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DENIS O'SULLIVAN & ASSOCIATES

CONSULTING ENGINEERS

PROPOSED DEVELOPMENT AT FARRANFERRIS, CORK FOR MAVRO LTD.

INFRASTRUCTURE REPORT

DATE 02/02/2022

REVISION 1

JOB NO. 6296

Joyce House, Barrack Square, Ballincollig, Co. Cork

T 021 4871781 E info@dosa.ie W www.dosa.ie

DOCUMENT CONTROL

PROJECT NAME: Proposed Development at Farranferris, Cork for Mavro Ltd.

PROJECT NUMBER: 6296

REVISION	DATE	FILE NAME:	Proposed Development at Farranferris, Cork for Mavro Ltd.		
0	02.02.2022	DESCRIPTION:	Infrastructure Report		
			PREPARED	CHECKED	APPROVED
		INITIAL	TB	LO'T	LO'T
		DATE	02.02.2022	02.02.2022	02.02.2022
1	16.06.2022	FILE NAME:	Proposed Development at Farranferris, Cork for Mavro Ltd.		
		DESCRIPTION:			
			PREPARED	CHECKED	APPROVED
		INITIAL	TB	TB	LO'T
		DATE	16.06.2022	16.06.2022	16.06.2022
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Introduction

Denis O'Sullivan & Associates were engaged as Consulting Engineers for the proposed development at Farranferris, Cork for Mavro Ltd.

This proposed development consists of the construction of 26 no. residential units split into two separate blocks and all associated landscaping and ancillary site works including a new entrance from the existing estate road.

The proposed development area comprises of approximately 0.49 hectares in total. Denis O'Sullivan & Associates carried out a site visit and desktop investigation and their findings have been incorporated to deal with solutions to:

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

A pre-connection enquiry has been submitted to Irish Water regarding connections into the existing watermains and foul sewer network. The Irish Water Connection Reference is CDS21005582.

1 Surface Water System

In order to reduce the effects of the surface runoff on potential flooding, a Stormwater Management Plan will be applied to surface water discharging into nearby existing surface water sewers. The Stormwater Management Plan can be applied to control the rate of runoff from the new development. The maximum permitted surface water outflow from the new development is to be restricted to that of the existing Greenfield site or 2.2 l/s.

Control of runoff by attenuation methods requires a hydraulic control to restrict the magnitude of flows passing downstream, together with an upstream storage capacity to contain the volume of runoff held back by the hydraulic control. The flows are proposed to be attenuated in the surface water system by adopting a flood storage detention tank along with a restricted outlet as the control devise. The storage volume required has been designed using the computer aided design package Windes 10.4.

This proposed stormwater management plan also takes note of the overall development on the grounds of the Farranferris Foundation including the residential development to the west and south west of the proposed site. In the previous planning application, see reference 11//34953, a number of stormwater attenuation systems were proposed including one within the site boundary of this proposed development. This new development now supersedes the original plans for this site but takes account of the maximum outfall from the total development of 38.1 l/s i.e. the greenfield runoff for the entire site. The final surface water outfall for the proposed development will be to the existing combined sewer to the north east corner of the site along Lover's Walk and which was previously agreed under the 2011 planning application. Irish Water have been contacted to seek approval for this connection and to accept the 2.2 l/s outfall from this development.

1.1 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 & F show the design for the proposed surface water drainage network layout, pipe and manhole numbering. These can be read in conjunction with Drawing 6296-0020-A.

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 6296-0020-A.

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.

1.2 Stormwater Attenuation Strategy

1.2.1 Pre-Development Conditions

The area of this proposed development is 0.49 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 B.

The Mean Annual Peak Flow (permissible outflow) was calculated for the particular design development areas.

The allowable runoff estimation method utilizes IH 124 and the Soil Index value taken from the Microdrainage Design Package mapping system gives a Soil Index of 0.3.

1.2.2 Post-Development Conditions

The area of this proposed development and catchment area is approximately 0.49 (ha) as shown in Fig 2.0 below. The stormwater management plan adopted for the particular development involves using an attenuation tank located in the eastern side of the site close to the main entrance.

All surface water runoff arising from the impermeable surfaces in the development will be drained away from the site. The attenuation tank is designed for a 100-year storm event. The maximum discharge from the attenuation tank will be limited to calculated permissible runoff (QBAR) for the site.

Based on the proposed development design there will be a change in the land surface. Therefore, due to this proposed change a corresponding increase in the peak rate of surface runoff from the site will arise during times of high rainfall.

Fig 1.0 Catchment Plan

Table 1.0 – Greenfield Run off

Contributing Area	Permissible Outflow (l/sec)
Catchment Area	2.2 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.

The Hydrobrake selected will control the max outflow rate from this development to 2.2l/s. Details for the Hydrobrake are included in Appendix J.

1.3 Attenuation Tank

1.3.1 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. The type of tank selected will be a ESS Ecocell type attenuation tank or similar approved and details of this system are included in Appendix K. This capacity is summarized as follows:

Table 2.0 – Attenuation Tank & Outflow Summary

Tank No.	Capacity (m^3)	Restricted Outlet (l/sec)
1	87	2.2 l/sec

1.3.2 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.

The hard-surfaced area that will be draining to the interceptor for entire catchment area is approximately 2050m^2. A Kingspan NSBP004 interceptor with a catchment capacity of 2500m^2 will be provided for the Catchment Area. Details for the Hydrocarbon Separator are included in Appendix H.

A summary of the proposed interceptor is as per the Table 3.0 below.

Table 3.0 – Petrol Interceptor Details

Catchment Reference	Petrol Interceptor Make & Model	Oil Storage Capacity (l)

Catchment Area	Kingspan NSBP004	60 litres

1.3.3 Silt Control

The proposed petrol interceptors from Kingspan 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 4.0 below.

Table 4.0 – Petrol Interceptor Silt Storage Details

Catchment Reference	Petrol Interceptor Make & Model	Silt Storage Capacity (l)
Catchment Area	Kingspan NSBP004	450 litres

2 *Foul Sewer System*

2.1 Foul Sewer Design

Prior to submitting the Services Report we have reviewed all available maps in relation to the existing drainage services in the area of the proposed development. The details of the local Cork City Council/Irish Water Foul Sewer Infrastructure are included in Appendix G of this Report

It is proposed to provide a new foul water drainage network on site which will connect to an existing manhole at the south east corner which connects directly to the public combined sewer running along Lover's Walk to the east of the site. The proposed new foul drainage network will also cater for and replace the existing foul outfall pipe serving the existing Gaelscoil and other adjoining buildings and which already connect to the existing manhole on site. Further details are shown on the proposed drainage layout, 6296-0020.

2.1.1 Development Breakdown

26 No. Dwellings

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 = (26) (446) / (24) (60) (60) = 0.134 litres/second

6 DWF = 0.805 litres/second

The layout of the proposed foul sewer network is shown on the attached Proposed Drainage Plan Drawing No. 6296 - 0020-A.

The overall quantity of wastewater for the proposed development is estimated at 11.6m^3 per day.

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.

3 *Water Supply*

The details of the local Irish Water/Cork City Council Watermain Infrastructure are included in Appendix A of this Report. In addition, there is an existing watermain running along the estate road serving the recently constructed residential development. A sluice valve was provided by the developers of the residential estate to allow for this proposed development and more details are shown on the watermain drawing 6296-0030-A. The existing 3" cast iron watermain running through the site will be decommissioned and a new connection is to be provided by the Farranferris Foundation directly to the watermain on the estate road to the north of the Gaelscoil.

It is proposed to provide a new 100mm HDPE connection to the estate watermain with associated valves, new hydrant and metering requirements. A new watermain will then be provided between the proposed residential blocks and will be looped in accordance with Irish Water's requirements.

Water distribution supply to each dwelling 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 Drawing No. 6296-3030-A

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.

Appendix A –Irish Water Pre-Connection Enquiry & Maps

Tim Brosnan

Dosa
Joyce House
Barrack Square
Ballincollig
Co. Cork
P31KP84

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

25 August 2021

Re: CDS21005582 pre-connection enquiry - Subject to contract | Contract denied

Connection for Housing Development of 24 unit(s) at Lovers Walk, Farranferris, Cork

