RESIDENTIAL DEVELOPMENT AT SCAIRT CROSS, CASTLETREASURE, DOUGLAS, CORK

INFRASTRUCTURE REPORT

DATE 29/06/2022

REVISION 2

JOB NO. 6415

DENIS O'SULLIVAN & ASSOCIATES
CONSULTING ENGINEERS

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 Scairt Cross, Castletreasure, Douglas, Cork

PROJECT NUMBER: 6415

REVISION	DATE	FILE NAME: Residential Development at Scairt Cross, Castletreasure, Douglas, Cork			
0	13.01.2022	DESCRIPTION: Infrastructure Report			
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		INITIAL	BO'S	CO'S	BO'S
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Contents

1 *Introduction*

Denis O'Sullivan & Associates were engaged as Consulting Engineers for the proposed development at Scairt Cross, Castletreasure, Douglas, Cork.

Planning permission is being sought for the construction of 52 no apartments in 2 blocks and 8 no residential dwellings and is accessed from Scairt Cross, Castletreasure, Douglas, Cork. The site is located on the outskirts of Cork City and is in close proximity to the town of Douglas. The overall development shall provide a mixture of apartments and dwelling units of varying sizes

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 Mr. Brian Lavelle, Design Engineer, Southern Region, Irish Water. The Confirmation of Feasibility as issued by Irish Water is included in Appendix A of this Report.

Prior to the submission of this application, engineering aspects relating to the proposed stormwater was discussed with Mr. Ken O'Keeffe, Executive Engineer, Cork City Council.

1.2 Site Location & Historical Aerial Photographs

The site is accessed from Scairt Cross, Castletreasure, Douglas, Cork. The site is located on the outskirts of Cork City and is in close proximity to the town of Douglas. 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

As was agreed with the engineering section of Cork City Council, the storm water system for the development will involve a network of underground pipelines and manholes discharging to the storm sewer on Donnybrook Hill 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 the introduction of the hydrocarbon interceptors, site control, which provide a degree of treatment before discharging to the attenuation system.

The second stage of the management train, regional control, is provided by the underground attenuation, 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 — 2.0 l/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 4.0m/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. 6415-5020.

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 0.7 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	2.0 l/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	262.5	2.0 l/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.004 & SW.003 is approximately 3,700m^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

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

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 CDS21006893. The response to this Enquiry issued on the 21st October 2021 confirmed that connection to the network was feasible subject to a detailed design survey and investigations to confirm the available capacity of the adjacent network and to determine the full extent of any upgrades which may be required to be completed to Irish Water Infrastructure. Following an on-site survey of the adjoining Irish Water Infrastructure it was determined that approximately 150m of the existing network in Bracken Court would require upgrade works. An alternative discharge location was identified at the junction between Donnybrook Hill and Scairt Hill however due to the concerns of the sewer surcharging om Donnybrook Hill this was ruled out.

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>84 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 = (59) (446) / (24) (60) (60) = 0.31 litres/second

6DWF = 1.86 litres/second

The layout of the proposed foul sewer network is shown on the Proposed Stormwater & Foul Sewer Layout Plan 6415-5020.

The overall quantity of wastewater for the proposed development is estimated at 26.35m^3 per day.

This is based on the unit schedule submitted by the architect. The foul waste within the development will be collected via an internal gravity network and will discharge to the existing public foul sewer on Donnybrook Hill.

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. CDS21006893. 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 Scairt Hill with associated valves and metering requirements. Internally within the development it is proposed to have a 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 6415-5030.

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	No surcharge of the stormwater network
	1 in 100 year	Surcharge

The stormwater system is designed to ensure no surcharge occurs during a 1 in 2-year return period event. 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	2.0 l/sec	3.5	38

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	262.5	82.1	85.6

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

Brian O' Sullivan
Dennis O'Sullivan and Associates
Joyce House
Barrack Square
Ballincollig
Cork

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

21 October 2021

Re: CDS21006893 pre-connection enquiry - Subject to contract | Contract denied

Connection for Housing Development of 57 unit(s) at Scairt Road, Castletreasure, Cork

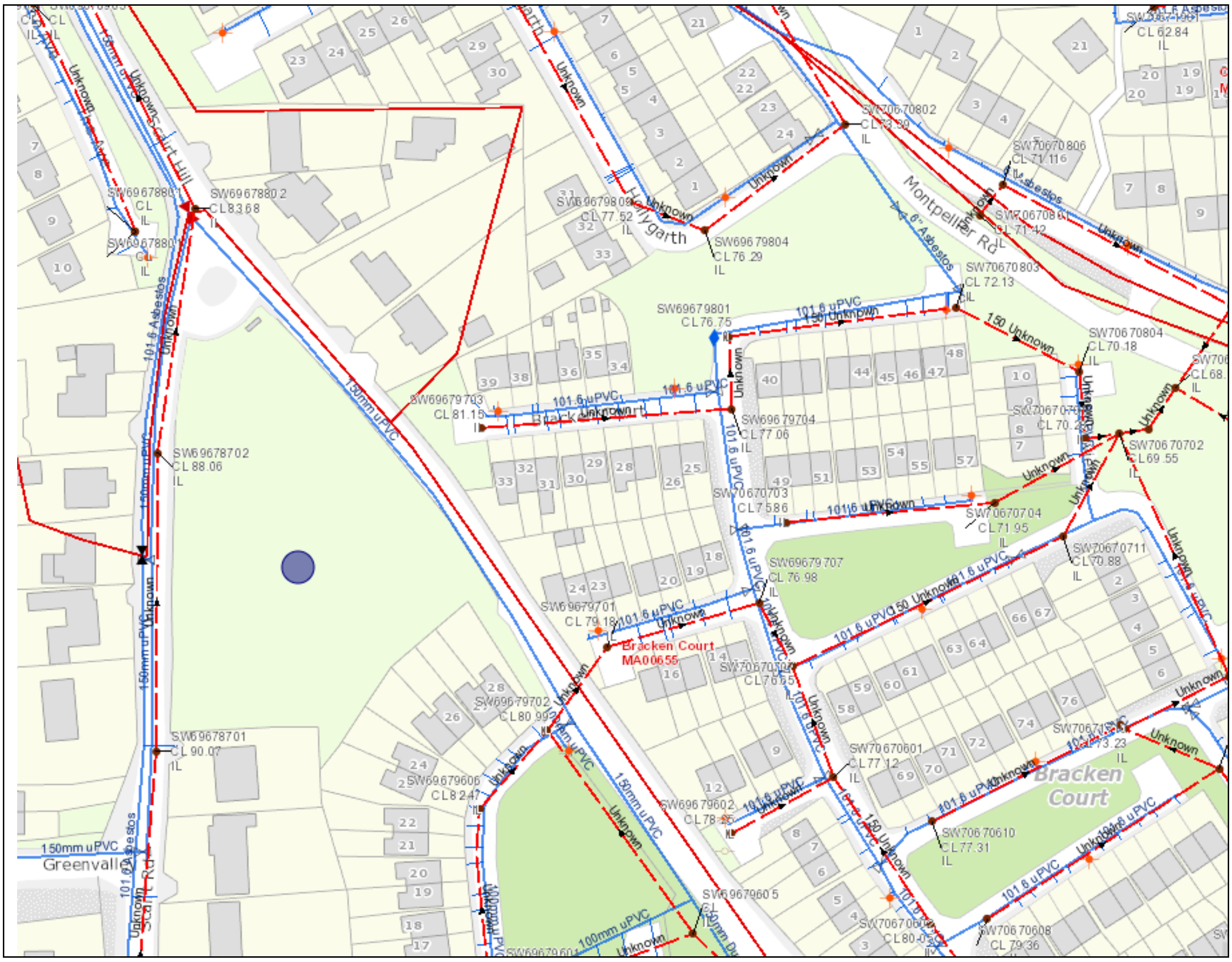
Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Scairt Road, Castletreasure, 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 Subject to upgrades
SITE SPECIFIC COMMENTS	
Water Connection	
Wastewater Connection	It will be necessary to carry out further detailed survey and investigations to confirm the available capacity of the adjacent network and to determine the full extent of any upgrades which may be required to be completed to Irish Water Infrastructure. Should you wish to have such studies and investigations progressed by Irish Water, you will be required to enter into Project Works Service Agreement.

