KAVANAGH BURKE
CONSULTING ENGINEERS

Drainage Design Report

for

Warehouse Development

at

Brownsbarn,
Citywest Campus,
Dublin 24

Job No:	**D1678**
Client:	**Exeter Ireland Property IV B Limited**
Date:	**February 2022**
Local Authority:	**South Dublin County Council**
Revision:	**PL3 Additional Information**

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Contents:

Introduction

This report details the site development works design for a development at Brownsbarn Drive, Citywest Business Campus, Dublin 24 revised as per additional information request.

The lands are bounded to the south by the N7 Naas Road, to the north and west by the National Distribution Centre and to the east by Brownsbarn Drive and the Royal Garter Stables, a Protected Structure (RPS Ref. 261).

The development will comprise the construction of 2 No. warehouses with ancillary office and staff facilities; vehicular access/egress routes to the subject site via the existing roundabout and access road plus alteration to the existing access arrangements to the subject lands to facilitate safe traffic flow to/from the proposed facilities; pedestrian access; 109 No. car parking spaces; bicycle parking; HGV Parking; HGV yards; level access goods doors; dock levellers; access gates; signage; hard and soft landscaping; lighting; boundary treatments; ESB substation; sprinkler tanks; pump houses; and all associated site development works above and below ground.

The site will be serviced primarily through connection to the existing services in the area.

The provision of the new on-site foul sewer, surface water & watermain are described as follows with calculations appended.

Surface Water:

Due to the industrial nature of the proposed development, the yard surfacing for HGV access and marshalling is concrete. An area of porous asphalt is provided to the car park area where traffic loads are light.

Runoff from the hardstanding areas will be collected by trapped road gullies and rainwater goods throughout the development and directed to an on-site surface water attenuation facility. This facility is designed to attenuate 1 in 30-year storm event of any duration, therefore no flooding will occur on site for any duration events up to 30 year return period as per "Greater Dublin Strategic Drainage Study" (GDSDS) requirements. In addition to providing attenuation volume, temporary flood storage is check and provided where needed (as an integrated part of the attenuation system) for 100-year return events as per GDSDS requirements. The restricted discharge from site will be limited by a proprietary flow control device. The maximum allowable discharge is limited to calculated flow (see calculations in the succeeding chapters) not exceeding Greenfield runoff rate, QBAR (as per criterion 4.3 "River Flood Protection" chapter 6.3.4 of GDSDS). All flows and runoffs for storm water network design and attenuation sizing are calculated incorporating 10% climate change factor for all rainfall intensities as per chapter 6.3.2.4 of GDSDS table 6.2 "Climate Change Factors". In addition a computer analysis in the storm network modelling software was performed to confirm the sizing of the pipe network and underground attenuation storage for 1 in 100 year storms of all durations. This analysis include a specific model of vortex flow control device with discharge of the calculated QBAR and 20% Climate Change Factor. The analysis indicated no on-site flooding (meaning that both the network and all proposed attenuation storage have sufficient capacities).

The attenuation facility proposed is "StormTech" or equivalent. This proprietary system consists of thermoplastic arches backfilled in specified stone and wrapped in a pervious geotextile. Prior to entering the system, the surface water runoff will pass through a proprietary silt trap and petrol interceptor to ensure debris, silt particles and hydrocarbons are removed. Subsequently the surface runoff enters the attenuation facility through an "isolator row" whereby a row of void forming thermoplastic arches are wrapped in a pervious geotextile which provides a second level of suspended solid removal prior to the water entering the greater attenuation area.

These water quality control measures can be cleaned out by suction hose/tanker if required from standard maintenance inspections. In the case of the isolator row, the chamber is backwashed with a proprietary power jet wash and its water removed by suction hose/tanker.

Water quantity control is provided downstream of the attenuation facilities by providing the above-mentioned flow control device. The proposed vortex style flow control device of discharge rate, calculated separately for each block, will be installed on the outfall from the last surface water manholes of each network. The discharge from sites, i.e. the restricted flow from the flow control device will ultimately discharge to the adjacent River Camac to the eastern site's boundary (at 2 no locations), as shown at the accompanying drawing ref. D1678 – D4 - Drainage and watermain Layout.

The details of the surface water attenuation system including interceptors, flow restrictions, volume and pipe designs are attached in this Drainage Design Report and on the accompanying Drainage details layout (drg. ref. D1678 – D4) for review by the Local Authority.

In considering the above surface water management solution we considered all SuDS devices and given the industrial nature of the proposed operations on this site, the above solution of underground surface water attenuation was decided on. In summary, a range of measures have been incorporated into the development as follows:

- Tree Pits
- Trapped Road Gullies
- Restricted discharge
- Silt trap and petrol interceptor
- Water butts
- Permeable paving
- Green roof
- Grasscrete paving

The above proposed SuDSs devices are shown at enclosed Site plan layout and Drainage and Watermain Layout and they are detailed and further specified by landscape architect at their enclosed documents and drawings, also submitted for the review of the Local Authority.

The proposed surface water management solution for the subject site provides both runoff quality and quantity control. Quality control is provided by ensuring all surface water runoff is dealt with on site as described earlier in this document with reference to the specified attenuation system with in-built "isolator row", proprietary silt traps & petrol interceptors. Quantity control is also provided through the surface water attenuation system coupled with the downstream flow control device. This system of surface water management has been put in place throughout the more recent developments of Baldonnell Business Park and Kingswood Business Park individual sites have been developed in a similar nature.

In summary, the following figures synopsis the surface water attenuation calculations:

	UNIT 1	UNIT 2
SITE AREA	18,220 m^2	18,850 m^2
SAAR	798	798
SOIL VALUE	0.3	0.3

STRUCTURE TYPE	RUNOFF COEFFICIENTS	UNIT 1 AREA (ha)	UNIT 2 AREA (ha)
Impermeable Areas *(roofs, footpaths, concrete yard, roads, paving)*	1.0	1.2475	1.1725
Green Roof (if any)	0.8	0	0.025
Grsscrete	0.3	0.1445	0.0625
Landscaping	0.3	0.43	0.645
TOTAL	-	1.822	1.885

Details of the surface water attenuation system including interceptors, flow restrictions, volume and pipe designs are included in this Drainage Design Report and on the accompanying Drainage Layout (drawing reference D1678 – D4 - Drainage & Watermain Layout PL3 AI) for review by the Local Authority.

Foul Sewer:

A new foul sewer has been designed to collect discharge from the proposed development and discharge to the existing foul sewer network at Brownsbarn Drive. This proposed network collects the sewage on site from the proposed 2 no units and ancillary offices/staff facilities. Connection to the existing foul sewer network is proposed at the existing foul sewer manholes currently located at the existing footpaths at the existing roundabout at Brownsbarn Drive.

The peak foul sewer discharge rate is based on the discharge unit method of drainage design for calculating maximum sewage and wastewater flows. The proposed ancillary offices and warehouse toilet facilities are the source of wastewater for overall development.

As per the requirements of the Irish Water Code of Practice, minimum velocities of 0.75 m/s are met for the proposed gradients and contributing discharge unit numbers (refer to discharge unit calculation sheet for details). The proposed foul sewer including manholes and service connections will be constructed in compliance with design standards set out by Irish Water in the IW Code of Practice for Wastewater Infrastructure and Wastewater Infrastructure Standard Details.

The method of calculating the total discharge units from the development is carried out in accordance with BS EN 752-4:1998 "Drain and sewer systems outside buildings", refer to insert below for the relative tabulated extract;

Table C.1 — Typical frequency factors (k_{DU})

Type of building	k_{DU}
Dwelling, guesthouse, office (intermittent use)	0.5
Hospital, school, restaurant, hotel (frequent use)	0.7
Toilets and/or shower open to the public (congested use)	1.0
Laboratory buildings (special use)	1.2

Table C.2 — Typical values of discharge units (*DU*)

Type of appliance	*DU*
Washbasin, shower	0.3 to 0.6
Urinal	0.3 to 0.8
Bath, kitchen sink	0.8 to 1.3
Dishwasher	0.2 to 0.8
Household washing machine	0.5 to 0.8
Commercial washing machine	1.0 to 1.5
WCs (4.0 l to 9.0 l cistern)	1.2 to 2.5
Floor drains (DN 50 to DN 100)	0.6 to 2.0
The discharge unit will depend on the type of drainage system inside the building and the size of the appliance. Where no specific information is available, the higher value should be used	

All proposed calculations of discharge units, flows and pipe designs are included further in this Drainage Design Report for the review of the Local Authority.

Watermain:

The watermain proposed to serve the development will form a metered connection from the existing 200mm watermain on site, at Brownsbarn Drive, the exact connection locations shown on accompanying drg. ref. D1678 – D4.

A new looped 150mm dia. HDPE watermain within the site will be provided with adequate sluice valves, water meter & fire hydrants to provide water supply and for firefighting purposes. Hydrants will not be placed within 6m of a building or structure and at a maximum 46m from proposed buildings. All associated details including watermain pipe material will be in accordance with the current Irish Water guidelines. Guidelines set out in the Irish Water Publications IW-CDS-5020-03 & IW-CDS-5030-03 have been consulted and adopted within the design of the proposed drainage & watermain networks. Refer to enclosed Drainage & Watermain drawing Ref. D1678 - D4 for layout details.

Surface Water Attenuation Design

- Unit 1
    - StormTech Cumulative Spreadsheet
- Unit 2
    - StormTech Cumulative Spreadsheet

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UNIT 1 - Surface Water Attenuation Calculation

1) Areas for Attenuation Calculation

Catchment Area:	18,220 m^2 (1.885 ha)
Landscaping:	4,300 m^2
Contributing Landscaping:	1,755 m^2
Grasscrete (to car parking spaces):	1,445 m^2
Roofs:	7,355 m^2
Footpaths & Concrete yard:	4,005 m^2
Permeable paving:	1,115 m^2
Total Impermeable Areas:	12,475 m^2

2) 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 in the concrete yard to the south of the building.

Design Impermeable Areas:	12,475 m^2 x 0.80 = 9,980 m^2
Total volume for 5mm rainfall:	5mm x 9,980 m^2 = **50 m^3**

Therefore, a minimum Interception Storage volume of 50 m^3 should be provided. This will prevent discharge from site during rainfall events of up to 5mm rainfall.

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

$Q_{BARrural}$ (m^3/sec) = 0.00108 x $AREA^{0.89}$ x $SAAR^{1.17}$ x $SOIL^{2.17}$

SAAR (E 304550, N 228200): <u>798 mm</u> (*as per Met Eireann data*)

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 will be 100% Soil2 as per online Wallingford Procedure Greenfield runoff estimation tool on www.uksuds.com (see Appendix to Surface Water Design for the HR Wallingford Greenfield runoff rate estimation report).

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

Q_{BAR}:
As the site area is less than 50 hectares, QBAR for 50 hectares is firstly calculated:

Q_{BAR} (m^3/sec) = 0.00108 x $AREA^{0.89}$ x $SAAR^{1.17}$ x $SOIL^{2.17}$ =
0.00108 x $(0.5)^{0.89}$ x $(798)^{1.17}$ x $(0.3)^{2.17}$ =
106.2 l/sec =
2.12 l/sec/ha

Q_{BAR} for the subject site area:

2.12 l/sec/ha x 1.822 ha =
Q_{BAR} = 3.87 l/sec

According to GDSDS chapter 6.3.1.4 if the separate long term storage cannot be provided and temporary flood storage forms part of the single attenuation system, all the runoff from the site should be discharged at either a rate of 2.0 l/s/ha or the average annual peak flow rate Q_{BAR}, whichever is greater:

<u>Therefore, allowable discharge (Q_{BAR}) will be set at 3.87 l/sec.</u>

4) Attenuation Storage Volume

100% of hardstand areas are assumed to contribute.

Equivalent Runoff Area: (roof, concrete yard, roads): 12,475 m^2

Met Eireann's Rainfall depths for the 30 year storm event have been used. The table below identified the 24 hour event as the critical event. The rainfall depth used includes a 10% allowance for climate change giving a volume of 1,242m^3 - (Column G).

A	B	C	D	E	F	G
Duration	**Runoff Area**	**Total Rainfall Depth**	**Revised Depth for 10% Climate Change**	**Total Surface Water**	**Total Permitted Discharge**	**Storage Volume Required**
	(m^2)	**(mm)**	**(mm) C x 1.1**	**(m^3) B x D**	**(m^3) Q2 x A** ***(Q_{BAR}=3.87 l/sec)***	**(m^3) E - F**
30 min	12475	25.30	27.83	347.18	6.97	340.21
1 hour	12475	32.10	35.31	440.49	13.93	426.56
2 hour	12475	40.70	44.77	558.51	27.87	530.64
4 hour	12475	51.50	56.65	706.71	55.74	650.97
6 hour	12475	59.20	65.12	812.37	83.61	728.77
12 hour	12475	75.00	82.50	1029.19	167.21	861.98
1 day	12475	95.00	104.50	1303.64	334.42	969.21
2 day	12475	106.40	117.04	1460.07	668.85	791.23

Critical Attenuation Volume = 969 m^3

Subtract Interception Storage: 969 m^3 – 50 m^3 = **919 m^3** **Required Attenuation Volume**

The calculated attenuation storage volume was analysed in the storm water network modelling software using the site-specific vortex type flow control device and there was no indication of flood or ponding for any storm duration for 1 in 30 year return period therefore calculated volume of attenuation tank is sufficient.
The detailed results of this analysis are enclosed in this report at Surface Water Network Design -Unit 1.

5) Temporary Flood Storage

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

For long term storage the GDSDS runoff model assumptions:

100% of hardstand areas are assumed to contribute.
Soil SPR Value – 0.3, therefore 30% of non-hardstand areas assumed to contribute.

Equivalent Runoff Area:	100% x 12,475 m^2 + 30% x 3,200 m^2 =
	= 9,980 m^2 + 960 m^2 =
	= **13,435 m^2**

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: 83.4 mm
Factor up by 20% for climate change: 91.74 mm

Total Volume of Runoff:	91.74mm x 13,435 m^2	=	1,233 m^3
Deduct discharge at Q_{BAR} for 6hrs:	3.87 l/sec x 6 hrs	=	84 m^3
Storage volume required;	1,233 – 84	=	1,149 m^3
Deduct Interception Storage;	50 m^3		
Deduct Req. Attenuation Storage;	919 m^3		
Temporary Flood Storage required:	1,149 – 50 – 919	=	180 m^3

The calculated attenuation volume was analysed in a storm water network modelling software using the site-specific vortex type flow control device and there was no indication of flood or ponding for any storm duration for 1 in 100-year storms with 20% CCF and there is no flooding or ponding during the analysis.

The detailed results of this analysis are shown and enclosed in this report at Surface Water Network Design – Unit 1.

In summary:

<u>INTERCEPTION STORAGE</u>: **50m³** to be provided by a lowered base to the attenuation system. Attenuation System Area: 1,520m². Therefore, the Interception Storage Depth will equal 100mm. 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.

ATTENUATION VOLUME: **919m³** to be provided within the attenuation system on site.

TEMPORARY FLOOD STORAGE: **180m³** to be provided within the attenuation system on site.

ATTENUATION VOLUME REQUIRED: 50 + 919 + 182 = 1,149 m³

ATTENUATION VOLUME PROVIDED: 1,151 m³
(Refer to StormTech Cumulative Storages spreadsheet below)

Project: D1678 - UNIT 1 PL3 AI

Chamber Model -	MC-3500	
Units -	Metric	Click Here for Imperial
Number of Chambers -	216	
Number of End Caps -	16	
Voids in the stone (porosity) -	43	%
Base of Stone Elevation -	96.80	m
Amount of Stone Above Chambers -	305	mm
Amount of Stone Below Chambers -	230	mm
Area of system -	1060	sq.meters

☑ Include Perimeter Stone in Calculations

Min. Area - 1056.04 sq.meters

StormTech MC-3500 Cumulative Storage Volumes

Height of System (mm)	Incremental Single Chamber (cubic meters)	Incremental Single End Cap (cubic meters)	Incremental Chambers (cubic meters)	Incremental End Cap (cubic meters)	Incremental Stone (cubic meters)	Incremental Chamber, End Cap and Stone (cubic meters)	Cumulative System (cubic meters)	Elevation (meters)
1676	0.00	0.00	0.00	0.00	11.571	11.57	1151.08	98.48
1651	0.00	0.00	0.00	0.00	11.571	11.57	1139.51	98.45
1626	0.00	0.00	0.00	0.00	11.571	11.57	1127.93	98.43
1600	0.00	0.00	0.00	0.00	11.571	11.57	1116.36	98.40
1575	0.00	0.00	0.00	0.00	11.571	11.57	1104.79	98.37
1549	0.00	0.00	0.00	0.00	11.571	11.57	1093.22	98.35
1524	0.00	0.00	0.00	0.00	11.571	11.57	1081.65	98.32
1499	0.00	0.00	0.00	0.00	11.571	11.57	1070.08	98.30
1473	0.00	0.00	0.00	0.00	11.571	11.57	1058.51	98.27
1448	0.00	0.00	0.00	0.00	11.571	11.57	1046.93	98.25
1422	0.00	0.00	0.00	0.00	11.571	11.57	1035.36	98.22
1397	0.00	0.00	0.00	0.00	11.571	11.57	1023.79	98.20
1372	0.00	0.00	0.36	0.00	11.419	11.77	1012.22	98.17
1346	0.01	0.00	1.19	0.00	11.059	12.25	1000.45	98.15
1321	0.01	0.00	1.80	0.00	10.796	12.60	988.20	98.12
1295	0.01	0.00	2.47	0.01	10.506	12.98	975.60	98.10
1270	0.02	0.00	4.20	0.02	9.756	13.98	962.61	98.07
1245	0.03	0.00	6.29	0.02	8.857	15.17	948.63	98.04
1219	0.04	0.00	7.64	0.03	8.271	15.95	933.47	98.02
1194	0.04	0.00	8.70	0.04	7.813	16.55	917.52	97.99
1168	0.04	0.00	9.62	0.05	7.415	17.08	900.97	97.97
1143	0.05	0.00	10.44	0.05	7.058	17.55	883.88	97.94
1118	0.05	0.00	11.18	0.06	6.735	17.98	866.33	97.92
1092	0.05	0.00	11.85	0.07	6.444	18.37	848.35	97.89
1067	0.06	0.01	12.48	0.08	6.169	18.73	829.98	97.87
1041	0.06	0.01	13.06	0.09	5.918	19.07	811.25	97.84
1016	0.06	0.01	13.60	0.10	5.681	19.38	792.18	97.82
991	0.07	0.01	14.11	0.11	5.458	19.68	772.80	97.79
965	0.07	0.01	14.59	0.12	5.249	19.95	753.12	97.77
940	0.07	0.01	15.04	0.12	5.051	20.21	733.17	97.74
914	0.07	0.01	15.46	0.13	4.866	20.46	712.96	97.71
889	0.07	0.01	15.86	0.14	4.687	20.70	692.50	97.69
864	0.08	0.01	16.25	0.15	4.522	20.92	671.80	97.66
838	0.08	0.01	16.61	0.16	4.362	21.13	650.88	97.64
813	0.08	0.01	16.95	0.17	4.211	21.33	629.75	97.61
787	0.08	0.01	17.28	0.18	4.066	21.52	608.43	97.59
762	0.08	0.01	17.59	0.19	3.929	21.70	586.91	97.56
737	0.08	0.01	17.89	0.19	3.797	21.88	565.20	97.54
711	0.08	0.01	18.17	0.20	3.673	22.04	543.33	97.51
686	0.09	0.01	18.43	0.21	3.559	22.19	521.28	97.49
660	0.09	0.01	18.68	0.22	3.448	22.34	499.09	97.46
635	0.09	0.01	18.93	0.22	3.338	22.49	476.75	97.44
610	0.09	0.01	19.15	0.23	3.238	22.62	454.26	97.41
584	0.09	0.01	19.36	0.24	3.144	22.74	431.65	97.38
559	0.09	0.02	19.57	0.24	3.051	22.87	408.90	97.36
533	0.09	0.02	19.76	0.24	2.968	22.98	386.04	97.33
508	0.09	0.02	19.95	0.25	2.885	23.09	363.06	97.31
483	0.09	0.02	20.12	0.26	2.807	23.19	339.98	97.28
457	0.09	0.02	20.29	0.26	2.732	23.29	316.79	97.26
432	0.09	0.02	20.45	0.26	2.663	23.38	293.50	97.23
406	0.10	0.02	20.60	0.27	2.595	23.47	270.12	97.21
381	0.10	0.02	20.75	0.27	2.532	23.55	246.65	97.18
356	0.10	0.02	20.89	0.28	2.472	23.63	223.09	97.16

330	0.10	0.02	21.02	0.28	2.413	23.71	199.46	97.13
305	0.10	0.02	21.15	0.28	2.357	23.79	175.75	97.10
279	0.10	0.02	21.28	0.29	2.299	23.86	151.96	97.08
254	0.10	0.02	21.44	0.29	2.230	23.95	128.10	97.05
229	0.00	0.00	0.00	0.00	11.571	11.57	104.14	97.03
203	0.00	0.00	0.00	0.00	11.571	11.57	92.57	97.00
178	0.00	0.00	0.00	0.00	11.571	11.57	81.00	96.98
152	0.00	0.00	0.00	0.00	11.571	11.57	69.43	96.95
127	0.00	0.00	0.00	0.00	11.571	11.57	57.86	96.93
102	0.00	0.00	0.00	0.00	11.571	11.57	46.29	96.90
76	0.00	0.00	0.00	0.00	11.571	11.57	34.71	96.88
51	0.00	0.00	0.00	0.00	11.571	11.57	23.14	96.85
25	0.00	0.00	0.00	0.00	11.571	11.57	11.57	96.83

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UNIT 2 - Surface Water Attenuation Calculation

1) Areas for Attenuation Calculation

Catchment Area:	18,850 m^2 (1.885 ha)
Landscaping:	6,450 m^2
Contributing Landscaping:	3,500 m^2
Grasscrete (to car parking spaces):	675 m^2
Green roof (office roof):	250 m^2
Roofs:	5,550 m^2
Footpaths & Concrete yard:	4,750 m^2
Permeable paving:	1,425 m^2
Total Impermeable Areas:	11,725 m^2

2) 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 in the concrete yard to the east of the building.