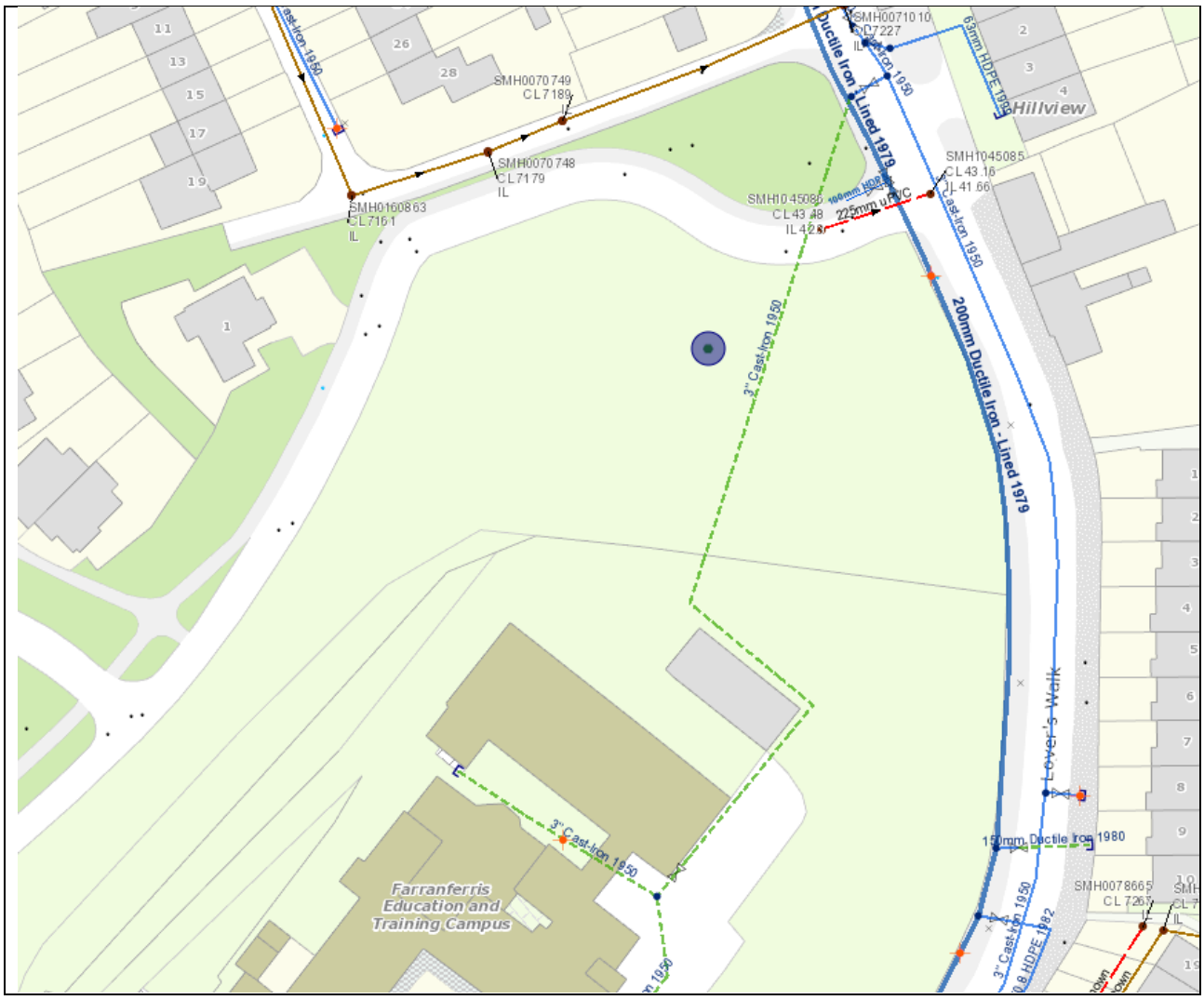
Dear Sir/Madam,

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

SERVICE	**OUTCOME OF PRE-CONNECTION ENQUIRY** **THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.**
Water Connection	Feasible without infrastructure upgrade by Irish Water
Wastewater Connection	Feasible without infrastructure upgrade by Irish Water
SITE SPECIFIC COMMENTS	
Water Connection	The proposed development indicates that a private watermain is present on the site. According to the layout proposal a diversion of the private watermain will be required.
Wastewater Connection	The foul water sewer network adjacent to the site has not been taken in charge by Irish Water. It will be necessary to get permission to connect to this sewer and confirmation that it has sufficient capacity and is in a good enough standard to be taken in charge upon connection. Any works required to bring this infrastructure up to standard will have to be carried out in advance of the connection at the cost of the developer or the current owner of the asset.

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

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



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

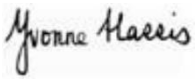
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish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

General Notes:

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

If you have any further questions, please contact Dario Alvarez from the design team on + 353 2254621 or email dalvarez@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	0.350
Area (ha)	0.496	Urban	0.000
SAAR (mm)	1128	Region Number	Ireland South

Results l/s

QBAR Rural	2.2
QBAR Urban	2.2
Q100 years	4.1
Q1 year	1.9
Q30 years	3.5
Q100 years	4.1

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	0.175	4-8	0.121

Total Area Contributing (ha) = 0.296

Total Pipe Volume (m³) = 9.078

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	14.475	0.370	39.1	0.057	5.00	0.0	0.600	o	225
S2.000	22.350	0.570	39.2	0.081	5.00	0.0	0.600	o	225
S1.001	15.145	0.150	101.0	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.11	44.570	0.057	0.0	0.0	0.0	2.10	83.4	7.7
S2.000	50.00	5.18	44.770	0.081	0.0	0.0	0.0	2.10	83.3	11.0
S1.001	50.00	5.37	44.200	0.138	0.0	0.0	0.0	1.30	51.7	18.7

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)
S3.000	24.720	0.148	167.0	0.035	5.00	0.0	0.600	o	225
S3.001	43.285	0.259	167.1	0.048	0.00	0.0	0.600	o	225
S1.002	12.165	0.073	166.6	0.000	0.00	0.0	0.600	o	225
S1.003	17.085	0.102	167.0	0.015	0.00	0.0	0.600	o	225
S4.000	26.645	0.325	82.0	0.025	5.00	0.0	0.600	o	225
S4.001	24.065	0.250	96.3	0.035	0.00	0.0	0.600	o	225
S1.004	3.000	0.015	200.0	0.000	0.00	0.0	0.600	o	300
S1.005	5.000	0.025	200.0	0.000	0.00	0.0	0.600	o	300
S1.006	14.150	0.057	250.0	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)
S3.000	50.00	5.41	44.075	0.035	0.0	0.0	0.0	1.01	40.1	4.7
S3.001	50.00	6.12	43.927	0.083	0.0	0.0	0.0	1.01	40.1	11.2
S1.002	50.00	6.32	43.668	0.221	0.0	0.0	0.0	1.01	40.2	29.9
S1.003	50.00	6.61	43.595	0.236	0.0	0.0	0.0	1.01	40.1	32.0
S4.000	50.00	5.31	43.625	0.025	0.0	0.0	0.0	1.45	57.5	3.4
S4.001	50.00	5.61	43.300	0.060	0.0	0.0	0.0	1.33	53.0	8.1
S1.004	50.00	6.65	43.050	0.296	0.0	0.0	0.0	1.11	78.3	40.1
S1.005	50.00	6.73	42.025	0.296	0.0	0.0	0.0	1.11	78.3	40.1
S1.006	50.00	5.29	42.000	0.000	2.2	0.0	0.0	0.82	32.7	2.2

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
SSMH.07	46.180	1.610	1050	S1.000	44.570	225				
SSMH.08	46.220	1.450	1050	S2.000	44.770	225				
SSMH.06	46.100	1.900	1200	S1.001	44.200	225	S1.000	44.200	225	
							S2.000	44.200	225	
SSMH.10	45.200	1.125	1050	S3.000	44.075	225				
SSMH.09	45.150	1.223	1050	S3.001	43.927	225	S3.000	43.927	225	
SSMH.05	45.150	1.482	1050	S1.002	43.668	225	S1.001	44.050	225	382
							S3.001	43.668	225	
SSMH.04	45.200	1.605	1050	S1.003	43.595	225	S1.002	43.595	225	
SSMH.01	45.050	1.425	1050	S4.000	43.625	225				
SSMH.02	44.530	1.230	1050	S4.001	43.300	225	S4.000	43.300	225	
SSMH.03	45.050	2.000	1200	S1.004	43.050	300	S1.003	43.493	225	368
							S4.001	43.050	225	
SSMH.11	45.050	3.025	1200	S1.005	42.025	300	S1.004	43.035	300	1010
SSMH.12	45.050	3.050	1200	S1.006	42.000	225	S1.005	42.000	300	
SExis SMH	43.590	1.647	0		OUTFALL		S1.006	41.943	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	SSMH.07	46.180	44.570	1.385	1050
S2.000	o	225	SSMH.08	46.220	44.770	1.225	1050
S1.001	o	225	SSMH.06	46.100	44.200	1.675	1200
S3.000	o	225	SSMH.10	45.200	44.075	0.900	1050
S3.001	o	225	SSMH.09	45.150	43.927	0.998	1050
S1.002	o	225	SSMH.05	45.150	43.668	1.257	1050
S1.003	o	225	SSMH.04	45.200	43.595	1.380	1050
S4.000	o	225	SSMH.01	45.050	43.625	1.200	1050
S4.001	o	225	SSMH.02	44.530	43.300	1.005	1050
S1.004	o	300	SSMH.03	45.050	43.050	1.700	1200
S1.005	o	300	SSMH.11	45.050	42.025	2.725	1200
S1.006	o	225	SSMH.12	45.050	42.000	2.825	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	14.475	39.1	SSMH.06	46.100	44.200	1.675	1200
S2.000	22.350	39.2	SSMH.06	46.100	44.200	1.675	1200
S1.001	15.145	101.0	SSMH.05	45.150	44.050	0.875	1050
S3.000	24.720	167.0	SSMH.09	45.150	43.927	0.998	1050
S3.001	43.285	167.1	SSMH.05	45.150	43.668	1.257	1050
S1.002	12.165	166.6	SSMH.04	45.200	43.595	1.380	1050
S1.003	17.085	167.0	SSMH.03	45.050	43.493	1.332	1200
S4.000	26.645	82.0	SSMH.02	44.530	43.300	1.005	1050
S4.001	24.065	96.3	SSMH.03	45.050	43.050	1.775	1200
S1.004	3.000	200.0	SSMH.11	45.050	43.035	1.715	1200
S1.005	5.000	200.0	SSMH.12	45.050	42.000	2.750	1200
S1.006	14.150	250.0	SExis SMH	43.590	41.943	1.422	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)
S1.006	SExis SMH	43.590	41.943	42.950	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 Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0		

