KAVANAGH BURKE
CONSULTING ENGINEERS

Drainage Design Report

for

Warehouse Development

at

Kingswood Road,
Citywest Business Campus,
Dublin 24

Job No:	**D1736**
Client:	**ROCKFACE DEVELOPMENTS LTD**
Date:	**December 2023**
Local Authority:	**South Dublin County Council**
Revision:	**CL1 (Planning Compliance)**

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Contents:

1. INTRODUCTION

This report details the site development works for a warehouse development at Kingswood Road, Citywest Business Campus, Dublin 24.

The subject site is located on the undeveloped land at Citywest Business Campus, bound by Kingswood Avenue to the south-east and Kingswood Road to the north-east.

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

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

Please note, this drainage design report forms a part of our compliance submission for a Granted Permission Reg. Ref. SD22A/0290 Condition No. 13.

Please refer to the drawings ref. D1736-KB-ZZ-ZZ-DR-C-0003_CL1 - Drainage & Watermain Layout & D1736-KB-ZZ-ZZ-DR-C-0004_CL1 - SuDS & Drainage Details enclosed with this report for the Local Authority records and review.

2. SURFACE WATER

The storm water runoff from the proposed development will be treated and collected in the proposed surface water drainage network. Thereafter, it will be attenuated in the detention basin and underground StormTech attenuation system (SC-740 or similar approved) before being discharged to the adjacent water channel to the north-western site's corner. The site area is divided to 3 no sub-catchments, with a flow control device proposed on the outlet of the manhole exiting each sub-catchment surface water storage system ensuring that no runoff will leave the site unattenuated. The discharge from site (sum of all 3 no sub-catchments) is set at the rate not exceeding the runoff from the site in its green field state as demonstrated in this report.

SuDS Management Plan

Due to the industrial nature of the proposed development, the yard surfacing for HGV access and marshalling is concrete. Permeable surfacing is provided to the car park area where traffic loads are light, with addition of grasscrete surfacing to the car parking spaces (excluding disabled carparking where permeable paving will be used) and fire tender route.

Runoff from the hardstanding areas in the yard will be collected by trapped road gullies and directed to an on-site underground 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, Q_{BAR} (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 20% 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 includes 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).

SuDS Treatment Train

The treatment train approach was applied to both the storm water network and the attenuation design to ascertain that both runoff quality and quantity are appropriately addressed. An array of techniques was used to fulfil requirements of each element of the treatment train:

- Pollution prevention –

To prevent chemicals and other pollutants from contaminating the rainfall runoff, a maintenance regime for the proposed development will be established. A proprietary silt trap and petrol interceptor will be provided on the surface water drainage network to intercept debris, silts and hydrocarbons and prevent them from entering the attenuation systems and from being discharged to the soil or receiving watercourse.

- Source control –

To detain and infiltrate the runoff as close as possible to the point of origin. The infiltration of the surface water, promoting water disposal at source and limiting the discharge to the SW network was proposed throughout the site, with the following measures being proposed in place:

  - Permeable paving / Grasscrete.

- Swales and tree pits.
- Green walls.

Permeable paving with integrated infiltration pit below is proposed to car access road and disabled car parking spaces. Any runoff from the permeable paving area will be discharged to the angular stone filled infiltration pit below the permeable paving blocks. This ensures the runoff water will be allowed to infiltrate to the ground. In case of the rainfall event exceeding the capacity of the infiltration pit, runoff water will be stored at adjacent swale from where it will be allowed to discharge through overflow gully located ar swale to the storm water drain.

- Site control –

to deal with as much of the runoff as possible within the site, interception storage is designed within the proposed attenuation tank. This interception storage is provided to capture first 5mm of any rainfall and store it in the lowered portion of the attenuation system where it will dissipate by infiltration to the soil beneath. This will reduce the quantity of water that discharges from the site.

- Regional control –

to mimic the behaviour of the green field site and protect the receiving watercourse, both underground attenuation storage and detention basin are designed to cater for all durations of rainfall up to 30 year return period with 20% climate change factor applied. These attenuation systems have also been designed to cater for 1 in 100-year storms of all durations exceeding the requirements of Greater Dublin Strategic Drainage Study (GDSDS). The proposed discharge from the site will not exceed the green field runoff rate Q_{BAR}.

Storage Systems

Proposed are underground attenuation facility "StormTech" or equivalent, pond (detention basin) and swales. In addition, proposed are storages in the paving sub base under access road. These systems were design to collect surface water runoff from dedicated sub-catchments, as shown at enclosed drawing ref D1736-KB-ZZ-ZZ-DR-C-0003_CL1 - Drainage & Watermain Layout.

"StormTech" or similar approved 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.

The proposed pond (detention basin) will cater run-off from 3/4 of the warehouse roof and any overflow runoff from the paved and landscaped surfaces located to the northern side of the building. A Maintenance Plan will be implemented to ensure the proper functioning and will include:

- Cleaning of litter and debris.
- Inlet and outlet structural integrity check.
- Removal of sediment accumulation.
- Re-establish of permanent vegetation on eroded areas.

Water quantity control is provided downstream of the attenuation facility and detention basin by providing the flow control devices, each set up to limit flow to corresponding sub-catchment Q_{BAR} (sum of sub-catchments discharge rates not exceeding Greenfield runoff rate). The proposed vortex style flow control device of discharge rate will be installed on the outfall of the last surface water manhole, shown at accompanying Drainage and Watermain Layout drg. ref. D1736 – D3. The discharge from site, i.e. the restricted flow will discharge to an existing open channel at Kingswood Avenue to the site's western corner and ultimately to Camac River.

Proposed SuDS elements

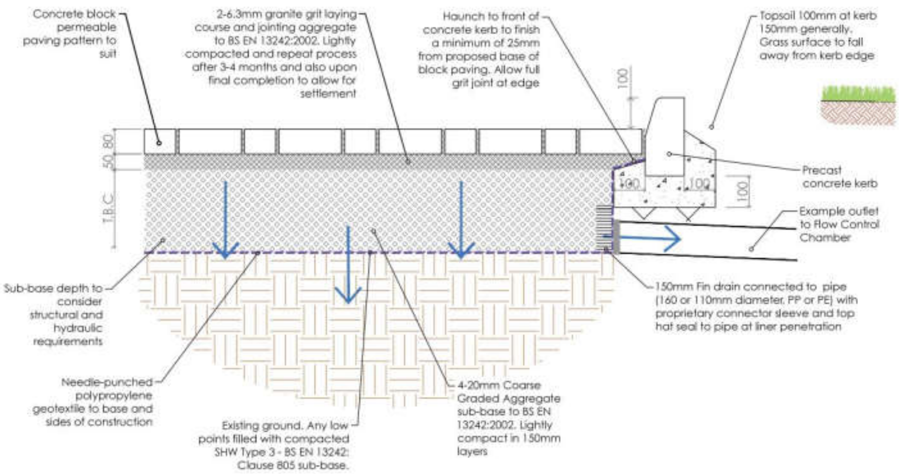
In considering the above surface water management solution, we considered all SuDS devices and given the industrial nature of the proposed operations on this site, the above solution of surface water attenuation was decided on with addition of a following range of measures being incorporated into the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

- Permeable paving (to the access road to the carparking);
- Grasscrete paving (to the car parking bays and to the fire tender route).;
- Green walls (to each side of proposed building);
- Tree Pits (at the car parking area for source control as per landscaping details);
- Swales (at the car parking area for source control);
- Pond;
- Trapped Road Gullies (to collect run-off from concrete surfaces);
- Restricted discharge (to the outlets of all attenuation systems for regional control);
- Silt trap and petrol interceptor (to the inlets of all attenuation systems for pollution prevention).
- Underground attenuation system,

Permeable paving

Proposed pervious paving will allow for infiltration of the storm water runoff from it into the underlying stone and soil. This system not only reduces the quantity of runoff, but it also has a positive impact on water quality. Due to the shallow nature of the underlying build-up, permeable paving can be utilised even on sites with high ground water levels where other deeper infiltration devices would not work.

