptor Details



NOTES:

1. PRODUCT INFORMATION
The Conder range of light liquid separators is produced from high grade GRP. Inlets are provided as sockets and outlets as spigots, Connections may be made by steel-banded flexible couplings, nitrile seal joints, rope-seal and mortar or any other appropriate jointing method.
Ventilation specifications should be in accordance with Local Authority requirements. Vent pipework from multiple chambers must never be manifolded below ground level.

2. PERFORMANCE CHARACTERISTICS
Separators are based on the requirements stated in European Standard EN858-1 and Environment Agency guideline PPG3, in particular:-
a. The nominal size has been established from performance tests where the residual oil at the outlet is less than 5mg/l for class 1 separators and less than 100mg/l for class 2 separators.

3. MAINTENANCE AND USE
It is important to recognise that light liquid separators require regular maintenance. The period between maintenance operations can vary depending on the location and use of the separator, therefore routine inspections shall be undertaken at least every six months and a log maintained of inspection date, depth of oil, depth of silt and any cleaning that is undertaken.
A Conder Alarm should be fitted to every separator to give automatic warning that the light liquid capacity has been reached.
Access to the separator should be kept clear and not used for storage.

4. PRODUCT DEVELOPMENT
In line with our policy of constant improvement and development, we reserve the right to change specification without prior notice.

IMPORTANT NOTE

DUE TO THE COMPACT DESIGN AND EASE OF INSTALLATION, CONDER SEPARATORS ARE NOW SUPPLIED AS STANDARD WITH AN IN LINE CONFIGURATION.

PIPE SIZE VARIANTS

100, 150, 225 PVC

300, 375 GRP

IMPORTANT INVERT LEVEL NOTE (RIBBED TANKS ONLY!):
The inlet and outlet Invert Level(IL) shown on this drawing is to internals of the shell unless otherwise stated.
For Invert level to the outside of the shell ribs, see the conversion below:
Ø1.0m, 1.2m, 1.5m, 1.8m, 2.5m IL+50mm ('X')
Ø3.0m,4.0m IL+75mm ('X')

INNER TANK SHELL
'X'
DETAIL 'Y'

TANKS SUPPLIED WITH LOOSE SHAFTS DO NOT COME SUPPLIED WITH A FIXING KIT.
THIS IS THE RESPONSIBILITY OF THE SITE CONTRACTOR.

PREMIER TECH AQUA

1ST ANGLE PROJECTION

TITLE: CNSB10S/21/SALES BYPASS SEPARATOR

REV.	DATE	BY	CHKD.	APPD.	DESCRIPTION
6	19.09.11	RU	DG	RU	VENT BOXES AND GROMMETS ADDED

DRAWN BY	CHKD.	APPD.	SCALE	DRAWING No.	REVISION
RU	PB	RP	NTS	CNSB10S/21 SALES	6
DATE 23.03.09	DATE 23.03.09	DATE 23.03.09			

A3 — DO NOT SCALE. IF IN DOUBT ASK. ALL DIMENSIONS IN MM

GENERAL TOLERANCES (unless noted otherwise)				
GRP	LINEAR	± 5mm	ANGLE	±0.5°
FABRICATED		± 2mm		±0.2°
MACHINED		± 0.5mm		±0.1°

Appendix J – Hydrobrake Details

Hydro-Brake® Flow Control

Modelling Guide

Unit Selection Design Guide

Overview

Hydro-Brake® Flow Controls restrict the flow in surface/storm water or foul/combined sewer systems by inducing a vortex flow pattern in the water passing through the device, having the effect of increasing back-pressure.

Their 'hydrodynamic' rather than 'physical restriction' based operation provides flow regulation whilst maintaining larger clearances than most other types of flow control, making them less susceptible to blockage. Their unique "S"-shaped head-flow characteristic also enables them to pass greater flows at lower heads, which can enable more efficient use of upstream storage facilities.

This document provides guidance relating to the selection and use of Hydro-Brake® Flow Controls for use in surface/storm water and foul/combined sewer systems.

The information provided here is intended for the purposes of general guidance only - individual application requirements may differ. If in doubt, or to enquire about new product additions, please contact HRD Technologies Ltd.