Synthetic Rainfall Details

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

Online Controls for Storm

Hydro-Brake® Manhole: SSMH.12, DS/PN: S1.006, Volume (m³): 3.7

Design Head (m) 2.000 Hydro-Brake® Type Md4 Invert Level (m) 42.000
Design Flow (l/s) 2.2 Diameter (mm) 45

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	1.200	1.7	3.000	2.7	7.000	4.2
0.200	0.7	1.400	1.9	3.500	3.0	7.500	4.3
0.300	0.9	1.600	2.0	4.000	3.2	8.000	4.5
0.400	1.0	1.800	2.1	4.500	3.3	8.500	4.6
0.500	1.1	2.000	2.2	5.000	3.5	9.000	4.7
0.600	1.2	2.200	2.3	5.500	3.7	9.500	4.9
0.800	1.4	2.400	2.4	6.000	3.9		
1.000	1.6	2.600	2.5	6.500	4.0		

Storage Structures for Storm

Tank or Pond Manhole: SSMH.12, DS/PN: S1.006

Invert Level (m) 42.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	58.0	2.000	58.0

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

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

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

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
S1.000	15 Winter	2	0%					
S2.000	15 Winter	2	0%					
S1.001	15 Winter	2	0%					
S3.000	15 Winter	2	0%					
S3.001	15 Winter	2	0%					
S1.002	15 Winter	2	0%					
S1.003	15 Winter	2	0%					
S4.000	15 Winter	2	0%					
S4.001	15 Winter	2	0%					
S1.004	15 Winter	2	0%					
S1.005	960 Winter	2	0%	2/15 Winter				
S1.006	960 Winter	2	0%	2/15 Summer				

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	SSMH.07	44.621	-0.174	0.000	0.12	0.0	8.6	OK
S2.000	SSMH.08	44.830	-0.165	0.000	0.16	0.0	12.1	OK
S1.001	SSMH.06	44.307	-0.118	0.000	0.45	0.0	20.4	OK
S3.000	SSMH.10	44.132	-0.168	0.000	0.14	0.0	5.2	OK
S3.001	SSMH.09	44.011	-0.141	0.000	0.29	0.0	11.0	OK
S1.002	SSMH.05	43.836	-0.057	0.000	0.91	0.0	31.4	OK
S1.003	SSMH.04	43.766	-0.054	0.000	0.93	0.0	33.1	OK
S4.000	SSMH.01	43.664	-0.186	0.000	0.07	0.0	3.7	OK
S4.001	SSMH.02	43.362	-0.163	0.000	0.17	0.0	8.2	OK
S1.004	SSMH.03	43.255	-0.095	0.000	0.80	0.0	41.1	OK
S1.005	SSMH.11	43.044	0.719	0.000	0.10	0.0	5.0	SURCHARGED
S1.006	SSMH.12	43.043	0.818	0.000	0.06	0.0	1.6	SURCHARGED

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	0.175	4-8	0.121

Total Area Contributing (ha) = 0.296

Total Pipe Volume (m³) = 9.078

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	14.475	0.370	39.1	0.057	5.00	0.0	0.600	o	225
S2.000	22.350	0.570	39.2	0.081	5.00	0.0	0.600	o	225
S1.001	15.145	0.150	101.0	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.11	44.570	0.057	0.0	0.0	0.0	2.10	83.4	7.7
S2.000	50.00	5.18	44.770	0.081	0.0	0.0	0.0	2.10	83.3	11.0
S1.001	50.00	5.37	44.200	0.138	0.0	0.0	0.0	1.30	51.7	18.7

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)
S3.000	24.720	0.148	167.0	0.035	5.00	0.0	0.600	o	225
S3.001	43.285	0.259	167.1	0.048	0.00	0.0	0.600	o	225
S1.002	12.165	0.073	166.6	0.000	0.00	0.0	0.600	o	225
S1.003	17.085	0.102	167.0	0.015	0.00	0.0	0.600	o	225
S4.000	26.645	0.325	82.0	0.025	5.00	0.0	0.600	o	225
S4.001	24.065	0.250	96.3	0.035	0.00	0.0	0.600	o	225
S1.004	3.000	0.015	200.0	0.000	0.00	0.0	0.600	o	300
S1.005	5.000	0.025	200.0	0.000	0.00	0.0	0.600	o	300
S1.006	14.150	0.057	250.0	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)
S3.000	50.00	5.41	44.075	0.035	0.0	0.0	0.0	1.01	40.1	4.7
S3.001	50.00	6.12	43.927	0.083	0.0	0.0	0.0	1.01	40.1	11.2
S1.002	50.00	6.32	43.668	0.221	0.0	0.0	0.0	1.01	40.2	29.9
S1.003	50.00	6.61	43.595	0.236	0.0	0.0	0.0	1.01	40.1	32.0
S4.000	50.00	5.31	43.625	0.025	0.0	0.0	0.0	1.45	57.5	3.4
S4.001	50.00	5.61	43.300	0.060	0.0	0.0	0.0	1.33	53.0	8.1
S1.004	50.00	6.65	43.050	0.296	0.0	0.0	0.0	1.11	78.3	40.1
S1.005	50.00	6.73	42.025	0.296	0.0	0.0	0.0	1.11	78.3	40.1
S1.006	50.00	5.29	42.000	0.000	2.2	0.0	0.0	0.82	32.7	2.2

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
SSMH.07	46.180	1.610	1050	S1.000	44.570	225				
SSMH.08	46.220	1.450	1050	S2.000	44.770	225				
SSMH.06	46.100	1.900	1200	S1.001	44.200	225	S1.000	44.200	225	
							S2.000	44.200	225	
SSMH.10	45.200	1.125	1050	S3.000	44.075	225				
SSMH.09	45.150	1.223	1050	S3.001	43.927	225	S3.000	43.927	225	
SSMH.05	45.150	1.482	1050	S1.002	43.668	225	S1.001	44.050	225	382
							S3.001	43.668	225	
SSMH.04	45.200	1.605	1050	S1.003	43.595	225	S1.002	43.595	225	
SSMH.01	45.050	1.425	1050	S4.000	43.625	225				
SSMH.02	44.530	1.230	1050	S4.001	43.300	225	S4.000	43.300	225	
SSMH.03	45.050	2.000	1200	S1.004	43.050	300	S1.003	43.493	225	368
							S4.001	43.050	225	
SSMH.11	45.050	3.025	1200	S1.005	42.025	300	S1.004	43.035	300	1010
SSMH.12	45.050	3.050	1200	S1.006	42.000	225	S1.005	42.000	300	
SExis SMH	43.590	1.647	0		OUTFALL		S1.006	41.943	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	SSMH.07	46.180	44.570	1.385	1050
S2.000	o	225	SSMH.08	46.220	44.770	1.225	1050
S1.001	o	225	SSMH.06	46.100	44.200	1.675	1200
S3.000	o	225	SSMH.10	45.200	44.075	0.900	1050
S3.001	o	225	SSMH.09	45.150	43.927	0.998	1050
S1.002	o	225	SSMH.05	45.150	43.668	1.257	1050
S1.003	o	225	SSMH.04	45.200	43.595	1.380	1050
S4.000	o	225	SSMH.01	45.050	43.625	1.200	1050
S4.001	o	225	SSMH.02	44.530	43.300	1.005	1050
S1.004	o	300	SSMH.03	45.050	43.050	1.700	1200
S1.005	o	300	SSMH.11	45.050	42.025	2.725	1200
S1.006	o	225	SSMH.12	45.050	42.000	2.825	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	14.475	39.1	SSMH.06	46.100	44.200	1.675	1200
S2.000	22.350	39.2	SSMH.06	46.100	44.200	1.675	1200
S1.001	15.145	101.0	SSMH.05	45.150	44.050	0.875	1050
S3.000	24.720	167.0	SSMH.09	45.150	43.927	0.998	1050
S3.001	43.285	167.1	SSMH.05	45.150	43.668	1.257	1050
S1.002	12.165	166.6	SSMH.04	45.200	43.595	1.380	1050
S1.003	17.085	167.0	SSMH.03	45.050	43.493	1.332	1200
S4.000	26.645	82.0	SSMH.02	44.530	43.300	1.005	1050
S4.001	24.065	96.3	SSMH.03	45.050	43.050	1.775	1200
S1.004	3.000	200.0	SSMH.11	45.050	43.035	1.715	1200
S1.005	5.000	200.0	SSMH.12	45.050	42.000	2.750	1200
S1.006	14.150	250.0	SExis SMH	43.590	41.943	1.422	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)
S1.006	SExis SMH	43.590	41.943	42.950	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 Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0		

Synthetic Rainfall Details

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

Online Controls for Storm

Hydro-Brake® Manhole: SSMH.12, DS/PN: S1.006, Volume (m³): 3.7

Design Head (m) 2.000 Hydro-Brake® Type Md4 Invert Level (m) 42.000
Design Flow (l/s) 2.2 Diameter (mm) 45

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	1.200	1.7	3.000	2.7	7.000	4.2
0.200	0.7	1.400	1.9	3.500	3.0	7.500	4.3
0.300	0.9	1.600	2.0	4.000	3.2	8.000	4.5
0.400	1.0	1.800	2.1	4.500	3.3	8.500	4.6
0.500	1.1	2.000	2.2	5.000	3.5	9.000	4.7
0.600	1.2	2.200	2.3	5.500	3.7	9.500	4.9
0.800	1.4	2.400	2.4	6.000	3.9		
1.000	1.6	2.600	2.5	6.500	4.0		