Detail 2 - Permeable Paving (System B) with Partial Infiltration



Grasscrete paving

To minimise the storm water runoff and to increase the ratio of the green surfaces on site, Grasscrete type surface is proposed to the carparking spaces (excluding disabled carparking where the permeable paving will be used). Grasscrete surface is not proposed to the circulation roads of the car park to prevent damage to the surfacing and to prevent reduction of the grip between tyres and road surface. However, permeable paving is proposed to the car park roads to assist other permeable hardstanding areas in rainfall runoff reduction. The excess runoff from the proposed pavement will be collected in a swale where an overflow gullies will collect any further excess runoff to the surface water network.

Green Walls

Green walls will create more visually appealing and dynamic facades that sway in the breeze and change with the seasons. These dense facade coverings will not only help to break the monotony of cladding surfaces but will also help to create efficient building envelope, minimizing heat loss and cooling loads, reducing rainwater runoff and filtering pollutants out of the air.

Tree Pits

Tree pits will be provided with overflow pipes discharging excess runoff to the proposed on-site storage system from which the storm water will be discharged to the existing storm water network at green field runoff rate.

The nature of the development will not allow for the storm water runoff from the marshalling yard to be discharged directly to swales or tree pits. The runoff from these areas will pass through the aforementioned silt trap, petrol interceptor and isolator row prior to being attenuated. These devices will ensure that the water trapped in the interception storage in the tank is free of pollutants before it is allowed to infiltrate to subsoil.

The following figures synopsise the surface water attenuation calculations:

Site area (red line)	*26,290 m²*
CATCHMENT AREA	21,600 m²
SAAR	779.5
SOIL VALUE	0.3

STRUCTURE TYPE	**RUNOFF COEFFICIENTS**	**AREA (ha)**	***AREA – factored (ha)***
Roofs	1.0	1.1203	*1.1203*
Concrete yard & docking area	1.0	0.320	*0.320*
Building perimeter concrete footpath	1.0	0.088	*0.088*
Permeable paving	1.0	0.099	*0.099*
Grasscrete	0.9	0.124	*0.112*
Contributing Landscaping	0.3	0.409	*0.123*
TOTAL	**-**	**2.160**	***1.858***

Details of the surface water attenuation system including SuDS measures, interceptors, flow restrictions, volume and pipe designs are attached in this Drainage Design Report and on the accompanying Drainage details layout and drainage details (drawings reference D1736-KB-ZZ-ZZ-DR-C-0003_CL1 - Drainage & Watermain Layout & D1736-KB-ZZ-ZZ-DR-C-0004_CL1 - SuDS & Drainage Details) for the review by the Local Authority.

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Surface Water Attenuation Design

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Surface Water Attenuation Calculation

1) Areas for Attenuation Calculation

Site Area (red line)	26,290 m^2 (2.629 ha)
Catchment area	21,600 m^2 (2.16ha)

	CATCHMENT AREAS	*Runoff coefficient*	Sub-catchment #1	Sub-catchment #2	Sub-catchment #3
	21,600 m2		11,045 m^2	7,470 m^2	3,085 m^2
Contributing Landscaping:	4,092 m^2	*0.3*	1,665 m^2	1,287 m^2	1,140 m^2
Overall landscaping:	*7,741 m^2*				
Impermeable Areas:					
1. Roofs	11,203 m^2	*1.0*	8,100 m^2	2,743 m^2	360 m^2
2. Concrete yard & docking area	3,200 m^2	*1.0*	-	3,200 m^2	-
3. Footpaths	875 m^2	*1.0*	250 m^2	240 m^2	385 m^2
4. Permeable paving	990 m^2	*1.0*	330 m^2	-	660 m^2
5. Grasscrete	1,240 m^2	*0.9*	700 m^2	-	540 m^2
TOTAL IMPERV. AREAS	17,508 m^2		9,380 m^2	6,183 m^2	1,945 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.

Design Impermeable Areas: 17,508 m^2 x 0.80 = 14,006.4 m^2

Total volume for 5mm rainfall: 5mm x 14,006.4 m^2 = **70 m^3**

Therefore, a minimum Interception Storage volume of 70 m^3 should be provided for corresponding sub-catchments. This will prevent discharge from the site during rainfall events of up to 5mm rainfall. For the basis of this calculation infiltration will be provided through the base of the attenuation system. The soft landscaping on site will also be a source of rainfall infiltration.

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 305400, N 228350): <u>779.5 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 (*refer to chapter: Surface Water Design for the HR Wallingford Greenfield runoff rate estimation report and details*).

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 $(779.5)^{1.17}$ x $(0.3)^{2.17}$ =
103.34 l/sec =
2.07 l/sec/ha

Q_{BAR} for the subject site area (overall catchment area):

2.07 l/sec/ha x 2.16ha =
Q_{BAR} = 4.46 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.

Subject site catchment area is divided to 3no sub-catchment areas; therefore, each sub catchment will be provided with flow control device. <u>The sum of 3 no sub-catchments runoff rate will be equal to greenfield runoff rate i.e. max Q_{BAR} will be set out at 4.46 l/sec, as shown below:</u>

Sub-catchment #1 Q_{BAR}:

Total sub-catchment area = 11,045 m^2

2.07 l/sec/ha x 1.1045ha =

C#1 Q_{BAR} = 2.28 l/sec

→ *Flow control device to be placed on outlet of C#1 SW MH 17 to limit flow to 2.28 l/sec.*

Sub-catchment #3 Q_{BAR}

Total sub-catchment area = 3,085 m^2

2.07 l/sec/ha x 0.3085ha =

C#3 Q_{BAR} = 0.64 l/sec

→ *Flow control device to be placed on outlet of C#3 SW MH 12 to limit flow to 0.9 l/sec.*

Sub-catchment #2 Q_{BAR}

Total sub-catchment area = 7,470 m^2

2.07 l/sec/ha x 0.747ha =

C#2 Q_{BAR} = 1.54 l/sec

→ *Flow control device to be placed on outlet of C#2 SW MH 14 to limit flow to 2.18 l/sec (i.e. sum of sub-catchment C#2 & C#3, Q_{BAR} = 0.64 +1.54 = 2.18 l/s).*

→ **Therefore,** $\sum Q_{BAR}$ (C#1, C#2, C#3) $\leq Q_{BAR}$

2.28 l/s + 1.54 l/s + 0.64 l/s ≤ 4.46 l/s *(greenfield runoff rate)*

4) Attenuation Storage Volume

Refer to enclosed Surface Water Network Design chapter in this Design Report for detailed storm water network modelling and attenuation storages volumes check with a specific Hydrobrake flow control devices included in the analysis. Storages were checked for storm durations up to 3 days for 1 year, 2 years, 30 years and 100 years return period including 20% CCF.

In summary:

INTERCEPTION STORAGE:

70m^3 to be provided by a lowered base to the attenuation system.
Attenuation System Area: 830m^2. Therefore, the Interception Storage Depth will equal 200mm. 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 REQUIRED:

- **Sub-catchment C#1:** **695m^3** to be provided within pond/basin on site.
- **Sub-catchment C#2 & C#3:** **686m^3** to be provided within the underground attenuation system on site.

TEMPORARY FLOOD STORAGE:

The proposed attenuation storage will accommodate all rainfall events of all durations up to 1 in 100 years return. Therefore no separate flood storage is needed.

TOTAL ATTENUATION VOLUME PROVIDED: 1,425 m^3

- Sub-catchment #1: **735m^3** (pond/basin)
- Sub-catchment #2 & #3: **690m^3** (underground attenuation system)

Storm Water Network analysis and Attenuation Tank Size checks were performed using a computer hydraulic analysis software. The analysis did not highlight any ponding for any storm durations up to 1:100y return therefore the network and attenuation capacity calculated above are satisfactory.
The results of the analysis are included in this report.