Design Impermeable Areas: 11,725 m^2 x 0.80 = 9,380 m^2

Total volume for 5mm rainfall: 5mm x 9,380 m^2 = **47 m^3**

Therefore, a minimum Interception Storage volume of 47 m^3 should be provided. This will prevent discharge from site during rainfall events of up to 5mm rainfall.

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

$Q_{BARrural}$ (m³/sec) = 0.00108 x $AREA^{0.89}$ x $SAAR^{1.17}$ x $SOIL^{2.17}$

SAAR (E 304550, N 228200): <u>798 mm</u> (*as per Met Eireann data*)

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 will be 100% Soil2 as per online Wallingford Procedure Greenfield runoff estimation tool on www.uksuds.com (see Appendix to Surface Water Design for the HR Wallingford Greenfield runoff rate estimation report).

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

Q_{BAR}:
As the site area is less than 50 hectares, QBAR for 50 hectares is firstly calculated:

Q_{BAR} (m³/sec) = 0.00108 x $AREA^{0.89}$ x $SAAR^{1.17}$ x $SOIL^{2.17}$ =
0.00108 x $(0.5)^{0.89}$ x $(798)^{1.17}$ x $(0.3)^{2.17}$ =
106.2 l/sec =
2.12 l/sec/ha

Q_{BAR} for the subject site area:

2.12 l/sec/ha x 1.885 ha =
Q_{BAR} = 4.0 l/sec

According to GDSDS chapter 6.3.1.4 if the separate long-term storage cannot be provided and temporary flood storage forms part of the single attenuation system, all the runoff from the site should be discharged at either a rate of 2.0 l/s/ha or the average annual peak flow rate Q_{BAR}, whichever is greater.

<u>Therefore, allowable discharge (Q_{BAR}) will be set at **4.0 l/sec.**</u>

4) Attenuation Storage Volume

100% of hardstand areas are assumed to contribute.

Equivalent Runoff Area: (roof, concrete yard, roads): 11,725 m²

Met Eireann's Rainfall depths for the 30 year storm event have been used. The table below identified the 24 hour event as the critical event. The rainfall depth used includes a 10% allowance for climate change giving a volume of 1,161m³ - (Column G).

A	B	C	D	E	F	G
Duration	**Runoff Area**	**Total Rainfall Depth**	**Revised Depth for 10% Climate Change**	**Total Surface Water**	**Total Permitted Discharge**	**Storage Volume Required**
	(m²)	**(mm)**	**(mm) C x 1.1**	**(m³) B x D**	**(m³) Q_{BAR} x A** *(Q_{BAR}=4.0 l/sec)*	**(m³) E - F**
15 min	11725	20.00	22.00	257.95	3.60	254.35
30 min	11725	25.30	27.83	326.31	7.21	319.10
1 hour	11725	32.10	35.31	414.01	14.42	399.59
2 hour	11725	40.70	44.77	524.93	28.83	496.10
4 hour	11725	51.50	56.65	664.22	57.66	606.56
6 hour	11725	59.20	65.12	763.53	86.50	677.04
12 hour	11725	75.00	82.50	967.31	172.99	794.32
1 day	11725	95.00	104.50	1225.26	345.99	879.28
2 day	11725	106.40	117.04	1372.29	691.97	680.32

Critical Attenuation Volume = 879 m³

Subtract Interception Storage: 879 m³ – 47 m³ = **832 m³** **Required Attenuation Volume**

The calculated attenuation storage volume was analysed in the storm water network modelling software using the site-specific vortex type flow control device and there was no indication of flood or ponding for any storm duration for 1 in 30 year return period therefore calculated volume of attenuation tank is sufficient.
The detailed results of this analysis are enclosed in this report at Surface Water Network Design -Unit 2.

5) Temporary Flood Storage

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

For long term storage the GDSDS runoff model assumptions:

100% 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 11,725 m^2 + 30% x 4,425 m^2 =
	= 11,725 m^2 + 1,327.5 m^2 =
	= **13,052.5 m^2**

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: 83.4 mm
Factor up by 10% for climate change: 91.74 mm

Total Volume of Runoff:	91.85mm x 13,052.5 m^2	=	1,197.5 m^3
Deduct discharge at Q_{BAR} for 6hrs:	4.0 l/sec x 6 hrs	=	86.5 m^3
Storage volume required;	1,197.5 – 86.5	=	1,111 m^3
Deduct Interception Storage;	47 m^3		
Deduct Req. Attenuation Storage;	832 m^3		
Temporary Flood Storage required:	1,111 –47 – 832	=	232 m^3

The calculated attenuation volume was analysed in a storm water network modelling software using the site-specific vortex type flow control device and there was no indication of flood or ponding for any storm duration for 1 in 100 year storms with 20% CCF and there is no flooding or ponding during the analysis.

The detailed results of this analysis are shown and enclosed in this report at Surface Water Network Design – Unit 2.

In summary:

<u>INTERCEPTION STORAGE</u>: **47m³** to be provided by a lowered base to the attenuation system. Attenuation System Area: 1,060m². Therefore, the Interception Storage Depth will equal 150mm. 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.

ATTENUATION VOLUME: **832m³** to be provided within the attenuation system on site.

TEMPORARY FLOOD STORAGE: **232m³** to be provided within the attenuation system on site.

ATTENUATION VOLUME REQUIRED: 47 + 832 + 232 = 1,111 m³

ATTENUATION VOLUME PROVIDED: 1,110 m³
(Refer to StormTech Cumulative Storages spreadsheet below)

Project: D1678 - UNIT 2 PL3 AI

StormTech
Detention • Retention • Water Quality
A division of ADS

Chamber Model -	SC-740	
Units -	Metric	Click Here for Imperial
Number of chambers -	468	
Voids in the stone (porosity) -	43	%
Base of Stone Elevation -	98.10	m
Amount of Stone Above Chambers -	200	mm
Amount of Stone Below Chambers -	200	mm
Area of system -	1520	sq.meters

☑ Include Perimeter Stone in Calculations

Min. Area - 1469.759 sq.mete

StormTech SC-740 Cumulative Storage Volumes

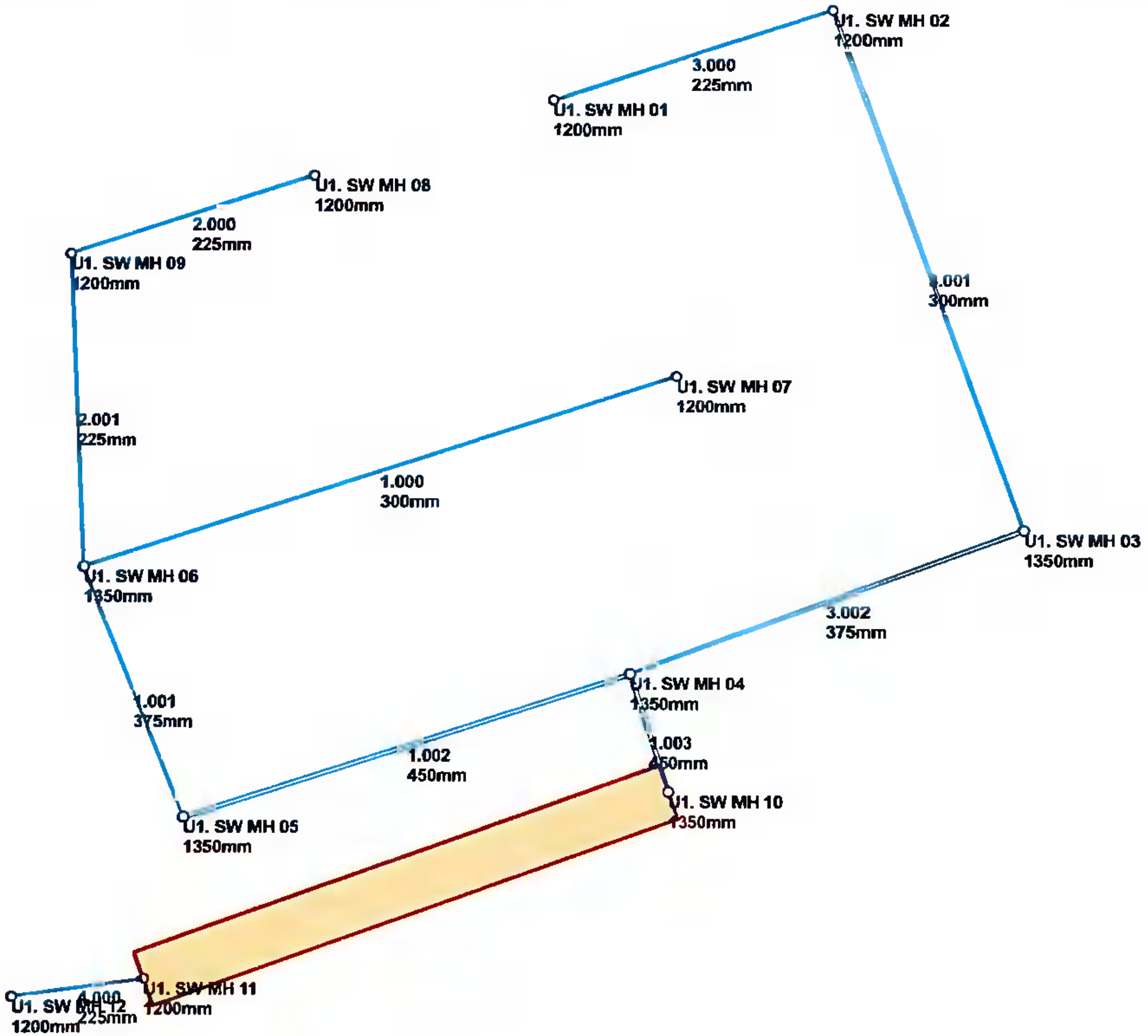
Height of System (mm)	Incremental Single Chamber (cubic meters)	Incremental Total Chamber (cubic meters)	Incremental Stone (cubic meters)	Incremental Ch & St (cubic meters)	Cumulative Chamber (cubic meters)	Elevation (meters)
1168	0.00	0.00	16.60	16.60	1110.763	99.27
1143	0.00	0.00	16.60	16.60	1094.162	99.24
1118	0.00	0.00	16.60	16.60	1077.561	99.22
1092	0.00	0.00	16.60	16.60	1060.959	99.19
1067	0.00	0.00	16.60	16.60	1044.358	99.17
1041	0.00	0.00	16.60	16.60	1027.757	99.14
1016	0.00	0.00	16.60	16.60	1011.155	99.12
991	0.00	0.00	16.60	16.60	994.554	99.09
965	0.00	0.73	16.29	17.02	977.953	99.07
940	0.00	2.16	15.67	17.83	960.936	99.04
914	0.01	3.74	14.99	18.73	943.104	99.01
889	0.02	8.00	13.16	21.16	924.373	98.99
864	0.02	10.62	12.03	22.66	903.210	98.96
838	0.03	12.60	11.18	23.78	880.552	98.94
813	0.03	14.24	10.48	24.72	856.770	98.91
787	0.03	15.64	9.87	25.52	832.052	98.89
762	0.04	16.77	9.39	26.16	806.533	98.86
737	0.04	17.96	8.88	26.84	780.372	98.84
711	0.04	19.27	8.32	27.59	753.535	98.81
686	0.04	20.21	7.91	28.12	725.950	98.79
660	0.04	20.97	7.58	28.55	697.831	98.76
635	0.05	21.76	7.24	29.01	669.277	98.74
610	0.05	22.52	6.92	29.44	640.270	98.71
584	0.05	23.23	6.61	29.84	610.831	98.68
559	0.05	23.89	6.33	30.22	580.988	98.66
533	0.05	24.58	6.03	30.61	550.769	98.63
508	0.05	25.09	5.81	30.90	520.155	98.61
483	0.05	25.63	5.58	31.21	489.254	98.58
457	0.06	26.17	5.35	31.52	458.044	98.56
432	0.06	26.64	5.15	31.78	426.524	98.53
406	0.06	27.10	4.95	32.05	394.740	98.51
381	0.06	27.50	4.78	32.28	362.691	98.48
356	0.06	27.89	4.61	32.50	330.416	98.46
330	0.06	28.25	4.45	32.70	297.915	98.43
305	0.06	28.54	4.33	32.87	265.210	98.40
279	0.06	28.85	4.20	33.05	232.339	98.38
254	0.06	29.13	4.07	33.21	199.293	98.35
229	0.06	29.25	4.02	33.28	166.085	98.33
203	0.00	0.00	16.60	16.60	132.810	98.30
178	0.00	0.00	16.60	16.60	116.209	98.28
152	0.00	0.00	16.60	16.60	99.608	98.25
127	0.00	0.00	16.60	16.60	83.006	98.23
102	0.00	0.00	16.60	16.60	66.405	98.20
76	0.00	0.00	16.60	16.60	49.804	98.18
51	0.00	0.00	16.60	16.60	33.203	98.15
25	0.00	0.00	16.60	16.60	16.601	98.13

KAVANAGH BURKE
CONSULTING ENGINEERS

Surface Water Network Design

- Unit 1
- Unit 2

KAVANAGH BURKE CONSULTING ENGINEERS	Kavanagh Burke Unit F3 Block F, Calmount Park, Ballymount, Dublin 12, D12PX28	File: D1678 - SW Networks_PL3 AI.pfd Network: SW_Unit 1 Elena Dragoje 01/02/2022	Page 1 Surface Water Network Scheme UNIT 1



Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.800	Minimum Backdrop Height (m)	1.000
Ratio-R	0.271	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
U1. SW MH 07	0.180	5.00	99.750	1200	1.450
U1. SW MH 08	0.100	5.00	99.425	1200	1.225
U1. SW MH 09			99.425	1200	1.425
U1. SW MH 06			99.375	1350	1.800
U1. SW MH 05	0.250	5.00	99.400	1350	2.050
U1. SW MH 01	0.084	5.00	99.425	1200	1.225
U1. SW MH 02	0.146	5.00	99.425	1200	1.475
U1. SW MH 03	0.156	5.00	100.200	1350	2.600
U1. SW MH 04			99.600	1350	2.450
U1. SW MH 10			99.540	1350	2.740
U1. SW MH 11		5.00	99.400	1200	2.650
U1. SW MH 12			99.450	1200	2.800

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)	Lateral Area (ha)
1.000	U1. SW MH 07	U1. SW MH 06	85.000	0.600	98.300	97.650	0.650	130.8	300	Circular	6.03	49.4	0.150
2.000	U1. SW MH 08	U1. SW MH 09	35.001	0.600	98.200	98.000	0.200	175.0	225	Circular	5.59	50.0	
2.001	U1. SW MH 09	U1. SW MH 06	43.000	0.600	98.000	97.725	0.275	156.4	225	Circular	6.28	48.7	
1.001	U1. SW MH 06	U1. SW MH 05	37.000	0.600	97.575	97.425	0.150	246.7	375	Circular	6.82	47.1	
1.002	U1. SW MH 05	U1. SW MH 04	63.997	0.600	97.350	97.150	0.200	320.0	450	Circular	7.76	44.5	0.200
3.000	U1. SW MH 01	U1. SW MH 02	40.001	0.600	98.200	98.025	0.175	228.6	225	Circular	5.77	50.0	
3.001	U1. SW MH 02	U1. SW MH 03	76.001	0.600	97.950	97.675	0.275	276.4	300	Circular	7.12	46.2	
3.002	U1. SW MH 03	U1. SW MH 04	56.999	0.600	97.600	97.350	0.250	228.0	375	Circular	7.92	44.1	
1.003	U1. SW MH 04	U1. SW MH 10	16.999	0.600	97.150	97.050	0.100	170.0	450	Circular	8.10	43.7	
4.000	U1. SW MH 11	U1. SW MH 12	18.274	0.600	96.750	96.650	0.100	182.7	225	Circular	5.32	50.0	

Name	US Node	DS Node	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Velocity (m/s)
1.000	U1. SW MH 07	U1. SW MH 06	97.1	44.2	1.150	1.425	1.425	0.330	0.0	1.342
2.000	U1. SW MH 08	U1. SW MH 09	39.2	13.6	1.000	1.200	1.200	0.100	0.0	0.896
2.001	U1. SW MH 09	U1. SW MH 06	41.5	13.2	1.200	1.425	1.425	0.100	0.0	0.931
1.001	U1. SW MH 06	U1. SW MH 05	126.9	54.8	1.425	1.600	1.600	0.430	0.0	1.109
1.002	U1. SW MH 05	U1. SW MH 04	179.8	106.2	1.600	2.000	2.000	0.880	0.0	1.176
3.000	U1. SW MH 01	U1. SW MH 02	34.2	11.4	1.000	1.175	1.175	0.084	0.0	0.775
3.001	U1. SW MH 02	U1. SW MH 03	66.5	28.8	1.175	2.225	2.225	0.230	0.0	0.908
3.002	U1. SW MH 03	U1. SW MH 04	132.0	46.2	2.225	1.875	2.225	0.386	0.0	1.093
1.003	U1. SW MH 04	U1. SW MH 10	247.5	150.0	2.000	2.040	2.040	1.266	0.0	1.628
4.000	U1. SW MH 11	U1. SW MH 12	38.3	0.0	2.425	2.575	2.575	0.000	0.0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	85.000	130.8	300	99.750	98.300	1.150	99.375	97.650	1.425
2.000	35.001	175.0	225	99.425	98.200	1.000	99.425	98.000	1.200
2.001	43.000	156.4	225	99.425	98.000	1.200	99.375	97.725	1.425
1.001	37.000	246.7	375	99.375	97.575	1.425	99.400	97.425	1.600
1.002	63.997	320.0	450	99.400	97.350	1.600	99.600	97.150	2.000
3.000	40.001	228.6	225	99.425	98.200	1.000	99.425	98.025	1.175
3.001	76.001	276.4	300	99.425	97.950	1.175	100.200	97.675	2.225
3.002	56.999	228.0	375	100.200	97.600	2.225	99.600	97.350	1.875
1.003	16.999	170.0	450	99.600	97.150	2.000	99.540	97.050	2.040
4.000	18.274	182.7	225	99.400	96.750	2.425	99.450	96.650	2.575