STH Range of Hydro-Brake® Flow Controls

BBA APPROVAL INSPECTION TESTING CERTIFICATION

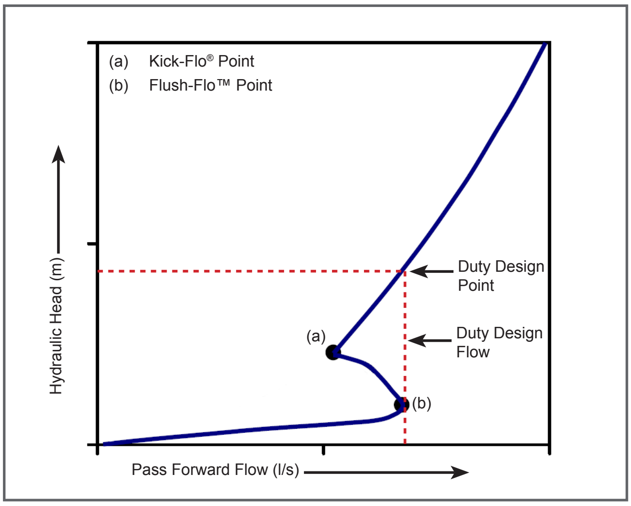
CERTIFICATE No 08/4599

See back cover for details.

Hydraulic Characteristics and Specification

Hydro-Brake® Flow Controls should be selected such that the duty/design flow is not exceeded at any point on the head-flow curve, see illustration right. If this is not achievable using the initially selected unit, it may be appropriate to select an alternative option (see selection guidance overleaf).

While the primary aim of a flow control is to provide a particular flow rate at a given upstream head (giving a design/duty point), it is important to note that secondary opportunities, such as potential for optimised storage use, derive from consideration of the full hydraulic characteristic. It is therefore important to ensure that the same flow control, or one confirmed to provide equivalent hydraulic performance, is implemented in any final installation.



Typical Hydro-Brake® Head Versus Flow Characteristics

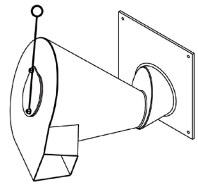
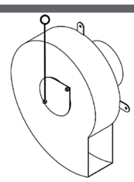
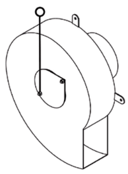
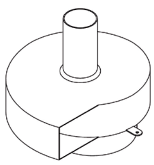
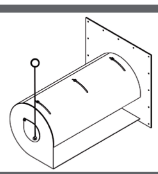
To ensure correct implementation a multiple design-point specification, defining the main hydraulic features of the selected flow control, can be provided by HRD Technologies Ltd. This should include at least the following information:

- outlet size and model of Hydro-Brake® Flow Control
- definition of the duty/design point (head and flow)
- definition of the Flush-Flo™ point (head and flow)
- definition of the Kick-Flo® point (head and flow)

To ensure that a drainage system performs as designed, it is strongly recommended that this information is reproduced on any technical specifications.

Hydro-Brake® Flow Control Models Supported in Micro Drainage

The Table below provides a summary of the Hydro-Brake® Flow Control models currently supported by the Micro Drainage programs, including details of unit styles, applications and design/installation considerations. Advice regarding unit selection is provided in subsequent sections.

Win*Des*® Reference Code	Style / Typical Shape	Application	Design / Installation Notes
Md1 Md2 Md4 Md14	**Conical** 	Foul / combined and surface / storm water.	With the exception of the Md14, conical units require benching into the intake (the Md14 has a piped intake). They generally require larger manholes than equivalent sump-type units.
Md5 Md6 Md7 Md12	**Sump-Type** 	Surface / storm water only.	Sump-type units require the provision of a sump to accommodate the flow control. As this will always be full of water, sump-type units are unsuitable for use in foul / combined systems.
Md13	**Sump-Type** BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE No 08/4599 STH Range of Hydro-Brake® Flow Controls 	Surface / storm water only.	The Md13 (STH) unit will always have an outlet size in excess of 75 mm and can always be fitted to a 225 mm diameter outlet pipe or larger.
Md8 Md9 Md11	**Vertical Discharge** 	Foul / combined and surface / storm water.	Vertical discharge units require a chamber design to accommodate the vertically directed outlet. They do not have S-shaped head / discharge curves and are for special applications only - please refer to HRD Technologies Ltd for advice.
Md10	**Tubular** 	Foul / combined and surface / storm water.	Tubular units require benching into the intake. They do not have S-shaped head / discharge curves and are for special applications only - please refer to HRD Technologies Ltd for advice.