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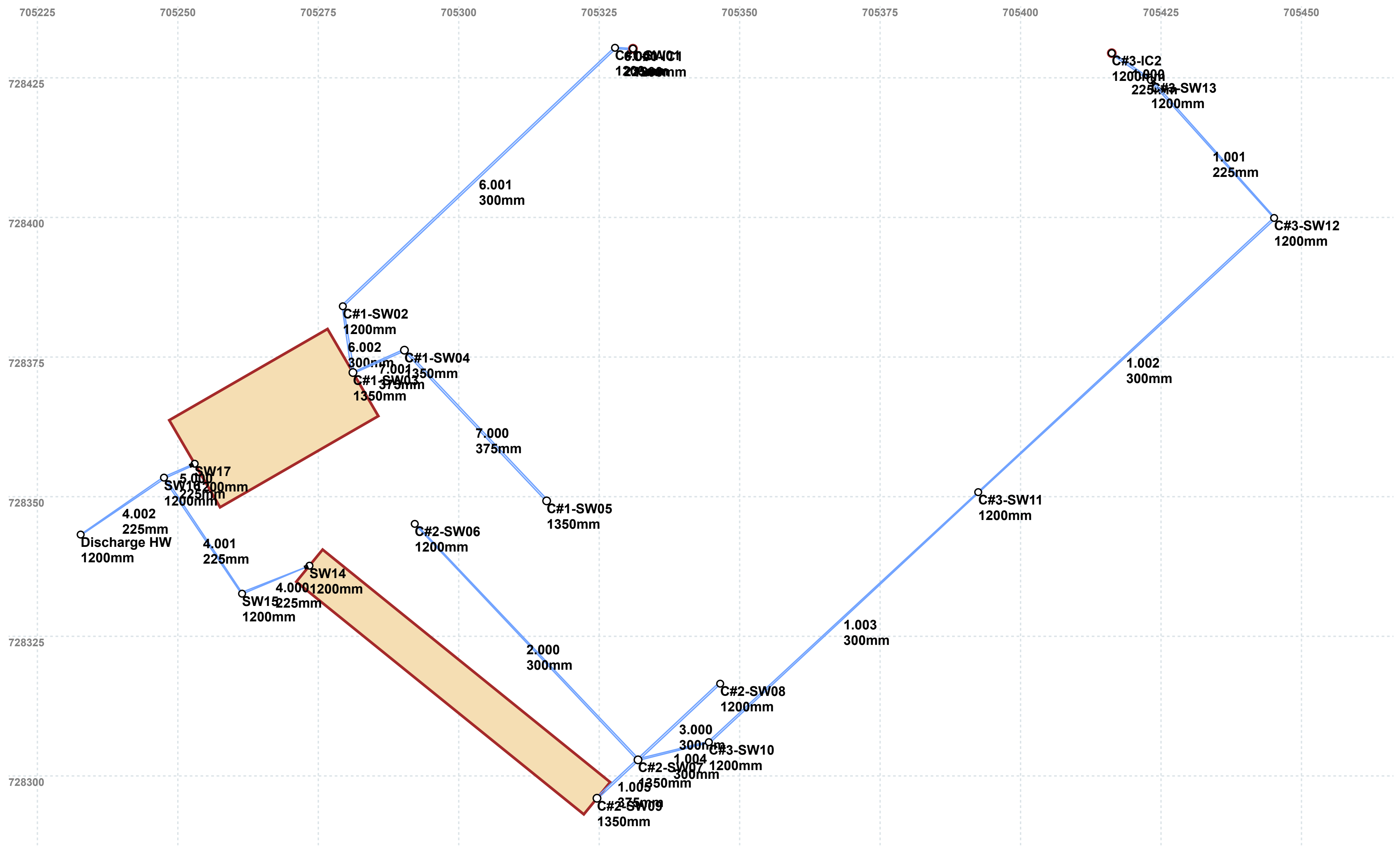
Surface Water Network Design

KAVANAGH BURKE CONSULTING ENGINEERS	Kavanagh Burke Unit F3 Block F, Calmount Park, Ballymount, Dublin 12, D12PX28	File: D1736 - SW Network CL1.pfd Network: Storm Network Elena Dragoje 22/12/2023	Page 1 Surface Water Network Scheme rev.CL1



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)	18.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.271	Preferred Cover Depth (m)	0.750
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
C#1-IC1	0.103	5.00	98.075	1200	705331.008	728430.223	1.000
C#1-SW01	0.025	5.00	98.075	1200	705327.815	728430.372	1.100
C#1-SW02	0.025	5.00	98.125	1200	705279.364	728384.095	1.375
C#1-SW03			98.100	1350	705281.166	728372.231	2.200
C#1-SW04	0.270	5.00	98.500	1350	705290.331	728376.231	1.725
C#1-SW05	0.540	5.00	98.500	1350	705315.646	728349.247	1.500
C#2-SW06	0.170	5.00	97.815	1200	705292.169	728345.130	1.115
C#2-SW07	0.155	5.00	98.075	1350	705331.906	728302.881	1.950
C#2-SW08	0.270	5.00	98.500	1200	705346.533	728316.520	1.500
C#2-SW09			97.975	1350	705324.603	728296.006	2.142
C#3-SW10	0.039	5.00	98.300	1200	705344.514	728306.046	2.050
C#3-SW11	0.024	5.00	98.325	1200	705392.462	728350.812	1.825
C#3-SW12	0.053	5.00	98.325	1200	705445.131	728399.903	1.550
C#3-SW13	0.104	5.00	98.325	1200	705423.225	728424.583	1.325
C#3-IC2	0.048	5.00	98.175	1200	705416.229	728429.417	1.125
SW14		5.00	98.060	1200	705273.426	728337.647	2.260
SW15			98.000	1200	705261.432	728332.631	2.300
SW16			98.000	1200	705247.533	728353.411	2.470
SW17		5.00	99.350	1200	705252.994	728355.897	3.550
Discharge HW			97.000	1200	705232.701	728343.213	1.550

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)
1.000	C#3-IC2	C#3-SW13	8.504	0.600	97.050	97.000	0.050	170.1	225	SW	5.14	50.0
1.001	C#3-SW13	C#3-SW12	33.000	0.600	97.000	96.850	0.150	220.0	225	SW	5.77	50.0
1.002	C#3-SW12	C#3-SW11	72.000	0.600	96.775	96.500	0.275	261.8	300	SW	7.01	47.0
1.003	C#3-SW11	C#3-SW10	65.597	0.600	96.500	96.250	0.250	262.4	300	SW	8.14	44.1

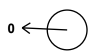
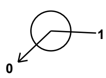
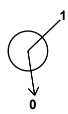
Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	C#3-IC2	C#3-SW13	0.999	39.7	6.5	0.900	1.100	1.100	0.048	0.0	61	0.739
1.001	C#3-SW13	C#3-SW12	0.877	34.9	20.6	1.100	1.250	1.250	0.152	0.0	124	0.912
1.002	C#3-SW12	C#3-SW11	0.967	68.3	26.1	1.250	1.525	1.525	0.205	0.0	129	0.904
1.003	C#3-SW11	C#3-SW10	0.966	68.3	27.4	1.525	1.750	1.750	0.229	0.0	132	0.914

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)
1.004	C#3-SW10	C#2-SW07	12.999	0.600	96.250	96.200	0.050	260.0	300	SW	8.37	43.6
2.000	C#2-SW06	C#2-SW07	58.000	0.600	96.700	96.400	0.300	193.3	300	SW	5.86	50.0
3.000	C#2-SW08	C#2-SW07	19.999	0.600	97.000	96.800	0.200	100.0	300	SW	5.21	50.0
1.005	C#2-SW07	C#2-SW09	10.030	0.600	96.125	96.075	0.050	200.6	375	SW	8.50	43.3
4.000	SW14	SW15	13.001	0.600	95.800	95.700	0.100	130.0	225	SW	5.19	50.0
4.001	SW15	SW16	25.000	0.600	95.700	95.530	0.170	147.1	225	SW	5.58	50.0
6.000	C#1-IC1	C#1-SW01	3.196	0.600	97.075	97.050	0.025	127.9	225	SW	5.05	50.0
6.001	C#1-SW01	C#1-SW02	67.000	0.600	96.975	96.750	0.225	297.8	300	SW	6.28	49.2
6.002	C#1-SW02	C#1-SW03	12.000	0.600	96.750	96.700	0.050	240.0	300	SW	6.48	48.6
7.000	C#1-SW05	C#1-SW04	37.000	0.600	97.000	96.775	0.225	164.4	375	SW	5.44	50.0
7.001	C#1-SW04	C#1-SW03	10.000	0.600	96.775	96.700	0.075	133.3	375	SW	5.54	50.0
5.000	SW17	SW16	6.000	0.600	95.800	95.760	0.040	150.0	225	SW	5.09	50.0
4.002	SW16	Discharge HW	18.000	0.600	95.530	95.450	0.080	225.0	225	SW	5.92	50.0

Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.004	C#3-SW10	C#2-SW07	0.970	68.6	31.6	1.750	1.575	1.750	0.268	0.0	143	0.952
2.000	C#2-SW06	C#2-SW07	1.127	79.7	23.0	0.815	1.375	1.375	0.170	0.0	110	0.978
3.000	C#2-SW08	C#2-SW07	1.572	111.1	36.6	1.200	0.975	1.200	0.270	0.0	118	1.413
1.005	C#2-SW07	C#2-SW09	1.275	140.9	101.2	1.575	1.525	1.575	0.863	0.0	236	1.383
4.000	SW14	SW15	1.145	45.5	0.0	2.035	2.075	2.075	0.000	0.0	0	0.000
4.001	SW15	SW16	1.076	42.8	0.0	2.075	2.245	2.245	0.000	0.0	0	0.000
6.000	C#1-IC1	C#1-SW01	1.155	45.9	14.0	0.775	0.800	0.800	0.103	0.0	85	1.015
6.001	C#1-SW01	C#1-SW02	0.906	64.0	17.1	0.800	1.075	1.075	0.128	0.0	106	0.771
6.002	C#1-SW02	C#1-SW03	1.010	71.4	20.2	1.075	1.100	1.100	0.153	0.0	109	0.872
7.000	C#1-SW05	C#1-SW04	1.410	155.7	73.2	1.125	1.350	1.350	0.540	0.0	181	1.388
7.001	C#1-SW04	C#1-SW03	1.567	173.1	109.8	1.350	1.025	1.350	0.810	0.0	217	1.655
5.000	SW17	SW16	1.065	42.3	0.0	3.325	2.015	3.325	0.000	0.0	0	0.000
4.002	SW16	Discharge HW	0.867	34.5	0.0	2.245	1.325	2.245	0.000	0.0	0	0.000

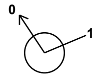
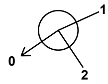
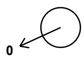
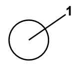
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
C#1-IC1	705331.008	728430.223	98.075	1.000	1200		0	6.000	97.075	225
C#1-SW01	705327.815	728430.372	98.075	1.100	1200		1	6.000	97.050	225
							0	6.001	96.975	300
C#1-SW02	705279.364	728384.095	98.125	1.375	1200		1	6.001	96.750	300
							0	6.002	96.750	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
C#1-SW03	705281.166	728372.231	98.100	2.200	1350	1	7.001	96.700	375
						2	6.002	96.700	300
C#1-SW04	705290.331	728376.231	98.500	1.725	1350	1	7.000	96.775	375
						0	7.001	96.775	375
C#1-SW05	705315.646	728349.247	98.500	1.500	1350	0	7.000	97.000	375
C#2-SW06	705292.169	728345.130	97.815	1.115	1200	0	2.000	96.700	300
C#2-SW07	705331.906	728302.881	98.075	1.950	1350	1	3.000	96.800	300
						2	2.000	96.400	300
						3	1.004	96.200	300
						0	1.005	96.125	375
C#2-SW08	705346.533	728316.520	98.500	1.500	1200	0	3.000	97.000	300
C#2-SW09	705324.603	728296.006	97.975	2.142	1350	1	1.005	96.075	375
C#3-SW10	705344.514	728306.046	98.300	2.050	1200	1	1.003	96.250	300
						0	1.004	96.250	300
C#3-SW11	705392.462	728350.812	98.325	1.825	1200	1	1.002	96.500	300
						0	1.003	96.500	300
C#3-SW12	705445.131	728399.903	98.325	1.550	1200	1	1.001	96.850	225
						0	1.002	96.775	300
C#3-SW13	705423.225	728424.583	98.325	1.325	1200	1	1.000	97.000	225
						0	1.001	97.000	225
C#3-IC2	705416.229	728429.417	98.175	1.125	1200	0	1.000	97.050	225
SW14	705273.426	728337.647	98.060	2.260	1200	0	4.000	95.800	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SW15	705261.432	728332.631	98.000	2.300	1200		1	4.000	95.700	225
							0	4.001	95.700	225
SW16	705247.533	728353.411	98.000	2.470	1200		1	5.000	95.760	225
							2	4.001	95.530	225
							0	4.002	95.530	225
SW17	705252.994	728355.897	99.350	3.550	1200		0	5.000	95.800	225
Discharge HW	705232.701	728343.213	97.000	1.550	1200		1	4.002	95.450	225

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	18.000	Drain Down Time (mins)	240
Ratio-R	0.271	Additional Storage (m³/ha)	25.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0
2	20	0	0
10	20	0	0
30	20	0	0
100	20	0	0

Node C#3-SW13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	97.000	Product Number	CTL-SHE-0046-9000-0850-9000
Design Depth (m)	0.850	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.9	Min Node Diameter (mm)	1200

Node SW14 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	96.000	Product Number	CTL-SHE-0068-2200-1200-2200
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.2	Min Node Diameter (mm)	1200

Node SW17 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	95.800	Product Number	CTL-SHE-0060-2300-2140-2300
Design Depth (m)	2.140	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.3	Min Node Diameter (mm)	1200

Node C#3-IC2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	97.250	Slope (1:X)	2000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.600
Safety Factor	2.0	Width (m)	6.000	Inf Depth (m)	
Porosity	0.30	Length (m)	79.000		

Node SW14 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	66.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	95.800	Main Channel Slope (1:X)	2000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.015

Inlets
C#2-SW09

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	490.0	0.0	1.400	490.0	0.0	1.410	5.0	0.0

Node C#1-IC1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	97.575	Slope (1:X)	2000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.510
Safety Factor	2.0	Width (m)	6.000	Inf Depth (m)	
Porosity	0.30	Length (m)	55.000		

Node SW17 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	17.500
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	95.800	Main Channel Slope (1:X)	175.0
Safety Factor	2.0	Time to half empty (mins)	0	Main Channel n	0.015

