KAVANAGH BURKE
CONSULTING ENGINEERS

Drainage Design Report

for

Proposed Warehousing Block

at

Block B4, Site B
Aerodrome Business Park,
Rathcoole,
Co. Dublin.

Job No:	**D1119-3**
Client:	**De La Salle Ltd.**
Date:	**November 2022**
Local Authority:	**South Dublin County Council**
Revision:	**Planning**




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Directors: U.Burke, R.Burke, P.Kavanagh

Contents:

Introduction:

The civil works design has been carried out in accordance with the Department of the Environment publication "Recommendations for Site Development Works for Housing Areas". The Sustainable Urban Drainage System policy is implemented as set out by Dublin City Council's Stormwater Management Policy for Developers and subsequently by The Greater Dublin Strategic Drainage Study. Climate change has been factored into the calculations at 10% increase in depth for rainfall.

The roof of the proposed Block B4 will drain to the new attenuation facility and from there it will slowly discharge through a flow control device to the existing storm water drainage outfall from the site. It will connect into the site outfall downstream of the existing concrete attenuation tank therefore will not interfere with the existing drainage on site.

Windes drainage design has been used to calculate the surface water and foul drainage networks – these calculations are included within this document. The peak discharge from the proposed surface water drainage network to the adjacent public storm water drainage has been calculated in accordance with "Greater Dublin Strategic Drainage Study" requirements and was set at 2 l/s (minimum achievable flow in "Hydrobrake" flow control device). The peak discharge from the proposed foul sewer network is 13 litres/second which discharges to the existing foul sewer manhole on the adjacent lands to the north east of the development.

A fully looped watermain is present on site as shown on Drg. No. D1119-3 D3. The proposed Block B4 is to be connected to this existing watermain.

The finished floor levels proposed on the drainage layout Drg. Ref. D1119-3 D3 have been chosen to tie in the proposed building floor level with the neighbouring Block B3 floor levels. A flood risk assessment is included with this application compiled by hydrologist JBA Consulting Engineers – the proposed finished floor level is also derived from the results of this study.

Surface Water Attenuation Calculations

Surface Water Attenuation Calculations:

1) Interception Storage

Calculate runoff from 5mm of rainfall on developed area. For this calculation only hardstanding areas are assumed to provide 80% runoff, and non-hardstanding areas are assumed to provide 0% runoff.
The equivalent volume of Interception Storage should be provided on site as no discharge from site should occur for this initial 5mm depth of rainfall. The Interception Storage on this subject site will be provided through the base of attenuation tank located to East of the site.

Site Area of development:	$3870m^2$ (0.387 ha)
Landscaping:	$675m^2$
Impermeable Areas:	
Roof Area:	$3195m^2$
Design Impermeable Areas:	$3195m^2 \times 0.8 =$ $2556m^2$
Total volume for 5mm rainfall:	$5mm \times 2556m^2 =$ **$13m^3$**

Therefore a minimum Interception Storage volume of $13m^3$ should be provided. This will prevent discharge from site during rainfall events of up to 5mm rainfall.

2) Greenfield Runoff Rate – QBAR, (mean annual flood flow):

$QBAR_{rural}$ (m^3/sec) = $0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$

SAAR (E 303000,N 228000): 809mm

Soil Index:
- S1 (very low runoff)
- S2
- S3 (moderate runoff)
- S4
- S5 (very high runoff)

$Soil = 0.1(Soil_1) + 0.3(Soil_2) + 0.37(Soil_3) + 0.47(Soil_4) + 0.53(Soil_5)$
As the site is relatively small in catchment terms the soil class is 100% $Soil_2$

Soil Class: $Soil_2$
Runoff Potential: Low
Soil Value: 0.3

QBAR:

As the site area is less than 50 hectares;

QBAR for 50 hectares is firstly calculated,

QBAR (m^3/sec) = $0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$
$0.00108 \times (0.5)^{0.89} \times (809)^{1.17} \times (0.3)^{2.17}$
107.93 l/sec
2.16 l/sec/ha

QBAR for the smaller area (i.e. the subject site area):

2.16 l/sec/ha x 0.387 ha
0.84 l/sec

Calculate flood flows for various return periods;

QBAR = 0.84 l/sec
Q2 = 0.95 x 0.84 l/sec = 0.80 l/sec
Q30 = 2.10 x 0.84 l/sec = 1.76 l/sec

The peak flow rate factors of 0.95 & 2.1 above are taken from tabulated values of growth curve multipliers for the Dublin area.