Link	US Node	DS Node
1.000	U1. SW MH 07	U1. SW MH 06
2.000	U1. SW MH 08	U1. SW MH 09
2.001	U1. SW MH 09	U1. SW MH 06
1.001	U1. SW MH 06	U1. SW MH 05
1.002	U1. SW MH 05	U1. SW MH 04
3.000	U1. SW MH 01	U1. SW MH 02
3.001	U1. SW MH 02	U1. SW MH 03
3.002	U1. SW MH 03	U1. SW MH 04
1.003	U1. SW MH 04	U1. SW MH 10
4.000	U1. SW MH 11	U1. SW MH 12

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
U1. SW MH 07	704513.551	728291.614	99.750	1.450	1200	0	1.000	98.300	300
U1. SW MH 08	704464.187	728319.342	99.425	1.225	1200	0	2.000	98.200	225
U1. SW MH 09	704430.851	728308.676	99.425	1.425	1200	1	2.000	98.000	225
						0	2.001	98.000	225
U1. SW MH 06	704432.594	728265.711	99.375	1.800	1350	1	2.001	97.725	225
						2	1.000	97.650	300
						0	1.001	97.575	375
U1. SW MH 05	704446.220	728231.311	99.400	2.050	1350	1	1.001	97.425	375
						0	1.002	97.350	450
U1. SW MH 01	704496.732	728329.656	99.425	1.225	1200	0	3.000	98.200	225
U1. SW MH 02	704534.805	728341.924	99.425	1.475	1200	1	3.000	98.025	225
						0	3.001	97.950	300
U1. SW MH 03	704560.679	728270.463	100.200	2.600	1350	1	3.001	97.675	300
						0	3.002	97.600	375
U1. SW MH 04	704507.173	728250.815	99.600	2.450	1350	1	3.002	97.350	375
						2	1.002	97.150	450
						0	1.003	97.150	450

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
U1. SW MH 10	704512.353	728234.624	99.540	2.740	1350	1	1.003	97.050	450
U1. SW MH 11	704440.738	728209.070	99.400	2.650	1200	0	4.000	96.750	225
U1. SW MH 12	704422.628	728206.629	99.450	2.800	1200	1	4.000	96.650	225

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Winter CV	0.840	Additional Storage (m³/ha)	20.0
M5-60 (mm)	17.800	Analysis Speed	Detailed	Check Discharge Rate(s)	x
Ratio-R	0.271	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200
30	120	240	480	720	1440	2880	5760	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	20	0	0	100	20	0	0

Node U1. SW MH 11 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	96.900	Product Number	CTL-SHE-0085-3900-1576-3900
Design Depth (m)	1.576	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.9	Min Node Diameter (mm)	1200

Node U1. SW MH 11 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	50.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	96.750	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.015

Inlets
U1. SW MH 10

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	685.0	0.0	1.676	685.0	0.0	1.686	5.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +20% CC 15 minute summer	253.887	71.841	30 year +20% CC 240 minute winter	32.450	12.908
30 year +20% CC 15 minute winter	178.167	71.841	30 year +20% CC 360 minute summer	38.107	9.806
30 year +20% CC 30 minute summer	174.382	49.344	30 year +20% CC 360 minute winter	24.770	9.806
30 year +20% CC 30 minute winter	122.373	49.344	30 year +20% CC 480 minute summer	30.501	8.060
30 year +20% CC 60 minute summer	121.804	32.189	30 year +20% CC 480 minute winter	20.264	8.060
30 year +20% CC 60 minute winter	80.923	32.189	30 year +20% CC 600 minute summer	25.301	6.920
30 year +20% CC 120 minute summer	77.654	20.522	30 year +20% CC 600 minute winter	17.287	6.920
30 year +20% CC 120 minute winter	51.591	20.522	30 year +20% CC 720 minute summer	22.792	6.108
30 year +20% CC 180 minute summer	60.874	15.665	30 year +20% CC 720 minute winter	15.317	6.108
30 year +20% CC 180 minute winter	39.569	15.665	30 year +20% CC 960 minute summer	19.047	5.016
30 year +20% CC 240 minute summer	48.843	12.908	30 year +20% CC 960 minute winter	12.617	5.016

<u>Rainfall</u>

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +20% CC 1440 minute summer	14.170	3.798	100 year +20% CC 240 minute winter	41.213	16.393
30 year +20% CC 1440 minute winter	9.523	3.798	100 year +20% CC 360 minute summer	48.047	12.364
30 year +20% CC 2160 minute summer	10.393	2.872	100 year +20% CC 360 minute winter	31.232	12.364
30 year +20% CC 2160 minute winter	7.161	2.872	100 year +20% CC 480 minute summer	38.251	10.109
30 year +20% CC 2880 minute summer	8.785	2.355	100 year +20% CC 480 minute winter	25.413	10.109
30 year +20% CC 2880 minute winter	5.904	2.355	100 year +20% CC 600 minute summer	31.597	8.642
30 year +20% CC 4320 minute summer	6.800	1.778	100 year +20% CC 600 minute winter	21.589	8.642
30 year +20% CC 4320 minute winter	4.478	1.778	100 year +20% CC 720 minute summer	28.365	7.602
30 year +20% CC 5760 minute summer	5.687	1.456	100 year +20% CC 720 minute winter	19.063	7.602
30 year +20% CC 5760 minute winter	3.681	1.456	100 year +20% CC 960 minute summer	23.575	6.208
30 year +20% CC 7200 minute summer	4.887	1.247	100 year +20% CC 960 minute winter	15.617	6.208
30 year +20% CC 7200 minute winter	3.154	1.247	100 year +20% CC 1440 minute summer	17.405	4.665
100 year +20% CC 15 minute summer	329.850	93.336	100 year +20% CC 1440 minute winter	11.697	4.665
100 year +20% CC 15 minute winter	231.474	93.336	100 year +20% CC 2160 minute summer	12.662	3.499
100 year +20% CC 30 minute summer	227.636	64.413	100 year +20% CC 2160 minute winter	8.725	3.499
100 year +20% CC 30 minute winter	159.744	64.413	100 year +20% CC 2880 minute summer	10.637	2.851
100 year +20% CC 60 minute summer	157.925	41.735	100 year +20% CC 2880 minute winter	7.149	2.851
100 year +20% CC 60 minute winter	104.922	41.735	100 year +20% CC 4320 minute summer	8.159	2.133
100 year +20% CC 120 minute summer	99.751	26.361	100 year +20% CC 4320 minute winter	5.373	2.133
100 year +20% CC 120 minute winter	66.272	26.361	100 year +20% CC 5760 minute summer	6.779	1.735
100 year +20% CC 180 minute summer	77.692	19.993	100 year +20% CC 5760 minute winter	4.388	1.735
100 year +20% CC 180 minute winter	50.502	19.993	100 year +20% CC 7200 minute summer	5.795	1.478
100 year +20% CC 240 minute summer	62.032	16.393	100 year +20% CC 7200 minute winter	3.740	1.478

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	U1. SW MH 07	12	98.630	0.330	58.8	1.1917	0.0000	SURCHARGED
15 minute winter	1.000:50%	12	98.534	0.559	106.8	0.0000	0.0000	SURCHARGED
15 minute winter	U1. SW MH 08	12	98.450	0.250	32.7	0.6909	0.0000	SURCHARGED
15 minute winter	U1. SW MH 09	12	98.355	0.355	31.9	0.4010	0.0000	SURCHARGED
15 minute winter	U1. SW MH 06	11	98.241	0.666	114.8	0.9528	0.0000	SURCHARGED
15 minute winter	U1. SW MH 05	11	98.099	0.749	183.4	2.8974	0.0000	SURCHARGED
15 minute winter	1.002:50%	11	97.981	0.731	241.2	0.0000	0.0000	SURCHARGED
15 minute winter	U1. SW MH 01	10	98.354	0.154	27.5	0.3863	0.0000	OK
15 minute winter	U1. SW MH 02	11	98.219	0.269	74.6	0.8382	0.0000	OK
15 minute winter	U1. SW MH 03	12	97.943	0.343	117.3	0.9027	0.0000	OK
2880 minute winter	U1. SW MH 04	2400	97.921	0.771	17.2	1.1032	0.0000	SURCHARGED
2880 minute winter	U1. SW MH 10	2400	97.921	1.121	16.8	1.6041	0.0000	OK
2880 minute winter	U1. SW MH 11	2400	97.921	1.171	10.1	1.3243	0.0000	SURCHARGED
15 minute summer	U1. SW MH 12	1	96.650	0.000	2.9	0.0000	0.0000	OK

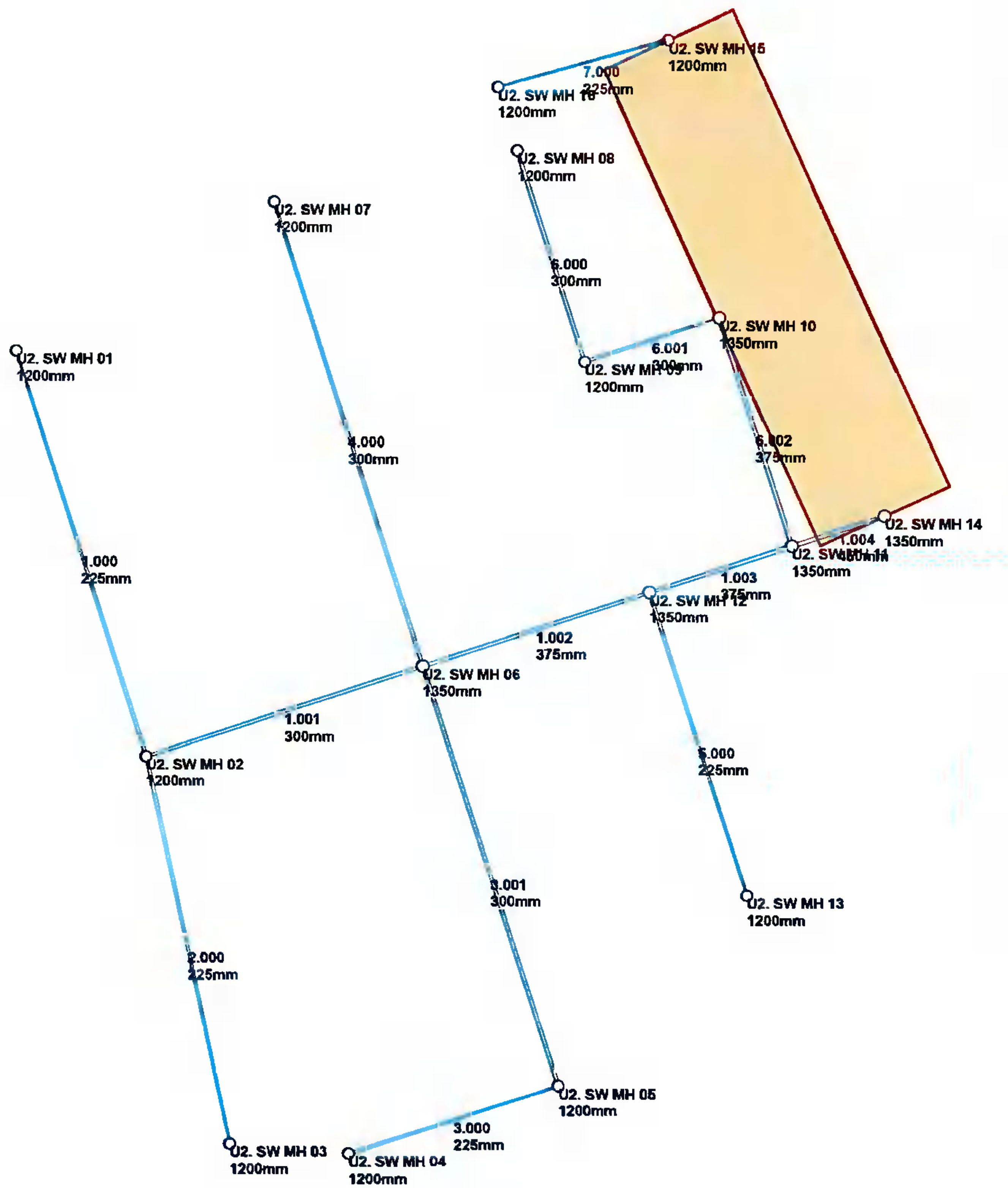
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	U1. SW MH 07	1.000	1.000:50%	57.8	1.089	0.596	2.9928	
15 minute winter	U1. SW MH 07	1.000	U1. SW MH 06	88.5	1.533	0.912	2.9928	
15 minute winter	U1. SW MH 08	2.000	U1. SW MH 09	31.9	1.094	0.815	1.3920	
15 minute winter	U1. SW MH 09	2.001	U1. SW MH 06	32.4	1.014	0.781	1.7102	
15 minute winter	U1. SW MH 06	1.001	U1. SW MH 05	117.3	1.098	0.924	4.0810	
15 minute winter	U1. SW MH 05	1.002	1.002:50%	180.8	1.141	1.005	5.0700	
15 minute winter	U1. SW MH 05	1.002	U1. SW MH 04	240.7	1.519	1.338	5.0700	
15 minute winter	U1. SW MH 01	3.000	U1. SW MH 02	27.0	0.897	0.788	1.2856	
15 minute winter	U1. SW MH 02	3.001	U1. SW MH 03	69.3	1.122	1.043	4.9561	
15 minute winter	U1. SW MH 03	3.002	U1. SW MH 04	111.2	1.191	0.842	6.1566	
2880 minute winter	U1. SW MH 04	1.003	U1. SW MH 10	16.8	0.787	0.068	2.6934	
2880 minute winter	U1. SW MH 10	Flow through pond	U1. SW MH 11	10.1	0.023	0.000	785.0138	
2880 minute winter	U1. SW MH 11	Hydro-Brake®	U1. SW MH 12	3.5				438.8

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	U1. SW MH 07	12	99.459	1.159	76.4	4.1893	0.0000	FLOOD RISK
15 minute winter	1.000:50%	12	99.296	1.321	117.8	0.0000	0.0000	SURCHARGED
15 minute winter	U1. SW MH 08	12	99.135	0.935	42.5	2.5833	0.0000	FLOOD RISK
15 minute winter	U1. SW MH 09	12	98.978	0.978	37.1	1.1058	0.0000	SURCHARGED
15 minute winter	U1. SW MH 06	12	98.784	1.209	147.1	1.7295	0.0000	SURCHARGED
15 minute winter	U1. SW MH 05	11	98.526	1.175	233.3	4.5492	0.0000	SURCHARGED
15 minute winter	1.002:50%	11	98.333	1.083	306.9	0.0000	0.0000	SURCHARGED
15 minute winter	U1. SW MH 01	12	98.903	0.703	35.7	1.7597	0.0000	SURCHARGED
15 minute winter	U1. SW MH 02	12	98.750	0.800	89.7	2.4885	0.0000	SURCHARGED
15 minute winter	U1. SW MH 03	11	98.297	0.697	137.6	1.8332	0.0000	SURCHARGED
2880 minute winter	U1. SW MH 04	2640	98.202	1.052	20.3	1.5052	0.0000	SURCHARGED
2880 minute winter	U1. SW MH 10	2640	98.202	1.402	20.0	2.0061	0.0000	OK
2880 minute winter	U1. SW MH 11	2640	98.202	1.452	11.6	1.6420	0.0000	SURCHARGED
15 minute summer	U1. SW MH 12	1	96.650	0.000	3.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	U1. SW MH 07	1.000	1.000:50%	66.1	1.122	0.681	2.9928	
15 minute winter	U1. SW MH 07	1.000	U1. SW MH 06	115.6	1.642	1.191	2.9928	
15 minute winter	U1. SW MH 08	2.000	U1. SW MH 09	37.1	1.120	0.947	1.3920	
15 minute winter	U1. SW MH 09	2.001	U1. SW MH 06	39.3	1.003	0.947	1.7102	
15 minute winter	U1. SW MH 06	1.001	U1. SW MH 05	151.6	1.374	1.195	4.0810	
15 minute winter	U1. SW MH 05	1.002	1.002:50%	236.8	1.495	1.317	5.0700	
15 minute winter	U1. SW MH 05	1.002	U1. SW MH 04	305.6	1.929	1.699	5.0700	
15 minute winter	U1. SW MH 01	3.000	U1. SW MH 02	31.3	0.897	0.916	1.5909	
15 minute winter	U1. SW MH 02	3.001	U1. SW MH 03	80.9	1.154	1.216	5.3519	
15 minute winter	U1. SW MH 03	3.002	U1. SW MH 04	135.6	1.230	1.027	6.2868	
2880 minute winter	U1. SW MH 04	1.003	U1. SW MH 10	20.0	0.774	0.081	2.6934	
2880 minute winter	U1. SW MH 10	Flow through pond	U1. SW MH 11	11.6	0.023	0.000	977.4548	
2880 minute winter	U1. SW MH 11	Hydro-Brake®	U1. SW MH 12	3.6				484.9

KAVANAGH BURKE CONSULTING ENGINEERS	Kavanagh Burke Unit F3 Block F, Calmount Park, Ballymount, Dublin 12, D12PX28	File: D1678 - SW Networks_PL3 Network: SW_Unit 1 Elena Dragoje 01/02/2022	Page 1 Surface Water Network Scheme UNIT 2



Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.800	Minimum Backdrop Height (m)	1.000
Ratio-R	0.271	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
U2. SW MH 01	0.060	5.00	100.300	1200	1.100
U2. SW MH 02			100.225	1200	1.325
U2. SW MH 03	0.090	5.00	100.250	1200	1.050
U2. SW MH 04	0.080	5.00	100.250	1200	1.050
U2. SW MH 05	0.120	5.00	100.250	1200	1.250
U2. SW MH 06			100.500	1350	1.800
U2. SW MH 07	0.160	5.00	100.500	1200	1.500
U2. SW MH 08	0.115	5.00	100.200	1200	1.200
U2. SW MH 09	0.030	5.00	100.350	1200	1.500
U2. SW MH 10	0.100	5.00	99.970	1350	1.320
U2. SW MH 11			100.050	1350	1.625
U2. SW MH 12			100.350	1350	1.750
U2. SW MH 13	0.120	5.00	100.350	1200	1.425
U2. SW MH 14			100.300	1350	2.150
U2. SW MH 15		5.00	100.050	1200	1.950
U2. SW MH 16			100.200	1200	2.200