Inlets
C#1-SW03

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	201.1	0.0	0.700	309.4	0.0	1.400	438.9	0.0	2.100	587.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year +20% CC 15 minute summer	115.481	32.677
1 year +20% CC 15 minute winter	81.039	32.677
1 year +20% CC 30 minute summer	79.567	22.515
1 year +20% CC 30 minute winter	55.837	22.515
1 year +20% CC 60 minute summer	56.887	15.034
1 year +20% CC 60 minute winter	37.794	15.034
1 year +20% CC 120 minute summer	37.363	9.874
1 year +20% CC 120 minute winter	24.823	9.874
1 year +20% CC 180 minute summer	29.896	7.693
1 year +20% CC 180 minute winter	19.433	7.693
1 year +20% CC 240 minute summer	24.370	6.440
1 year +20% CC 240 minute winter	16.191	6.440
1 year +20% CC 360 minute summer	19.417	4.997
1 year +20% CC 360 minute winter	12.622	4.997
1 year +20% CC 480 minute summer	15.790	4.173
1 year +20% CC 480 minute winter	10.491	4.173
1 year +20% CC 600 minute summer	13.349	3.651
1 year +20% CC 600 minute winter	9.121	3.651
1 year +20% CC 720 minute summer	12.135	3.252
1 year +20% CC 720 minute winter	8.155	3.252
1 year +20% CC 960 minute summer	10.292	2.710
1 year +20% CC 960 minute winter	6.817	2.710
1 year +20% CC 1440 minute summer	7.813	2.094
1 year +20% CC 1440 minute winter	5.251	2.094
1 year +20% CC 2160 minute summer	5.856	1.618
1 year +20% CC 2160 minute winter	4.035	1.618
1 year +20% CC 2880 minute summer	5.033	1.349
1 year +20% CC 2880 minute winter	3.382	1.349
1 year +20% CC 4320 minute summer	3.983	1.041
1 year +20% CC 4320 minute winter	2.623	1.041
1 year +20% CC 5760 minute summer	3.381	0.865
1 year +20% CC 5760 minute winter	2.188	0.865
1 year +20% CC 7200 minute summer	2.940	0.750
1 year +20% CC 7200 minute winter	1.897	0.750
1 year +20% CC 8640 minute summer	2.614	0.667
1 year +20% CC 8640 minute winter	1.687	0.667
1 year +20% CC 10080 minute summer	2.365	0.603
1 year +20% CC 10080 minute winter	1.527	0.603
2 year +20% CC 15 minute summer	139.256	39.405
2 year +20% CC 15 minute winter	97.723	39.405
2 year +20% CC 30 minute summer	95.775	27.101
2 year +20% CC 30 minute winter	67.210	27.101
2 year +20% CC 60 minute summer	68.330	18.058
2 year +20% CC 60 minute winter	45.397	18.058
2 year +20% CC 120 minute summer	44.418	11.738
2 year +20% CC 120 minute winter	29.510	11.738
2 year +20% CC 180 minute summer	35.340	9.094
2 year +20% CC 180 minute winter	22.972	9.094
2 year +20% CC 240 minute summer	28.772	7.604
2 year +20% CC 240 minute winter	19.115	7.604
2 year +20% CC 360 minute summer	22.833	5.876
2 year +20% CC 360 minute winter	14.842	5.876
2 year +20% CC 480 minute summer	18.508	4.891
2 year +20% CC 480 minute winter	12.296	4.891
2 year +20% CC 600 minute summer	15.511	4.242
2 year +20% CC 600 minute winter	10.598	4.242
2 year +20% CC 720 minute summer	14.093	3.777
2 year +20% CC 720 minute winter	9.471	3.777
2 year +20% CC 960 minute summer	11.942	3.145
2 year +20% CC 960 minute winter	7.911	3.145
2 year +20% CC 1440 minute summer	9.033	2.421
2 year +20% CC 1440 minute winter	6.071	2.421
2 year +20% CC 2160 minute summer	6.737	1.862
2 year +20% CC 2160 minute winter	4.642	1.862
2 year +20% CC 2880 minute summer	5.767	1.546
2 year +20% CC 2880 minute winter	3.876	1.546
2 year +20% CC 4320 minute summer	4.538	1.186
2 year +20% CC 4320 minute winter	2.988	1.186
2 year +20% CC 5760 minute summer	3.835	0.982
2 year +20% CC 5760 minute winter	2.482	0.982
2 year +20% CC 7200 minute summer	3.323	0.848
2 year +20% CC 7200 minute winter	2.145	0.848
2 year +20% CC 8640 minute summer	2.949	0.752
2 year +20% CC 8640 minute winter	1.903	0.752
2 year +20% CC 10080 minute summer	2.668	0.681
2 year +20% CC 10080 minute winter	1.722	0.681
10 year +20% CC 15 minute summer	202.234	57.225
10 year +20% CC 15 minute winter	141.918	57.225
10 year +20% CC 30 minute summer	138.254	39.121
10 year +20% CC 30 minute winter	97.020	39.121
10 year +20% CC 60 minute summer	97.162	25.677
10 year +20% CC 60 minute winter	64.552	25.677
10 year +20% CC 120 minute summer	62.465	16.508
10 year +20% CC 120 minute winter	41.500	16.508
10 year +20% CC 180 minute summer	49.255	12.675
10 year +20% CC 180 minute winter	32.017	12.675
10 year +20% CC 240 minute summer	39.698	10.491
10 year +20% CC 240 minute winter	26.374	10.491
10 year +20% CC 360 minute summer	31.177	8.023
10 year +20% CC 360 minute winter	20.266	8.023
10 year +20% CC 480 minute summer	25.076	6.627
10 year +20% CC 480 minute winter	16.660	6.627
10 year +20% CC 600 minute summer	20.881	5.711
10 year +20% CC 600 minute winter	14.267	5.711
10 year +20% CC 720 minute summer	18.870	5.057
10 year +20% CC 720 minute winter	12.682	5.057
10 year +20% CC 960 minute summer	15.848	4.173
10 year +20% CC 960 minute winter	10.498	4.173
10 year +20% CC 1440 minute summer	11.873	3.182
10 year +20% CC 1440 minute winter	7.979	3.182
10 year +20% CC 2160 minute summer	8.773	2.425
10 year +20% CC 2160 minute winter	6.045	2.425

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
10 year +20% CC 2880 minute summer	7.457	1.999
10 year +20% CC 2880 minute winter	5.012	1.999
10 year +20% CC 4320 minute summer	5.820	1.522
10 year +20% CC 4320 minute winter	3.832	1.522
10 year +20% CC 5760 minute summer	4.897	1.254
10 year +20% CC 5760 minute winter	3.170	1.254
10 year +20% CC 7200 minute summer	4.228	1.079
10 year +20% CC 7200 minute winter	2.729	1.079
10 year +20% CC 8640 minute summer	3.740	0.954
10 year +20% CC 8640 minute winter	2.414	0.954
10 year +20% CC 10080 minute summer	3.371	0.860
10 year +20% CC 10080 minute winter	2.176	0.860
30 year +20% CC 15 minute summer	256.863	72.683
30 year +20% CC 15 minute winter	180.255	72.683
30 year +20% CC 30 minute summer	176.278	49.881
30 year +20% CC 30 minute winter	123.704	49.881
30 year +20% CC 60 minute summer	123.107	32.534
30 year +20% CC 60 minute winter	81.790	32.534
30 year +20% CC 120 minute summer	78.466	20.736
30 year +20% CC 120 minute winter	52.131	20.736
30 year +20% CC 180 minute summer	61.506	15.828
30 year +20% CC 180 minute winter	39.981	15.828
30 year +20% CC 240 minute summer	49.349	13.041
30 year +20% CC 240 minute winter	32.786	13.041
30 year +20% CC 360 minute summer	38.499	9.907
30 year +20% CC 360 minute winter	25.025	9.907
30 year +20% CC 480 minute summer	30.814	8.143
30 year +20% CC 480 minute winter	20.472	8.143
30 year +20% CC 600 minute summer	25.560	6.991
30 year +20% CC 600 minute winter	17.464	6.991
30 year +20% CC 720 minute summer	23.025	6.171
30 year +20% CC 720 minute winter	15.475	6.171
30 year +20% CC 960 minute summer	19.243	5.067
30 year +20% CC 960 minute winter	12.747	5.067
30 year +20% CC 1440 minute summer	14.315	3.837
30 year +20% CC 1440 minute winter	9.621	3.837
30 year +20% CC 2160 minute summer	10.499	2.902
30 year +20% CC 2160 minute winter	7.234	2.902
30 year +20% CC 2880 minute summer	8.874	2.378
30 year +20% CC 2880 minute winter	5.964	2.378
30 year +20% CC 4320 minute summer	6.868	1.796
30 year +20% CC 4320 minute winter	4.523	1.796
30 year +20% CC 5760 minute summer	5.744	1.470
30 year +20% CC 5760 minute winter	3.718	1.470