Minimum achievable hydrobrake flow rate is 2 l/sec therefore allowable discharge (Q2) will be set at 2 l/sec. Since calculated Q30 discharge is less than 2 l/sec only one hydrobrake is to be provided.

2a) Attenuation Volume

80% of hardstand areas are assumed to contribute.
Soil SPR Value – 0.3, therefore 30% of non-hardstand areas assumed to contribute.

Equivalent Runoff Area: 80% x 3195m^2 + 30% x 675m^2
2556m^2 + 203m^2 =
2759m^2

Met Eireann's Rainfall depths for the 30 year storm event have been used. The table below identified the 12 hour event as the critical event. The rainfall depth used includes a 10% allowance for climate change giving a volume of 144m^3 - (Column G).

A	B	C	D	E	F	G
Duration	**Runoff Area**	**Tot Rainfall Depth 30year return period**	**Revised Depth for Climate Change**	**Total Surface Water**	**Total Permitted Discharge**	**Storage Volume Required**
	(m2)	**(mm)**	**(mm) C x 1.1**	**(m3) B x D**	**(m3)Q2 x A** ***(Q2=2 l/sec)***	**(m3) E - F**
15 min	2759	20.2	22.22	61.30	1.80	59.50
30 min	2759	25.6	28.16	77.69	3.60	74.09
1 hour	2759	32.5	35.75	98.63	7.20	91.43
2 hour	2759	41.1	45.21	124.73	14.40	110.33
4 hour	2759	52.1	57.31	158.12	28.80	129.32
6 hour	2759	59.9	65.89	181.79	43.20	138.59
12 hour	**2759**	**75.8**	**83.38**	**230.05**	**86.40**	**143.65**
1 day	2759	96.1	105.71	291.65	172.80	118.85
2 day	2759	107.6	118.36	326.56	345.60	-19.04

An allowance to account for the simplifying assumption of head – discharge relationship of 1.25 is applied (due to simple calculations assuming the maximum flow rate can be mobilised immediately for each design return period.

Revised Critical Volume: 144 x 1.25 = 180m^3

Subtract Interception Storage: 180 – 13 = **167m^3 (Req'd Attenuation Vol)**

3) Temporary Flood Storage

In addition to the previous calculations for interception & attenuation storage, the temporary flood storage must be calculated.

The 6 hour duration, 100 year return period must be checked to assess the **temporary flood storage** required for the site.

100 year 6 hour event, rainfall depth: 84.1mm
Factor up by 10% for climate change: 92.5mm

Total Volume of Runoff:	92.5mm x 2759m^2	=	255m^3
Deduct discharge at Q2 for 6hrs:	2 l/sec x 6 hrs	=	43m^3
Storage volume required;	255 – 43	=	212m^3
Factor up for head relationship factor;	212 x 1.25	=	265m^3
Deduct Interception Storage;	13m^3		
Deduct Attenuation Storage;	167m^3		
Temporary Flood Storage Required:	265 – 13 – 167	=	85m^3

In summary:

Interception Storage: 13m^3 to be provided by a lowered base to the attenuation system.
Attenuation System Area: 410m^2. Therefore the Interception Storage Depth will equal 80mm. A lowered base level to the attenuation facility allowing base infiltration will facilitate on site discharge of this interception volume. This storage volume being lower than the system outlet cannot discharge from site.

Required Attenuation Volume: 167m^3 to be provided within the attenuation system on site.

Temporary Flood Storage: 85m^3 can also be accommodated within the attenuation system provided – see system volumes below.