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)	Lateral Area (ha)
1.000	U2. SW MH 01	U2. SW MH 02	48.000	0.600	99.200	98.975	0.225	213.3	225	Circular	5.90	49.9	0.060
2.000	U2. SW MH 03	U2. SW MH 02	45.000	0.600	99.200	98.975	0.225	200.0	225	Circular	5.81	50.0	
1.001	U2. SW MH 02	U2. SW MH 06	33.000	0.600	98.900	98.775	0.125	264.0	300	Circular	6.47	48.1	
3.000	U2. SW MH 04	U2. SW MH 05	25.000	0.600	99.200	99.075	0.125	200.0	225	Circular	5.45	50.0	
3.001	U2. SW MH 05	U2. SW MH 06	50.000	0.600	99.000	98.775	0.225	222.2	300	Circular	6.25	48.8	
4.000	U2. SW MH 07	U2. SW MH 06	55.000	0.600	99.000	98.775	0.225	244.4	300	Circular	5.92	49.8	
1.002	U2. SW MH 06	U2. SW MH 12	27.000	0.600	98.700	98.600	0.100	270.0	375	Circular	6.88	46.9	
5.000	U2. SW MH 13	U2. SW MH 12	36.000	0.600	98.925	98.750	0.175	205.7	225	Circular	5.66	50.0	
1.003	U2. SW MH 12	U2. SW MH 11	17.000	0.600	98.600	98.500	0.100	170.0	375	Circular	7.08	46.3	
6.000	U2. SW MH 08	U2. SW MH 09	25.000	0.600	99.000	98.850	0.150	166.7	300	Circular	5.34	50.0	0.120
6.001	U2. SW MH 09	U2. SW MH 10	16.000	0.600	98.850	98.725	0.125	128.0	300	Circular	5.54	50.0	
6.002	U2. SW MH 10	U2. SW MH 11	27.001	0.600	98.650	98.500	0.150	180.0	375	Circular	5.87	50.0	0.120
1.004	U2. SW MH 11	U2. SW MH 14	11.000	0.600	98.425	98.325	0.100	110.0	450	Circular	7.18	46.0	

Name	US Node	DS Node	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Velocity (m/s)
1.000	U2. SW MH 01	U2. SW MH 02	35.4	16.2	0.875	1.025	1.025	0.120	0.0	0.872
2.000	U2. SW MH 03	U2. SW MH 02	36.6	12.2	0.825	1.025	1.025	0.090	0.0	0.829
1.001	U2. SW MH 02	U2. SW MH 06	68.0	27.4	1.025	1.425	1.425	0.210	0.0	0.912
3.000	U2. SW MH 04	U2. SW MH 05	36.6	10.8	0.825	0.950	0.950	0.080	0.0	0.805
3.001	U2. SW MH 05	U2. SW MH 06	74.2	26.4	0.950	1.425	1.425	0.200	0.0	0.964
4.000	U2. SW MH 07	U2. SW MH 06	70.8	21.6	1.200	1.425	1.425	0.160	0.0	0.882
1.002	U2. SW MH 06	U2. SW MH 12	121.2	72.4	1.425	1.375	1.425	0.570	0.0	1.144
5.000	U2. SW MH 13	U2. SW MH 12	36.1	16.3	1.200	1.375	1.375	0.120	0.0	0.885
1.003	U2. SW MH 12	U2. SW MH 11	153.1	86.6	1.375	1.175	1.375	0.690	0.0	1.427
6.000	U2. SW MH 08	U2. SW MH 09	85.9	31.8	0.900	1.200	1.200	0.235	0.0	1.127
6.001	U2. SW MH 09	U2. SW MH 10	98.1	35.9	1.200	0.945	1.200	0.265	0.0	1.282
6.002	U2. SW MH 10	U2. SW MH 11	148.8	65.7	0.945	1.175	1.175	0.485	0.0	1.308
1.004	U2. SW MH 11	U2. SW MH 14	308.2	146.6	1.175	1.525	1.525	1.175	0.0	1.914

<u>Links</u>

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)	Lateral Area (ha)
7.000	U2. SW MH 15	U2. SW MH 16	20.001	0.600	98.100	98.000	0.100	200.0	225	Circular	5.36	50.0	

Name	US Node	DS Node	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Velocity (m/s)
7.000	U2. SW MH 15	U2. SW MH 16	36.6	0.0	1.725	1.975	1.975	0.000	0.0	0.000

<u>Pipeline Schedule</u>

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	48.000	213.3	225	100.300	99.200	0.875	100.225	98.975	1.025
2.000	45.000	200.0	225	100.250	99.200	0.825	100.225	98.975	1.025
1.001	33.000	264.0	300	100.225	98.900	1.025	100.500	98.775	1.425
3.000	25.000	200.0	225	100.250	99.200	0.825	100.250	99.075	0.950
3.001	50.000	222.2	300	100.250	99.000	0.950	100.500	98.775	1.425
4.000	55.000	244.4	300	100.500	99.000	1.200	100.500	98.775	1.425
1.002	27.000	270.0	375	100.500	98.700	1.425	100.350	98.600	1.375
5.000	36.000	205.7	225	100.350	98.925	1.200	100.350	98.750	1.375
1.003	17.000	170.0	375	100.350	98.600	1.375	100.050	98.500	1.175
6.000	25.000	166.7	300	100.200	99.000	0.900	100.350	98.850	1.200
6.001	16.000	128.0	300	100.350	98.850	1.200	99.970	98.725	0.945
6.002	27.001	180.0	375	99.970	98.650	0.945	100.050	98.500	1.175
1.004	11.000	110.0	450	100.050	98.425	1.175	100.300	98.325	1.525
7.000	20.001	200.0	225	100.050	98.100	1.725	100.200	98.000	1.975

Link	US Node	DS Node
1.000	U2. SW MH 01	U2. SW MH 02
2.000	U2. SW MH 03	U2. SW MH 02
1.001	U2. SW MH 02	U2. SW MH 06
3.000	U2. SW MH 04	U2. SW MH 05
3.001	U2. SW MH 05	U2. SW MH 06
4.000	U2. SW MH 07	U2. SW MH 06
1.002	U2. SW MH 06	U2. SW MH 12
5.000	U2. SW MH 13	U2. SW MH 12
1.003	U2. SW MH 12	U2. SW MH 11
6.000	U2. SW MH 08	U2. SW MH 09
6.001	U2. SW MH 09	U2. SW MH 10
6.002	U2. SW MH 10	U2. SW MH 11
1.004	U2. SW MH 11	U2. SW MH 14
7.000	U2. SW MH 15	U2. SW MH 16

<u>Manhole Schedule</u>

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
U2. SW MH 01	704436.337	728177.313	100.300	1.100	1200		0	1.000	99.200	225
U2. SW MH 02	704450.964	728131.596	100.225	1.325	1200		1	2.000	98.975	225
							2	1.000	98.975	225
							0	1.001	98.900	300
U2. SW MH 03	704460.323	728087.580	100.250	1.050	1200		0	2.000	99.200	225
U2. SW MH 04	704473.828	728086.428	100.250	1.050	1200		0	3.000	99.200	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
U2. SW MH 05	704497.638	728094.049	100.250	1.250	1200	1	3.000	99.075	225
						0	3.001	99.000	300
U2. SW MH 06	704482.390	728141.667	100.500	1.800	1350	1	4.000	98.775	300
						2	3.001	98.775	300
						3	1.001	98.775	300
						0	1.002	98.700	375
U2. SW MH 07	704465.617	728194.047	100.500	1.500	1200	0	4.000	99.000	300
U2. SW MH 08	704493.203	728199.745	100.200	1.200	1200	0	6.000	99.000	300
U2. SW MH 09	704500.822	728175.934	100.350	1.500	1200	1	6.000	98.850	300
						0	6.001	98.850	300
U2. SW MH 10	704516.061	728180.811	99.970	1.320	1350	1	6.001	98.725	300
						0	6.002	98.650	375
U2. SW MH 11	704524.291	728155.095	100.050	1.625	1350	1	1.003	98.500	375
						2	6.002	98.500	375
						0	1.004	98.425	450
U2. SW MH 12	704508.102	728149.907	100.350	1.750	1350	1	5.000	98.750	225
						2	1.002	98.600	375
						0	1.003	98.600	375
U2. SW MH 13	704519.068	728115.618	100.350	1.425	1200	0	5.000	98.925	225
U2. SW MH 14	704534.766	728158.452	100.300	2.150	1350	1	1.004	98.325	450
U2. SW MH 15	704510.313	728212.105	100.050	1.950	1200	0	7.000	98.100	225
U2. SW MH 16	704491.007	728206.880	100.200	2.200	1200	1	7.000	98.000	225

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Winter CV	0.840	Additional Storage (m³/ha)	20.0
M5-60 (mm)	17.800	Analysis Speed	Detailed	Check Discharge Rate(s)	x
Ratio-R	0.271	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200
30	120	240	480	720	1440	2880	5760	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	20	0	0	100	20	0	0

Node U2. SW MH 15 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	98.200	Product Number	CTL-SHE-0094-4000-1070-4000
Design Depth (m)	1.070	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Node U2. SW MH 15 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	50.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	98.100	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.015

Inlets
U2. SW MH 14

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	945.0	0.0	1.170	945.0	0.0	1.180	10.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +20% CC 15 minute summer	253.887	71.841	100 year +20% CC 15 minute summer	329.850	93.336
30 year +20% CC 15 minute winter	178.167	71.841	100 year +20% CC 15 minute winter	231.474	93.336
30 year +20% CC 30 minute summer	174.382	49.344	100 year +20% CC 30 minute summer	227.636	64.413
30 year +20% CC 30 minute winter	122.373	49.344	100 year +20% CC 30 minute winter	159.744	64.413
30 year +20% CC 60 minute summer	121.804	32.189	100 year +20% CC 60 minute summer	157.925	41.735
30 year +20% CC 60 minute winter	80.923	32.189	100 year +20% CC 60 minute winter	104.922	41.735
30 year +20% CC 120 minute summer	77.654	20.522	100 year +20% CC 120 minute summer	99.751	26.361
30 year +20% CC 120 minute winter	51.591	20.522	100 year +20% CC 120 minute winter	66.272	26.361
30 year +20% CC 180 minute summer	60.874	15.665	100 year +20% CC 180 minute summer	77.692	19.993
30 year +20% CC 180 minute winter	39.569	15.665	100 year +20% CC 180 minute winter	50.502	19.993
30 year +20% CC 240 minute summer	48.843	12.908	100 year +20% CC 240 minute summer	62.032	16.393
30 year +20% CC 240 minute winter	32.450	12.908	100 year +20% CC 240 minute winter	41.213	16.393
30 year +20% CC 360 minute summer	38.107	9.806	100 year +20% CC 360 minute summer	48.047	12.364
30 year +20% CC 360 minute winter	24.770	9.806	100 year +20% CC 360 minute winter	31.232	12.364
30 year +20% CC 480 minute summer	30.501	8.060	100 year +20% CC 480 minute summer	38.251	10.109
30 year +20% CC 480 minute winter	20.264	8.060	100 year +20% CC 480 minute winter	25.413	10.109
30 year +20% CC 600 minute summer	25.301	6.920	100 year +20% CC 600 minute summer	31.597	8.642
30 year +20% CC 600 minute winter	17.287	6.920	100 year +20% CC 600 minute winter	21.589	8.642
30 year +20% CC 720 minute summer	22.792	6.108	100 year +20% CC 720 minute summer	28.365	7.602
30 year +20% CC 720 minute winter	15.317	6.108	100 year +20% CC 720 minute winter	19.063	7.602
30 year +20% CC 960 minute summer	19.047	5.016	100 year +20% CC 960 minute summer	23.575	6.208
30 year +20% CC 960 minute winter	12.617	5.016	100 year +20% CC 960 minute winter	15.617	6.208
30 year +20% CC 1440 minute summer	14.170	3.798	100 year +20% CC 1440 minute summer	17.405	4.665
30 year +20% CC 1440 minute winter	9.523	3.798	100 year +20% CC 1440 minute winter	11.697	4.665
30 year +20% CC 2160 minute summer	10.393	2.872	100 year +20% CC 2160 minute summer	12.662	3.499
30 year +20% CC 2160 minute winter	7.161	2.872	100 year +20% CC 2160 minute winter	8.725	3.499
30 year +20% CC 2880 minute summer	8.785	2.355	100 year +20% CC 2880 minute summer	10.637	2.851
30 year +20% CC 2880 minute winter	5.904	2.355	100 year +20% CC 2880 minute winter	7.149	2.851
30 year +20% CC 4320 minute summer	6.800	1.778	100 year +20% CC 4320 minute summer	8.159	2.133
30 year +20% CC 4320 minute winter	4.478	1.778	100 year +20% CC 4320 minute winter	5.373	2.133
30 year +20% CC 5760 minute summer	5.687	1.456	100 year +20% CC 5760 minute summer	6.779	1.735
30 year +20% CC 5760 minute winter	3.681	1.456	100 year +20% CC 5760 minute winter	4.388	1.735
30 year +20% CC 7200 minute summer	4.887	1.247	100 year +20% CC 7200 minute summer	5.795	1.478
30 year +20% CC 7200 minute winter	3.154	1.247	100 year +20% CC 7200 minute winter	3.740	1.478

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	U2. SW MH 01	12	99.511	0.311	19.6	0.6920	0.0000	SURCHARGED
15 minute winter	1.000:50%	12	99.491	0.404	38.8	0.0000	0.0000	SURCHARGED
15 minute winter	U2. SW MH 02	12	99.402	0.502	56.6	0.5673	0.0000	SURCHARGED
15 minute winter	U2. SW MH 03	12	99.491	0.291	29.4	0.8291	0.0000	SURCHARGED
15 minute winter	U2. SW MH 04	12	99.478	0.278	26.2	0.7377	0.0000	SURCHARGED
15 minute winter	U2. SW MH 05	12	99.434	0.434	65.0	1.3242	0.0000	SURCHARGED
15 minute winter	U2. SW MH 06	12	99.312	0.612	151.9	0.8754	0.0000	SURCHARGED
15 minute winter	U2. SW MH 07	12	99.394	0.394	52.3	1.2845	0.0000	SURCHARGED
15 minute winter	U2. SW MH 08	12	99.194	0.194	37.6	0.5915	0.0000	OK
15 minute winter	6.000:50%	11	99.190	0.265	75.3	0.0000	0.0000	OK
15 minute winter	U2. SW MH 09	11	99.152	0.302	83.9	0.4622	0.0000	SURCHARGED
15 minute winter	U2. SW MH 10	12	99.048	0.398	114.4	1.1729	0.0000	SURCHARGED
15 minute winter	6.002:50%	12	99.004	0.429	145.4	0.0000	0.0000	SURCHARGED
15 minute winter	U2. SW MH 11	12	98.927	0.502	307.5	0.7184	0.0000	SURCHARGED
15 minute winter	U2. SW MH 12	12	99.126	0.526	175.3	0.7522	0.0000	SURCHARGED
15 minute winter	U2. SW MH 13	12	99.283	0.358	39.2	1.0071	0.0000	SURCHARGED
2160 minute winter	U2. SW MH 14	2040	98.864	0.714	19.5	1.0218	0.0000	OK
2160 minute winter	U2. SW MH 15	2040	98.864	0.764	12.2	0.8641	0.0000	SURCHARGED
15 minute summer	U2. SW MH 16	1	98.000	0.000	2.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	U2. SW MH 01	1.000	1.000:50%	19.2	0.662	0.542	0.9545	
15 minute winter	U2. SW MH 01	1.000	U2. SW MH 02	32.2	1.052	0.909	0.9545	
15 minute winter	U2. SW MH 02	1.001	U2. SW MH 06	53.5	0.881	0.787	2.3238	
15 minute winter	U2. SW MH 03	2.000	U2. SW MH 02	26.6	0.955	0.728	1.7897	
15 minute winter	U2. SW MH 04	3.000	U2. SW MH 05	25.8	0.944	0.704	0.9943	
15 minute winter	U2. SW MH 05	3.001	U2. SW MH 06	56.2	0.976	0.757	3.5210	
15 minute winter	U2. SW MH 06	1.002	U2. SW MH 12	143.0	1.297	1.180	2.9780	
15 minute winter	U2. SW MH 07	4.000	U2. SW MH 06	45.7	0.884	0.646	3.8731	
15 minute winter	U2. SW MH 08	6.000	6.000:50%	36.1	0.702	0.421	0.7075	
15 minute winter	U2. SW MH 08	6.000	U2. SW MH 09	74.1	1.215	0.863	0.8513	
15 minute winter	U2. SW MH 09	6.001	U2. SW MH 10	81.7	1.403	0.833	1.1265	
15 minute winter	U2. SW MH 10	6.002	6.002:50%	106.2	1.070	0.714	1.4890	
15 minute winter	U2. SW MH 10	6.002	U2. SW MH 11	143.3	1.391	0.963	1.4890	
15 minute winter	U2. SW MH 11	1.004	U2. SW MH 14	307.5	2.042	0.998	1.6661	
15 minute winter	U2. SW MH 12	1.003	U2. SW MH 11	175.4	1.590	1.145	1.8751	
15 minute winter	U2. SW MH 13	5.000	U2. SW MH 12	34.5	0.970	0.955	1.4318	
2160 minute winter	U2. SW MH 14	Flow through pond	U2. SW MH 15	12.2	0.022	0.000	698.4325	
2160 minute winter	U2. SW MH 15	Hydro-Brake®	U2. SW MH 16	4.0				369.7

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	U2. SW MH 01	12	100.078	0.878	25.5	1.9515	0.0000	FLOOD RISK
15 minute winter	1.000:50%	12	100.040	0.952	40.7	0.0000	0.0000	SURCHARGED
15 minute winter	U2. SW MH 02	12	99.891	0.991	66.6	1.1212	0.0000	SURCHARGED
15 minute winter	U2. SW MH 03	12	100.047	0.847	38.2	2.4085	0.0000	FLOOD RISK
15 minute winter	U2. SW MH 04	12	100.025	0.825	34.0	2.1896	0.0000	FLOOD RISK
15 minute winter	U2. SW MH 05	12	99.947	0.947	78.9	2.8890	0.0000	SURCHARGED
15 minute winter	U2. SW MH 06	12	99.743	1.043	185.7	1.4922	0.0000	SURCHARGED
15 minute winter	U2. SW MH 07	12	99.890	0.890	67.9	2.9040	0.0000	SURCHARGED
15 minute winter	U2. SW MH 08	11	99.654	0.654	48.8	1.9927	0.0000	SURCHARGED
15 minute winter	6.000:50%	11	99.629	0.704	90.9	0.0000	0.0000	SURCHARGED
15 minute winter	U2. SW MH 09	11	99.522	0.672	102.0	1.0289	0.0000	SURCHARGED
15 minute winter	U2. SW MH 10	11	99.331	0.681	140.6	2.0084	0.0000	SURCHARGED
15 minute winter	6.002:50%	11	99.244	0.669	186.5	0.0000	0.0000	SURCHARGED
15 minute winter	U2. SW MH 11	12	99.094	0.669	404.0	0.9580	0.0000	SURCHARGED
15 minute winter	U2. SW MH 12	12	99.430	0.830	227.7	1.1883	0.0000	SURCHARGED
15 minute winter	U2. SW MH 13	12	99.701	0.776	51.0	2.1856	0.0000	SURCHARGED
2880 minute winter	U2. SW MH 14	2580	99.057	0.907	23.6	1.2986	0.0000	OK
2880 minute winter	U2. SW MH 15	2580	99.057	0.957	17.7	1.0829	0.0000	SURCHARGED
15 minute summer	U2. SW MH 16	1	98.000	0.000	3.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	U2. SW MH 01	1.000	1.000:50%	20.3	0.677	0.573	0.9545	
15 minute winter	U2. SW MH 01	1.000	U2. SW MH 02	38.3	1.046	1.082	0.9545	
15 minute winter	U2. SW MH 02	1.001	U2. SW MH 06	68.9	0.979	1.013	2.3238	
15 minute winter	U2. SW MH 03	2.000	U2. SW MH 02	28.8	0.948	0.787	1.7897	
15 minute winter	U2. SW MH 04	3.000	U2. SW MH 05	30.9	0.942	0.843	0.9943	
15 minute winter	U2. SW MH 05	3.001	U2. SW MH 06	65.4	0.982	0.881	3.5210	
15 minute winter	U2. SW MH 06	1.002	U2. SW MH 12	185.6	1.683	1.531	2.9780	
15 minute winter	U2. SW MH 07	4.000	U2. SW MH 06	55.5	0.892	0.784	3.8731	
15 minute winter	U2. SW MH 08	6.000	6.000:50%	44.4	0.697	0.517	0.8802	
15 minute winter	U2. SW MH 08	6.000	U2. SW MH 09	90.0	1.278	1.048	0.8802	
15 minute winter	U2. SW MH 09	6.001	U2. SW MH 10	100.6	1.429	1.026	1.1267	
15 minute winter	U2. SW MH 10	6.002	6.002:50%	138.5	1.256	0.931	1.4890	
15 minute winter	U2. SW MH 10	6.002	U2. SW MH 11	185.8	1.685	1.249	1.4890	
15 minute winter	U2. SW MH 11	1.004	U2. SW MH 14	404.6	2.554	1.313	1.7177	
15 minute winter	U2. SW MH 12	1.003	U2. SW MH 11	227.9	2.067	1.488	1.8751	
15 minute winter	U2. SW MH 13	5.000	U2. SW MH 12	42.8	1.076	1.186	1.4318	
2880 minute winter	U2. SW MH 14	Flow through pond	U2. SW MH 15	17.7	0.022	0.001	881.2216	
2880 minute winter	U2. SW MH 15	Hydro-Brake®	U2. SW MH 16	4.0				511.1