Storage Structures for Storm

Tank or Pond Manhole: SSMH.12, DS/PN: S1.006

Invert Level (m) 42.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	58.0	2.000	58.0

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 (%) 10

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	+10%					
S2.000	15 Winter	100	+10%					
S1.001	15 Winter	100	+10%	100/15 Summer				
S3.000	15 Winter	100	+10%	100/15 Summer				
S3.001	15 Winter	100	+10%	100/15 Summer				
S1.002	960 Winter	100	+10%	100/15 Summer				
S1.003	960 Winter	100	+10%	100/15 Summer				
S4.000	960 Winter	100	+10%	100/240 Summer				
S4.001	960 Winter	100	+10%	100/60 Winter				
S1.004	960 Winter	100	+10%	100/15 Summer				
S1.005	960 Winter	100	+10%	100/15 Summer				
S1.006	960 Winter	100	+10%	100/15 Summer				

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	SSMH.07	44.656	-0.139	0.000	0.31	0.0	22.6	OK
S2.000	SSMH.08	44.872	-0.123	0.000	0.42	0.0	32.1	OK
S1.001	SSMH.06	44.613	0.188	0.000	1.09	0.0	49.5	SURCHARGED
S3.000	SSMH.10	44.591	0.291	0.000	0.30	0.0	11.0	SURCHARGED
S3.001	SSMH.09	44.566	0.414	0.000	0.63	0.0	24.1	SURCHARGED
S1.002	SSMH.05	44.463	0.570	0.000	0.24	0.0	8.1	SURCHARGED
S1.003	SSMH.04	44.460	0.640	0.000	0.24	0.0	8.6	SURCHARGED
S4.000	SSMH.01	44.457	0.607	0.000	0.02	0.0	0.9	SURCHARGED
S4.001	SSMH.02	44.457	0.932	0.000	0.04	0.0	2.1	FLOOD RISK
S1.004	SSMH.03	44.456	1.106	0.000	0.20	0.0	10.0	SURCHARGED
S1.005	SSMH.11	44.455	2.130	0.000	0.19	0.0	9.8	SURCHARGED
S1.006	SSMH.12	44.454	2.229	0.000	0.09	0.0	2.5	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	38.150	0.636	60.0	0.000	10	0.0	1.500	o	150
F1.001	21.165	0.545	38.8	0.000	0	0.0	1.500	o	150
F2.000	27.055	0.451	60.0	0.000	4	0.0	1.500	o	150
F1.002	37.915	0.253	150.0	0.000	0	0.0	1.500	o	150
F1.003	13.495	0.090	150.0	0.000	0	0.0	1.500	o	150
F1.004	9.975	0.067	150.0	0.000	0	0.0	1.500	o	150

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	44.830	0.000	0.0	10	0.0	13	0.40	1.13	20.0	0.3
F1.001	44.194	0.000	0.0	10	0.0	12	0.47	1.41	24.9	0.3
F2.000	44.100	0.000	0.0	4	0.0	9	0.30	1.13	20.0	0.1
F1.002	43.649	0.000	0.0	14	0.0	19	0.33	0.71	12.6	0.4
F1.003	43.396	0.000	0.0	14	0.0	19	0.33	0.71	12.6	0.4
F1.004	43.306	0.000	0.0	14	0.0	19	0.33	0.71	12.6	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)
FFMH.06	46.180	1.350	1050	F1.000	44.830	150				
FFMH.05	46.220	2.026	1200	F1.001	44.194	150	F1.000	44.194	150	
FFMH.04	45.150	1.050	1050	F2.000	44.100	150				
FFMH.03	45.150	1.501	1050	F1.002	43.649	150	F1.001	43.649	150	
							F2.000	43.649	150	
FFMH.02	45.300	1.904	1200	F1.003	43.396	150	F1.002	43.396	150	
FFMH.01	45.200	1.894	1200	F1.004	43.306	150	F1.003	43.306	150	
FExis FS.MH	45.050	1.810	0		OUTFALL		F1.004	43.240	150	

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	FFMH.06	46.180	44.830	1.200	1050
F1.001	o	150	FFMH.05	46.220	44.194	1.876	1200
F2.000	o	150	FFMH.04	45.150	44.100	0.900	1050
F1.002	o	150	FFMH.03	45.150	43.649	1.351	1050
F1.003	o	150	FFMH.02	45.300	43.396	1.754	1200
F1.004	o	150	FFMH.01	45.200	43.306	1.744	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	38.150	60.0	FFMH.05	46.220	44.194	1.876	1200
F1.001	21.165	38.8	FFMH.03	45.150	43.649	1.351	1050
F2.000	27.055	60.0	FFMH.03	45.150	43.649	1.351	1050
F1.002	37.915	150.0	FFMH.02	45.300	43.396	1.754	1200
F1.003	13.495	150.0	FFMH.01	45.200	43.306	1.744	1200
F1.004	9.975	150.0	FExis FS.MH	45.050	43.240	1.660	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)
F1.004	FExis FS.MH	45.050	43.240	41.800	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

Denis O'Sullivan & Associates		Page 1
Unit 5, Joyce House Barrack Square Ballincollig, Co. Cork	Residential Development Farranferris Cork	
Date 02/02/2022 File SW Model.MDX	Designed By S.O.'Grady Checked By	
Micro Drainage	Network W.12.4	

MH Name	SSMH.04	SSMH.05	SSMH.06	SSMH.07	
Hor Scale 500 Ver Scale 500 Datum (m) 33.000			3.001	2.000	
PN		S1.002	S1.001	S1.000	
Dia (mm)		225	225	225	
Slope (1:X)		166.6	101.0	39.1	
Cover Level (m)	45.200	45.150	46.100	46.180	
Invert Level (m)		43.595	43.668 / 44.050	44.200 / 44.200	44.570
Length (m)		12.165	15.145	14.475	

MH Name	SExis SMH	SSMH.12			SSMH.04	
Hor Scale 500 Ver Scale 500 Datum (m) 32.000				4.001		
PN		S1.006			S1.003	
Dia (mm)		225			225	
Slope (1:X)		250.0			167.0	
Cover Level (m)	43.590	45.050	45.050	45.050	45.200	
Invert Level (m)		41.943 / 42.000	42.000	42.025 / 43.050	43.493 / 43.595	
Length (m)		14.150			17.085	

MH Name	SSMH.06	SSMH.08	
Hor Scale 500 Ver Scale 500 Datum (m) 34.000			
PN		S2.000	
Dia (mm)		225	
Slope (1:X)		39.2	
Cover Level (m)	46.100	46.220	
Invert Level (m)		44.200	44.770
Length (m)		22.350	

MH Name	SSMH.09	SSMH.10	
Hor Scale 500 Ver Scale 500 Datum (m) 33.000			
PN		S3.000	
Dia (mm)		225	
Slope (1:X)		167.0	
Cover Level (m)	45.150	45.200	
Invert Level (m)		43.927	44.075
Length (m)		24.720	

MH Name	SSMH.05	SSMH.09	
Hor Scale 500 Ver Scale 500 Datum (m) 33.000		1.001	
PN		S3.001	
Dia (mm)		225	
Slope (1:X)		167.1	
Cover Level (m)	45.150	45.150	
Invert Level (m)		43.668	43.927
Length (m)		43.285	

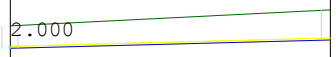
MH Name	SSMH.02	SSMH.01	
Hor Scale 500 Ver Scale 500 Datum (m) 33.000			
PN		S4.000	
Dia (mm)		225	
Slope (1:X)		82.0	
Cover Level (m)	44.530	45.050	
Invert Level (m)		43.300	43.625
Length (m)		26.645	

MH Name	SSMH.03	SSMH.02	
Hor Scale 500 Ver Scale 500 Datum (m) 33.000			
PN		S4.001	
Dia (mm)		225	
Slope (1:X)		96.3	
Cover Level (m)	45.050	44.530	
Invert Level (m)	43.050	43.300	
Length (m)		24.065	

Appendix G – Foul Sewer Longitudinal Sections

Denis O'Sullivan & Associates		Page 1
Unit 5, Joyce House Barrack Square Ballincollig, Co. Cork	Residential Development Farranferris Cork	
Date 02/02/2022 File FS MODEL.MDX	Designed By S.O.'Grady Checked By	
Micro Drainage	Network W.12.4	

MH Name	FFMH.05	FFMH.06	
Hor Scale 500 Ver Scale 500 Datum (m) 34.000			
PN		F1.000	
Dia (mm)		150	
Slope (1:X)		60.0	
Cover Level (m)	46.220	46.180	
Invert Level (m)	44.194	44.830	
Length (m)		38.150	