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:



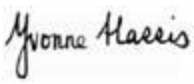
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish 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 Lavelle (C) from the design team on or email brian.lavelle@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



Yvonne Harris

Head of Customer Operations

Appendix B – Allowable Runoff QBAR Values

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	0.635	Urban	0.000
SAAR (mm)	1138	Region Number	Ireland South

Results	**l/s**
QBAR Rural	2.0
QBAR Urban	2.0
Q100 years	3.8
Q1 year	1.7
Q30 years	3.2
Q100 years	3.8

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 (%)	0
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)
0-4	0.250	4-8	0.120

Total Area Contributing (ha) = 0.370

Total Pipe Volume (m³) = 12.791

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	25.375	1.450	17.5	0.094	5.00	0.0	0.600	o	225
S2.000	34.185	0.205	166.8	0.041	5.00	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	5.13	87.450	0.094	0.0	0.0	0.0	3.14	125.0	12.7
S2.000	50.00	5.56	86.200	0.041	0.0	0.0	0.0	1.01	40.1	5.6

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)
S2.001	22.785	0.136	167.5	0.021	0.00	0.0	0.600	o	225
S2.002	32.565	0.195	167.0	0.000	0.00	0.0	0.600	o	225
S1.001	26.665	0.764	34.9	0.069	0.00	0.0	0.600	o	225
S1.002	3.965	0.024	165.2	0.052	0.00	0.0	0.600	o	225
S3.000	16.875	0.600	28.1	0.020	5.00	0.0	0.600	o	225
S3.001	5.960	0.036	165.6	0.000	0.00	0.0	0.600	o	225
S4.000	15.945	0.080	199.3	0.021	5.00	0.0	0.600	o	225
S4.001	20.345	0.102	199.5	0.000	0.00	0.0	0.600	o	225
S4.002	15.225	0.076	200.3	0.021	0.00	0.0	0.600	o	225
S4.003	5.865	0.029	202.2	0.000	0.00	0.0	0.600	o	225
S1.003	5.000	0.030	166.7	0.000	0.00	0.0	0.600	o	300
S5.000	24.635	0.123	200.3	0.031	5.00	0.0	0.600	o	225
S5.001	29.350	0.147	199.7	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)
S2.001	50.00	5.94	85.995	0.062	0.0	0.0	0.0	1.01	40.1	8.4
S2.002	50.00	6.48	85.859	0.062	0.0	0.0	0.0	1.01	40.1	8.4
S1.001	50.00	6.68	85.664	0.225	0.0	0.0	0.0	2.22	88.3	30.5
S1.002	50.00	6.74	84.900	0.277	0.0	0.0	0.0	1.01	40.3	37.5
S3.000	50.00	5.11	85.875	0.020	0.0	0.0	0.0	2.48	98.5	2.7
S3.001	50.00	5.21	85.275	0.020	0.0	0.0	0.0	1.01	40.3	2.7
S4.000	50.00	5.29	84.725	0.021	0.0	0.0	0.0	0.92	36.7	2.8
S4.001	50.00	5.66	84.645	0.021	0.0	0.0	0.0	0.92	36.7	2.8
S4.002	50.00	5.93	84.543	0.042	0.0	0.0	0.0	0.92	36.6	5.7
S4.003	50.00	6.04	84.467	0.042	0.0	0.0	0.0	0.92	36.4	5.7
S1.003	50.00	6.81	84.438	0.339	0.0	0.0	0.0	1.22	85.9	45.9
S5.000	50.00	5.45	83.225	0.031	0.0	0.0	0.0	0.92	36.6	4.2
S5.001	50.00	5.98	83.102	0.031	0.0	0.0	0.0	0.92	36.6	4.2

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)
S1.004	12.500	0.050	250.0	0.000	0.00	0.0	0.600	o	300
S1.005	10.850	0.150	72.3	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)
S1.004	50.00	7.02	82.150	0.370	0.0	0.0	0.0	0.99	70.0	50.1
S1.005	50.00	5.12	82.100	0.000	2.0	0.0	0.0	1.54	61.2	2.0

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)
SSW.007	88.950	1.500	1050	S1.000	87.450	225				
SSW.010	87.700	1.500	1050	S2.000	86.200	225				
SSW.009	87.700	1.705	1050	S2.001	85.995	225	S2.000	85.995	225	
SSW.008	87.700	1.841	1200	S2.002	85.859	225	S2.001	85.859	225	
SSW.006	87.500	1.836	1200	S1.001	85.664	225	S1.000	86.000	225	336
							S2.002	85.664	225	
SSW.005	86.400	1.500	1050	S1.002	84.900	225	S1.001	84.900	225	
SSW.012	87.000	1.125	1050	S3.000	85.875	225				
SSW.011	86.400	1.125	1050	S3.001	85.275	225	S3.000	85.275	225	
SSW.016	85.850	1.125	1050	S4.000	84.725	225				
SSW.015	87.700	3.055	1200	S4.001	84.645	225	S4.000	84.645	225	
SSW.014	85.850	1.307	1050	S4.002	84.543	225	S4.001	84.543	225	
SSW.013	85.850	1.383	1050	S4.003	84.467	225	S4.002	84.467	225	
SSW.004	86.400	1.962	1200	S1.003	84.438	300	S1.002	84.876	225	363
							S3.001	85.239	225	726
							S4.003	84.438	225	
SSW.019	84.350	1.125	1050	S5.000	83.225	225				
SSW.018	84.350	1.248	1050	S5.001	83.102	225	S5.000	83.102	225	
SSW.003	86.400	4.250	1200	S1.004	82.150	300	S1.003	84.408	300	2258
							S5.001	82.955	225	730
SSW.002	85.450	3.350	1200	S1.005	82.100	225	S1.004	82.100	300	
SSW.016	83.070	1.120	0		OUTFALL		S1.005	81.950	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	SSW.007	88.950	87.450	1.275	1050
S2.000	o	225	SSW.010	87.700	86.200	1.275	1050
S2.001	o	225	SSW.009	87.700	85.995	1.480	1050
S2.002	o	225	SSW.008	87.700	85.859	1.616	1200
S1.001	o	225	SSW.006	87.500	85.664	1.611	1200
S1.002	o	225	SSW.005	86.400	84.900	1.275	1050
S3.000	o	225	SSW.012	87.000	85.875	0.900	1050
S3.001	o	225	SSW.011	86.400	85.275	0.900	1050
S4.000	o	225	SSW.016	85.850	84.725	0.900	1050
S4.001	o	225	SSW.015	87.700	84.645	2.830	1200
S4.002	o	225	SSW.014	85.850	84.543	1.082	1050
S4.003	o	225	SSW.013	85.850	84.467	1.158	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)
S1.000	25.375	17.5	SSW.006	87.500	86.000	1.275	1200
S2.000	34.185	166.8	SSW.009	87.700	85.995	1.480	1050
S2.001	22.785	167.5	SSW.008	87.700	85.859	1.616	1200
S2.002	32.565	167.0	SSW.006	87.500	85.664	1.611	1200
S1.001	26.665	34.9	SSW.005	86.400	84.900	1.275	1050
S1.002	3.965	165.2	SSW.004	86.400	84.876	1.299	1200
S3.000	16.875	28.1	SSW.011	86.400	85.275	0.900	1050
S3.001	5.960	165.6	SSW.004	86.400	85.239	0.936	1200
S4.000	15.945	199.3	SSW.015	87.700	84.645	2.830	1200
S4.001	20.345	199.5	SSW.014	85.850	84.543	1.082	1050
S4.002	15.225	200.3	SSW.013	85.850	84.467	1.158	1050
S4.003	5.865	202.2	SSW.004	86.400	84.438	1.737	1200

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)
S1.003	o	300	SSW.004	86.400	84.438	1.662	1200
S5.000	o	225	SSW.019	84.350	83.225	0.900	1050
S5.001	o	225	SSW.018	84.350	83.102	1.023	1050
S1.004	o	300	SSW.003	86.400	82.150	3.950	1200
S1.005	o	225	SSW.002	85.450	82.100	3.125	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)
S1.003	5.000	166.7	SSW.003	86.400	84.408	1.692	1200
S5.000	24.635	200.3	SSW.018	84.350	83.102	1.023	1050
S5.001	29.350	199.7	SSW.003	86.400	82.955	3.220	1200
S1.004	12.500	250.0	SSW.002	85.450	82.100	3.050	1200
S1.005	10.850	72.3	SSW.016	83.070	81.950	0.895	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)
S1.005	SSW.016	83.070	81.950	81.950	0	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	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 Online Controls 1

Simulation Criteria for Storm

Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Storage Structures 1

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: SSW.002, DS/PN: S1.005, Volume (m³): 4.6

Design Head (m) 3.500 Hydro-Brake® Type Md4 Invert Level (m) 82.100
Design Flow (l/s) 2.0 Diameter (mm) 38

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	0.5	1.200	1.2	3.000	1.9	7.000	3.0
0.200	0.5	1.400	1.3	3.500	2.1	7.500	3.1
0.300	0.6	1.600	1.4	4.000	2.3	8.000	3.2
0.400	0.7	1.800	1.5	4.500	2.4	8.500	3.3
0.500	0.8	2.000	1.6	5.000	2.5	9.000	3.4
0.600	0.9	2.200	1.7	5.500	2.6	9.500	3.5
0.800	1.0	2.400	1.7	6.000	2.8		
1.000	1.1	2.600	1.8	6.500	2.9		

Storage Structures for Storm

Tank or Pond Manhole: SSW.002, DS/PN: S1.005

Invert Level (m) 82.100

Depth (m)	Area (m^2)	Depth (m)	Area (m^2)
0.000	75.0	3.500	75.0

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 (%)	0
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)
0-4	0.250	4-8	0.120

Total Area Contributing (ha) = 0.370

Total Pipe Volume (m³) = 12.791

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	25.375	1.450	17.5	0.094	5.00	0.0	0.600	o	225
S2.000	34.185	0.205	166.8	0.041	5.00	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	5.13	87.450	0.094	0.0	0.0	0.0	3.14	125.0	12.7
S2.000	50.00	5.56	86.200	0.041	0.0	0.0	0.0	1.01	40.1	5.6