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Appendix to Surface Water Design

- Rainfall table for subject's site
- HR Wallingford Greenfield runoff rate estimation report
  - Unit 1
  - Unit 2
- Specification/Product Information for:
  - Separators
  - Silt Trap
  - Flow Control Device
- StormTech Chamber Information Sheets: SC-740™ & MC-3500™

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 304550, Northing: 228200,

	Interval		Years													
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.4,	3.6,	4.3,	5.3,	6.0,	6.6,	8.5,	10.7,	12.2,	14.4,	16.3,	17.9,	20.3,	22.2,	23.8,	N/A ,
10 mins	3.4,	5.0,	6.0,	7.4,	8.4,	9.2,	11.8,	14.9,	17.0,	20.0,	22.8,	24.9,	28.3,	30.9,	33.2,	N/A ,
15 mins	4.0,	5.9,	7.0,	8.7,	9.9,	10.8,	13.9,	17.5,	20.0,	23.5,	26.8,	29.3,	33.3,	36.4,	39.0,	N/A ,
30 mins	5.2,	7.7,	9.1,	11.2,	12.7,	13.9,	17.8,	22.3,	25.3,	29.7,	33.7,	36.8,	41.7,	45.5,	48.7,	N/A ,
1 hours	6.9,	10.0,	11.8,	14.5,	16.4,	17.8,	22.7,	28.3,	32.1,	37.5,	42.4,	46.2,	52.2,	56.9,	60.8,	N/A ,
2 hours	9.0,	13.1,	15.3,	18.7,	21.1,	22.9,	29.0,	36.0,	40.7,	47.4,	53.4,	58.1,	65.4,	71.1,	75.9,	N/A ,
3 hours	10.6,	15.3,	17.8,	21.7,	24.4,	26.5,	33.4,	41.4,	46.7,	54.3,	61.1,	66.4,	74.6,	81.0,	86.4,	N/A ,
4 hours	11.8,	17.0,	19.9,	24.2,	27.1,	29.4,	37.0,	45.7,	51.5,	59.8,	67.2,	73.0,	81.9,	88.9,	94.7,	N/A ,
6 hours	13.9,	19.9,	23.1,	28.1,	31.4,	34.0,	42.7,	52.6,	59.2,	68.5,	76.9,	83.4,	93.5,	101.3,	107.9,	N/A ,
9 hours	16.3,	23.2,	26.9,	32.6,	36.4,	39.4,	49.3,	60.5,	68.0,	78.5,	87.9,	95.3,	106.6,	115.4,	122.8,	N/A ,
12 hours	18.2,	25.9,	30.0,	36.2,	40.4,	43.7,	54.5,	66.8,	75.0,	86.5,	96.8,	104.7,	117.1,	126.7,	134.6,	N/A ,
18 hours	21.4,	30.2,	34.9,	42.0,	46.9,	50.6,	62.9,	76.9,	86.1,	99.1,	110.7,	119.7,	133.5,	144.3,	153.3,	N/A ,
24 hours	23.9,	33.7,	38.9,	46.7,	52.0,	56.2,	69.6,	84.9,	95.0,	109.2,	121.8,	131.6,	146.6,	158.3,	168.0,	202.1,
2 days	30.1,	41.2,	47.0,	55.6,	61.4,	65.8,	80.1,	96.0,	106.4,	120.8,	133.5,	143.3,	158.2,	169.7,	179.2,	212.1,
3 days	35.2,	47.3,	53.6,	62.8,	68.9,	73.6,	88.6,	105.2,	115.9,	130.7,	143.6,	153.5,	168.6,	180.2,	189.7,	222.5,
4 days	39.6,	52.6,	59.3,	69.0,	75.4,	80.4,	96.0,	113.2,	124.2,	139.4,	152.6,	162.7,	177.9,	189.6,	199.2,	232.1,
6 days	47.4,	61.8,	69.2,	79.8,	86.8,	92.1,	108.8,	127.0,	138.6,	154.4,	168.2,	178.6,	194.3,	206.3,	216.0,	249.4,
8 days	54.2,	69.9,	77.8,	89.2,	96.6,	102.3,	120.0,	139.0,	151.1,	167.5,	181.7,	192.4,	208.6,	220.8,	230.8,	264.7,
10 days	60.6,	77.3,	85.7,	97.8,	105.6,	111.5,	130.0,	149.8,	162.4,	179.3,	193.9,	204.9,	221.5,	234.0,	244.1,	278.5,
12 days	66.5,	84.2,	93.1,	105.7,	113.9,	120.0,	139.3,	159.8,	172.7,	190.2,	205.2,	216.4,	233.3,	246.1,	256.4,	291.3,
16 days	77.4,	96.9,	106.6,	120.2,	129.0,	135.7,	156.3,	178.0,	191.6,	209.9,	225.6,	237.3,	254.8,	268.0,	278.7,	314.6,
20 days	87.6,	108.6,	118.9,	133.5,	142.9,	149.9,	171.6,	194.4,	208.6,	227.7,	244.0,	256.1,	274.2,	287.8,	298.7,	335.5,
25 days	99.5,	122.2,	133.3,	148.9,	158.9,	166.3,	189.3,	213.3,	228.2,	248.1,	265.0,	277.6,	296.3,	310.3,	321.6,	359.3,

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

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Elena Dragoje
Site name:	Unit 1 Brownsbarn PL3 AI
Site location:	Brownsbarn Drive, Citywest Business Campus, D24

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

Site Details

Latitude:	53.29451° N
Longitude:	6.43243° W
Reference:	1051033465
Date:	Feb 01 2022

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 1.822

Methodology

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

Soil characteristics	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics	Default	Edited
SAAR (mm):	903	798
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	4.47	3.87
1 in 1 year (l/s):	3.8	3.29
1 in 30 years (l/s):	9.53	8.24
1 in 100 year (l/s):	11.67	10.1
1 in 200 years (l/s):	12.79	11.07

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Elena Dragoje
Site name:	Unit 2 Brownsbarn PL3 AI
Site location:	Brownsbarn Drive, Citywest Business Campus, D24

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

Site Details

Latitude:	53.29339° N
Longitude:	6.4324° W
Reference:	3584553047
Date:	Feb 01 2022

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 1.885

Methodology

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

Soil characteristics	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics	Default	Edited
SAAR (mm):	903	798
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	4.63	4
1 in 1 year (l/s):	3.93	3.4
1 in 30 years (l/s):	9.86	8.53
1 in 100 year (l/s):	12.08	10.45
1 in 200 years (l/s):	13.23	11.45

Kingspan Klargester

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Separators

A RANGE OF FUEL/OIL SEPARATORS FOR PEACE OF MIND

Surface water drains normally discharge to a watercourse or indirectly into underground waters (groundwater) via a soakaway. Contamination of surface water by oil, chemicals or suspended solids can cause these discharges to have a serious impact on the receiving water.

The Environment Regulators, Environment Agency, England and Wales, SEPA, Scottish Environmental Protection Agency in Scotland and Department of Environment & Heritage in Northern Ireland, have published guidance on surface water disposal, which offers a range of means of dealing with pollution both at source and at the point of discharge from site (so called 'end of pipe' treatment). These techniques are known as 'Sustainable Drainage Systems' (SuDS).

Where run-off is draining from relatively low risk areas such as car-parks and non-operational areas, a source control approach, such as permeable surfaces or infiltration trenches, may offer a suitable means of treatment, removing the need for a separator.

Oil separators are installed on surface water drainage systems to protect receiving waters from pollution by oil, which may be present due to minor leaks from vehicles and plant, from accidental spillage.

Effluent from industrial processes and vehicle washing should normally be discharged to the foul sewer (subject to the approval of the sewerage undertaker) for further treatment at a municipal treatment works.

SEPARATOR STANDARDS AND TYPES

A British (and European) standard (EN 858-1 and 858-2) for the design and use of prefabricated oil separators has been adopted. New prefabricated separators should comply with the standard.

SEPARATOR CLASSES

The standard refers to two 'classes' of separator, based on performance under standard test conditions.

CLASS I

Designed to achieve a concentration of less than 5mg/l of oil under standard test conditions, should be used when the separator is required to remove very small oil droplets.

CLASS II

Designed to achieve a concentration of less than 100mg/l oil under standard test conditions and are suitable for dealing with discharges where a lower quality requirement applies (for example where the effluent passes to foul sewer).

Both classes can be produced as full retention or bypass separators. The oil concentration limits of 5 mg/l and 100 mg/l are only applicable under standard test conditions. It should not be expected that separators will comply with these limits when operating under field conditions.

FULL RETENTION SEPARATORS

Full retention separators treat the full flow that can be delivered by the drainage system, which is normally equivalent to the flow generated by a rainfall intensity of 65mm/hr.

On large sites, some short term flooding may be an acceptable means of limiting the flow rate and hence the size of full retention systems.

Get in touch for a **FREE** professional site visit and a representative will contact you within 5 working days to arrange a visit.
helpingyou@klargester.com to make the right decision or call **028 302 66799**

BYPASS SEPARATORS

Bypass separators fully treat all flows generated by rainfall rates of up to 6.5mm/hr. This covers over 99% of all rainfall events. Flows above this rate are allowed to bypass the separator. These separators are used when it is considered an acceptable risk not to provide full treatment for high flows, for example where the risk of a large spillage and heavy rainfall occurring at the same time is small.

FORECOURT SEPARATORS

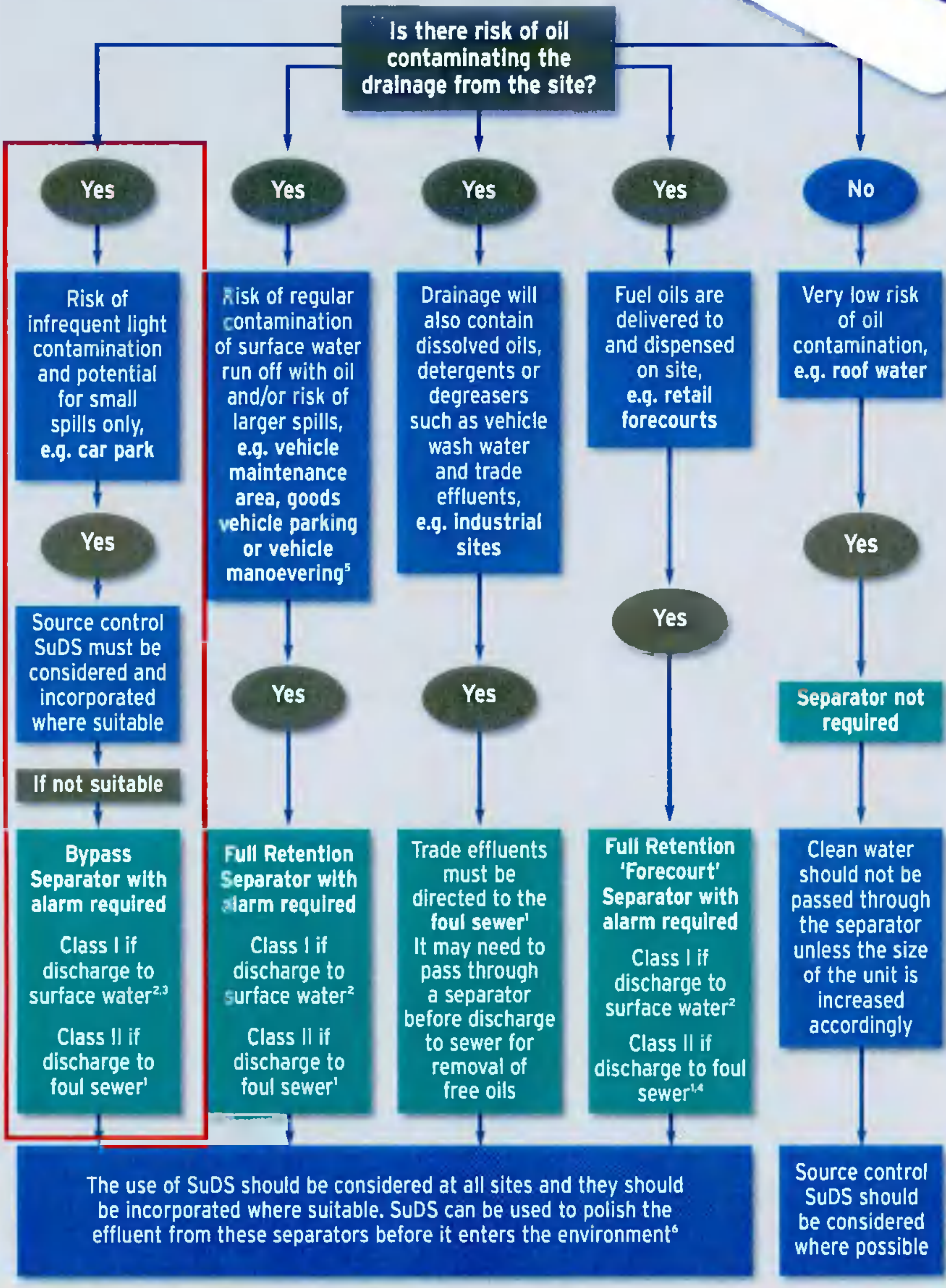
Forecourt separators are full retention separators specified to retain on site the maximum spillage likely to occur on a petrol filling station. They are required for both safety and environmental reasons and will treat spillages occurring during vehicle refuelling and road tanker delivery. The size of the separator is increased in order to retain the possible loss of the contents of one compartment of a road tanker, which may be up to 7,600 litres.

SELECTING THE RIGHT SEPARATOR

The chart on the following page gives guidance to aid selection of the appropriate type of fuel/oil separator for use in surface water drainage systems which discharge into rivers and soakaways.

For further detailed information, please consult the Environment Agency Pollution Prevention Guideline 03 (PPG 3) 'Use and design of oil separators in surface water drainage systems' available from their website.

Klargester has a specialist team who provide technical assistance in selecting the appropriate separator for your application.



1 You must seek prior permission from your local sewer provider before you decide which separator to install and before you make any discharge.
2 You must seek prior permission from the relevant environmental body before you decide which separator to install.
3 In this case, if it is considered that there is a low risk of pollution a source control SuDS scheme may be appropriate.
4 In certain circumstances, the sewer provider may require a Class 1 separator for discharges to sewer to prevent explosive atmospheres from being generated.
5 Drainage from higher risk areas such as vehicle maintenance yards and goods vehicle parking areas should be connected to foul sewer in preference to surface water.
6 In certain circumstances, a separator may be one of the devices used in the SuDS scheme. Ask us for advice.

Bypass NSB RANGE

APPLICATION

Bypass separators are used when it is considered an acceptable risk not to provide full treatment, for very high flows, and are used, for example, where the risk of a large spillage and heavy rainfall occurring at the same time is small, e.g.

- Surface car parks.
- Roadways.
- Lightly contaminated commercial areas.

PERFORMANCE

Klargester were one of the first UK manufacturers to have separators tested to EN 858-1. Klargester have now added the NSB bypass range to their portfolio of certified and tested models. The NSB number denotes the maximum flow at which the separator treats liquids. The British Standards Institute (BSI) tested the required range of Klargester full retention separators and certified their performance in relation to their flow and process performance assessing the effluent qualities to the requirements of EN 858-1. Klargester bypass separator designs follow the parameters determined during the testing of the required range of bypass separators.

Each bypass separator design includes the necessary volume requirements for:

- Oil separation capacity.
- Oil storage volume.
- Silt storage capacity.
- Coalescer.

The unit is designed to treat 10% of peak flow. The calculated drainage areas served by each separator are indicated according to the formula given by PPG3 NSB = 0.0018A(m2). Flows generated by higher rainfall rates will pass through part of the separator and bypass the main separation chamber.

Class I separators are designed to achieve a concentration of 5mg/litre of oil under standard test conditions.

Class II separators are designed to achieve a concentration of 100mg/litre of oil under standard test conditions.

FEATURES

- Light and easy to install.
- Class I and Class II designs.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.
- Vent points within necks.
- Oil alarm system available (required by EN 858-1 and PPG3).
- Extension access shafts for deep inverts.
- Maintenance from ground level.
- GRP or rotomoulded construction (subject to model).

To specify a nominal size bypass separator, the following information is needed:-

- The calculated flow rate for the drainage area served. Our designs are based on the assumption that any interconnecting pipework fitted elsewhere on site does not impede flow into or out of the separator and that the flow is not pumped.
- The required discharge standard. This will decide whether a Class I or Class II unit is required.
- The drain invert inlet depth.
- Pipework type, size and orientation.

SIZES AND SPECIFICATIONS

UNIT NOMINAL SIZE	FLOW (l/s)	PEAK FLOW RATE (l/s)	DRAINAGE AREA (m²)	STORAGE CAPACITY (litres) SILT	OIL	UNIT LENGTH (mm)	UNIT DIA. (mm)	ACCESS SHAFT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT	STANDARD FALL ACROSS (mm)	MIN. INLET INVERT (mm)	STANDARD PIPEWORK DIA. (mm)
NSBP003	3	30	1670	300	45	1700	1350	600	1420	1320	100	500	160
NSBP004	4.5	45	2500	450	60	1700	1350	600	1420	1320	100	500	160
NSBP006	6	60	3335	600	90	1700	1350	600	1420	1320	100	500	160
NSBE010	10	100	5560	1000	150	2069	1220	750	1450	1350	100	700	315
NSBE015	15	150	8335	1500	225	2947	1220	750	1450	1350	100	700	315
NSBE020	20	200	11111	2000	300	3893	1220	750	1450	1350	100	700	375
NSBE025	25	250	13890	2500	375	3575	1420	750	1680	1580	100	700	375
NSBE030	30	300	16670	3000	450	4265	1420	750	1680	1580	100	700	450
NSBE040	40	400	22222	4000	600	3230	1920	600	2185	2035	150	1000	500
NSBE050	50	500	27778	5000	750	3960	1920	600	2185	2035	150	1000	600
NSBE075	75	750	41667	7500	1125	5841	1920	600	2235	2035	200	950	675
NSBE100	100	1000	55556	10000	1500	7661	1920	600	2235	2035	200	950	750
NSBE125	125	1250	69444	12500	1875	9548	1920	600	2235	2035	200	950	750

Rotomoulded chamber construction *GRP chamber construction* ** Some units have more than one access shaft – diameter of largest shown.*

Full Retention NSF RANGE

Kingspan Klargester

APPLICATION

Full retention separators are used in high risk spillage areas such as:

- Fuel distribution depots.
- Vehicle workshops.
- Scrap Yards

PERFORMANCE

Klargester were the first UK manufacturer to have the required range (3-30 l/sec) certified to EN 858-1 in the UK. The NSF number denotes the flow at which the separator operates.