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +20% CC 7200 minute summer	4.936	1.259
30 year +20% CC 7200 minute winter	3.186	1.259
30 year +20% CC 8640 minute summer	4.349	1.109
30 year +20% CC 8640 minute winter	2.807	1.109
30 year +20% CC 10080 minute summer	3.908	0.997
30 year +20% CC 10080 minute winter	2.522	0.997
100 year +20% CC 15 minute summer	333.817	94.459
100 year +20% CC 15 minute winter	234.257	94.459
100 year +20% CC 30 minute summer	230.059	65.099
100 year +20% CC 30 minute winter	161.445	65.099
100 year +20% CC 60 minute summer	159.562	42.167
100 year +20% CC 60 minute winter	106.009	42.167
100 year +20% CC 120 minute summer	100.744	26.624
100 year +20% CC 120 minute winter	66.932	26.624
100 year +20% CC 180 minute summer	78.458	20.190
100 year +20% CC 180 minute winter	51.000	20.190
100 year +20% CC 240 minute summer	62.640	16.554
100 year +20% CC 240 minute winter	41.616	16.554
100 year +20% CC 360 minute summer	48.513	12.484
100 year +20% CC 360 minute winter	31.535	12.484
100 year +20% CC 480 minute summer	38.621	10.206
100 year +20% CC 480 minute winter	25.659	10.206
100 year +20% CC 600 minute summer	31.901	8.726
100 year +20% CC 600 minute winter	21.797	8.726
100 year +20% CC 720 minute summer	28.638	7.675
100 year +20% CC 720 minute winter	19.246	7.675
100 year +20% CC 960 minute summer	23.803	6.268
100 year +20% CC 960 minute winter	15.767	6.268
100 year +20% CC 1440 minute summer	17.572	4.709
100 year +20% CC 1440 minute winter	11.809	4.709
100 year +20% CC 2160 minute summer	12.782	3.533
100 year +20% CC 2160 minute winter	8.807	3.533
100 year +20% CC 2880 minute summer	10.737	2.878
100 year +20% CC 2880 minute winter	7.216	2.878
100 year +20% CC 4320 minute summer	8.235	2.153
100 year +20% CC 4320 minute winter	5.423	2.153
100 year +20% CC 5760 minute summer	6.842	1.751
100 year +20% CC 5760 minute winter	4.428	1.751
100 year +20% CC 7200 minute summer	5.849	1.492
100 year +20% CC 7200 minute winter	3.775	1.492
100 year +20% CC 8640 minute summer	5.131	1.309
100 year +20% CC 8640 minute winter	3.312	1.309
100 year +20% CC 10080 minute summer	4.594	1.172
100 year +20% CC 10080 minute winter	2.965	1.172

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	C#1-IC1	10	97.176	0.101	15.3	0.3743	0.0000	OK
15 minute winter	C#1-SW01	11	97.085	0.110	18.7	0.1864	0.0000	OK
2880 minute winter	C#1-SW02	2220	96.888	0.138	1.9	0.2196	0.0000	OK
2880 minute winter	C#1-SW03	2220	96.888	0.988	7.6	1.4141	0.0000	OK
15 minute winter	C#1-SW04	11	97.033	0.258	118.3	1.3781	0.0000	OK
15 minute winter	C#1-SW05	10	97.196	0.196	80.3	2.0459	0.0000	OK
15 minute winter	C#2-SW06	11	96.815	0.115	25.3	0.5675	0.0000	OK
4320 minute winter	C#2-SW07	3060	96.418	0.293	5.0	1.0007	0.0000	OK
15 minute winter	C#2-SW08	10	97.131	0.131	40.1	0.7397	0.0000	OK
4320 minute winter	C#2-SW09	3060	96.418	0.585	4.9	0.8367	0.0000	OK
4320 minute winter	C#3-SW10	3060	96.418	0.168	1.4	0.2695	0.0000	OK
15 minute winter	C#3-SW11	12	96.580	0.080	11.9	0.1173	0.0000	OK
15 minute winter	C#3-SW12	11	96.845	0.070	8.7	0.1392	0.0000	OK
600 minute winter	C#3-SW13	465	97.423	0.423	2.2	1.3074	0.0000	SURCHARGED
600 minute winter	C#3-IC2	465	97.423	0.373	2.4	22.5363	0.0000	SURCHARGED
4320 minute winter	SW14	3060	96.418	0.618	3.5	0.6986	0.0000	SURCHARGED
960 minute winter	SW15	915	95.733	0.033	2.0	0.0372	0.0000	OK
1440 minute winter	SW16	1380	95.580	0.050	3.7	0.0571	0.0000	OK
2880 minute winter	SW17	2220	96.888	1.088	4.5	1.2307	0.0000	SURCHARGED
1440 minute winter	Discharge HW	1380	95.499	0.049	3.7	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	C#1-IC1	6.000	C#1-SW01	15.0	0.952	0.328	0.0505	
15 minute winter	C#1-SW01	6.001	C#1-SW02	18.7	0.756	0.293	1.6678	
2880 minute winter	C#1-SW02	6.002	C#1-SW03	-1.3	0.394	-0.018	0.4696	
2880 minute winter	C#1-SW03	Flow through pond	SW17	4.5	0.010	0.000	294.2380	
15 minute winter	C#1-SW04	7.001	C#1-SW03	117.4	1.577	0.678	0.7438	
15 minute winter	C#1-SW05	7.000	C#1-SW04	78.3	1.129	0.503	2.5577	
15 minute winter	C#2-SW06	2.000	C#2-SW07	24.2	0.992	0.304	1.4139	
4320 minute winter	C#2-SW07	1.005	C#2-SW09	4.9	0.565	0.035	0.9926	
15 minute winter	C#2-SW08	3.000	C#2-SW07	39.2	1.392	0.353	0.5647	
4320 minute winter	C#2-SW09	Flow through pond	SW14	3.5	0.017	0.000	294.5602	
4320 minute winter	C#3-SW10	1.004	C#2-SW07	1.4	0.403	0.020	0.6191	
15 minute winter	C#3-SW11	1.003	C#3-SW10	11.0	0.517	0.161	1.5825	
15 minute winter	C#3-SW12	1.002	C#3-SW11	8.4	0.635	0.122	0.9882	
600 minute winter	C#3-SW13	Hydro-Brake®	C#3-SW12	0.8				
600 minute winter	C#3-IC2	1.000	C#3-SW13	-1.4	0.072	-0.035	0.3382	
4320 minute winter	SW14	Hydro-Brake®	SW15	2.0				
960 minute winter	SW15	4.001	SW16	2.0	0.398	0.047	0.1272	
1440 minute winter	SW16	4.002	Discharge HW	3.7	0.566	0.106	0.1165	265.7
2880 minute winter	SW17	Hydro-Brake®	SW16	1.7				