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)
S2.001	22.785	0.136	167.5	0.021	0.00	0.0	0.600	o	225
S2.002	32.565	0.195	167.0	0.000	0.00	0.0	0.600	o	225
S1.001	26.665	0.764	34.9	0.069	0.00	0.0	0.600	o	225
S1.002	3.965	0.024	165.2	0.052	0.00	0.0	0.600	o	225
S3.000	16.875	0.600	28.1	0.020	5.00	0.0	0.600	o	225
S3.001	5.960	0.036	165.6	0.000	0.00	0.0	0.600	o	225
S4.000	15.945	0.080	199.3	0.021	5.00	0.0	0.600	o	225
S4.001	20.345	0.102	199.5	0.000	0.00	0.0	0.600	o	225
S4.002	15.225	0.076	200.3	0.021	0.00	0.0	0.600	o	225
S4.003	5.865	0.029	202.2	0.000	0.00	0.0	0.600	o	225
S1.003	5.000	0.030	166.7	0.000	0.00	0.0	0.600	o	300
S5.000	24.635	0.123	200.3	0.031	5.00	0.0	0.600	o	225
S5.001	29.350	0.147	199.7	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)
S2.001	50.00	5.94	85.995	0.062	0.0	0.0	0.0	1.01	40.1	8.4
S2.002	50.00	6.48	85.859	0.062	0.0	0.0	0.0	1.01	40.1	8.4
S1.001	50.00	6.68	85.664	0.225	0.0	0.0	0.0	2.22	88.3	30.5
S1.002	50.00	6.74	84.900	0.277	0.0	0.0	0.0	1.01	40.3	37.5
S3.000	50.00	5.11	85.875	0.020	0.0	0.0	0.0	2.48	98.5	2.7
S3.001	50.00	5.21	85.275	0.020	0.0	0.0	0.0	1.01	40.3	2.7
S4.000	50.00	5.29	84.725	0.021	0.0	0.0	0.0	0.92	36.7	2.8
S4.001	50.00	5.66	84.645	0.021	0.0	0.0	0.0	0.92	36.7	2.8
S4.002	50.00	5.93	84.543	0.042	0.0	0.0	0.0	0.92	36.6	5.7
S4.003	50.00	6.04	84.467	0.042	0.0	0.0	0.0	0.92	36.4	5.7
S1.003	50.00	6.81	84.438	0.339	0.0	0.0	0.0	1.22	85.9	45.9
S5.000	50.00	5.45	83.225	0.031	0.0	0.0	0.0	0.92	36.6	4.2
S5.001	50.00	5.98	83.102	0.031	0.0	0.0	0.0	0.92	36.6	4.2

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)
S1.004	12.500	0.050	250.0	0.000	0.00	0.0	0.600	o	300
S1.005	10.850	0.150	72.3	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)
S1.004	50.00	7.02	82.150	0.370	0.0	0.0	0.0	0.99	70.0	50.1
S1.005	50.00	5.12	82.100	0.000	2.0	0.0	0.0	1.54	61.2	2.0

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)
SSW.007	88.950	1.500	1050	S1.000	87.450	225				
SSW.010	87.700	1.500	1050	S2.000	86.200	225				
SSW.009	87.700	1.705	1050	S2.001	85.995	225	S2.000	85.995	225	
SSW.008	87.700	1.841	1200	S2.002	85.859	225	S2.001	85.859	225	
SSW.006	87.500	1.836	1200	S1.001	85.664	225	S1.000	86.000	225	336
							S2.002	85.664	225	
SSW.005	86.400	1.500	1050	S1.002	84.900	225	S1.001	84.900	225	
SSW.012	87.000	1.125	1050	S3.000	85.875	225				
SSW.011	86.400	1.125	1050	S3.001	85.275	225	S3.000	85.275	225	
SSW.016	85.850	1.125	1050	S4.000	84.725	225				
SSW.015	87.700	3.055	1200	S4.001	84.645	225	S4.000	84.645	225	
SSW.014	85.850	1.307	1050	S4.002	84.543	225	S4.001	84.543	225	
SSW.013	85.850	1.383	1050	S4.003	84.467	225	S4.002	84.467	225	
SSW.004	86.400	1.962	1200	S1.003	84.438	300	S1.002	84.876	225	363
							S3.001	85.239	225	726
							S4.003	84.438	225	
SSW.019	84.350	1.125	1050	S5.000	83.225	225				
SSW.018	84.350	1.248	1050	S5.001	83.102	225	S5.000	83.102	225	
SSW.003	86.400	4.250	1200	S1.004	82.150	300	S1.003	84.408	300	2258
							S5.001	82.955	225	730
SSW.002	85.450	3.350	1200	S1.005	82.100	225	S1.004	82.100	300	
SSW.016	83.070	1.120	0		OUTFALL		S1.005	81.950	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	SSW.007	88.950	87.450	1.275	1050
S2.000	o	225	SSW.010	87.700	86.200	1.275	1050
S2.001	o	225	SSW.009	87.700	85.995	1.480	1050
S2.002	o	225	SSW.008	87.700	85.859	1.616	1200
S1.001	o	225	SSW.006	87.500	85.664	1.611	1200
S1.002	o	225	SSW.005	86.400	84.900	1.275	1050
S3.000	o	225	SSW.012	87.000	85.875	0.900	1050
S3.001	o	225	SSW.011	86.400	85.275	0.900	1050
S4.000	o	225	SSW.016	85.850	84.725	0.900	1050
S4.001	o	225	SSW.015	87.700	84.645	2.830	1200
S4.002	o	225	SSW.014	85.850	84.543	1.082	1050
S4.003	o	225	SSW.013	85.850	84.467	1.158	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)
S1.000	25.375	17.5	SSW.006	87.500	86.000	1.275	1200
S2.000	34.185	166.8	SSW.009	87.700	85.995	1.480	1050
S2.001	22.785	167.5	SSW.008	87.700	85.859	1.616	1200
S2.002	32.565	167.0	SSW.006	87.500	85.664	1.611	1200
S1.001	26.665	34.9	SSW.005	86.400	84.900	1.275	1050
S1.002	3.965	165.2	SSW.004	86.400	84.876	1.299	1200
S3.000	16.875	28.1	SSW.011	86.400	85.275	0.900	1050
S3.001	5.960	165.6	SSW.004	86.400	85.239	0.936	1200
S4.000	15.945	199.3	SSW.015	87.700	84.645	2.830	1200
S4.001	20.345	199.5	SSW.014	85.850	84.543	1.082	1050
S4.002	15.225	200.3	SSW.013	85.850	84.467	1.158	1050
S4.003	5.865	202.2	SSW.004	86.400	84.438	1.737	1200

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)
S1.003	o	300	SSW.004	86.400	84.438	1.662	1200
S5.000	o	225	SSW.019	84.350	83.225	0.900	1050
S5.001	o	225	SSW.018	84.350	83.102	1.023	1050
S1.004	o	300	SSW.003	86.400	82.150	3.950	1200
S1.005	o	225	SSW.002	85.450	82.100	3.125	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)
S1.003	5.000	166.7	SSW.003	86.400	84.408	1.692	1200
S5.000	24.635	200.3	SSW.018	84.350	83.102	1.023	1050
S5.001	29.350	199.7	SSW.003	86.400	82.955	3.220	1200
S1.004	12.500	250.0	SSW.002	85.450	82.100	3.050	1200
S1.005	10.850	72.3	SSW.016	83.070	81.950	0.895	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)
S1.005	SSW.016	83.070	81.950	81.950	0	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	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 Online Controls 1

Simulation Criteria for Storm

Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Storage Structures	1		

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: SSW.002, DS/PN: S1.005, Volume (m³): 4.6

Design Head (m) 3.500 Hydro-Brake® Type Md4 Invert Level (m) 82.100
Design Flow (l/s) 2.0 Diameter (mm) 38

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	0.5	1.200	1.2	3.000	1.9	7.000	3.0
0.200	0.5	1.400	1.3	3.500	2.1	7.500	3.1
0.300	0.6	1.600	1.4	4.000	2.3	8.000	3.2
0.400	0.7	1.800	1.5	4.500	2.4	8.500	3.3
0.500	0.8	2.000	1.6	5.000	2.5	9.000	3.4
0.600	0.9	2.200	1.7	5.500	2.6	9.500	3.5
0.800	1.0	2.400	1.7	6.000	2.8		
1.000	1.1	2.600	1.8	6.500	2.9		

Storage Structures for Storm

Tank or Pond Manhole: SSW.002, DS/PN: S1.005

Invert Level (m) 82.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	75.0	3.500	75.0

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%					
S2.000	15 Winter	100	0%					
S2.001	15 Winter	100	0%					
S2.002	15 Winter	100	0%	100/15 Winter				
S1.001	15 Winter	100	0%	100/15 Summer				
S1.002	15 Winter	100	0%	100/15 Summer				
S3.000	15 Winter	100	0%					
S3.001	15 Winter	100	0%					
S4.000	15 Winter	100	0%					
S4.001	15 Winter	100	0%	100/15 Summer				
S4.002	15 Winter	100	0%	100/15 Summer				
S4.003	15 Winter	100	0%	100/15 Summer				
S1.003	15 Winter	100	0%	100/15 Summer				
S5.000	1440 Winter	100	0%	100/60 Winter	100/360 Winter			6
S5.001	1440 Winter	100	0%	100/60 Summer	100/360 Winter			6
S1.004	1440 Winter	100	0%	100/15 Summer				
S1.005	1440 Winter	100	0%	100/15 Summer				

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	SSW.007	87.534	-0.141	0.000	0.29	0.0	33.9	OK
S2.000	SSW.010	86.298	-0.127	0.000	0.38	0.0	14.5	OK
S2.001	SSW.009	86.129	-0.091	0.000	0.59	0.0	21.5	OK
S2.002	SSW.008	86.087	0.003	0.000	0.64	0.0	24.1	SURCHARGED
S1.001	SSW.006	86.039	0.150	0.000	0.85	0.0	69.9	SURCHARGED
S1.002	SSW.005	85.470	0.345	0.000	3.11	0.0	86.3	SURCHARGED
S3.000	SSW.012	85.918	-0.182	0.000	0.08	0.0	7.2	OK
S3.001	SSW.011	85.350	-0.150	0.000	0.24	0.0	7.1	OK
S4.000	SSW.016	84.932	-0.018	0.000	0.21	0.0	6.8	OK
S4.001	SSW.015	84.919	0.049	0.000	0.24	0.0	7.9	SURCHARGED
S4.002	SSW.014	84.906	0.138	0.000	0.49	0.0	16.0	SURCHARGED
S4.003	SSW.013	84.882	0.190	0.000	0.70	0.0	19.1	SURCHARGED
S1.003	SSW.004	84.871	0.133	0.000	1.84	0.0	104.6	SURCHARGED
S5.000	SSW.019	84.372	0.922	21.671	0.04	0.0	1.5	FLOOD
S5.001	SSW.018	84.372	1.045	21.768	0.05	0.0	1.7	FLOOD
S1.004	SSW.003	84.380	1.930	0.000	0.16	0.0	9.0	SURCHARGED
S1.005	SSW.002	84.379	2.054	0.000	0.03	0.0	1.7	SURCHARGED