The British Standards Institute (BSI) have witnessed the performance tests of the required range of separators and have certified their performance, in relation to their flow and process performance to ensure that they met the effluent quality requirements of EN 858-1. Larger separator designs have been determined using the formulas extrapolated from the test range.

Each full retention separator design includes the necessary volume requirements for:

- Oil separation capacity.
- Silt storage capacity.
- Automatic closure device.
- Oil storage volume.
- Coalescer (Class I units only).

Klargester full retention separators treat the whole of the specified flow.

FEATURES

- Light and easy to install.
- Class I and Class II designs.
- 3-30 l/sec range independently tested and performance sampled, certified by the BSI.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.

- Oil alarm system available.
- Vent points within necks.
- Extension access shafts for deep inverts.
- Maintenance from ground level.
- GRP or rotomoulded construction (subject to model).

To specify a nominal size full retention separator, the following information is needed:-

- The calculated flow rate for the drainage area served. Our designs are based on the assumption that any interconnecting pipework fitted elsewhere on site does not impede flow into or out of the separator and that the influent is not pumped.
- The required discharge standard. This will decide whether a Class I or Class II unit is required.
- The drain invert inlet depth.
- Pipework type, size and orientation.

SIZES AND SPECIFICATIONS

UNIT NOMINAL SIZE	FLOW (l/s)	DRAINAGE AREA (m^2) PPG-3 (0.018)	STORAGE CAPACITY (litres) SILT	OIL	UNIT LENGTH (mm)	UNIT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT	MIN. INLET INLET (mm)	STANDARD PIPEWORK DIA. (mm)
NSFP003	3	170	300	30	1700	1350	1420	1345	500	160
NSFP006	6	335	600	60	1700	1350	1420	1345	500	160
NSFA010	10	555	1000	100	2610	1225	1050	1000	500	200
NSFA015	15	835	1500	150	3910	1225	1050	1000	500	200
NSFA020	20	1115	2000	200	3200	2010	1810	1760	1000	315
NSFA030	30	1670	3000	300	3915	2010	1810	1760	1000	315
NSFA040	40	2225	4000	400	4640	2010	1810	1760	1000	315
NSFA050	50	2780	5000	500	5425	2010	1810	1760	1000	315
NSFA065	65	3610	6500	650	6850	2010	1810	1760	1000	315
NSFA080	80	4445	8000	800	5744	2820	2500	2450	1000	300
NSFA100	100	5560	10000	1000	6200	2820	2500	2450	1000	400
NSFA125	125	6945	12500	1250	7365	2820	2500	2450	1000	450
NSFA150	150	8335	15000	1500	8675	2820	2550	2450	1000	525
NSFA175	175	9725	17500	1750	9975	2820	2550	2450	1000	525
NSFA200	200	11110	20000	2000	11280	2820	2550	2450	1000	600

Rotomoulded chamber construction *GRP chamber construction*

PROFESSIONAL INSTALLERS

Klargester Accredited Installers

Experience shows that correct installation is a prerequisite for the long-lasting and successful operation of any wastewater treatment product. This is why using an installer with the experience and expertise to install your product is highly recommended.

Services include :

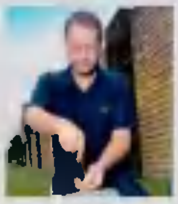
- Site survey to establish ground conditions and soil types
- Advice on system design and product selection
- Assistance on gaining environmental consents and building approvals
- Tank and drainage system installation
- Connection to discharge point and electrical networks
- Waste emptying and disposal

Discover more about the Accredited Installers and locate your local expert online.

www.klargester.com/installers

Kingspan Klargester Accredited Installer

CARE & MAINTENANCE



Kingspan Environmental Services

Who better to look after your treatment plant than the people who designed and built it?

Kingspan Environmental have a dedicated service division providing maintenance for wastewater products.

Factory trained engineers are available for site visits as part of a planned maintenance contract or on a one-off call out basis.

To find out more about protecting your investment and ensuring peace of mind, call us on:

0844 846 0500

or visit us online:

www.kingspanenvservice.com

Kingspan Services

Kingspan Klargester

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- **KILLMASTER** PACKAGE PUMP STATIONS
- **PUMPSTOR24** PUMPING SYSTEMS
- STORMWATER ATTENUATION SYSTEMS
- OIL/WATER SEPARATORS
- BELOW GROUND STORAGE TANKS
- GREASE & SILT TRAPS

Kingspan Water

NEW BUILD & RETROFIT SOLUTIONS

- BELOW GROUND RAINWATER HARVESTING SYSTEMS
- ABOVE GROUND RAINWATER HARVESTING SYSTEMS

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UK: College Road North, Aston Clinton, Aylesbury, Buckinghamshire HP22 5EW

Tel: +44 (0) 1296 633000 Fax: +44 (0) 1296 633001 Scottish Office: Tel: +44 (0) 1355 248484

email: info@klargester.com

Ireland: Unit 1a, Derryboy Road, Carnbane Business Park, Newry, Co. Down BT35 6QH

NI Tel : +44 (0) 28 302 66799 Fax: +44 (0) 28 302 60046 ROI Tel: 048 302 66799 Fax: 048 302 60046

email: info@klargester.ie

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BRITISH WATER

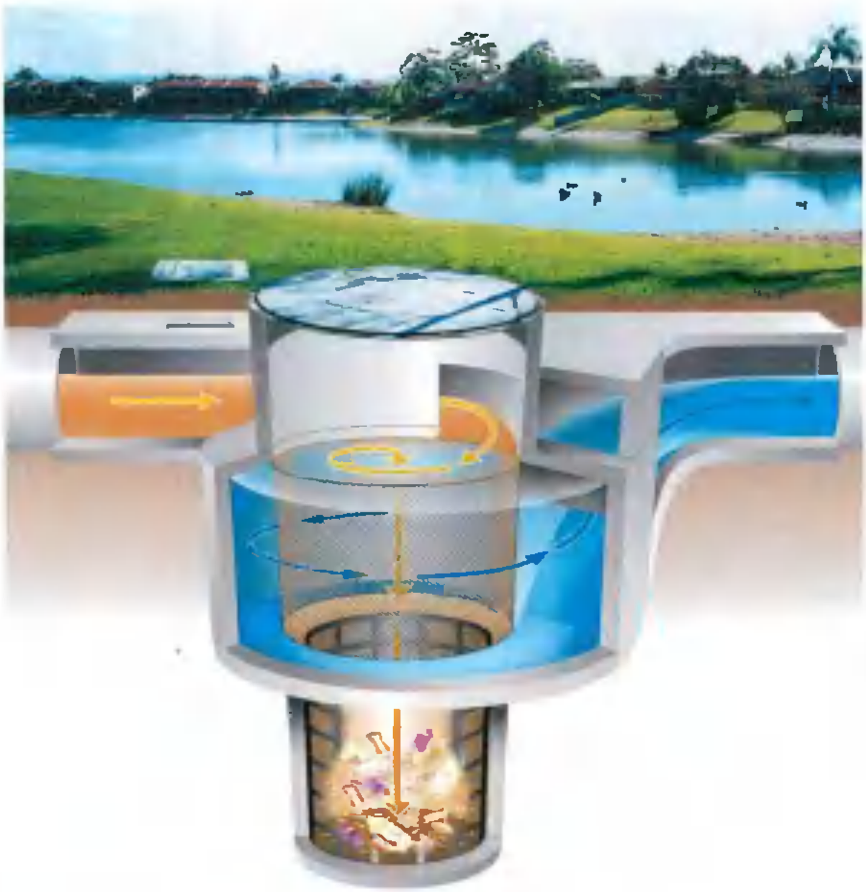
UK GREEN BUILDING COUNCIL

Issue No. 20: August 2014

CDS TECHNOLOGIES

Specialists in Wastewater Treatment & Stormwater Management

Surface Water Treatment SUDs Protector



The CDS Non Blocking screening technology is an innovative method of liquid / solid separation for Surface Water, Combined Sewer Overflows (CSO) and Foul Sewage Systems.

- ***SurfSep*** for Surface Water applications
- ***OverSep*** for Combined Sewer Overflow applications.

The technology accomplishes high efficiency separation of settleable particulate matter and capture of floatable material.

A unique feature of the CDS Technology is it's compact design. Both the *SurfSep* and *OverSep* are available as packaged systems, which can either be installed inside pre-cast concrete chamber rings, or complete BBA Approved Polyethylene Chambers unit.

Applications

- Storm-water Treatment
- Combined Sewer Overflow Treatment
- Parking Area Run-Off Treatment
- Vehicle Service Yard Areas
- Pre-treatment for Wetlands, Ponds and Swales
- Rainwater Harvesting
- Pre-treatment for Oil Separators
- Pre-treatment for media and Ground In-filtration Systems




Rapid installation

Primary features

- **Effective**: Capturing more than 95% of solid pollutants.
- **Non-Blocking**: Unique design takes advantage of indirect filtration and properly proportioned hydraulic forces that virtually makes the unit unblockable
- **Non-Mechanical**: The unit has no moving parts and requires no mechanical devices to support the solid separation function.
- **Low Maintenance Costs**: The system has no moving parts and is fabricated of durable materials.
- **Compact & Flexible**: Design and size flexibility enables the use of various configurations.
- **High Flow Effectiveness**: The technology remains highly effective across a broad spectrum of flow ranges.
- **Assured Pollutant Capture**: All materials captured are retained during high flow conditions.
- **Safe & Easy Pollutant Removal**: Extraction methods allow safe and easy removal of pollutants without manual handling.

Surface Water System

Hydraulic Analysis

In storm water applications, an analysis of the catchment in terms of its size, topography and land use will provide information for determining flow to be expected for various return periods.

The *SurfSep* is designed for the flow that mobilizes the gross pollutants within the catchment. Since there are variations in catchment response due to region, land use and topography, it is recommended that the selection of flow to be treated will be for return periods of between 3 months and 1 year.

Balancing the cost to the operator against the benefits to the environment

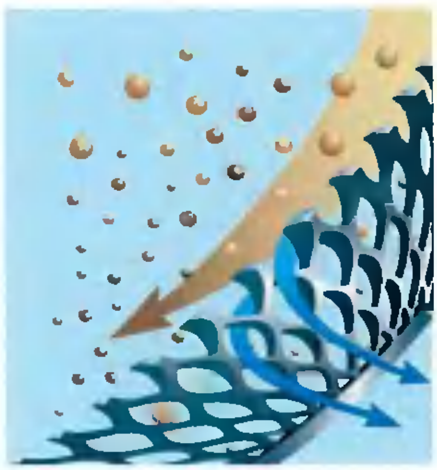
Field evaluations to determine pollutant mobilization have found that the vast majority of pollutants are mobilized in flows that are well below the design capacity' for the conveyance facility - typically known as the 'first flush'.

Therefore it is typical not to design the *SurfSep* models to process the conveyance system's maximum flow in order to achieve a very high level of pollutant removal.

The added value benefit to the operator is reduced civil costs without compromising the benefits to the environment.

How it works

Water and pollutants enter the system and are introduced tangentially inside the separation chamber forming a circular flow motion. Floatables and suspended solids are diverted to the slow moving centre of the flow. Negatively buoyant solids settle out to an undisturbed sump chamber below, while the water passes countercurrently through the separation screen. Floatables remain at the water surface and retained within the screen.



Surface Water Treatment Systems

Hydraulic Design

Every application requires a detailed hydraulic analysis to ensure the final installation will perform to effect optimum solids separation without blocking the screen.

After the design flow has been determined, the appropriate standard model can be selected. A selection table is provided on page 7.

The Ultimate SUDs Protector

There a four principal areas of proprietary SUDs technology:

• Infiltration • Flow Control • Storage/attenuation • Treatment

SurfSeps, although a common form of treatment are unique. When installed upstream of any proprietary SUDs technology, the *SurfSep* protects the receiving SUDs from fine solids and debris that would otherwise accumulate over time rendering the SUDs non-operational, as the worst case.

SurfSeps have been successfully installed in front of;

- Soakaways
- Infiltration Trenches
- Filters
- Wetlands
- Ponds and Water Features
- Detention and Retention Systems
- Oil Separators
- Create storage storage systems

to remove fine solids and debris that would otherwise accumulate over time reducing the down stream effectiveness of downstream SUDs assets.

Various independent field trials have shown that the *SurfSep* can remove high levels of Phosphates, Heavy Metals and PolyAramatic Hydrocarbons (PAH's) from the flow.

Infiltration

SurfSeps have been successfully installed in front of ground Infiltration systems to remove grit, fine solids and debris which accumulates in and around the SUDs causing visual degradation in the short term and accumulation of silt and grits leading to reduced volume in the long term.

Studies have also shown that Heavy metals & PAH's accumulate within the SUDs over time before being released back to the environment resulting in elevated concentrations.

Detention & Retention Systems

SurfSeps have been successfully installed in front of collection and attenuation SUDs to remove grit, fine solids and debris which accumulates in the SUDs leading to potential blockage of flow regulators resulting in increased Occupational Health & Safety risk during the treatment of blockages and during the periodic cleaning operations.

Applications

- Rainwater Harvesting
- Road run off
- New Developments
- Motorways
- A / B Roads
- Local Roads
- Residential
- Industrial
- Commercial

Purpose

Removal of plastics, oil, grit, fine solids, organic and inorganic debris, from point source pollution.

Flow Control Systems

Flow Control

Flow control is often required to reduce flooding of downstream sewer networks or receiving water courses. There are a number of ways to achieve this. The Hydroslide - Float controlled, constant flow regulator, as detailed below is ideally suited to the providing an efficient and reliable means of flow control.

There are four types of standard Hydroslide flow regulators as pictured.

1) Mini
2) HydroLimiter
3) VS - Vertical Standard
4) Combi - self flushing, can be mounted on the dry or wet side of the flow chamber.

Most applications can be dealt with using any of the four models to suit the flow. An accuracy of +/-5% is achievable.

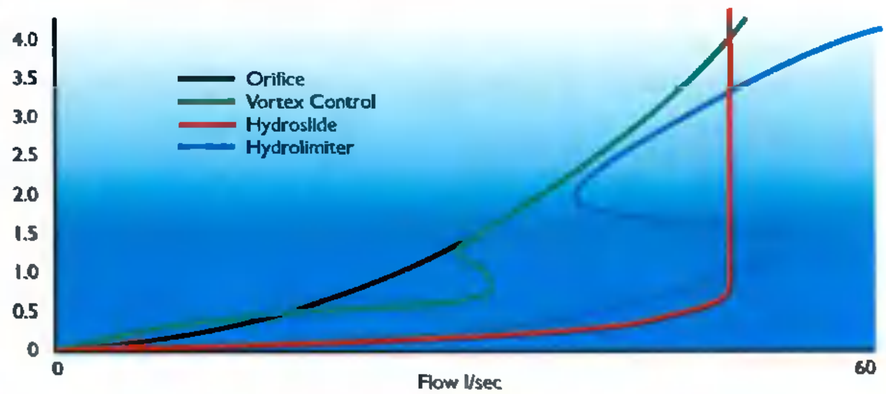
Typical SurfSep installation

Flow Control Technical Design

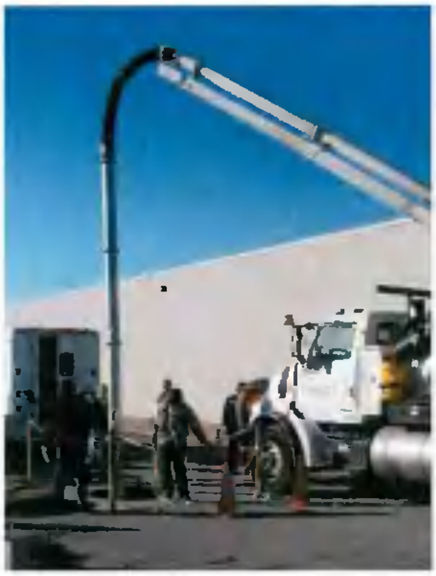
The Hydroslide regulator does not affect the flow until the flow is approaching the set discharge limit, this allows all flow (the first flush) to be discharged to the sewer. Because the flow to the sewer can be optimised at it's maximum permitted capacity the attentuation/storage capacity can be reduced over other methods of flow control, thus giving cost savings in storage provision. This is best explained by looking at a single storm event and comparing the 3 flow regulation processes as was done independantly by WRc in the report titled 'REDUCING THE COST OF STORMWATER STORAGE', Report No. PT1052, March 1995. The chart below represents 50 l/s control and up to 4m of head. The area difference between the curves being the detention volume saving.

Typically the volume saving when using a Hydroslide regulator is between 7% to 40%

Representation of flow through an orifice



Operation & Performance



Performance Criteria

Note: Screen apertures of 4.8 mm , 2.4 mm and 1.2 mm are available.

The 4.8 and 2.4 mm screens are generally used for Surface Water applications, with foul applications using either 2.4 or 1.2 mm aperture units.

Typical 1.2 mm aperture Performance

- shall remove all solids with a single dimension greater than 1.2 mm and positively contain those solids until the unit is cleaned.
- shall remove and positively contain 100 percent of all neutrally buoyant particles with a single dimension greater than 1.2 mm for all flow conditions to design capacity.
- shall remove and positively contain 100 percent of all floating trash and debris with a single dimension greater than 1.2 mm for all flow conditions to the design capacity.
- shall remove a minimum of 50 percent of oil and grease (as defined as the floating portion of total hexane extractable materials) for all flow conditions to the design capacity, without the addition of absorbents.
- shall provide the following minimum particle removal efficiencies (based on a specific gravity of 2.65):

a) 100 percent of all particles greater than 1100 microns.

b) 95 percent of all particles greater than 550 microns.

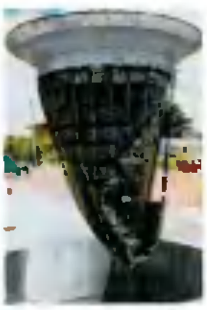
c) 90 percent of all particles greater than 367 microns.

d) 20 percent of all particles greater than 200 microns.

Maintenance

SurfSep maintenance can be site and drainage area specific. The installation should be inspected periodically to assure its condition to handle anticipated runoff. If pollutant loadings are known, then a preventive maintenance schedule can be developed based on runoff volumes processed.

Since this is seldom the case we recommend;



New Installations

Check the condition of the installation after the first few events. This includes a visual inspection to ascertain that the unit is operating correctly and measuring the amount of deposition that has occurred in the unit. This may be achieved using a 'Dip Stick'.

Ongoing Operation

For the first 12 months the installations sump full volume should be inspected monthly and recorded. When the inspection indicates that the sump full volume is approaching the top of the sump (base of screen) a cleanout should be undertaken.