Total volume required: 13 + 167 + 85 = 265m^3

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 302532, Northing: 227782,

	Interval		Years													
DURATION	6months	1year	2	3	4	5	10	20	30	50	75	100	150	200	250	500
5 mins	2.5	3.7	4.4	5.4	6.1	6.7	8.6	10.8	12.3	14.5	16.5	18.0	20.4	22.4	24.0	N/A
10 mins	3.5	5.1	6.1	7.5	8.5	9.3	12.0	15.1	17.2	20.2	23.0	25.1	28.5	31.1	33.4	N/A
15 mins	4.1	6.1	7.2	8.9	10.0	11.0	14.1	17.8	20.2	23.8	27.0	29.5	33.5	36.6	39.3	N/A
30 mins	5.3	7.9	9.3	11.4	12.9	14.1	18.0	22.6	25.6	30.0	34.0	37.1	42.0	45.8	49.0	N/A
1 hours	7.0	10.3	12.0	14.8	16.6	18.1	23.0	28.7	32.5	37.9	42.8	46.6	52.6	57.3	61.2	N/A
2 hours	9.2	13.4	15.6	19.1	21.4	23.3	29.4	36.4	41.1	47.8	53.9	58.6	65.9	71.6	76.4	N/A
3 hours	10.8	15.6	18.2	22.1	24.8	26.9	33.9	41.9	47.2	54.8	61.6	66.9	75.2	81.6	86.9	N/A
4 hours	12.1	17.4	20.3	24.6	27.6	29.9	37.5	46.3	52.1	60.4	67.8	73.6	82.5	89.5	95.3	N/A
6 hours	14.2	20.3	23.6	28.6	32.0	34.6	43.3	53.2	59.9	69.2	77.6	84.1	94.1	102.0	108.5	N/A
9 hours	16.7	23.7	27.4	33.2	37.0	40.1	50.0	61.3	68.7	79.3	88.7	96.1	107.4	116.2	123.5	N/A
12 hours	18.7	26.4	30.6	36.9	41.1	44.4	55.3	67.7	75.8	87.4	97.6	105.6	117.9	127.5	135.4	N/A
18 hours	21.9	30.8	35.6	42.8	47.7	51.4	63.8	77.8	87.1	100.1	111.7	120.7	134.5	145.3	154.2	N/A
24 hours	24.5	34.4	39.7	47.6	52.9	57.1	70.6	86.0	96.1	110.3	122.9	132.7	147.7	159.4	169.0	202.9
2 days	30.9	42.1	48.0	56.6	62.4	66.9	81.2	97.2	107.6	122.0	134.7	144.4	159.3	170.7	180.2	212.9
3 days	36.1	48.4	54.7	64.0	70.2	74.9	90.0	106.6	117.3	132.1	145.0	154.9	169.9	181.4	190.9	223.4
4 days	40.7	53.9	60.6	70.4	76.9	81.9	97.6	114.8	125.9	141.0	154.2	164.3	179.5	191.2	200.7	233.4
6 days	48.8	63.5	70.9	81.7	88.7	94.1	111.0	129.2	140.8	156.7	170.4	180.8	196.5	208.4	218.2	251.3
8 days	56.1	72.0	80.0	91.6	99.1	104.8	122.6	141.8	153.9	170.4	184.6	195.3	211.4	223.6	233.6	267.3
10 days	62.8	79.8	88.4	100.6	108.5	114.5	133.2	153.1	165.7	182.8	197.4	208.4	225.0	237.4	247.6	281.9
12 days	69.0	87.1	96.1	109.0	117.2	123.5	143.0	163.7	176.7	194.2	209.2	220.5	237.5	250.2	260.5	295.4
16 days	80.7	100.6	110.5	124.4	133.3	140.1	160.9	182.9	196.6	215.1	230.8	242.6	260.2	273.4	284.1	320.0
20 days	91.6	113.2	123.7	138.6	148.1	155.3	177.3	200.4	214.8	234.0	250.4	262.6	280.8	294.4	305.5	342.3
25 days	104.5	127.8	139.2	155.1	165.3	172.9	196.3	220.6	235.7	255.8	272.9	285.6	304.4	318.5	329.9	367.8

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

Project: **Block B4**

Chamber Model -	SC-740		
Units -	Metric	Click Here for Imperial	
	48		
Number of chambers -	120		
Voids in the stone (porosity) -	40	%	
Base of Stone Elevation -	92.73	m	☑ Include Perimeter Stone in Calculations
Amount of Stone Above Chambers -	160	mm	
Amount of Stone Below Chambers -	160	mm	
Area of system -	410	sq.meters	Min. Area - 376.861 sq.meter