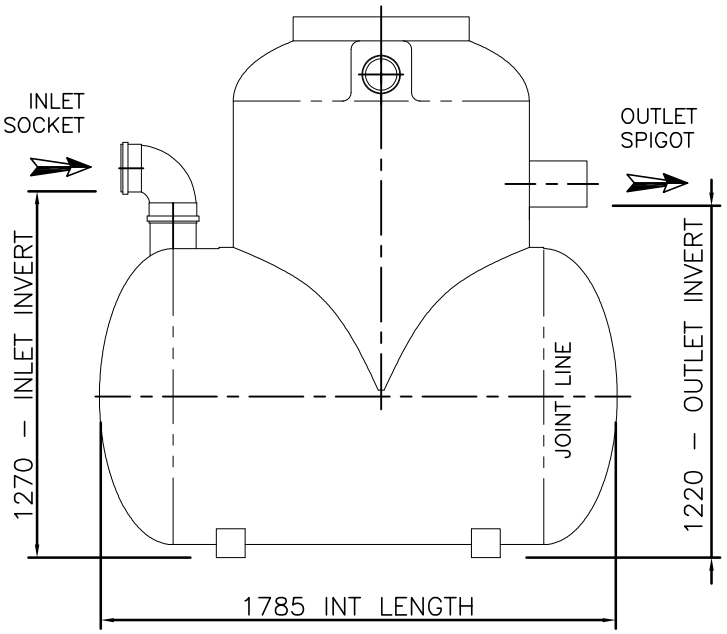
MH Name	FFMH.03	FFMH.05	
Hor Scale 500 Ver Scale 500 Datum (m) 33.000			
PN		F1.001	
Dia (mm)		150	
Slope (1:X)		38.8	
Cover Level (m)	45.150	46.220	
Invert Level (m)	43.649	44.194	
Length (m)		21.165	

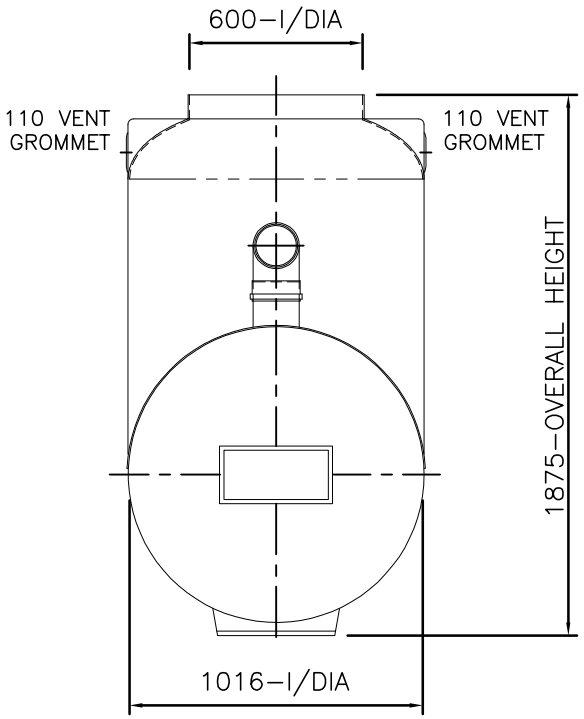
MH Name	FFMH.02	FFMH.03	
Hor Scale 500 Ver Scale 500 Datum (m) 33.000			2.000
PN		F1.002	
Dia (mm)		150	
Slope (1:X)		150.0	
Cover Level (m)	45.300	45.150	
Invert Level (m)	43.396	43.649	
Length (m)		37.915	

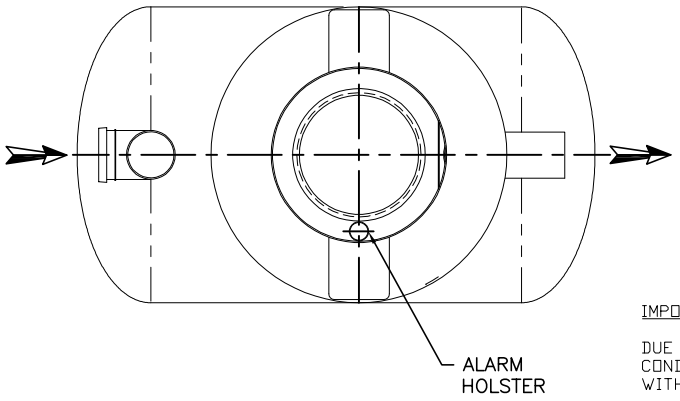
MH Name	FExis FS.MH	FFMH.01	FFMH.02	
Hor Scale 500 Ver Scale 500 Datum (m) 33.000				
PN		F1.004	F1.003	
Dia (mm)		150	150	
Slope (1:X)		150.0	150.0	
Cover Level (m)	45.050	45.200	45.300	
Invert Level (m)		43.240 43.306	43.306 43.396	
Length (m)		9.975	13.495	

MH Name	FFMH.03	FFMH.04	
Hor Scale 500 Ver Scale 500 Datum (m) 33.000		1.001	
PN		F2.000	
Dia (mm)		150	
Slope (1:X)		60.0	
Cover Level (m)	45.150	45.150	
Invert Level (m)	43.649	44.100	
Length (m)		27.055	

Appendix H – Petrol Interceptor Details







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

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

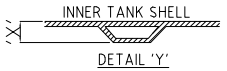
In line with our policy of constant improvement and development, we reserve the right to change specification without prior notice.

IMPORTANT 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

CNSB4.5S/21/SALES BYPASS SEPARATOR

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

DRAWN BY	CHKD.	APPD.	SCALE	DRAWING No.	REVISION
RU	PB	RP	NTS	CNSB4.5S/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 FABRICATED MACHINED	LINEAR	± 5mm ± 2mm ± 0.5mm	ANGLE	±0.5° ±0.2° ±0.1°

Appendix J – Hydrobrake Details

Hydro-Brake® Flow Control

Modelling Guide

Unit Selection Design Guide

Overview

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

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

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

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

STH Range of Hydro-Brake® Flow Controls

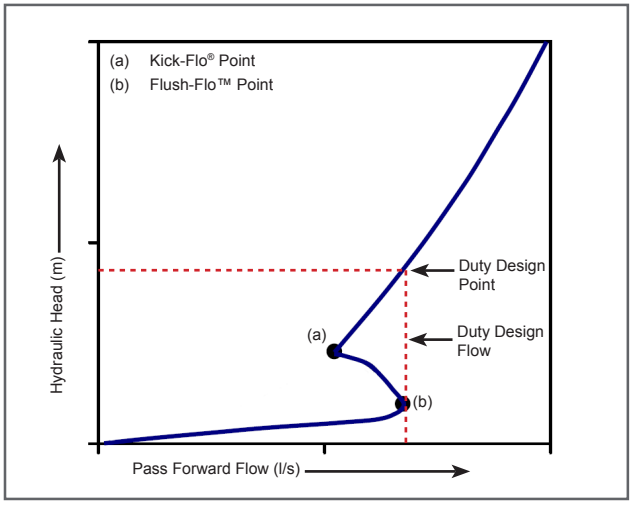
BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4599

See back cover for details.

Hydraulic Characteristics and Specification

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

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



Typical Hydro-Brake® Head Versus Flow Characteristics

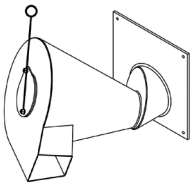
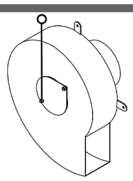
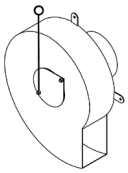
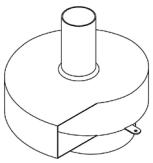
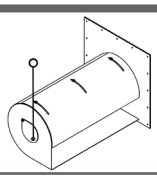
To ensure correct implementation a multiple design-point specification, defining the main hydraulic features of the selected flow control, can be provided by HRD Technologies Ltd. This should include at least the following information:

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

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

Hydro-Brake® Flow Control Models Supported in Micro Drainage

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

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

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

General Advice

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

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

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

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

General Guidance on Unit Selection

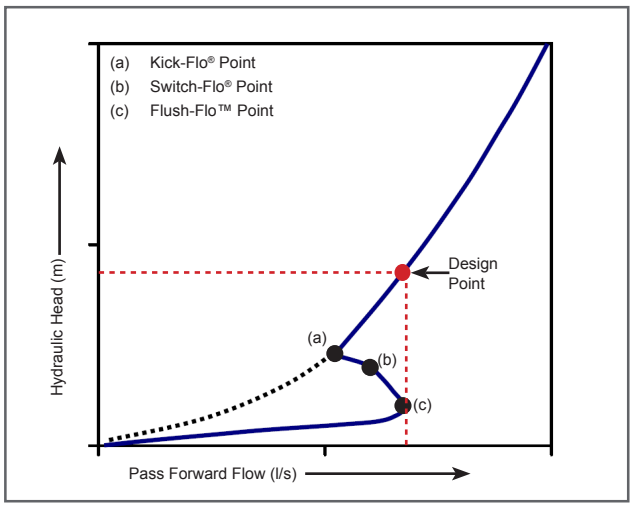
Surface / Storm Water Applications	Foul / Combined Applications
1) Select sump-type Md13 (STH) initially. This is a British Board of Agrément (BBA) approved product that is currently only available in certain sizes – if a size is not available for the specified duty/ design point go to 2) otherwise use Md13 (STH). The Md13 (STH) has a minimum outlet size in excess of 75 mm and can always be fitted to a 225 mm diameter outlet pipe (or greater).	1) Select conical-type Md4 (CX) initially provided the required outlet >150 mm. If the required manhole/ chamber size is too large go to 2) otherwise use Md4 (CX).
2) Select sump-type Md6 (SXH) initially provided the required outlet >75 mm (please seek advice if outlet <75 mm). If required outlet >200 mm go to 3) otherwise use Md6 (SXH).	2) Select conical-type Md2 (CH) provided the required outlet >150 mm. If the required manhole/chamber size is too large go to 3) otherwise use Md2 (CH).
3) Select sump-type Md5 (SH) or Md12 (SMXH) provided the required outlet >75 mm (please seek advice if outlet <75 mm). If required outlet >250 mm (Md5 - SH) or >300 mm (Md12 - SMXH) go to 4) otherwise use Md5 (SH) /Md12 (SMXH).	3) Select conical-type Md1 (C) provided the required outlet >429 mm. If the required manhole/chamber size is too large go to 4) otherwise use Md1 (C).
4) Select conical-type Md4 (CX) provided the required outlet >100 mm. This unit does not require a sump arrangement but requires benching into the intake. If the required manhole/ chamber size is too large go to 5), otherwise use Md4 (CX).	4) Vertical discharge units Md8 (SV), Md9 (SMV) and Md11 (SXV) can be considered if their outlets are >150 mm. Their physical dimensions should be considered - the Md9 (SMV) is typically used when the diameter of the Md8 (SV) and Md11 (SXV) >200 to 250 mm. If none of these units are suitable go to 5).
5) Select conical-type Md2 (CH) unit provided the required outlet >100 mm. This unit does not require a sump arrangement but requires benching into the intake. If the required manhole/ chamber size is too large go to 6), otherwise use Md2 (CH).	5) Select tubular-type Md10 (TH) provided the required outlet >333 mm. This is sometimes the only option that will meet a certain head/discharge relationship (eg. low head, low flow situations). It should only be used when there is no other alternative.
6) Select conical-type Md1 (C) provided the required outlet >285 mm. This unit does not require a sump arrangement but requires benching into the intake. If the required manhole/chamber size is too large go to 7), otherwise use Md1 (C).	For design assistance for any Hydro-Brake® Flow Control please call: **01-4013964** or **e-mail: enquiries@hrdtec.com**
7) Select sump-type Md7 (SMH) provided the required outlet >75 mm. If the required outlet >300 mm then go to 8), otherwise use Md7 (SMH).	
8) Vertical discharge units Md8 (SV), Md9 (SMV) and Md11 (SXV) can be considered provided the required outlet >75 mm. Their physical dimensions should be considered - the Md9 (SMV) is typically used when the diameter of the Md8 (SV) and Md11 (SXV) >200 to 250 mm. If none of these units are suitable go to 9).	
9) Select tubular-type Md10 (TH) provided the required outlet >222 mm. This is sometimes the only option that will meet a certain head/discharge relationship (eg. low head, low flow situations). It should only be used when there is no other alternative.	
General Comments: The minimum sizes quoted for Hydro-Brake® Flow Controls represent sizes based on experience as offering significant reduction in risk of blockage and hence maintenance and derive from general practice in flow control selection in the UK and Ireland. Sizes below the minimum recommended can be specified though it should be recognised these might incur increased risks of blockage and associated maintenance. Sizes above the maximum recommended can also be specified though may require oversized manholes/chambers. For the larger units, refer to HRD Technologies Ltd for advice.	

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

STH Type Hydro-Brake® Flow Control with BBA Approval

Now included in Win*Des*® W.12.6!

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



Typical STH Head Versus Flow Characteristics

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

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

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

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4599

STH Range of Hydro-Brake® Flow Controls

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

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

www.hrdtec.com

Take a Look at Our New Stormwater Web Resource

Engineering Nature's Way™

www.engineeringnaturesway.co.uk

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

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

turning water around ...®

HRD Technologies Ltd

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

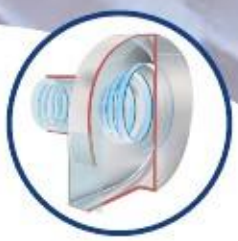
Appendix K – Attenuation Tank – ESS Ecocell Details

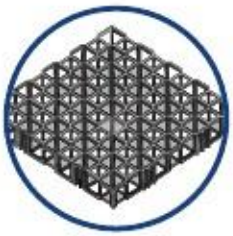
Modular Geo-Void Systems

Total Water Management

ESS EcoCell

Ecological Tank Systems





ENVIRONMENTAL SUSTAINABLE SOLUTIONS LTD

Environmental Sustainable Solutions

Welcome to Environmental Sustainable Solutions; specialist suppliers and designers of geocomposites and water re-use systems. Environmental Sustainable Solutions can help you achieve innovative results for all your requirements:-

- Stormwater Management
- Gas Barrier Protection
- Stormwater Attenuation
- Contaminated Land Development
- Stormwater Drainage
- Ground Stabilisation
- Rainwater Recycling Management
- Structural Waterproofing
- Gas Venting Systems
- Damp-proofing projects

Over the last 12 years Environmental Sustainable Solutions, and associated companies, have designed and installed thousands of water recycling, drainage and attenuation tank systems for schools, car parks, retail parks, offices and sports arenas throughout Ireland, UK, Europe and the Middle East.

Our wide range of environmental protection products, surface water drainage modules and modular water storage tank systems provides maximum design flexibility for engineers and architects working on even the most demanding of storm water storage and recycling projects.

Stormwater Management And Design

Stormwater is the phrase used to describe the excess rainwater that flows from rooftops, roads, car parks and other buildings. This water can contain many pollutants picked up from roofs and highways. In extreme weather conditions sudden heavy downpours of rain can cause major environmental disasters. Using our Rainmanager products; stormwater can not only safely be removed, but it can be stored and recycled for commercial and domestic use.

How it works - ESS Attenuation Tank

Stormwater enters the attenuation tank via the inlet manhole, which incorporates a silt collection sump and a galvanised leaf collection basket. Water passes through the tank and exits through the outlet manhole, which contains an AquaBrake flow control device.
This flow control device regulates the release rate of water from the tank, and in so doing, enables the tank to fill. As a result of water entering the tank at a greater rate than it can exit, the void space then fills with water. While the tank fills, air is vented from the tank.
The Inlet/Outlet pipe will act as a flushing channel. This perforated pipe is wrapped completely in High Flow Filtering Geotextile, which prevents silt entering the block area. As the tank continues to empty at a pre-determined rate, air re-enters the tank via the same air vent system. The roof of the completed tank must be lower than the lowest gully trap on site.

Benefits

- 100% sealed tank
- Full installation service provided
- 12 years experience as market leader
- Quick installation – reduce site access delays
- Increased land usage – tanks are sub surface
- Economical – generally more cost efficient than any other equivalent sealed tank
- Cost effective – reduced costs for excavation and disposal of material
- Modular – easy to create any shape
- Strong – designed to support shear loading
- Lightweight – no cranes required
- Determinate volume – one cubic metre of matrix tank modules contain 950 litres of water, whereas stone fill will only provide 300 litres of storage per cubic metre.

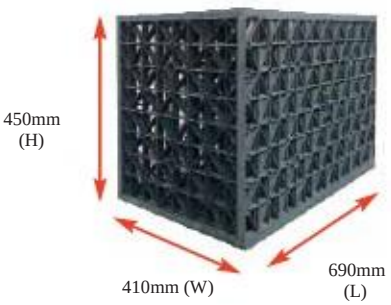
Soakaway

The soakaway is normally best built as a long narrow structure.
The inlet pipe comes in at roof level and faces downwards so that the water can percolate into the tank.
The blocks are wrapped in Geotextile, to protect them and also to keep clay from filling up the void.
An air vent pipe is installed on the highest point with a cowl on top or vented back to an inlet manhole.
There is no outlet from a soakaway, therefore no flow control unit is required.

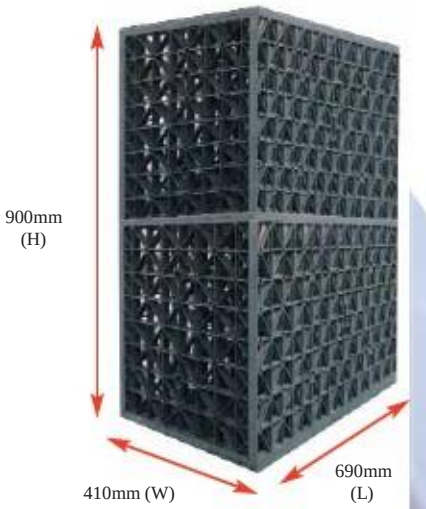
Protecting the Environment

Stormwater Storage Tank

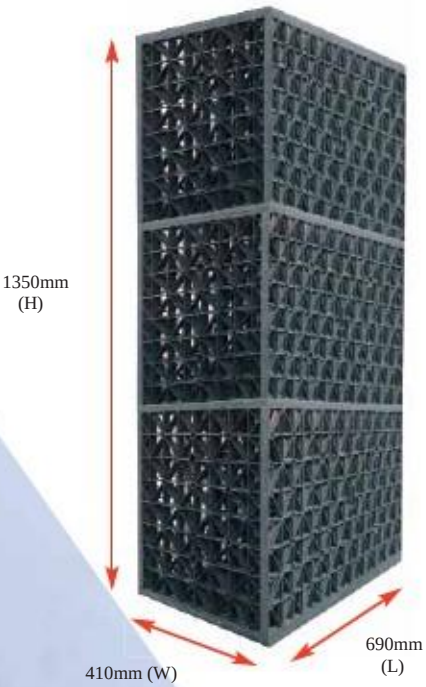
SUITABLE FOR USE UNDER:
- Roadways
- Car parks
- Green areas