Cleaning Methods

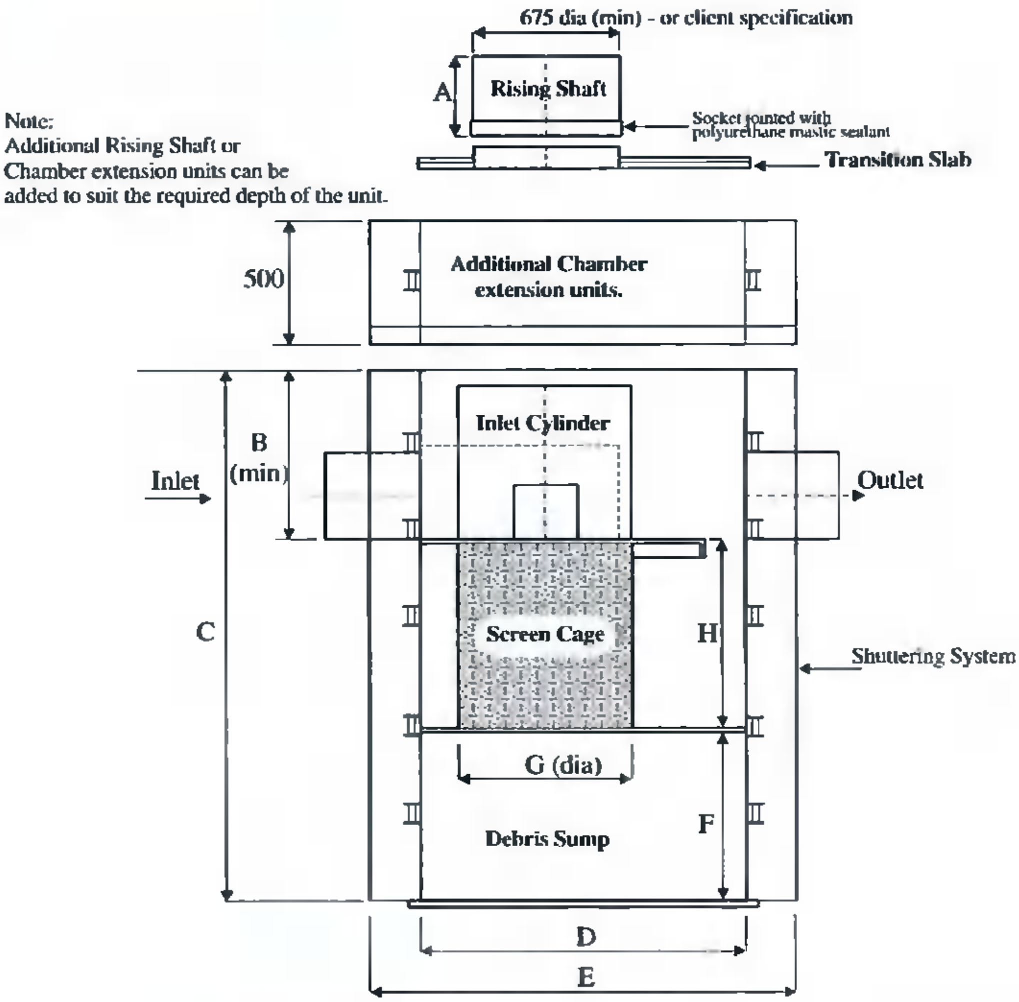
- Eduction (Suction)
- Basket Removal
- Mechanical Grab

Maintenance Cycle

Minimum once per year. Depending on the pollutant load it may be necessary to maintain the installation more frequently.

The operator shall be able to devise the most efficient maintenance schedule for any particular installation over a 12 month operating cycle.

SurfSep Dimensions



SurfSep Dimensions (mm)

	SW0404	SW0604	SW0606	SW0804	SW0806	SW0808	SW1010	SW1012	SW1015
A	370	370	370	370	370	370	500	500	500
B	444	815	615	810	830	810	800	800	830
C	1250	1985	1985	2080	2300	2480	2800	3000	3330
D	800	1200	1200	1500	1500	1500	2000	2000	2000
E	1112	1665	1665	1966	1966	1966	2475	2475	2475
F	400	700	700	700	700	800	1000	1000	1000
G (dia)	400	600	600	800	800	800	1000	1000	1000
H	400	400	600	400	600	800	1000	1200	1500

Selection Table - *SurfSep*

Model Reference	Hydraulic Peak Flow Rate l/s	Drainage Area - Impermeable m^2	Chamber Diameter (mm)	Internal Pipe Diameter (mm)
SWI 0404	30	2,000	900	150 / 225
SWI 0604	70	5,000	1200	225
SWI 0606 / 01	140	10,000	1200	225 - 375
SWI 0606 / 02	200	15,000	1200	225 - 375
SWI 0804	275	20,000	1500	300
SWI 0806	350	25,000	1500	450
SWI 0808	400	30,000	1500	450
SWI 1010	480	35,000	2000	450
SWI 1012	550	40,000	2000	450 / 750
SWI 1015	700	50,000	2000	450 / 750

* Proposed Peak Flow Rate for each model calculated using Rational Lloyd Davies with a rainfall intensity of 50mm/hr. For greater flows - special design / construction required.

In-Line *SurfSep* Units (SWI)

These units are used with in the drainage system in-line and are supplied as BBA Approved complete Polyethylene Chamber units from the selection table above.

Off-Line *SurfSep* Units (SWO)

These can be designed either using pre-cast concrete or specially designed Polyethylene chambers.

Model Designation

SurfSep models are firstly identified by the letters SW for Surface Water followed by a letter (**I** or **O**) representing the configuration (**I**nline or **O**ffline).

A four digit number representing the screen diameter and screen height then follows to give the standard model designation for a *SurfSep* screen for installation into standard commercially available pre-fabricated manhole chambers i.e SWI 0806. Example: SWI 0806 designates Surface Water Inline with a separation screen dia 0.8 m and screen height of 0.6m.

TECHNOLOGIES

Surface Water Treatment

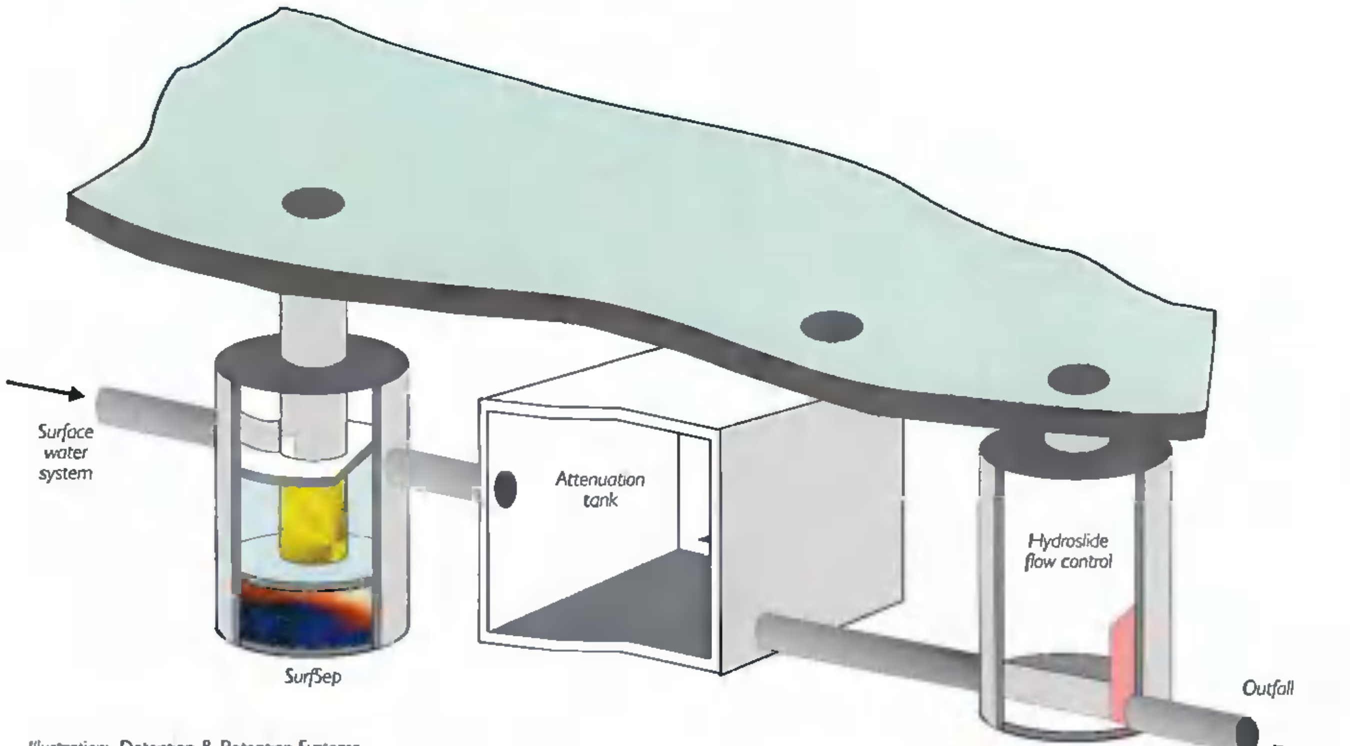


Illustration: Detention & Retention Systems

SurfSeps unit installed in front of attenuation tank / cellular storage system, to remove grit, fine sediments and floating debris which can accumulate within surface water systems. Hydroslide flow control regulating the discharge to the outfall. The Hydroslide can be supplied for installation in an insitu constructed chamber, or as a complete unit housed within a pre-fabricated polyethylene manhole chamber.

BBA BRITISH BOARD OF AGRÉMENT

* BBA - THIS CERTIFICATE RELATES TO PIPEX UNIVERSAL MANHOLES AND ACCESS CHAMBERS, WHICH ARE MANUFACTURED FROM WELDED POLYPROPYLENE. This Certificate covers the use of the manholes and chambers for drain and sewer applications where they are used for maintenance to depths of 6 mtrs.

Approved Suppliers

If you would like more information please contact:

CDS Technologies is a multi disciplined, international, company offering a comprehensive product range of; wastewater treatment technologies and processes, and stormwater management solutions for attenuation, infiltration, flow control and overflow treatment. CDS have an established network of Distributors and Representatives. Further information can be found on our website www.cdstech.com.au
Alternatively please contact our approved supplier detailed left.

Unit Selection Design Guide

Overview

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

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

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

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

STH Range of Hydro-Brake® Flow Controls

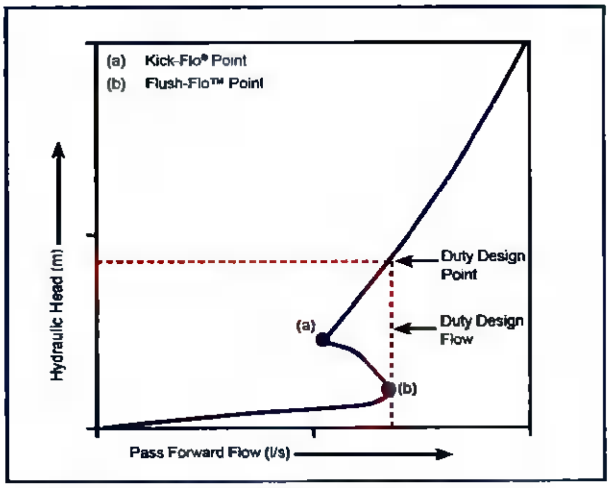
APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4599

See back cover for details.

Hydraulic Characteristics and Specification

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

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



Typical Hydro-Brake® Head Versus Flow Characteristics

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

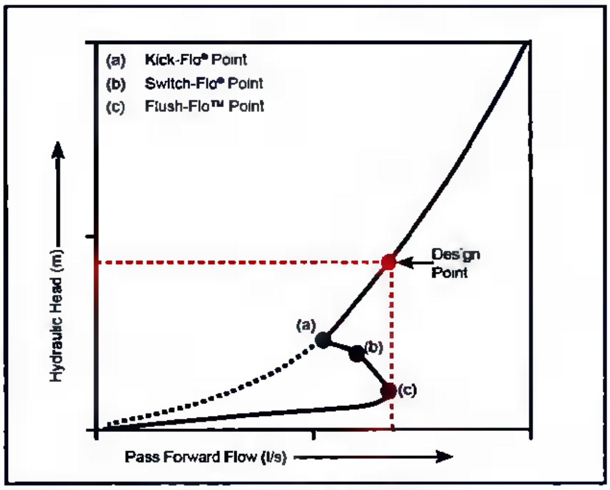
- outlet size and model of Hydro-Brake® Flow Control
- definition of the duty/design point (head and flow)
- definition of the Flush-Flo™ point (head and flow)
- definition of the Kick-Flo® point (head and flow)

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

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

STORMTECH SC-740 CHAMBER

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

STORMTECH SC-740 CHAMBER
(not to scale)

Nominal Chamber Specifications

Size (L x W x H)
85.4" x 51" x 30"
2,170 mm x 1,295 mm x 762 mm

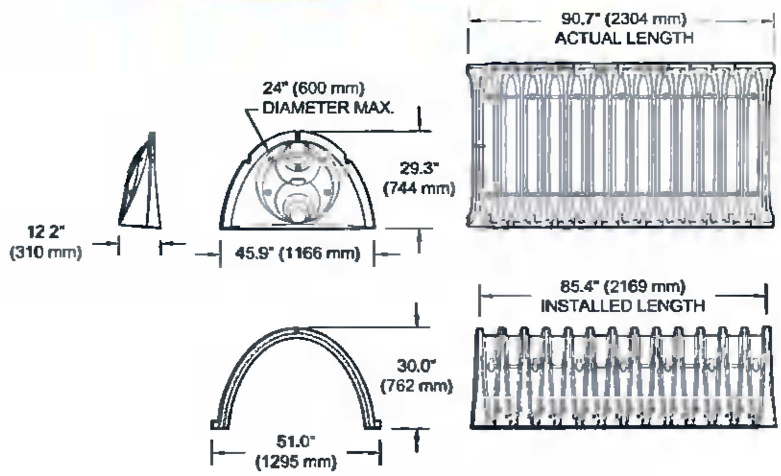
Chamber Storage
45.9 ft³ (1.30 m³)

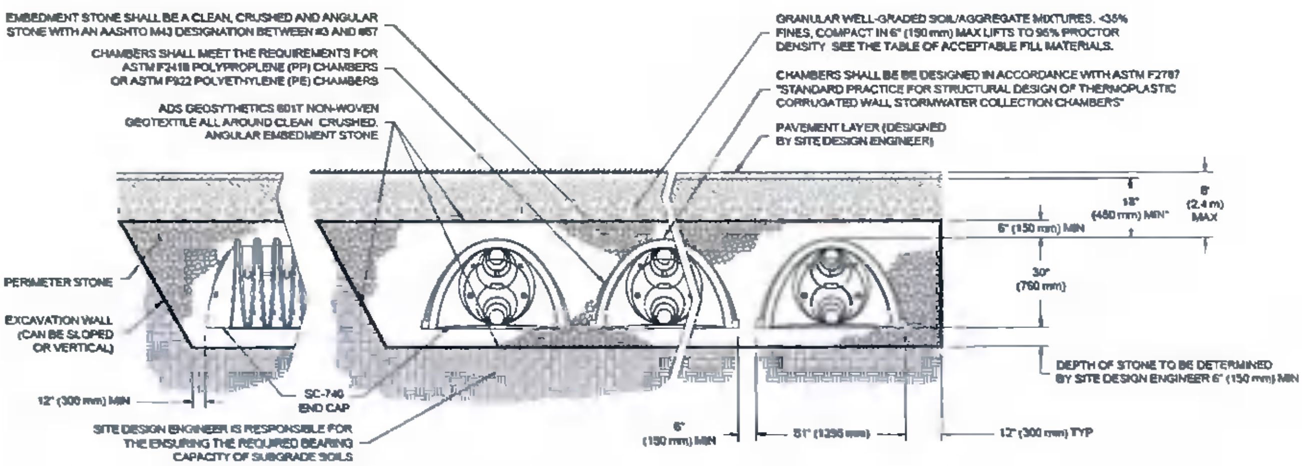
Min. Installed Storage*
74.9 ft³ (2.12 m³)

Weight
74.0 lbs (33.6 kg)

Shipping
30 chambers/pallet
60 end caps/pallet
12 pallets/truck

*Assumes 6" (150 mm) stone above, below and between chambers and 40% stone porosity.





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

StormTech

ADS

SC-740 CUMULATIVE STORAGE VOLUMES PER CHAMBER

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (150 mm) Stone Base Under Chambers.

Depth of Water in System Inches (mm)		Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
42 (1067)	Stone Cover ↑	45.90 (1.300)	74.90 (2.121)
41 (1041)		45.90 (1.300)	73.77 (2.089)
40 (1016)		45.90 (1.300)	72.64 (2.057)
39 (991)		45.90 (1.300)	71.52 (2.025)
38 (965)		45.90 (1.300)	70.39 (1.993)
37 (940)	↓	45.90 (1.300)	69.26 (1.961)
36 (914)		45.90 (1.300)	68.14 (1.929)
35 (889)		45.85 (1.298)	66.98 (1.897)
34 (864)		45.69 (1.294)	65.75 (1.862)
33 (838)		45.41 (1.286)	64.46 (1.825)
32 (813)		44.81 (1.269)	62.97 (1.783)
31 (787)		44.01 (1.246)	61.36 (1.737)
30 (762)		43.06 (1.219)	59.66 (1.689)
29 (737)		41.98 (1.189)	57.89 (1.639)
28 (711)		40.80 (1.155)	56.05 (1.587)
27 (686)		39.54 (1.120)	54.17 (1.534)
26 (660)		38.18 (1.081)	52.23 (1.479)
25 (635)		36.74 (1.040)	50.23 (1.422)
24 (610)		35.22 (0.977)	48.19 (1.365)
23 (584)		33.64 (0.953)	46.11 (1.306)
22 (559)		31.99 (0.906)	44.00 (1.246)
21 (533)		30.29 (0.858)	1.85 (1.185)
20 (508)		28.54 (0.808)	39.67 (1.123)
19 (483)		26.74 (0.757)	37.47 (1.061)
18 (457)		24.89 (0.705)	35.23 (0.997)
17 (432)		23.00 (0.651)	32.96 (0.939)
16 (406)		21.06 (0.596)	30.68 (0.869)
15 (381)		19.09 (0.541)	28.36 (0.803)
14 (356)		17.08 (0.484)	26.03 (0.737)
13 (330)		15.04 (0.426)	23.68 (0.670)
12 (305)		12.97 (0.367)	21.31 (0.608)
11 (279)		10.87 (0.309)	18.92 (0.535)
10 (254)		8.74 (0.247)	16.51 (0.468)
9 (229)		6.58 (0.186)	14.09 (0.399)
8 (203)		4.41 (0.125)	11.66 (0.330)
7 (178)		2.21 (0.063)	9.21 (0.264)
6 (152)	Stone Foundation ↑	0 (0)	6.76 (0.191)
5 (127)		0 (0)	5.63 (0.160)
4 (102)		0 (0)	4.51 (0.128)
3 (76)		0 (0)	3.38 (0.096)
2 (51)		0 (0)	2.25 (0.064)
1 (25)	↓	0 (0)	1.13 (0.032)

Note: Add 1.13 ft³ (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

STORAGE VOLUME PER CHAMBER FT³ (M³)

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Foundation Depth in. (mm)		
		6 (150)	12 (300)	18 (450)
SC-740 Chamber	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)

Note: Assumes 6" (150 mm) stone above chambers, 6" (150 mm) row spacing and 40% stone porosity.

AMOUNT OF STONE PER CHAMBER

ENGLISH TONS (yds³)	Stone Foundation Depth		
	6"	12"	18"
SC-740	3.8 (2.8)	4.6 (3.3)	5.5 (3.9)
METRIC KILOGRAMS (m³)	150 mm	300 mm	450 mm
SC-740	3,450 (2.1)	4,170 (2.5)	4,490 (3.0)

Note: Assumes 6" (150 mm) of stone above and between chambers.

VOLUME EXCAVATION PER CHAMBER YD³ (M³)

	Stone Foundation Depth		
	6 (150)	12 (300)	18 (450)
SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)

Note: Assumes 6" (150 mm) of row separation and 18" (450 mm) of cover. The volume of excavation will vary as depth of cover increases.