StormTech
Detention • Retention • Water Quality
A division of ADS

Height of System (mm)	Incremental Single Chamber (cubic meters)	Incremental Total Chamber (cubic meters)	Incremental Stone (cubic meters)	Incremental Ch & St (cubic meters)	Cumulative Chamber (cubic meters)	Elevation (meters)
1067	0.00	0.00	4.17	4.17	268.632	93.80
1041	0.00	0.00	4.17	4.17	264.467	93.77
1016	0.00	0.00	4.17	4.17	260.302	93.75
991	0.00	0.00	4.17	4.17	256.136	93.72
965	0.00	0.00	4.17	4.17	251.971	93.70
940	0.00	0.00	4.17	4.17	247.805	93.67
914	0.00	0.19	4.09	4.28	243.640	93.64
889	0.00	0.55	3.94	4.50	239.362	93.62
864	0.01	0.96	3.78	4.74	234.865	93.59
838	0.02	2.05	3.34	5.40	230.125	93.57
813	0.02	2.72	3.08	5.80	224.728	93.54
787	0.03	3.23	2.87	6.10	218.928	93.52
762	0.03	3.65	2.70	6.36	212.824	93.49
737	0.03	4.01	2.56	6.57	206.468	93.47
711	0.04	4.30	2.45	6.75	199.896	93.44
686	0.04	4.60	2.32	6.93	193.150	93.42
660	0.04	4.94	2.19	7.13	186.222	93.39
635	0.04	5.18	2.09	7.27	179.092	93.37
610	0.04	5.38	2.01	7.39	171.818	93.34
584	0.05	5.58	1.93	7.51	164.426	93.31
559	0.05	5.77	1.86	7.63	156.913	93.29
533	0.05	5.96	1.78	7.74	149.282	93.26
508	0.05	6.13	1.72	7.84	141.543	93.24
483	0.05	6.30	1.64	7.95	133.702	93.21
457	0.05	6.43	1.59	8.03	125.755	93.19
432	0.05	6.57	1.54	8.11	117.729	93.16
406	0.06	6.71	1.48	8.19	109.621	93.14
381	0.06	6.83	1.43	8.26	101.429	93.11
356	0.06	6.95	1.39	8.33	93.166	93.09
330	0.06	7.05	1.35	8.40	84.831	93.06
305	0.06	7.15	1.30	8.46	76.435	93.03
279	0.06	7.24	1.27	8.51	67.978	93.01
254	0.06	7.32	1.24	8.56	59.466	92.98
229	0.06	7.40	1.21	8.60	50.910	92.96
203	0.06	7.47	1.18	8.65	42.306	92.93
178	0.06	7.50	1.17	8.67	33.658	92.91
152	0.00	0.00	4.17	4.17	24.992	92.88
127	0.00	0.00	4.17	4.17	20.827	92.86
102	0.00	0.00	4.17	4.17	16.662	92.83
76	0.00	0.00	4.17	4.17	12.496	92.81
51	0.00	0.00	4.17	4.17	8.331	92.78
25	0.00	0.00	4.17	4.17	4.165	92.76

Surface Water Network Design

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	90.00	0.400	225.0	0.160	5.00	0.0	0.600	o	225
1.001	40.70	0.180	226.1	0.000	0.00	0.0	0.600	o	225
2.000	90.00	0.400	225.0	0.160	5.00	0.0	0.600	o	225
1.002	10.60	0.050	212.0	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Infil. (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	36.3	6.7	93.530	0.160	0	0	0	0.87	34	16
1.001	34.7	7.5	93.130	0.160	0	0	0	0.87	34	16
2.000	36.3	6.7	93.350	0.160	0	0	0	0.87	34	16
1.002	34.3	7.7	92.950	0.320	0	0	0	0.89	36	30

Specification/Product Information for;

Flow Control Devices

Hydro-Brake® Flow Control

Modelling Guide

Unit Selection Design Guide

Overview

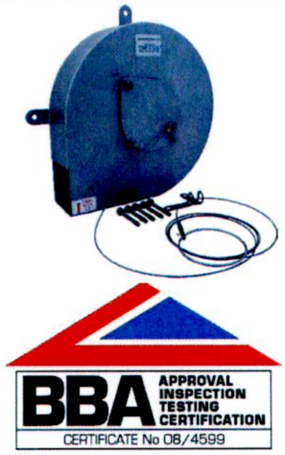
Hydro-Brake® Flow Controls restrict the flow in surface/storm water or foul/combined sewer systems by inducing a vortex flow pattern in the water passing through the device, having the effect of increasing back-pressure.