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)	446.00	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	28.385	1.419	20.0	0.000	4	0.0	1.500	o	150
F1.001	44.050	2.046	21.5	0.000	4	0.0	1.500	o	150
F1.002	11.780	0.079	150.0	0.000	0	0.0	1.500	o	150
F2.000	17.735	0.500	35.5	0.000	2	0.0	1.500	o	150
F2.001	3.650	0.183	19.9	0.000	0	0.0	1.500	o	150
F2.002	16.565	0.350	47.3	0.000	0	0.0	1.500	o	150
F2.003	3.300	0.055	60.0	0.000	0	0.0	1.500	o	150
F1.003	21.315	0.221	96.4	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)
F1.000	87.065	0.000	0.0	4	0.0	7	0.43	1.96	34.7	0.1
F1.001	85.646	0.000	0.0	8	0.0	10	0.53	1.89	33.5	0.2
F1.002	83.600	0.000	0.0	8	0.0	15	0.27	0.71	12.6	0.2
F2.000	85.950	0.000	0.0	2	0.0	6	0.28	1.47	26.1	0.1
F2.001	84.983	0.000	0.0	2	0.0	5	0.34	1.97	34.8	0.1
F2.002	84.800	0.000	0.0	2	0.0	6	0.26	1.28	22.5	0.1
F2.003	84.450	0.000	0.0	2	0.0	6	0.24	1.13	20.0	0.1
F1.003	83.521	0.000	0.0	10	0.0	13	0.32	1.17	46.5	0.3

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)
F3.000	18.915	0.315	60.0	0.000	2	0.0	1.500	o	150
F4.000	37.090	0.618	60.0	0.000	2	0.0	1.500	o	150
F3.001	2.385	0.040	59.6	0.000	0	0.0	1.500	o	150
F3.002	19.975	0.333	60.0	0.000	0	0.0	1.500	o	150
F1.004	3.865	0.064	60.0	0.000	0	0.0	1.500	o	225
F1.005	25.965	0.173	150.0	0.000	0	0.0	1.500	o	225
F1.006	5.165	0.034	150.0	0.000	0	0.0	1.500	o	225
F1.007	42.775	0.285	150.0	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)
F3.000	86.950	0.000	0.0	2	0.0	6	0.24	1.13	20.0	0.1
F4.000	86.300	0.000	0.0	2	0.0	6	0.24	1.13	20.0	0.1
F3.001	83.673	0.000	0.0	4	0.0	9	0.30	1.14	20.1	0.1
F3.002	83.633	0.000	0.0	4	0.0	9	0.30	1.13	20.0	0.1
F1.004	83.300	0.000	0.0	14	0.0	14	0.42	1.48	59.0	0.4
F1.005	83.236	0.000	0.0	14	0.0	17	0.31	0.94	37.2	0.4
F1.006	82.839	0.000	0.0	14	0.0	17	0.31	0.94	37.2	0.4
F1.007	82.805	0.000	0.0	14	0.0	17	0.31	0.94	37.2	0.4

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)
FFS.001	88.950	1.885	1200	F1.000	87.065	150				
FFS.002	87.500	1.854	1200	F1.001	85.646	150	F1.000	85.646	150	
FFS.003	85.450	1.850	1200	F1.002	83.600	150	F1.001	83.600	150	
FFS.010	87.000	1.050	1050	F2.000	85.950	150				
FFS.011	86.500	1.517	1050	F2.001	84.983	150	F2.000	85.450	150	467
FFS.012	85.850	1.050	1050	F2.002	84.800	150	F2.001	84.800	150	
FFS.013	85.500	1.050	1050	F2.003	84.450	150	F2.002	84.450	150	
FFS.004	85.500	1.979	1200	F1.003	83.521	225	F1.002	83.521	150	
							F2.003	84.395	150	799
FFS.014	88.000	1.050	1050	F3.000	86.950	150				
FFS.017	87.350	1.050	1050	F4.000	86.300	150				
FFS.015	87.700	4.027	1200	F3.001	83.673	150	F3.000	86.635	150	2962
							F4.000	85.682	150	2009
FFS.016	86.000	2.367	1200	F3.002	83.633	150	F3.001	83.633	150	
FFS.005	84.350	1.050	1050	F1.004	83.300	225	F1.003	83.300	225	
							F3.002	83.300	150	
FFS.006	84.350	1.114	1050	F1.005	83.236	225	F1.004	83.236	225	
FFS.007	84.350	1.511	1050	F1.006	82.839	225	F1.005	83.063	225	224
FFS.008	83.250	0.445	1050	F1.007	82.805	225	F1.006	82.805	225	
FFS.009	83.720	1.201	0		OUTFALL		F1.007	82.519	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	150	FFS.001	88.950	87.065	1.735	1200
F1.001	o	150	FFS.002	87.500	85.646	1.704	1200
F1.002	o	150	FFS.003	85.450	83.600	1.700	1200
F2.000	o	150	FFS.010	87.000	85.950	0.900	1050
F2.001	o	150	FFS.011	86.500	84.983	1.367	1050
F2.002	o	150	FFS.012	85.850	84.800	0.900	1050
F2.003	o	150	FFS.013	85.500	84.450	0.900	1050
F1.003	o	225	FFS.004	85.500	83.521	1.754	1200
F3.000	o	150	FFS.014	88.000	86.950	0.900	1050
F4.000	o	150	FFS.017	87.350	86.300	0.900	1050
F3.001	o	150	FFS.015	87.700	83.673	3.877	1200
F3.002	o	150	FFS.016	86.000	83.633	2.217	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	28.385	20.0	FFS.002	87.500	85.646	1.704	1200
F1.001	44.050	21.5	FFS.003	85.450	83.600	1.700	1200
F1.002	11.780	150.0	FFS.004	85.500	83.521	1.829	1200
F2.000	17.735	35.5	FFS.011	86.500	85.450	0.900	1050
F2.001	3.650	19.9	FFS.012	85.850	84.800	0.900	1050
F2.002	16.565	47.3	FFS.013	85.500	84.450	0.900	1050
F2.003	3.300	60.0	FFS.004	85.500	84.395	0.955	1200
F1.003	21.315	96.4	FFS.005	84.350	83.300	0.825	1050
F3.000	18.915	60.0	FFS.015	87.700	86.635	0.915	1200
F4.000	37.090	60.0	FFS.015	87.700	85.682	1.868	1200
F3.001	2.385	59.6	FFS.016	86.000	83.633	2.217	1200
F3.002	19.975	60.0	FFS.005	84.350	83.300	0.900	1050

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)
F1.004	o	225	FFS.005	84.350	83.300	0.825	1050
F1.005	o	225	FFS.006	84.350	83.236	0.889	1050
F1.006	o	225	FFS.007	84.350	82.839	1.286	1050
F1.007	o	225	FFS.008	83.250	82.805	0.220	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)
F1.004	3.865	60.0	FFS.006	84.350	83.236	0.889	1050
F1.005	25.965	150.0	FFS.007	84.350	83.063	1.062	1050
F1.006	5.165	150.0	FFS.008	83.250	82.805	0.220	1050
F1.007	42.775	150.0	FFS.009	83.720	82.519	0.976	0

Free Flowing Outfall Details for Foul - Main

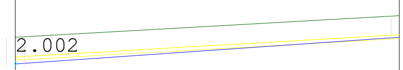
Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.007	FFS.009	83.720	82.519	82.520	0	0

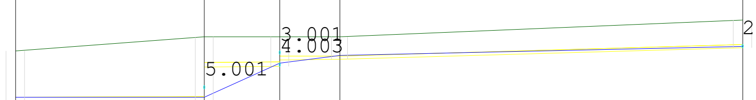
Simulation Criteria for Foul - Main

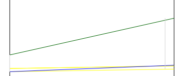
Volumetric Runoff Coeff	0.750	Foul Sewage per hectare (l/s)	0.000
PIMP (% impervious)	100	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (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	SSW.006	SSW.007	
Hor Scale 500 Ver Scale 500 Datum (m) 78.000			
PN		S1.000	
Dia (mm)		225	
Slope (1:X)		17.5	
Cover Level (m)	87.500	88.950	
Invert Level (m)		86.000 87.450	
Length (m)		25.375	

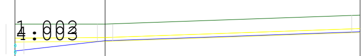
MH Name	SSW.002	SSW.003			SSW.006	
Hor Scale 500 Ver Scale 500 Datum (m) 75.000						
PN		S1.004			S1.001	
Dia (mm)		300			225	
Slope (1:X)		250.0			34.9	
Cover Level (m)	85.450	86.400	86.400	86.400	87.500	
Invert Level (m)		82.100 82.150	84.408 84.438	84.876 84.900	84.900 85.664	
Length (m)		12.500			26.665	

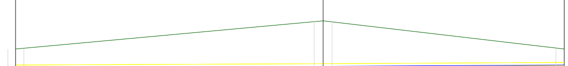
MH Name	SSW.016	SSW.002	
Hor Scale 500 Ver Scale 500 Datum (m) 74.000			
PN		S1.005	
Dia (mm)		225	
Slope (1:X)		72.3	
Cover Level (m)	83.070	85.450	
Invert Level (m)		81.950 / 82.100	
Length (m)		10.850	