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Visit us at www.stormtech.com
and utilize the StormTech Design Tool

For more information on the StormTech SC-740 Chamber and other ADS products, please contact our Customer Service Representatives at 1-800-821-6710

Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

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ADS

STORMTECH MC-3500 CHAMBER

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

STORMTECH MC-3500 CHAMBER
(not to scale)

Nominal Chamber Specifications

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

Chamber Storage
109.9 ft^3 (3.11 m^3)

Min. Installed Storage*
175.0 ft^3 (4.96 m^3)

Weight
134 lbs (60.8 kg)

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

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

STORMTECH MC-3500 END CAP
(not to scale)

Nominal End Cap Specifications

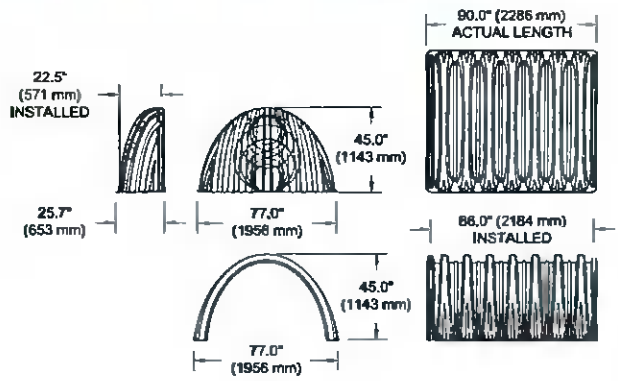
Size (L x W x H)
26.5" x 71" x 45.1"
673 mm x 1,803 mm x 1,145 mm

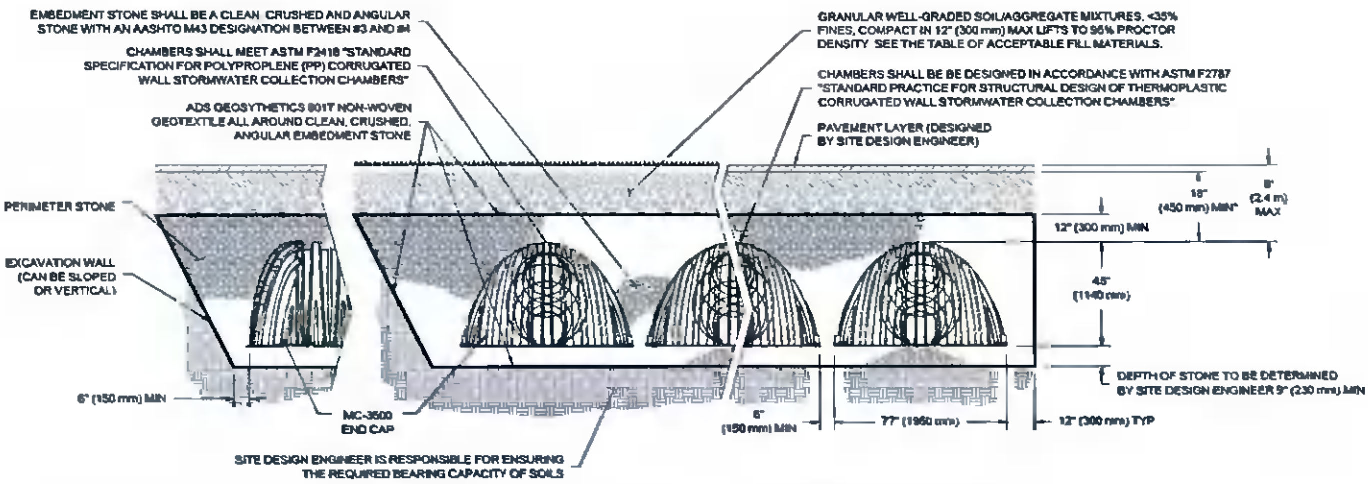
End Cap Storage
14.9 ft^3 (0.42 m^3)

Min. Installed Storage*
45.1 ft^3 (1.28 m^3)

Weight
49 lbs (22.2 kg)

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





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

StormTech ADS

MC-3500 CHAMBER SPECIFICATION

STORAGE VOLUME PER CHAMBER FT³ (M³)

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

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

AMOUNT OF STONE PER CHAMBER

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

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

VOLUME EXCAVATION PER CHAMBER YD³ (M³)

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

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

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and utilize the StormTech Design Tool

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

KAVANAGH BURKE
CONSULTING ENGINEERS

Discharge Units Calculation

KAVANAGH BURKE
CONSULTING ENGINEERS

INPUT FOR FOUL SEWER NETWORK DESIGN

Client: Exeter Ireland Property IV B Limited

Project: WAREHOUSE DEVELOPMENT AT BROWNSBARN DRIVE, CITYWEST BUSINESS CAMPUS, DUBLIN 24

Project Ref: **D1678 - UNIT 1 *(PL3 A.I.)***

Floors	Type of Applience	Discharge Unit per Applience	No of Applie.	Discharge Units
UNIT 1 - OFFICE/STAFF FACILITIES				
GROUND FLOOR PLAN:	WB	0.6	10	6.0
	WC	2.5	8	20.0
	URINAL	0.8	3	2.4
	SHOWER	0.6	1	0.6
	SINK	1.3	1	1.3
	DISHWASHER	0.8	1	0.8
		TOTAL:		***31***
FIRST FLOOR PLAN:	WB	0.6	5	3.0
	WC	2.5	4	10.0
	URINAL	0.8	2	1.6
	SINK	1.3	1	1.3
	DISHWASHER	0.8	1	0.8
		TOTAL:		***17***
SECOND FLOOR PLAN:	WB	0.6	5	3
	WC	2.5	4	10
	URINAL	0.8	2	1.6
	SINK	1.3	1	1
	DISHWASHER	0.8	1	0.8
		TOTAL:		***17***
TOTAL NO OF DICHARGE UNITS FOR OFFICE BLOCK:				***65***
			Q (l/sec) =	5.62
UNIT 1 - WAREHOUSE TOILET BLOCK				
GROUND FLOOR PLAN:	WB	0.6	6	3.6
	WC	2.5	3	7.5
	URINAL	0.8	2	1.6
TOTAL NO OF DICHARGE UNITS FOR WAREHOUSE TOILET BLOCK:				***13***
			Q (l/sec) =	2.49

NOTE:
Discharge units calculated as per Table C.2. Typical values of discharge units of BS EN 752-4.
Typical frequency factors are taken from Table C.1. (k_{DU}=0.7)
Design flow rate is given by the equation: $Q = kDU \sqrt{\Sigma DU}$

KAVANAGH BURKE
CONSULTING ENGINEERS

INPUT FOR FOUL SEWER NETWORK DESIGN

Client:	Exeter Ireland Property IV B Limited
Project:	WAREHOUSE DEVELOPMENT AT BROWNSBARN DRIVE, CITYWEST BUSINESS CAMPUS, DUBLIN 24
Project Ref:	**D1678 - UNIT 2 *(PL3 A.I.)***

Floors	Type of Applience	Discharge Unit per Applience	No of Applie.	Discharge Units
UNIT 2 - OFFICE/STAFF FACILITIES				
GROUND FLOOR PLAN:	WB	0.6	7	4.2
	WC	2.5	6	15.0
	URINAL	0.8	2	1.6
	SHOWER	0.6	1	0.6
	SINK	1.3	1	1.3
	DISHWASHER	0.8	1	0.8
			TOTAL:	***24***
FIRST FLOOR PLAN:	WB	0.6	7	4.2
	WC	2.5	6	15.0
	URINAL	0.8	2	1.6
	SINK	1.3	1	1.3
			TOTAL:	**22**
SECOND FLOOR PLAN:	WB	0.6	7	4
	WC	2.5	6	15
	URINAL	0.8	2	1.6
	SINK	1.3	1	1.3
			TOTAL:	**22**
TOTAL NO OF DICHARGE UNITS FOR OFFICE BLOCK:				**68**
			Q (l/sec) =	*5.76*
UNIT 2 - WAREHOUSE TOILET BLOCK				
GROUND FLOOR PLAN:	WB	0.6	6	3.6
	WC	2.5	3	7.5
	URINAL	0.8	2	1.6
	SHOWER	0.6	2	1.2
	SINK	1.3	1	1.3
TOTAL NO OF DICHARGE UNITS FOR WAREHOUSE TOILET BLOCK:				**15**
			Q (l/sec) =	*2.73*

NOTE:
Discharge units calculated as per Table C.2. Typical values of discharge units of BS EN 752-4.
Typical frequency factors are taken from Table C.1. (k_{DU}=0.7)
Design flow rate is given by the equation: $Q = kDU \sqrt{\Sigma DU}$

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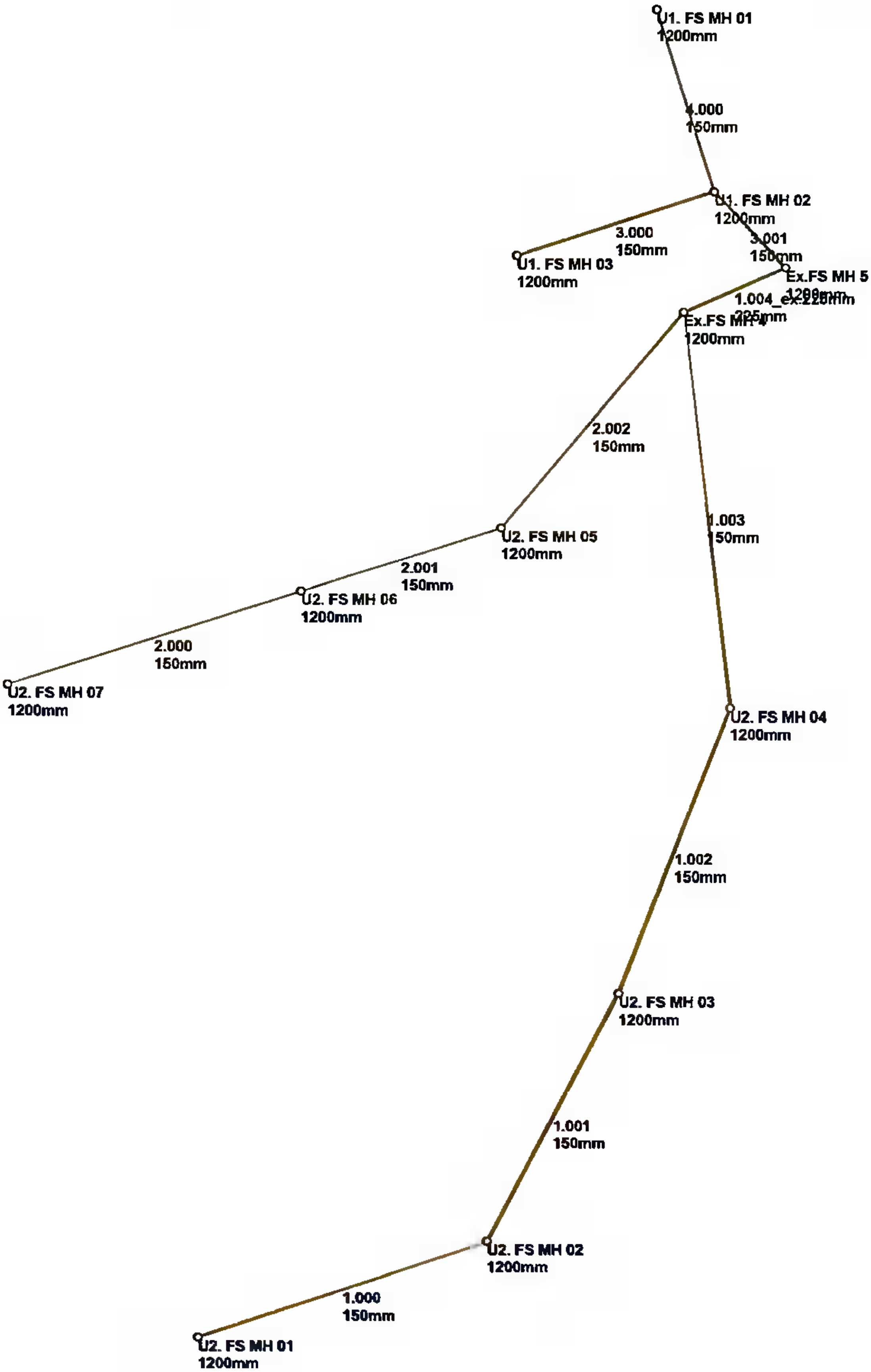
Foul Sewer Network Design

KAVANAGH BURKE CONSULTING ENGINEERS	Kavanagh Burke Unit F3 Block F, Calmount Park, Ballymount, Dublin 12, D12PX28	File: D1678 - FS Network_PL3 AI Network: FS_Unit 1 & 2 Elena Dragoje 01/02/2022	Page 1 Foul Network Scheme



Design Settings

Frequency of use (kDU)	0.70	Additional Flow (%)	0	Preferred Cover Depth (m)	1.200
Flow per dwelling per day (l/day)	2700	Minimum Velocity (m/s)	0.75	Include Intermediate Ground	✓
Domestic Flow (l/s/ha)	0.0	Connection Type	Level Soffits		
Industrial Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Units	Cover Level (m)	Manhole Type	Depth (m)
U2. FS MH 01	68.0	100.300	Adoptable	1.050
U2. FS MH 02		100.150	Adoptable	1.330
U2. FS MH 03		101.050	Adoptable	2.600
U2. FS MH 04		100.850	Adoptable	2.800
U2. FS MH 05		100.350	Adoptable	2.200
U2. FS MH 06		100.225	Adoptable	1.575
U2. FS MH 07	15.0	100.350	Adoptable	1.000
Ex.FS MH 4		101.400	Adoptable	3.975
U1. FS MH 01	65.0	99.450	Adoptable	1.050
U1. FS MH 02		100.200	Adoptable	2.200
U1. FS MH 03	13.0	99.475	Adoptable	0.925
Ex.FS MH 5		101.700	Adoptable	4.785

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type
1.000	U2. FS MH 01	U2. FS MH 02	50.001	1.500	99.250	98.820	0.430	116.3	150	Circular
1.001	U2. FS MH 02	U2. FS MH 03	46.000	1.500	98.820	98.450	0.370	124.3	150	Circular
1.002	U2. FS MH 03	U2. FS MH 04	50.000	1.500	98.450	98.050	0.400	125.0	150	Circular
1.003	U2. FS MH 04	Ex.FS MH 4	65.000	1.500	98.050	97.500	0.550	118.2	150	Circular
2.000	U2. FS MH 07	U2. FS MH 06	50.499	1.500	99.350	98.650	0.700	72.1	150	Circular
2.001	U2. FS MH 06	U2. FS MH 05	34.500	1.500	98.650	98.150	0.500	69.0	150	Circular
2.002	U2. FS MH 05	Ex.FS MH 4	45.999	1.500	98.150	97.500	0.650	70.8	150	Circular
1.004_ex.225mm	Ex.FS MH 4	Ex.FS MH 5	18.161	1.500	97.425	96.915	0.510	35.6	225	Circular
4.000	U1. FS MH 01	U1. FS MH 02	31.000	1.500	98.400	98.000	0.400	77.5	150	Circular
3.000	U1. FS MH 03	U1. FS MH 02	34.000	1.500	98.550	98.000	0.550	61.8	150	Circular
3.001	U1. FS MH 02	Ex.FS MH 5	17.000	1.500	98.000	97.800	0.200	85.0	150	Circular

Name	US Node	DS Node	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Velocity (m/s)
1.000	U2. FS MH 01	U2. FS MH 02	14.3	5.8	0.900	1.180	1.180	0.000	68.0	0.0	0.769
1.001	U2. FS MH 02	U2. FS MH 03	13.9	5.8	1.180	2.450	2.450	0.000	68.0	0.0	0.750
1.002	U2. FS MH 03	U2. FS MH 04	13.8	5.8	2.450	2.650	2.650	0.000	68.0	0.0	0.747
1.003	U2. FS MH 04	Ex.FS MH 4	14.2	5.8	2.650	3.750	3.750	0.000	68.0	0.0	0.763
2.000	U2. FS MH 07	U2. FS MH 06	18.2	2.7	0.850	1.425	1.425	0.000	15.0	0.0	0.734
2.001	U2. FS MH 06	U2. FS MH 05	18.6	2.7	1.425	2.050	2.050	0.000	15.0	0.0	0.750
2.002	U2. FS MH 05	Ex.FS MH 4	18.4	2.7	2.050	3.750	3.750	0.000	15.0	0.0	0.741
1.004_ex.225mm	Ex.FS MH 4	Ex.FS MH 5	76.6	6.4	3.750	4.560	4.560	0.000	83.0	0.0	1.172
4.000	U1. FS MH 01	U1. FS MH 02	17.6	5.6	0.900	2.050	2.050	0.000	65.0	0.0	0.884
3.000	U1. FS MH 03	U1. FS MH 02	19.7	2.5	0.775	2.050	2.050	0.000	13.0	0.0	0.765
3.001	U1. FS MH 02	Ex.FS MH 5	16.8	6.2	2.050	3.750	3.750	0.000	78.0	0.0	0.877

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	50.001	116.3	150	100.300	99.250	0.900	100.150	98.820	1.180
1.001	46.000	124.3	150	100.150	98.820	1.180	101.050	98.450	2.450
1.002	50.000	125.0	150	101.050	98.450	2.450	100.850	98.050	2.650
1.003	65.000	118.2	150	100.850	98.050	2.650	101.400	97.500	3.750
2.000	50.499	72.1	150	100.350	99.350	0.850	100.225	98.650	1.425
2.001	34.500	69.0	150	100.225	98.650	1.425	100.350	98.150	2.050
2.002	45.999	70.8	150	100.350	98.150	2.050	101.400	97.500	3.750
1.004_ex.225mm	18.161	35.6	225	101.400	97.425	3.750	101.700	96.915	4.560
4.000	31.000	77.5	150	99.450	98.400	0.900	100.200	98.000	2.050
3.000	34.000	61.8	150	99.475	98.550	0.775	100.200	98.000	2.050
3.001	17.000	85.0	150	100.200	98.000	2.050	101.700	97.800	3.750

Link	US Node	DS Node
1.000	U2. FS MH 01	U2. FS MH 02
1.001	U2. FS MH 02	U2. FS MH 03
1.002	U2. FS MH 03	U2. FS MH 04
1.003	U2. FS MH 04	Ex.FS MH 4
2.000	U2. FS MH 07	U2. FS MH 06
2.001	U2. FS MH 06	U2. FS MH 05
2.002	U2. FS MH 05	Ex.FS MH 4
1.004_ex.225mm	Ex.FS MH 4	Ex.FS MH 5
4.000	U1. FS MH 01	U1. FS MH 02
3.000	U1. FS MH 03	U1. FS MH 02
3.001	U1. FS MH 02	Ex.FS MH 5

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
U2. FS MH 01	704472.437	728084.287	100.300	1.050	1200		0	1.000	99.250	150
U2. FS MH 02	704519.928	728099.929	100.150	1.330	1200		1	1.000	98.820	150
							0	1.001	98.820	150
U2. FS MH 03	704541.625	728140.490	101.050	2.600	1200		1	1.001	98.450	150
							0	1.002	98.450	150
U2. FS MH 04	704559.976	728187.001	100.850	2.800	1200		1	1.002	98.050	150
							0	1.003	98.050	150
U2. FS MH 05	704522.425	728216.637	100.350	2.200	1200		1	2.001	98.150	150
							0	2.002	98.150	150
U2. FS MH 06	704489.531	728206.232	100.225	1.575	1200		1	2.000	98.650	150
							0	2.001	98.650	150
U2. FS MH 07	704441.383	728191.002	100.350	1.000	1200		0	2.000	99.350	150
Ex FS MH 4	704552.370	728251.554	101.400	3.975	1200		1	2.002	97.500	150
							2	1.003	97.500	150
							0	1.004_ex.225mm	97.425	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
U1. FS MH 01	704547.948	728300.653	99.450	1.050	1200	0	4.000	98.400	150
U1. FS MH 02	704557.397	728271.128	100.200	2.200	1200	1	4.000	98.000	150
						2	3.000	98.000	150
						0	3.001	98.000	150
U1. FS MH 03	704525.014	728260.766	99.475	0.925	1200	0	3.000	98.550	150
Ex.FS MH 5	704569.046	728258.747	101.700	4.785	1200	1	3.001	97.800	150
						2	1.004_ex.225mm	96.915	225