Results for 2 year +20% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	C#1-IC1	10	97.188	0.113	18.5	0.4183	0.0000	OK
15 minute winter	C#1-SW01	10	97.097	0.122	22.7	0.2068	0.0000	OK
4320 minute winter	C#1-SW02	3240	97.036	0.286	2.2	0.4528	0.0000	OK
4320 minute winter	C#1-SW03	3240	97.036	1.136	6.8	1.6249	0.0000	OK
15 minute winter	C#1-SW04	11	97.070	0.295	142.6	1.5781	0.0000	OK
15 minute winter	C#1-SW05	10	97.222	0.222	96.7	2.3202	0.0000	OK
15 minute winter	C#2-SW06	11	96.828	0.128	30.5	0.6312	0.0000	OK
4320 minute winter	C#2-SW07	3240	96.531	0.406	5.9	1.3895	0.0000	SURCHARGED
15 minute winter	C#2-SW08	10	97.147	0.147	48.4	0.8282	0.0000	OK
4320 minute winter	C#2-SW09	3240	96.531	0.698	5.8	0.9994	0.0000	OK
4320 minute winter	C#3-SW10	3240	96.531	0.281	1.7	0.4522	0.0000	OK
15 minute winter	C#3-SW11	12	96.588	0.088	14.1	0.1285	0.0000	OK
15 minute winter	C#3-SW12	11	96.851	0.076	10.3	0.1515	0.0000	OK
720 minute winter	C#3-SW13	570	97.468	0.468	2.3	1.4464	0.0000	SURCHARGED
720 minute winter	C#3-IC2	570	97.468	0.418	2.6	29.0229	0.0000	SURCHARGED
4320 minute winter	SW14	3240	96.531	0.731	3.9	0.8272	0.0000	SURCHARGED
600 minute winter	SW15	540	95.733	0.033	2.0	0.0372	0.0000	OK
1440 minute winter	SW16	1380	95.581	0.051	3.7	0.0575	0.0000	OK
4320 minute winter	SW17	3240	97.036	1.236	4.2	1.3974	0.0000	SURCHARGED
1440 minute winter	Discharge HW	1380	95.499	0.049	3.7	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	C#1-IC1	6.000	C#1-SW01	18.2	1.000	0.396	0.0582	
15 minute winter	C#1-SW01	6.001	C#1-SW02	22.7	0.790	0.354	1.9259	
4320 minute winter	C#1-SW02	6.002	C#1-SW03	-1.4	0.387	-0.020	0.8377	
4320 minute winter	C#1-SW03	Flow through pond	SW17	4.2	0.010	0.000	351.1494	
15 minute winter	C#1-SW04	7.001	C#1-SW03	141.4	1.641	0.817	0.8593	
15 minute winter	C#1-SW05	7.000	C#1-SW04	94.2	1.169	0.605	2.9632	
15 minute winter	C#2-SW06	2.000	C#2-SW07	29.3	1.043	0.367	1.6277	
4320 minute winter	C#2-SW07	1.005	C#2-SW09	5.8	0.565	0.041	1.1063	
15 minute winter	C#2-SW08	3.000	C#2-SW07	47.4	1.457	0.426	0.6515	
4320 minute winter	C#2-SW09	Flow through pond	SW14	3.9	0.017	0.000	350.2792	
4320 minute winter	C#3-SW10	1.004	C#2-SW07	1.7	0.427	0.024	0.9038	
15 minute winter	C#3-SW11	1.003	C#3-SW10	13.1	0.517	0.192	2.0393	
15 minute winter	C#3-SW12	1.002	C#3-SW11	9.9	0.662	0.145	1.1217	
720 minute winter	C#3-SW13	Hydro-Brake®	C#3-SW12	0.8				
720 minute winter	C#3-IC2	1.000	C#3-SW13	-1.5	0.065	-0.038	0.3382	
4320 minute winter	SW14	Hydro-Brake®	SW15	2.0				
600 minute winter	SW15	4.001	SW16	2.0	0.397	0.047	0.1278	
1440 minute winter	SW16	4.002	Discharge HW	3.7	0.568	0.108	0.1178	274.9
4320 minute winter	SW17	Hydro-Brake®	SW16	1.8				

Results for 10 year +20% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2880 minute winter	C#1-IC1	2640	97.353	0.278	1.2	1.0295	0.0000	SURCHARGED
2880 minute winter	C#1-SW01	2640	97.353	0.378	1.5	0.6419	0.0000	SURCHARGED
2880 minute winter	C#1-SW02	2640	97.353	0.603	3.1	0.9560	0.0000	SURCHARGED
2880 minute winter	C#1-SW03	2640	97.353	1.453	11.1	2.0789	0.0000	OK
2880 minute winter	C#1-SW04	2640	97.353	0.578	9.5	3.0877	0.0000	SURCHARGED
15 minute winter	C#1-SW05	11	97.408	0.408	140.6	4.2588	0.0000	SURCHARGED
15 minute winter	C#2-SW06	11	96.860	0.160	44.3	0.7885	0.0000	OK
5760 minute winter	C#2-SW07	4500	96.797	0.672	6.0	2.2989	0.0000	SURCHARGED
15 minute winter	C#2-SW08	10	97.187	0.187	70.3	1.0529	0.0000	OK
5760 minute winter	C#2-SW09	4500	96.797	0.964	5.9	1.3800	0.0000	OK
5760 minute winter	C#3-SW10	4500	96.797	0.547	1.7	0.8797	0.0000	SURCHARGED
5760 minute winter	C#3-SW11	4500	96.797	0.297	1.4	0.4343	0.0000	OK
15 minute winter	C#3-SW12	10	96.866	0.091	14.5	0.1816	0.0000	OK
720 minute winter	C#3-SW13	645	97.582	0.582	3.1	1.7994	0.0000	SURCHARGED
720 minute winter	C#3-IC2	645	97.582	0.532	3.8	45.5052	0.0000	SURCHARGED
5760 minute winter	SW14	4500	96.797	0.997	3.9	1.1280	0.0000	SURCHARGED
240 minute winter	SW15	212	95.733	0.033	2.0	0.0372	0.0000	OK
5760 minute winter	SW16	4380	95.581	0.051	3.8	0.0582	0.0000	OK
2880 minute winter	SW17	2640	97.353	1.553	6.4	1.7562	0.0000	SURCHARGED
5760 minute winter	Discharge HW	4380	95.500	0.050	3.8	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)
2880 minute winter	C#1-IC1	6.000	C#1-SW01	1.2	0.481	0.026	0.1271	
2880 minute winter	C#1-SW01	6.001	C#1-SW02	1.5	0.366	0.023	4.7181	
2880 minute winter	C#1-SW02	6.002	C#1-SW03	1.8	0.444	0.025	0.8450	
2880 minute winter	C#1-SW03	Flow through pond	SW17	6.4	0.009	0.000	487.3242	
2880 minute winter	C#1-SW04	7.001	C#1-SW03	9.6	0.814	0.055	1.1030	
15 minute winter	C#1-SW05	7.000	C#1-SW04	129.4	1.197	0.831	4.0810	
15 minute winter	C#2-SW06	2.000	C#2-SW07	42.7	1.147	0.537	2.1621	
5760 minute winter	C#2-SW07	1.005	C#2-SW09	5.9	0.537	0.042	1.1063	
15 minute winter	C#2-SW08	3.000	C#2-SW07	68.9	1.586	0.620	0.8698	
5760 minute winter	C#2-SW09	Flow through pond	SW14	3.9	0.017	0.000	480.5978	
5760 minute winter	C#3-SW10	1.004	C#2-SW07	1.6	0.403	0.023	0.9154	
5760 minute winter	C#3-SW11	1.003	C#3-SW10	1.4	0.355	0.020	4.6163	
15 minute winter	C#3-SW12	1.002	C#3-SW11	14.1	0.724	0.206	1.4590	
720 minute winter	C#3-SW13	Hydro-Brake®	C#3-SW12	0.8				
720 minute winter	C#3-IC2	1.000	C#3-SW13	-2.4	-0.059	-0.059	0.3382	
5760 minute winter	SW14	Hydro-Brake®	SW15	2.0				
240 minute winter	SW15	4.001	SW16	2.0	0.395	0.047	0.1285	
5760 minute winter	SW16	4.002	Discharge HW	3.8	0.571	0.110	0.1199	1018.1
2880 minute winter	SW17	Hydro-Brake®	SW16	2.0				