MH Name	SSW.009	SSW.010	
Hor Scale 500 Ver Scale 500 Datum (m) 78.000			
PN		S2.000	
Dia (mm)		225	
Slope (1:X)		166.8	
Cover Level (m)	87.700	87.700	
Invert Level (m)		85.995 / 86.200	
Length (m)		34.185	

MH Name	SSW.008	SSW.009	
Hor Scale 500 Ver Scale 500 Datum (m)77.000			
PN		S2.001	
Dia (mm)		225	
Slope (1:X)		167.5	
Cover Level (m)	87.700	87.700	
Invert Level (m)	85.859	85.995	
Length (m)		22.785	

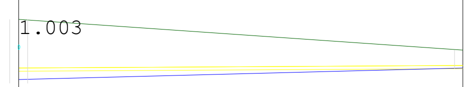
MH Name	SSW.006	SSW.008	
Hor Scale 500 Ver Scale 500 Datum (m)77.000		1.000	
PN		S2.002	
Dia (mm)		225	
Slope (1:X)		167.0	
Cover Level (m)	87.500	87.700	
Invert Level (m)	85.664	85.859	
Length (m)		32.565	

MH Name	SSW.004		SSW.012	
Hor Scale 500 Ver Scale 500 Datum (m) 76.000				
PN			S3.000	
Dia (mm)			225	
Slope (1:X)			28.1	
Cover Level (m)	86.400	86.400	87.000	
Invert Level (m)		85.239 85.275	85.275 85.875	
Length (m)			16.875	

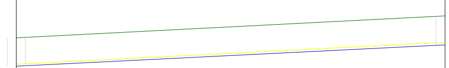
MH Name	SSW.014	SSW.015	SSW.016	
Hor Scale 500 Ver Scale 500 Datum (m) 77.000				
PN		S4.001	S4.000	
Dia (mm)		225	225	
Slope (1:X)		199.5	199.3	
Cover Level (m)	85.850	87.700	85.850	
Invert Level (m)		84.543 84.645	84.645 84.725	
Length (m)		20.345	15.945	

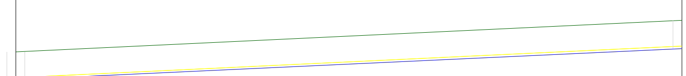
MH Name	SSW.004		SSW.014	
Hor Scale 500 Ver Scale 500 Datum (m) 76.000				
PN			S4.002	
Dia (mm)			225	
Slope (1:X)			200.3	
Cover Level (m)	86.400	85.850	85.850	
Invert Level (m)		84.438 84.467	84.467 84.543	
Length (m)			15.225	

MH Name	SSW.018	SSW.019	
Hor Scale 500 Ver Scale 500 Datum (m) 74.000			
PN		S5.000	
Dia (mm)		225	
Slope (1:X)		200.3	
Cover Level (m)	84.350	84.350	
Invert Level (m)		83.102 83.225	
Length (m)		24.635	

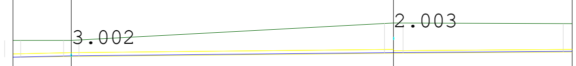
MH Name	SSW.003		SSW.018	
Hor Scale 500 Ver Scale 500 Datum (m) 75.000				
PN		S5.001		
Dia (mm)		225		
Slope (1:X)		199.7		
Cover Level (m)	86.400		84.350	
Invert Level (m)	82.955		83.102	
Length (m)		29.350		

Appendix G – Foul Sewer Longitudinal Sections

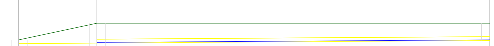
MH Name	FFS.002	FFS.001	
Hor Scale 500 Ver Scale 500 Datum (m)78.000			
PN		F1.000	
Dia (mm)		150	
Slope (1:X)		20.0	
Cover Level (m)	87.500	88.950	
Invert Level (m)		85.646 87.065	
Length (m)		28.385	

MH Name	FFS.003	FFS.002	
Hor Scale 500 Ver Scale 500 Datum (m)76.000			
PN		F1.001	
Dia (mm)		150	
Slope (1:X)		21.5	
Cover Level (m)	85.450	87.500	
Invert Level (m)		83.600 85.646	
Length (m)		44.050	

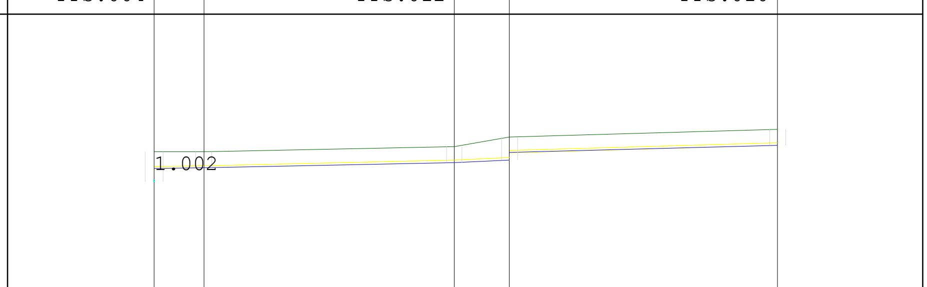
MH Name	FFS.006		FFS.004	FFS.003	
Hor Scale 500 Ver Scale 500 Datum (m) 75.000					
PN			F1.003	F1.002	
Dia (mm)			225	150	
Slope (1:X)			96.4	150.0	
Cover Level (m)	84.350	84.350	85.500	85.450	
Invert Level (m)		83.236 83.300	83.300 83.521	83.521 83.600	
Length (m)			21.315	11.780	



MH Name	FFS.008		FFS.006	
Hor Scale 500 Ver Scale 500 Datum (m) 74.000				
PN			F1.005	
Dia (mm)			225	
Slope (1:X)			150.0	
Cover Level (m)	83.250	84.350	84.350	
Invert Level (m)		82.805 82.839	83.063 83.236	
Length (m)			25.965	



MH Name	FFS.009	FFS.008		
Hor Scale 500 Ver Scale 500 Datum (m) 74.000				
PN		F1.007		
Dia (mm)		225		
Slope (1:X)		150.0		
Cover Level (m)	83.720	83.250		
Invert Level (m)		82.519 82.805		
Length (m)		42.775		

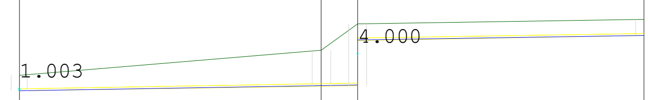


MH Name	FFS.004		FFS.012		FFS.010	
Hor Scale 500 Ver Scale 500 Datum (m) 76.000						
PN			F2.002		F2.000	
Dia (mm)			150		150	
Slope (1:X)			47.3		35.5	
Cover Level (m)	85.500	85.500	85.850	86.500	87.000	
Invert Level (m)		84.450	84.450 84.800	84.800 84.983	85.450 85.950	
Length (m)			16.565		17.735	

Hor Scale 500

Ver Scale 500

Datum (m) 76.000

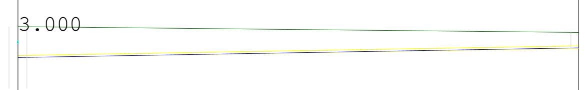


MH Name	FFS.005		FFS.016			FFS.014
PN		F3.002			F3.000	
Dia (mm)		150			150	
Slope (1:X)		60.0			60.0	
Cover Level (m)	84.350		86.000	87.700		88.000
Invert Level (m)	83.300		83.633	83.673 86.635		86.950
Length (m)		19.975			18.915	

Hor Scale 500

Ver Scale 500

Datum (m) 76.000



MH Name	FFS.015		FFS.017
PN		F4.000	
Dia (mm)		150	
Slope (1:X)		60.0	
Cover Level (m)	87.700		87.350
Invert Level (m)	85.682		86.300
Length (m)		37.090	

Appendix H - Petrol Interceptor Details

Conder® OIL/WATER SEPARATORS

OIL/WATER SEPARATORS

THE PARTNER OF CHOICE

PREMIER TECH AQUA

40 years OF PASSION

The Conder Range of Oil Separators are for installation on surface water drainage systems and are designed to prevent hydrocarbons (e.g. diesel, petrol, engine oil) from mixing with surface water and entering our drainage systems.

Pollution prevention is a critical part of sustainable drainage systems and statutory regulations are in force to control the discharge of hydrocarbons, with severe penalties imposed for non-compliance.

Compliance

The Conder Range of Oil Separators fully conform to both the Environment Agency's latest PPG guidelines and European standard BSEN-858-1-2 and are proven to effectively separate oil and water. Under test, the Conder Bypass performed to less than 1 mg/L and in doing so guarantees minimal environmental impact and ensures public safety.

Classes of Separators

There are two classes of separators which are defined by performance.

Class 1	Class 2*
Class 1 Separators are designed to achieve a concentration of less than 5 mg/L of oil under standard test conditions. These conditions are required for discharges to surface water drains and the water environment.	Class 2 Separators are designed to achieve a concentration of less than 100 mg/L oil under standard test conditions and are suitable for dealing with discharges where a lower quality requirement applies, such as discharges to the foul sewer.

*Class 2 available in forecourt separators only.