Single
8 Modules/m3
Flowrate - 2300 I/min



Double
4 Modules/m3
Flowrate - 4600 I/min



Triple
2.6 Modules/m3
Flowrate - 6900 I/min

Notes:
Blocks must be positioned in the correct orientation.
See opposite above

SPECIFICATION (SINGLE)

Weight (maximum)	9.17kg
Crush Strength (up to)	400kN/m2
Lateral Strength	80kN/m2
Minimum Cover (green areas)	500mm
(trafficked areas)	650mm
Maximum Cover	3m
Material	Polypropylene
Void Ratio (Internal)	>95%

Design Requirements:

Tank storage capacity (m3)
Depth restrictions
Location (Road, Car Park, Green Area)
Design constraints on site

A set of loading calculations specific to the site requirement will be done by ESS and submitted on all tanks

DESIGN CRITERIA

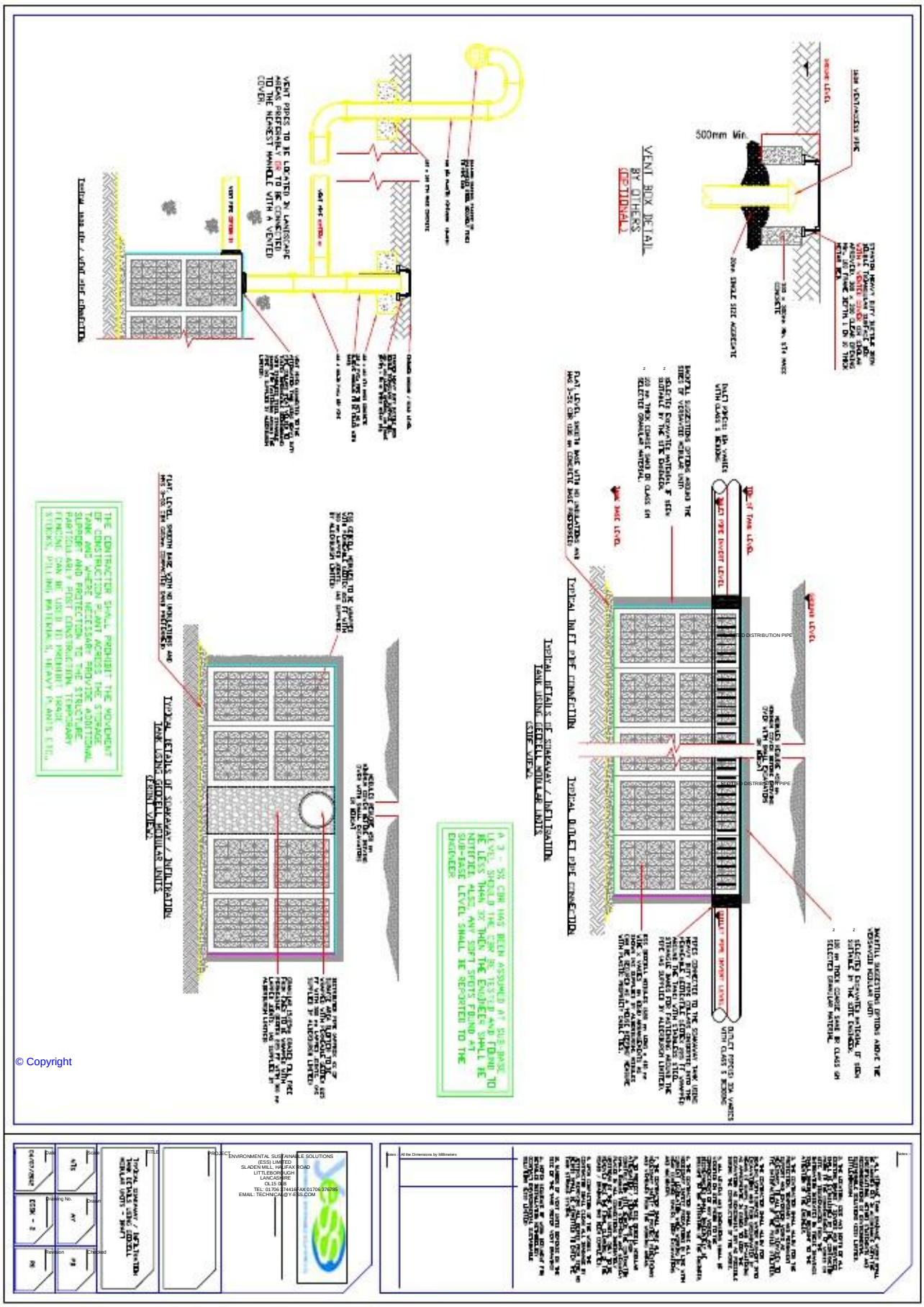
The attenuation tank is constructed using matrix module blocks. These blocks can take passing loads of up to 40 tonnes/m2. The void ratio of each block is 95%. The blocks are made from polypropylene.

The tank is sealed with a layer of Tuflex membrane, which is fully welded together to form a 100% seal. All pipe penetrations are fully sealed to the membrane. The Tuflex membrane is protected by a layer of heavy duty protection geotextile, to prevent damage from construction or backfilling. A number of air extraction vents/flushing points are placed in the roof of the tank.

Note:
It is vital that the underground tanks are fully sealed, otherwise ground water and silt particles may enter the void space and use up capacity. Preferably, the base of the tank should be 500mm above the ground water level. Otherwise ground water relief measures should be implemented.

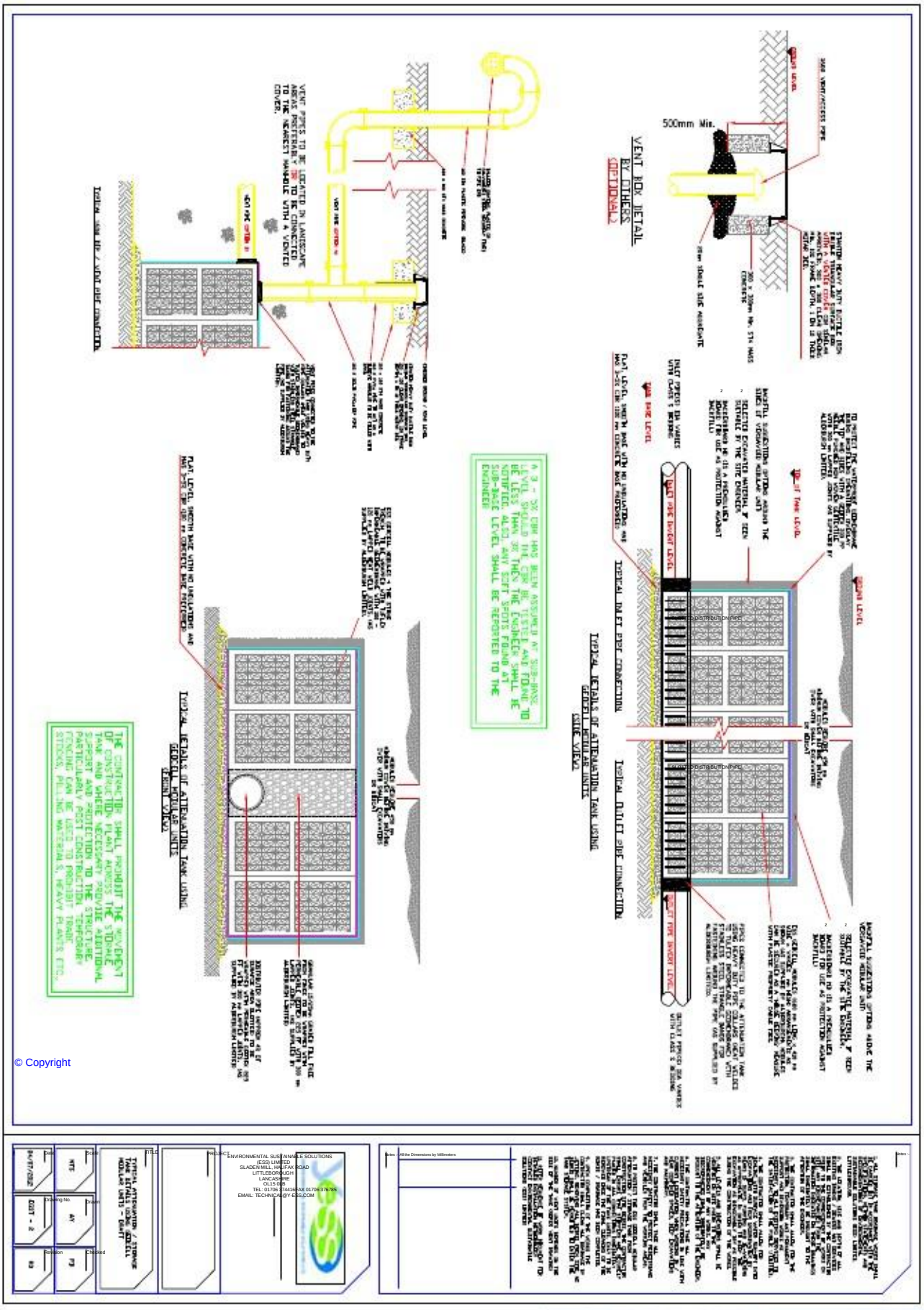
Infiltration System

Typical arrangement using ESS Ecological Tank System for water quality



Retention System

Typical on site collection and recycling arrangement using ESS Ecological Tank System



Infiltration Swales & Underground Channels

Please refer to separate data sheets for the following products

Modular VersaVoid System

Benefits

G **Quick**
Reduce site access delays

G **Lightweight**
No cranes required

G **Strong**
Designed for maximum anticipated loads

G **Maintenance Free Tank**
All debris and sediment is pre-filtered

G **Determinate Volume**
One cubic metre of Tank modules contain 950 litres of water

G **Cost Effective**
Reduces excavation and disposal by up to 5 x compared with conventional soak wells

G **High Infiltration**
98% void surface area

G **Totally Modular**
For greatest flexibility designed to cope. Units start at 300mm deep for shallow inverts to 3050mm+ deep in 250mm increments.