Note: For system modelling using other software packages, HRD Technologies Ltd can provide individual unit head / flow characteristics in an appropriate format.

General Advice

Selection of the most appropriate Hydro-Brake® Flow Control for a particular application depends on a number of considerations, including the type of sewer system, the hydraulic characteristic of the device, device clearances and overall physical dimensions. The Micro Drainage programs provide outputs for hydraulic characteristic and outlet size.

The table opposite provides general selection guidance taking into account the considerations of type of sewer system, device clearances and overall physical dimensions. This should be considered along with other information provided here and in conjunction with the advice contained within the software design program that is being used.

The Table should be followed from the top, using the left hand column for surface/storm water applications and the right hand column for foul/combined applications. The 'general comments' provided are relevant to both applications.

HRD Technologies Ltd offer a free design service and can assist with unit selection.

General Guidance on Unit Selection

Surface / Storm Water Applications	Foul / Combined Applications
1) Select sump-type Md13 (STH) initially. This is a British Board of Agrément (BBA) approved product that is currently only available in certain sizes – if a size is not available for the specified duty/ design point go to 2) otherwise use Md13 (STH). The Md13 (STH) has a minimum outlet size in excess of 75 mm and can always be fitted to a 225 mm diameter outlet pipe (or greater).	1) Select conical-type Md4 (CX) initially provided the required outlet >150 mm. If the required manhole/ chamber size is too large go to 2) otherwise use Md4 (CX).
2) Select sump-type Md6 (SXH) initially provided the required outlet >75 mm (please seek advice if outlet <75 mm). If required outlet >200 mm go to 3) otherwise use Md6 (SXH).	2) Select conical-type Md2 (CH) provided the required outlet >150 mm. If the required manhole/chamber size is too large go to 3) otherwise use Md2 (CH).
3) Select sump-type Md5 (SH) or Md12 (SMXH) provided the required outlet >75 mm (please seek advice if outlet <75 mm). If required outlet >250 mm (Md5 - SH) or >300 mm (Md12 - SMXH) go to 4) otherwise use Md5 (SH) /Md12 (SMXH).	3) Select conical-type Md1 (C) provided the required outlet >429 mm. If the required manhole/chamber size is too large go to 4) otherwise use Md1 (C).
4) Select conical-type Md4 (CX) provided the required outlet >100 mm. This unit does not require a sump arrangement but requires benching into the intake. If the required manhole/ chamber size is too large go to 5), otherwise use Md4 (CX).	4) Vertical discharge units Md8 (SV), Md9 (SMV) and Md11 (SXV) can be considered if their outlets are >150 mm. Their physical dimensions should be considered - the Md9 (SMV) is typically used when the diameter of the Md8 (SV) and Md11 (SXV) >200 to 250 mm. If none of these units are suitable go to 5).
5) Select conical-type Md2 (CH) unit provided the required outlet >100 mm. This unit does not require a sump arrangement but requires benching into the intake. If the required manhole/ chamber size is too large go to 6), otherwise use Md2 (CH).	5) Select tubular-type Md10 (TH) provided the required outlet >333 mm. This is sometimes the only option that will meet a certain head/discharge relationship (eg. low head, low flow situations). It should only be used when there is no other alternative.
6) Select conical-type Md1 (C) provided the required outlet >285 mm. This unit does not require a sump arrangement but requires benching into the intake. If the required manhole/chamber size is too large go to 7), otherwise use Md1 (C).	For design assistance for any Hydro-Brake® Flow Control please call: **01-4013964** or **e-mail: enquiries@hrdtec.com**
7) Select sump-type Md7 (SMH) provided the required outlet >75 mm. If the required outlet >300 mm then go to 8), otherwise use Md7 (SMH).	
8) Vertical discharge units Md8 (SV), Md9 (SMV) and Md11 (SXV) can be considered provided the required outlet >75 mm. Their physical dimensions should be considered - the Md9 (SMV) is typically used when the diameter of the Md8 (SV) and Md11 (SXV) >200 to 250 mm. If none of these units are suitable go to 9).	
9) Select tubular-type Md10 (TH) provided the required outlet >222 mm. This is sometimes the only option that will meet a certain head/discharge relationship (eg. low head, low flow situations). It should only be used when there is no other alternative.	