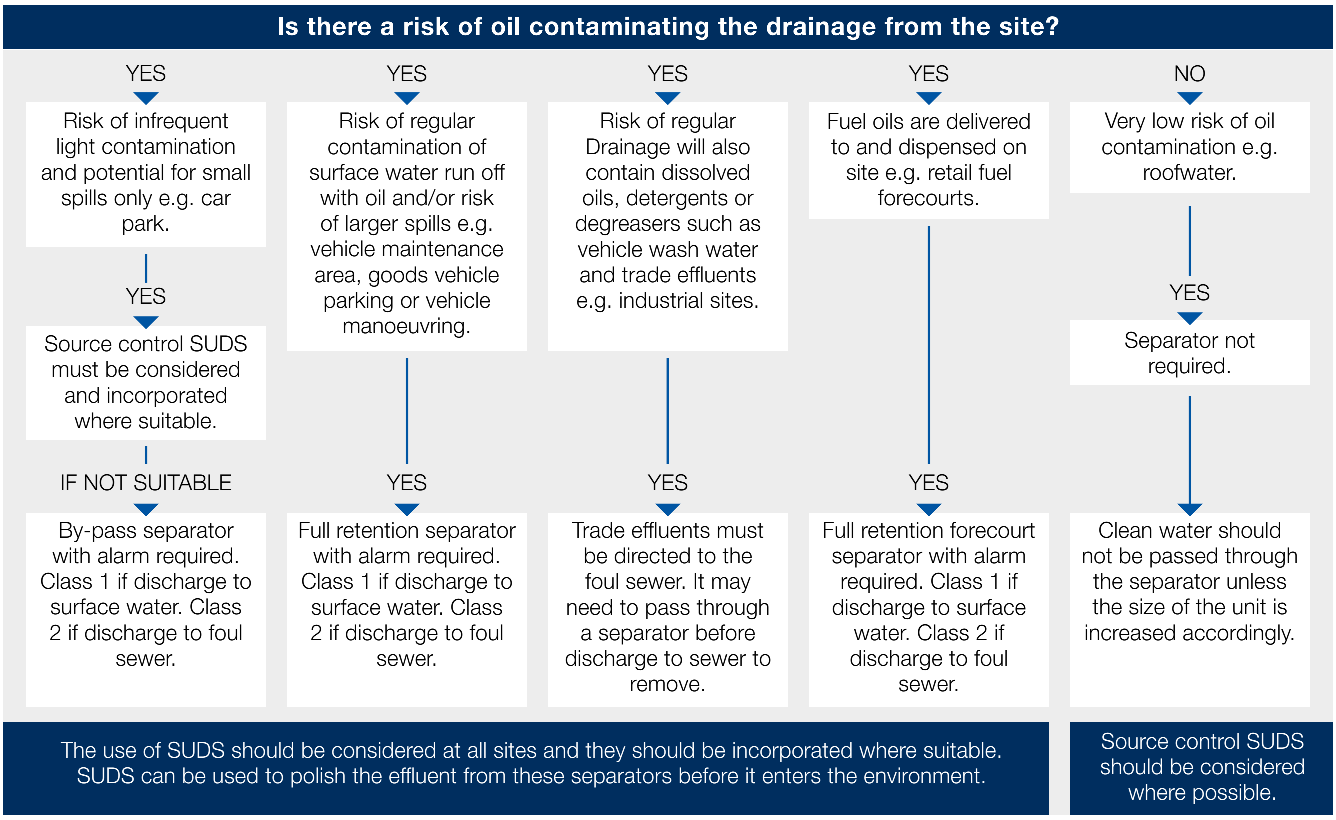
Selecting the Right Separator

Premier Tech Aqua offers a full range of Separators for varying use and application:

- Bypass Separator
- Full Retention Separator
- Forecourt Separator
- Wash Down and Silt Separators

If you're unsure of what type of Conder Oil Separator you require, please use the chart below to help you identify the most suitable product for your project.

The guidance given is for the use of separators in surface water drainage systems that discharge to rivers and soakways.



Separator Alarms

All oil separators are required by legislation to be fitted with an oil level alarm system with recommendations that the alarm is installed, tested, commissioned and regularly serviced by a qualified technician.

The alarm indicates when the separator is in need of immediate maintenance in order for it to continue to work effectively. Premier Tech Aqua can offer a full technical and service package for a variety of alarm options.

The Conder Range of Bypass Separators

The Conder Range of Bypass Separators are used to fully treat all flows generated by rainfall rates of up to 6.5 mm/hr. Bypass Separators are used when it is considered an acceptable risk not to provide full treatment for high flows, for example where only small spillages occur and the risk of spillage is small.

Typical Applications

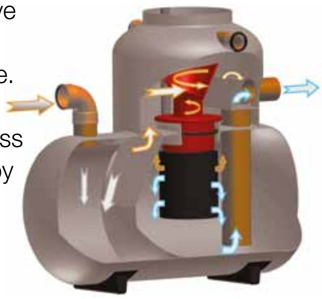
- Car parks
- Roadways and major trunk roads
- Light industrial and goods yards

Features and Benefits

- Innovative design
- Compact and easy to handle/install
- Fully compliant to the Environment Agency's PPG3 guidelines
- Low product and install costs
- Full BSI certification
- Exceeds industry standards
- Easy to service
- Fully tested and verified with a range from CNSB 3 to CNSB 1000 (Class 1)

Performance

Conder Bypass Separators have been designed to treat all flow up to the designed nominal size. Any flow in excess of the nominal size is allowed to bypass the separation chamber, thereby keeping the separated and trapped oil safe.



How it Works

Step 1

During the early part of a rain storm, which is a time of high oil contamination, all of the contaminated water flow passes through the sediment collection chamber and enters the separation chamber through a patented oil skimming and filter device.

Step 2

All of the oil then proceeds to the separation chamber where it is separated to the Class 1 standard of 5 mg/L and safely trapped.

Step 3

As the rainstorm builds up to its maximum and the level of oil contamination reduces significantly, the nominal size flow continues to pass through the separation chamber and any excess flow of virtually clean water is allowed to bypass directly to the outlet.

Specifications

Larger models up to CNSB 1000 are available.

Area Drained (m^2)	Tank Code including Silt	Length including Silt (mm)	Silt Capacity (L)	Oil Storage Capacity (L)	Diameter (mm)	Height (mm)	Base to Inlet Invert (mm)	Base to Outlet Invert (mm)	Access (mm)
1667	CNSB3s/21	1400	300	45	1026	2200	1730	1680	750
2500	CNSB4.5s/21	1785	450	67.5	1026	1875	1270	1220	600
3333	CNSB6s/21	1975	600	90	1026	1875	1270	1220	600
4444	CNSB8s/21	2165	800	120	1026	1875	1270	1220	600
5555	CNSB10s/21	2485	1000	150	1026	1875	1270	1220	600
8333	CNSB15s/21	2670	1500	225	1210	2150	1450	1400	600
11111	CNSB20s/21	3115	2000	300	1210	2150	1450	1400	600
13889	CNSB25s/21	3555	2500	375	1210	2150	1450	1400	600
16667	CNSB30s/21	3470	3000	450	1510	2690	1770	1720	750
22222	CNSB40s/21	4040	4000	600	1510	2690	1770	1720	750
27778	CNSB50s/21	4655	5000	750	1510	2690	1770	1720	750
33333	CNSB60s/21	4415	6000	900	1880	3300	2025	1975	2 x 600
44444	CNSB80s/21	5225	8000	1200	1880	3300	2025	1975	2 x 600
55556	CNSB100s/21	6010	10,000	1500	1880	3300	2025	1975	2 x 600

Note: It is a requirement of PPG3 that you have a silt capacity either in your tank or in an upstream catch pit.

The Conder Range of Full Retention Separators

The Conder Range of Full Retention Separators are designed to treat the full flow that can be delivered by a drainage system, which is normally equivalent to the flow generated by a rainfall intensity of 65 mm/hr. Full Retention Separators are used where there is a risk of regular contamination with oil and a foreseeable risk of significant spillages.

Typical Applications

- Sites with a high-risk of oil contamination
- Fuel storage depots
- Refuelling facilities
- Petrol forecourts
- Vehicle maintenance areas/workshops
- Where discharge is to a sensitive environment

Features and Benefits

- All surface water is treated
- Automatic closure device (ACD) fitted as standard

Performance

All Conder Full Retention Separators have an automatic closure device (ACD) fitted as standard. This is compulsory for all PPG3 compliant Full Retention Separators and prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

How it Works

Step 1

Contaminated water enters the separator where the liquid is retained for a sufficient period to ensure that the lighter than water pollutants (such as oil, petrol) separate and rise to the surface of the water.

Step 2

The decontaminated water then passes through the coalescing filter before it is safely discharged from the separator, with the remaining pollutants being retained in the separator.

Step 3

Retained pollutants must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated. This waste should be removed from the separator under the terms of The Waste Management Code of Practice.

Specifications

Larger models available upon request.

Area Drained (m^2)	Tank code Incl. Silt	Length including Silt (mm)	Slit Capacity (L)	Oil Storage Capacity	Diameter (mm)	Height (mm)	Base to Inlet Invert (mm)	Base to Outlet Invert (mm)
222	CNS4s/11	2319	400	40	1026	1655	1295	1245
333	CNS6s/11	3414	600	60	1026	1655	1295	1245
444	CNS8s/11	3197	800	80	1210	1855	1480	1430
556	CNS10s/11	3957	1000	100	1210	1855	1480	1430
833	CNS15s/11	3870	1500	150	1510	2180	1780	1730
1111	CNS20s/11	5060	2000	200	1510	2180	1780	1730
1667	CNS30s/11	5369	3000	300	1880	2560	2030	1980
2222	CNS40s/11	7059	4000	400	1880	2560	2030	1980
2778	CNS50s/11	4080	5000	500	2600	3315	2730	2680
3333	CNS60s/11	4805	6000	600	2600	3315	2730	2680
3889	CNS70s/11	5529	7000	700	2600	3315	2730	2680
4444	CNS80s/11	6254	8000	800	2600	3315	2730	2680
5556	CNS100s/11	6751	10,000	1,000	2600	3315	2730	2680

Note: It is a requirement of PPG3 that you have a silt capacity either in your tank or in an upstream catch pit.