G **Designed by Engineers for Engineers** – to specify with confidence.

G **Designing out Problems**
with such systems (access, maintenance, loading etc.)

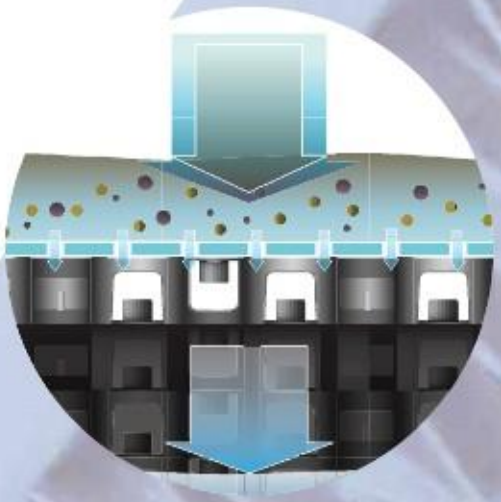
G **Designing in Answers**
to design requirements.

G **Total 3D Access**
For total maintenance with total confidence.

G **Structurally Designed**
with built in safety factor to carry all loads with complete confidence.
16 clear vertical access chambers per m2.

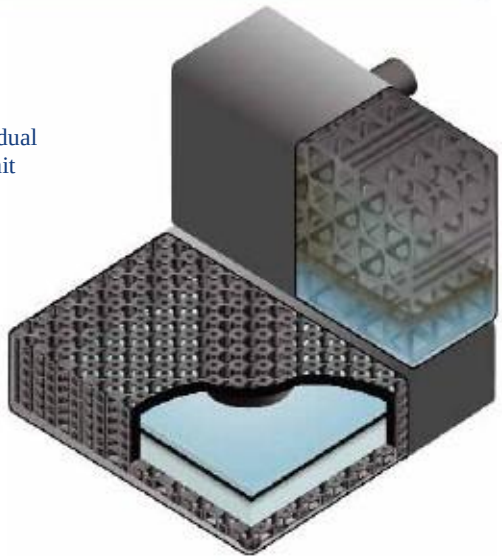
G **Total Void Creation**
With the greatest strength from any modular systems.

Oil Filtration

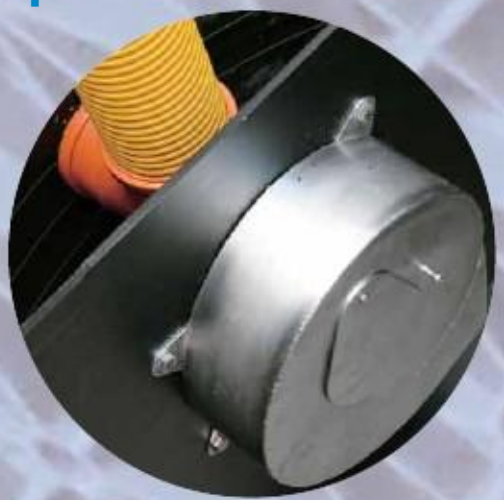


Benefits

G Source control designed to handle catastrophic spillages
G Capture, filter and break down residual hydrocarbons - all in one compact unit
G Self-maintaining ecosystems decompose hydrocarbon compounds and clean filters
G Load bearing, modular components provide up to 200t/m² loading capacity



Aquabrake



Benefits

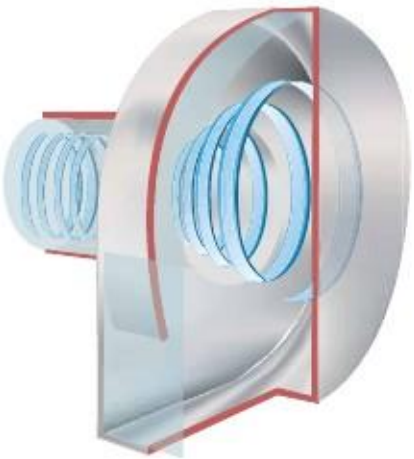
G Cost Savings
Can reduce upstream storage requirements by up to 30%.

G Durability
Corrosion resistant stainless steel.

G No energy requirements
Self-activating solution with no moving parts.

G Clog Resistant
AquaBrake design prevents blockages likely to occur in traditional orifices.

G Flexible Design
Several options for attachment available.



The ESS CombiSwale

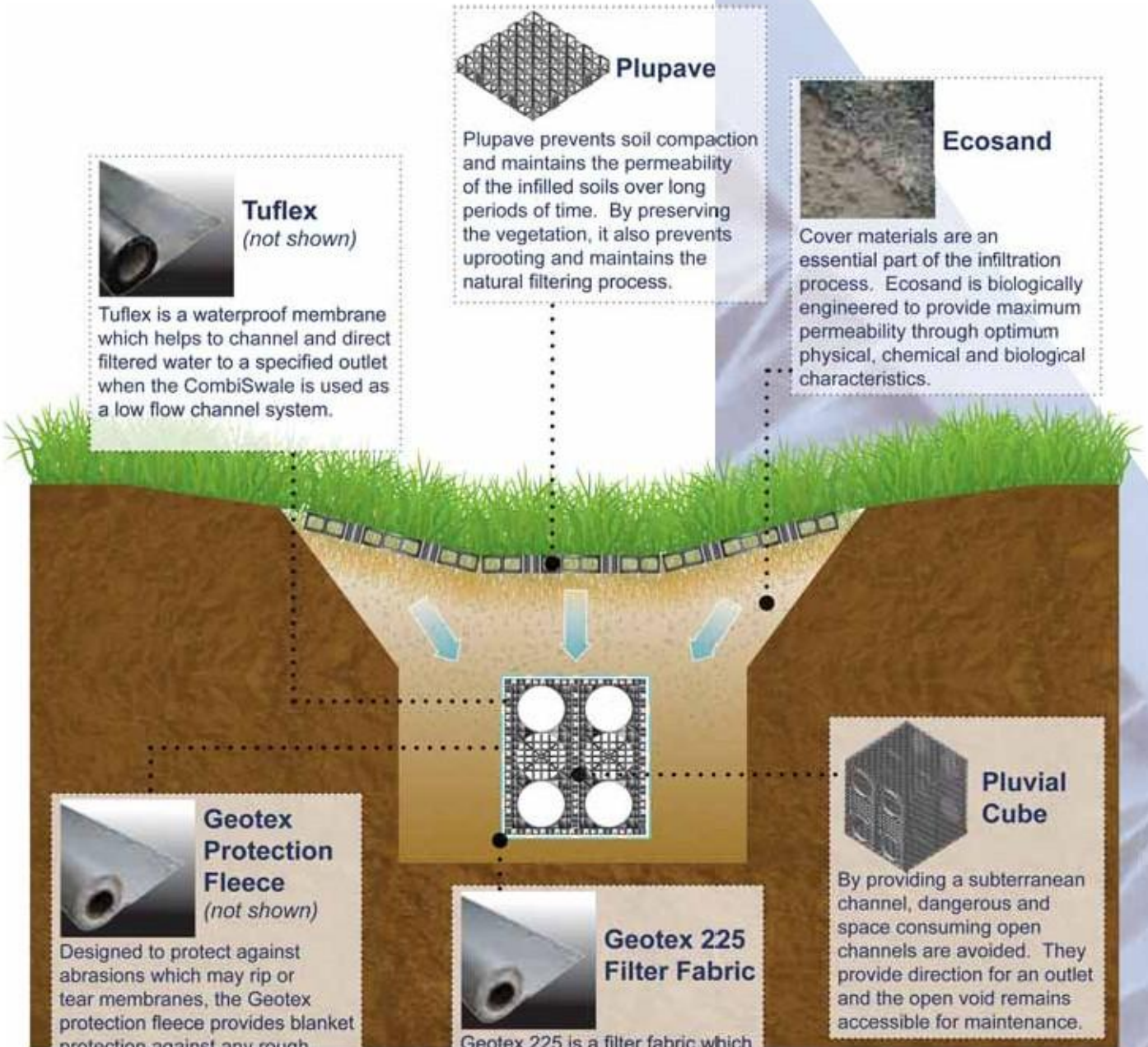
Please refer to separate data sheets for the following products

Water Sensitive Urban Channels

Surface and Sub-Surface Water Treatment

By combining surface and sub-surface channeling and treatment solutions, ESS has created the ideal in bioswale water management.

The CombiSwale system includes the addition of permeable sub-surface waterways that further restore water quality and recharge the natural environment. The sub-surface ESS channel system provides a unique way of working with nature to solve the enormous problems currently associated with open concrete channels and swales.



All products are manufactured to the highest quality, being subject to rigid quality control. However, the company cannot control conditions of application and use of its products, thus any warranty, written or implied, is given in good faith for materials only. ESS Ltd will not accept any responsibility for damage or injury arising from storage handling, misapplication or misuse of its products All transactions are subject to our standard condition of sale, copies of which are available on request.