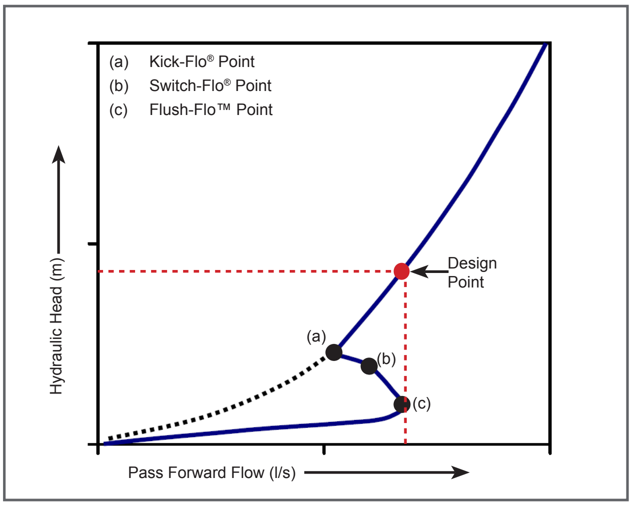
General Comments: The minimum sizes quoted for Hydro-Brake® Flow Controls represent sizes based on experience as offering significant reduction in risk of blockage and hence maintenance and derive from general practice in flow control selection in the UK and Ireland. Sizes below the minimum recommended can be specified though it should be recognised these might incur increased risks of blockage and associated maintenance. Sizes above the maximum recommended can also be specified though may require oversized manholes/chambers. For the larger units, refer to HRD Technologies Ltd for advice.

The information provided here is intended for the purposes of general guidance only - individual application requirements may differ. **If in doubt, please contact HRD Technologies Ltd.**

STH Type Hydro-Brake® Flow Control with BBA Approval

Now included in Win*Des*® W.12.6!

The new STH type Hydro-Brake® Flow Control range has a unique head / discharge performance curve which introduces a very important feature - the Switch-Flo® Point. This point illustrates the unique performance feature of the STH range which can lead to further savings in upstream storage, whilst also enabling increased inlet / outlet size to further reduce the risk of blockage.



Typical STH Head Versus Flow Characteristics

Kick-Flo® (a) - the point at which the vortex has initiated and at which the curve begins to return back to follow the orifice curve and reach the same design point or desired head / flow condition.

NEW Switch-Flo® (b) - marks the transition between the Kick-Flo® and Flush-Flo™, from vortex initiation to stabilisation. This point adds a new layer of resolution to the Hydro-Brake® curve that has implications to upstream storage savings.

Flush-Flo™ (c) - the point at which the vortex begins to initiate and have a throttling effect. This point on the Hydro-Brake® curve is usually much nearer to the maximum design flow (Design Point), than other vortex flow controls leading to more water passing through the unit during the earlier stages of a storm, thus reducing the amount of water that needs to be stored upstream.

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4599

STH Range of
Hydro-Brake® Flow Controls

The STH Hydro-Brake® Flow Control is the only vortex flow control available today that has been given the prestigious BBA Approval Certificate. The BBA assessment procedure entails rigorous assessment of production and manufacturing standards, and confirms that the hydraulic performance of the Hydro-Brake® Flow Control matches the data given to designers by HRD Technologies with their head / discharge curves.

A worked example showing the steps to model a Hydro-Brake® Flow Control and associated Stormcell® Storage System within Micro Drainage Win*Des*® is available on our website:

www.hrdtec.com

Take a Look at Our New Stormwater Web Resource

Engineering Nature's Way™

www.engineeringnaturesway.co.uk

Engineering Nature's Way is a brand new resource for people working with Sustainable Drainage and flood management in the UK.

The site provides an opportunity to share news, opinion, information and best practice for people working in local and central Government; developers, consulting engineers and contractors. Do you have something to share? We would be delighted to receive your contributions.

turning water around ...®

HRD Technologies Ltd • Tootenhill House • Rathcoole • Co. Dublin • Ireland
Tel: +353 (0) 1 4013964 • Fax: +353 (0) 1 4013978 • www.hrdtec.com
HRD Technologies Ltd is a subsidiary of Hydro International plc