Conder Range of Forecourt Separators

Conder Forecourt Separators have been designed for specific use in petrol filling stations and other similar applications. The size of this separator has been specifically increased in order to retain the possible loss of the contents from one compartment of a road tanker, which could be up to 7,600 litres.

Forecourt separators are an essential infrastructure requirement for all forecourts so as to ensure compliance with both health and safety and environmental legislation.

Typical Applications

- Petrol forecourts
- Refuelling facilities
- Fuel storage depot

Features and Benefits

- All surface water is treated
- Available in Class 1 and Class 2
- Automatic Closure Device (ACD) fitted as standard
- Includes 2000L silt capacity

Performance

All Conder Forecourt Separators have an automatic closure device (ACD) fitted as standard. This is compulsory for all PPG3 compliant Full Retention Separators and prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

How it Works

Step 1

Contaminated water enters the separator where the liquid is retained for a sufficient period to ensure that the lighter than water pollutants (such as oil, petrol) separate and rise to the surface of the water.

Step 2

The decontaminated water then passes through the coalescing filter before it is safely discharged from the separator, with the remaining pollutants being retained in the separator.

Step 3

Retained pollutants must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated. This waste should be removed from the separator under the terms of The Waste Management Code of Practice.

Specifications

Tank Code	Volume (L)	Length (mm)	Diameter (mm)	Height (mm)	Base to Inlet (mm)	Base to Outlet (mm)	Access (mm)
ANO/11*	10,000	4,250	1,800	2,100	1,600	1,550	750
ANT/12**	10,000	4,250	1,800	2,100	1,600	1,550	750
LNO/11***	10,000	4,250	1,800	2,100	1,600	1,550	750

*Class 1 Forecourt Separator suitable for discharging to surface water drains

**Class 2 Forecourt Separator suitable for discharging to foul drains only

***Class 1 Forecourt Separator suitable for installation in granular materials

Conder Range of Washdown and Silt Separators

Conder Washdown and Silt Separators are for use in areas such as car washes, pressure wash facilities or other cleaning facilities and must be discharged to the foul water drainage system in accordance with PPG13.

Typical Applications

- Car wash facilities
- Tool hire depots
- Pressure washer facilities

Features and Benefits

- Available in 1,2 and 3 stage options
- Efficient silt and hydrocarbon removal

Performance

The Environment Agency's PPG13 requires that discharge from pressure washers must discharge to a foul drainage system. Where there is no foul drainage available, the effluent must be contained within a sealed drainage system or catchpit for disposal by a licenced waste contractor.

Silt build-up is the primary concern with washdown facilities and so the Conder range of washdown and silt separators are used to remove the silt and will allow some separation of hydrocarbons.

Detergents that are used in wash down areas will break down and disperse hydrocarbons (hindering the separation process). Therefore, it is important to remember the main function of wash down separators is to remove silt.

How it Works

Step 1

Contaminated wash down water enters the unit where the heavier solids, silts and settle to the bottom of the tank.

Step 2

The lighter liquids, hydrocarbons, will rise to the surface and be retained within the tank.

Step 3

Treated water will exit the separator via the dipped outlet.

Specifications

Although it is recognised that single stage separators give the most efficient separation, 2 and 3 chamber Conder Washdown and Silt Separators are available on request.

Tank Code	Capacity (L)	Silt Storage	Diameter (mm)	Length (mm)	Access Diameter (mm)	Base to Inlet Invert (mm)	Base to Outlet Invert (mm)
CWS2/12	2,000	1,000	1,000	2,713	600	1,290	1,240
CWS3/12	3,000	1,500	1,200	2,853	600	1,475	1,425
CWS4/12	4,000	2,000	1,200	3,737	600	1,475	1,425
CWS6/12	6,000	3,000	1,500	3,636	600	1,775	1,725
CWS8/12	8,000	4,000	1,800	3,443	600	2,030	1,980
CWS10/12	10,000	5,000	1,800	4,250	600	2,030	1,980

FST Silt Trap

Large quantities of silt can be associated with washdown areas. The Conder FST silt trap is ideal for easy removal of silt either manually or by a waste disposal contractor.

The FST range of silt traps are available with varying grades of covers from B125 up to E600 to allow installation in all types of vehicle or plant washdown facilities.

Conder Range of Alarm Systems

All separators must be fitted with an alarm in order to provide visual and audible warning when the level of oil reaches 90% of its storage volume, as required by The Environment Agency's PPG3.

The alarm system will then be triggered to indicate that the separator is in need of immediate emptying, in order to continue effective operation.

Features and Benefits

- Option for installation at a remote supervisory point
- Audible and visual
- Eliminates unnecessary waste management visits
- Easy installation
- Audible, visual and text message alert alarm systems available

Mains Powered System

Mains powered alarm systems are best suited to new build situations or sites where installation of the necessary cabling and ducting is straight forward and economical. The probe located in the separator will, when surrounded by floating hydrocarbons, activate an alarm condition on the remote panel to advise that the unit requires emptying.

Solar Powered System (Flashing Beacon)

This option requires no mains power supply or any significant cabling or ducting, making it extremely economical for large sites and retro fitting alarms to existing oil separators. A High Intensity Beacon will flash when a problem is detected.

Solar GSM Alarm

The Solar GSM Alarm sends a status report on your separator to a mobile phone number of your choice. The status of the GSM Alarm can also be tested at any time by simply sending a pre-recorded text message via your directed mobile phone, for additional peace of mind.

Peripherals

Coalescing Filters

The Conder Coalescing Filter is designed to separate residual oil in already separated oil/water and ensures a discharge quality of less than 5 mg/L of oil in water.

Features and Benefits

- Handle for easy removal and cleaning
- Flashing beacons (with option of siren kit)
- Kiosks
- Probe brackets
- Bas 1000 intrinsically safe junction box
- High level probe
- Silt level probe
- Oil level probe