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

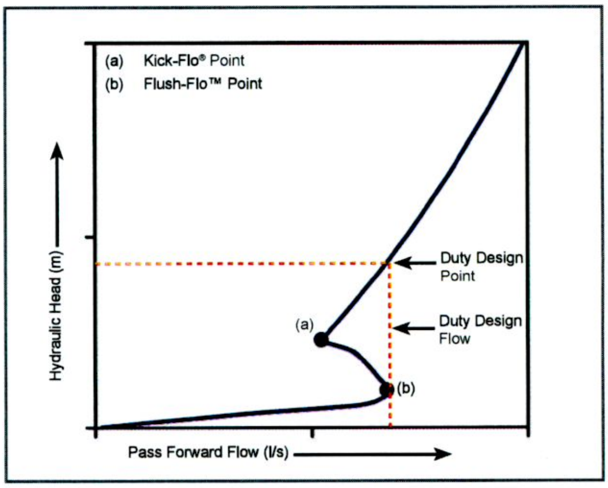


See back cover for details.

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:

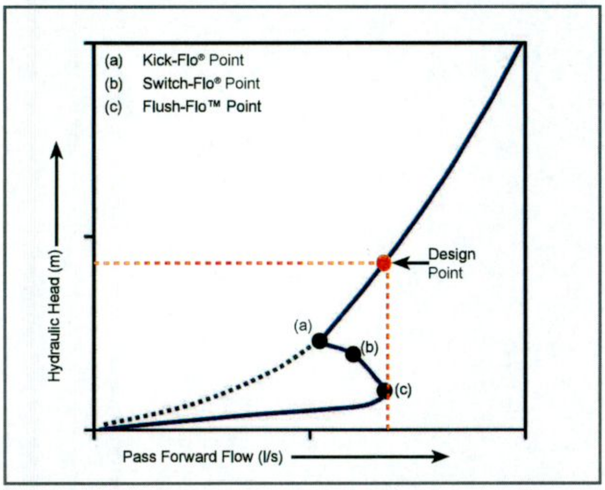
- outlet size and model of Hydro-Brake® Flow Control
- definition of the duty/design point (head and flow)
- definition of the Flush-Flo™ point (head and flow)
- definition of the Kick-Flo® point (head and flow)

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

STH Type Hydro-Brake® Flow Control with BBA Approval

Now included in WinDes® 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.

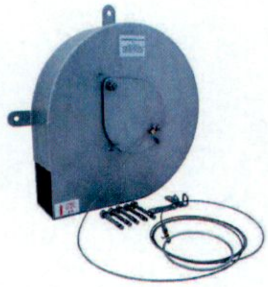
NEW Switch-Flo® (b) - marks the transition between the Kick-Flo® and Flush-Flo™, from vortex initiation to stabilisation. This point adds a new layer of resolution to the Hydro-Brake® curve that has implications to upstream storage savings.

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 WinDes® is available on our website:

www.hrdtec.com

SINGLE FLOW CONTROL DEVICE TO BE PROVIDED ON SWMH 25 OUTFALL:

Q = 2.0 l/sec

Our New Stormwater Web Resource

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

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HRD Technologies Ltd is a subsidiary of Hydro International plc

Foul Sewer Network Design

Proposed Block B4 to be connected into existing foul sewer.
Discharge units calculation for F1-F2 run: 288 (Ex. Block B3) + 384 (Proposed Block B4) = 672.
Existing pipe run F1 - F2 capacity check for total number of 672 discharge units:

FOUL SEWERAGE DESIGN

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	85.88	0.570	150.7	0.000	672.0	0.0	0.600	o	150

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Units	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	93.320	0.000	0	672.0	0	73	0.81	0.82	14	7

Proposed Block B4 to be connected into existing foul sewer.
Revised total number of discharge units for the entire site: 2208 (Existing) + 384 (New B4) = 2592
Existing pipe run F3 - F4 capacity check for total number of 2592 discharge units:

Unit G3 Calmount Pk.
Ballymount, Dublin 12

Tel. (01) 450 0694
Fax. (01) 426 4340
pkavanagh@kavanaghburke.ie

Date 01-09-16

Designed By OEM
Checked By

ENCAD

System1 W.10.2

FOUL SEWERAGE DESIGN

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	20.39	0.130	156.8	0.000	2592.0	0.0	0.600	o	150

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Units	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	92.236	0.000	0	2592.0	0	115	0.91	0.80	14	13

Existing foul surface network can serve the proposed block B4. All pipe runs on site are 150mm diameter at 1:150 gradient. Pipe run F1-F2 with the head of the line at MH F1 can accommodate additional 384 discharge units from proposed block B4. Effluent velocities in run F1-F2 are greater than required minimum 0.75m/sec. Pipe run F3-F4 (last foul sewer run discharging to the public sewer) can accommodate additional 384 discharge units from Block B4. Pipe capacity is sufficient for the additional foul.