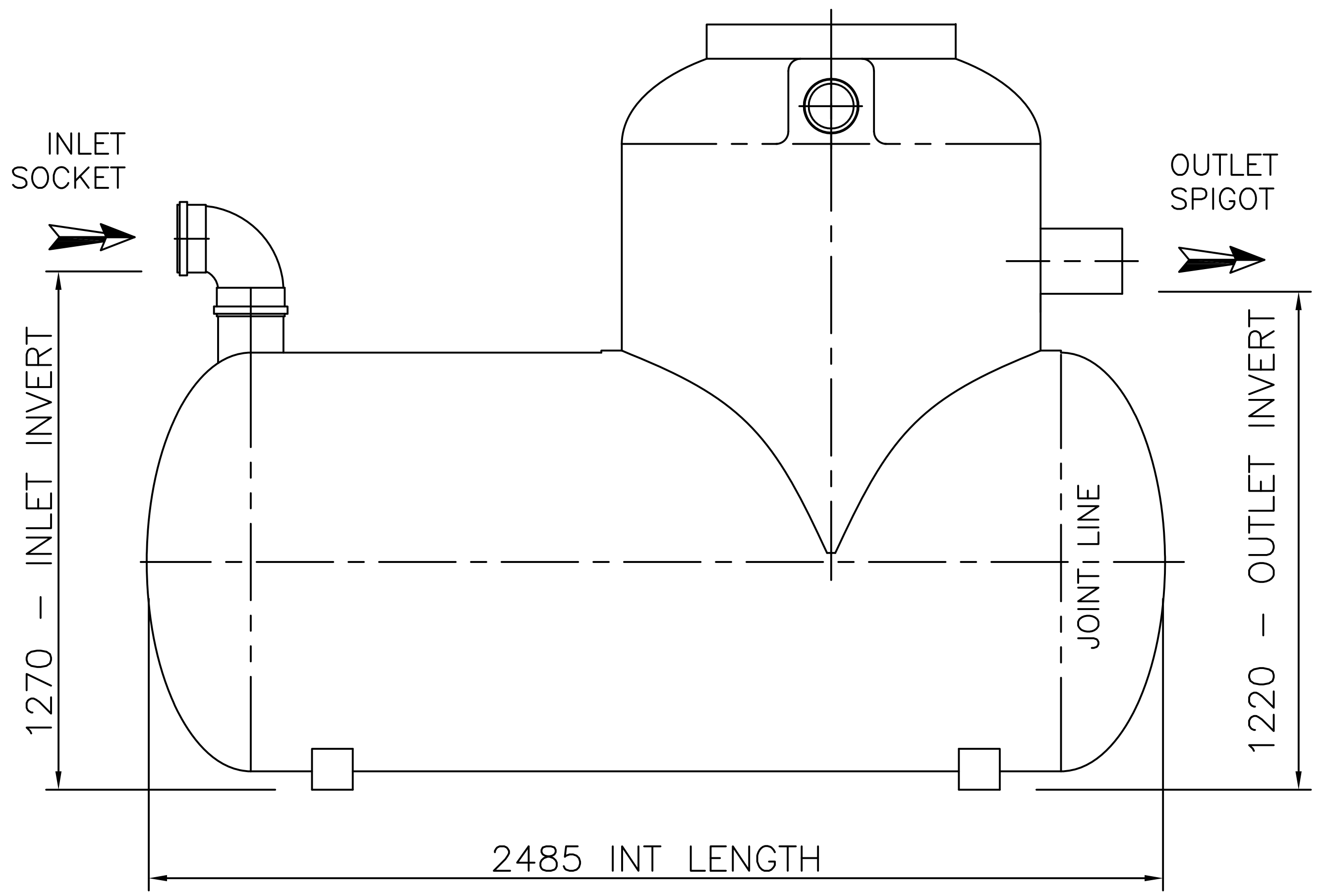
Servicing

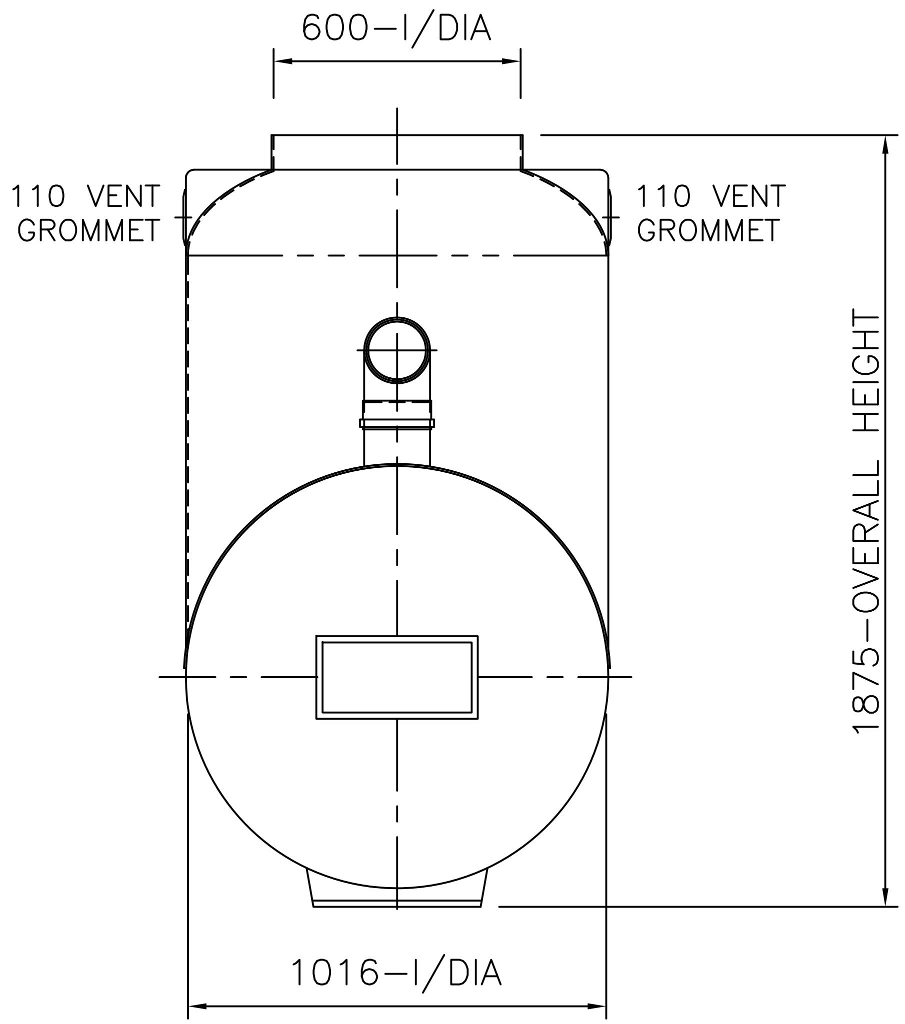
The Environmental Agency's PPG3 guidelines stipulate that every 6 months, and in accordance with manufacturer's instructions, experienced personnel should carry out maintenance to both the separator and alarm.

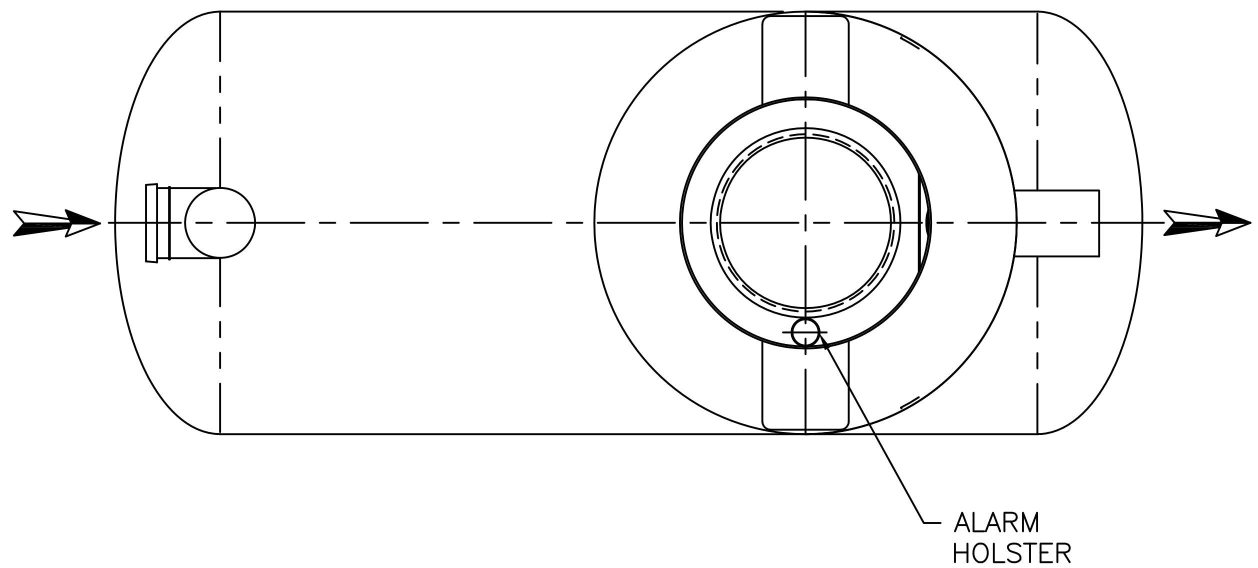
Premier Tech Aqua and our service partners can offer a full technical and service package including separator and alarm installation, commissioning, oil and silt removal and route service contracts.

PREMIER TECH AQUA

2 Whitehouse Way, South West Industrial Estate, Peterlee, Co Durham, SR8 2RA UNITED KINGDOM.
+44 (0) 8702 640004 | ptauk-sales@premiertech.com | PREMIERTECHAQUA.CO.UK







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.

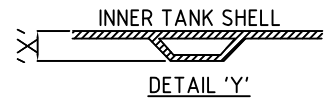
PIPE SIZE VARIANTS

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')



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

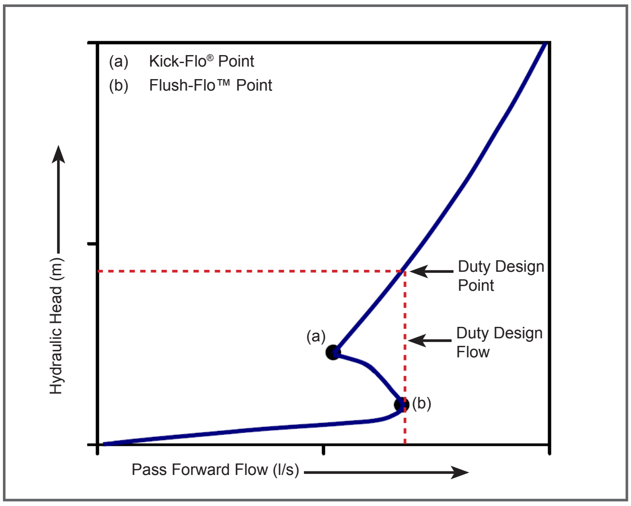
APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4599

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)

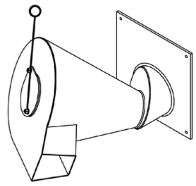
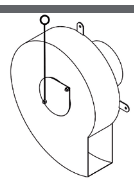
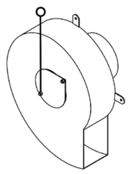
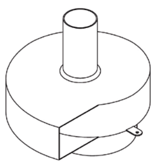
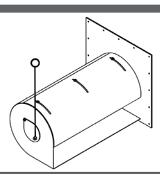
To ensure that a drainage system performs as designed, it is strongly recommended that this information is reproduced on any technical specifications.

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.

Micro Drainage® The complete drainage software system

WinDes®

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.	

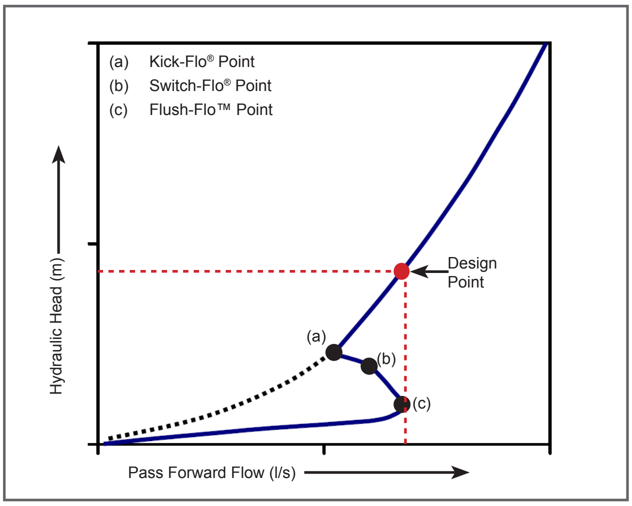
General Comments: The minimum sizes quoted for Hydro-Brake® Flow Controls represent sizes based on experience as offering significant reduction in risk of blockage and hence maintenance and derive from general practice in flow control selection in the UK and Ireland. Sizes below the minimum recommended 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 ...®

This information is for guidance only and not intended to form part of a contract. HRD Technologies Ltd pursues a policy of continual development and reserves the right to amend specifications without prior notice. Equipment is patented in countries throughout the world.

HRD Technologies Ltd

HRD Technologies Ltd • Tootenhill House • Rathcoole • Co. Dublin • Ireland
Tel: +353 (0) 1 4013964 • Fax: +353 (0) 1 4013978 • www.hrdtec.com
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