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2880 minute winter	C#1-IC1	2700	97.604	0.529	1.4	3.4579	0.0000	SURCHARGED
2880 minute winter	C#1-SW01	2700	97.604	0.629	1.7	1.0685	0.0000	SURCHARGED
2880 minute winter	C#1-SW02	2700	97.604	0.854	2.0	1.3543	0.0000	SURCHARGED
2880 minute winter	C#1-SW03	2700	97.604	1.704	12.7	2.4383	0.0000	OK
2880 minute winter	C#1-SW04	2700	97.604	0.829	11.3	4.4296	0.0000	SURCHARGED
15 minute winter	C#1-SW05	11	97.673	0.673	178.6	7.0251	0.0000	SURCHARGED
5760 minute winter	C#2-SW06	4440	96.963	0.263	1.5	1.3003	0.0000	OK
5760 minute winter	C#2-SW07	4440	96.963	0.838	6.7	2.8653	0.0000	SURCHARGED
15 minute winter	C#2-SW08	10	97.223	0.223	89.3	1.2537	0.0000	OK
5760 minute winter	C#2-SW09	4440	96.963	1.130	6.6	1.6171	0.0000	OK
5760 minute winter	C#3-SW10	4440	96.963	0.713	1.7	1.1459	0.0000	SURCHARGED
5760 minute winter	C#3-SW11	4440	96.963	0.463	1.4	0.6761	0.0000	SURCHARGED
5760 minute winter	C#3-SW12	4440	96.963	0.188	1.2	0.3736	0.0000	OK
720 minute winter	C#3-SW13	675	97.686	0.686	3.8	2.1228	0.0000	SURCHARGED
720 minute winter	C#3-IC2	675	97.686	0.636	4.7	60.6041	0.0000	SURCHARGED
5760 minute winter	SW14	4440	96.963	1.163	4.3	1.3154	0.0000	SURCHARGED
5760 minute winter	SW15	4440	95.733	0.033	2.0	0.0372	0.0000	OK
4320 minute winter	SW16	3480	95.584	0.054	4.1	0.0606	0.0000	OK
2880 minute winter	SW17	2700	97.604	1.804	7.3	2.0402	0.0000	SURCHARGED
4320 minute winter	Discharge HW	3480	95.502	0.052	4.1	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)
2880 minute winter	C#1-IC1	6.000	C#1-SW01	1.4	0.503	0.030	0.1271	
2880 minute winter	C#1-SW01	6.001	C#1-SW02	1.7	0.382	0.027	4.7181	
2880 minute winter	C#1-SW02	6.002	C#1-SW03	1.9	0.444	0.027	0.8450	
2880 minute winter	C#1-SW03	Flow through pond	SW17	7.3	0.009	0.000	609.3823	
2880 minute winter	C#1-SW04	7.001	C#1-SW03	11.0	0.840	0.064	1.1030	
15 minute winter	C#1-SW05	7.000	C#1-SW04	167.0	1.514	1.073	4.0810	
5760 minute winter	C#2-SW06	2.000	C#2-SW07	1.5	0.435	0.019	3.9410	
5760 minute winter	C#2-SW07	1.005	C#2-SW09	6.6	0.537	0.047	1.1063	
15 minute winter	C#2-SW08	3.000	C#2-SW07	87.4	1.663	0.786	1.0525	
5760 minute winter	C#2-SW09	Flow through pond	SW14	4.3	0.017	0.000	561.7689	
5760 minute winter	C#3-SW10	1.004	C#2-SW07	1.7	0.403	0.024	0.9154	
5760 minute winter	C#3-SW11	1.003	C#3-SW10	1.4	0.364	0.021	4.6193	
5760 minute winter	C#3-SW12	1.002	C#3-SW11	1.2	0.359	0.018	4.2089	
720 minute winter	C#3-SW13	Hydro-Brake®	C#3-SW12	0.8				
720 minute winter	C#3-IC2	1.000	C#3-SW13	-3.0	-0.076	-0.076	0.3382	
5760 minute winter	SW14	Hydro-Brake®	SW15	2.0				
5760 minute winter	SW15	4.001	SW16	2.0	0.412	0.047	0.1351	
4320 minute winter	SW16	4.002	Discharge HW	4.1	0.584	0.119	0.1267	838.4
2880 minute winter	SW17	Hydro-Brake®	SW16	2.1				

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2880 minute winter	C#1-IC1	2760	97.869	0.794	1.7	30.3398	0.0000	FLOOD RISK
2880 minute winter	C#1-SW01	2760	97.869	0.894	2.1	1.5188	0.0000	FLOOD RISK
2880 minute winter	C#1-SW02	2760	97.869	1.119	2.4	1.7746	0.0000	FLOOD RISK
2880 minute winter	C#1-SW03	2760	97.869	1.969	15.1	2.8176	0.0000	OK
2880 minute winter	C#1-SW04	2760	97.869	1.094	13.1	5.8461	0.0000	SURCHARGED
15 minute winter	C#1-SW05	11	98.072	1.072	232.0	11.1869	0.0000	SURCHARGED
4320 minute winter	C#2-SW06	4020	97.207	0.507	2.2	2.5037	0.0000	SURCHARGED
4320 minute winter	C#2-SW07	4020	97.207	1.082	9.4	3.6977	0.0000	SURCHARGED
15 minute winter	C#2-SW08	11	97.315	0.315	116.0	1.7734	0.0000	SURCHARGED
4320 minute winter	C#2-SW09	4020	97.206	1.373	9.3	1.9655	0.0000	OK
4320 minute winter	C#3-SW10	4020	97.207	0.957	2.1	1.5371	0.0000	SURCHARGED
4320 minute winter	C#3-SW11	4020	97.207	0.707	1.7	1.0316	0.0000	SURCHARGED
4320 minute winter	C#3-SW12	4020	97.207	0.432	1.4	0.8572	0.0000	SURCHARGED
960 minute winter	C#3-SW13	915	97.832	0.832	3.8	2.5746	0.0000	SURCHARGED
960 minute winter	C#3-IC2	915	97.832	0.782	4.8	81.6947	0.0000	SURCHARGED
4320 minute winter	SW14	4020	97.206	1.406	5.5	1.5907	0.0000	SURCHARGED
4320 minute winter	SW15	4020	95.735	0.035	2.2	0.0391	0.0000	OK
4320 minute winter	SW16	4020	95.586	0.056	4.5	0.0633	0.0000	OK
2880 minute winter	SW17	2760	97.869	2.069	8.6	2.3399	0.0000	SURCHARGED
4320 minute winter	Discharge HW	4020	95.504	0.054	4.5	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)
2880 minute winter	C#1-IC1	6.000	C#1-SW01	1.7	0.531	0.037	0.1271	
2880 minute winter	C#1-SW01	6.001	C#1-SW02	2.0	0.375	0.031	4.7181	
2880 minute winter	C#1-SW02	6.002	C#1-SW03	2.3	0.451	0.032	0.8450	
2880 minute winter	C#1-SW03	Flow through pond	SW17	8.6	0.009	0.000	753.1313	
2880 minute winter	C#1-SW04	7.001	C#1-SW03	12.9	0.840	0.075	1.1030	
15 minute winter	C#1-SW05	7.000	C#1-SW04	213.6	1.937	1.372	4.0810	
4320 minute winter	C#2-SW06	2.000	C#2-SW07	2.2	0.477	0.028	4.0843	
4320 minute winter	C#2-SW07	1.005	C#2-SW09	9.3	0.572	0.066	1.1063	
15 minute winter	C#2-SW08	3.000	C#2-SW07	110.7	1.726	0.996	1.3445	
4320 minute winter	C#2-SW09	Flow through pond	SW14	5.5	0.019	0.001	676.0888	
4320 minute winter	C#3-SW10	1.004	C#2-SW07	1.9	0.428	0.028	0.9154	
4320 minute winter	C#3-SW11	1.003	C#3-SW10	1.6	0.366	0.024	4.6193	
4320 minute winter	C#3-SW12	1.002	C#3-SW11	1.4	0.362	0.021	5.0702	
960 minute winter	C#3-SW13	Hydro-Brake®	C#3-SW12	0.9				
960 minute winter	C#3-IC2	1.000	C#3-SW13	-3.0	-0.074	-0.074	0.3382	
4320 minute winter	SW14	Hydro-Brake®	SW15	2.2				
4320 minute winter	SW15	4.001	SW16	2.2	0.407	0.052	0.1441	
4320 minute winter	SW16	4.002	Discharge HW	4.5	0.598	0.130	0.1346	907.1
2880 minute winter	SW17	Hydro-Brake®	SW16	2.3				

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Appendix to Surface Water Design

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

Met Eireann

Return Period Rainfall Depths for sliding Durations

Irish Grid: Easting: 305400, Northing: 228350,

DURATION	Interval 6months	1year	Years 2	3	4	5	10	20	30	50	75	100	150	200	250	500
5 mins	2.4	3.6	4.3	5.4	6.1	6.6	8.5	10.8	12.3	14.4	16.4	17.9	20.4	22.3	23.9	N/A
10 mins	3.4	5.1	6.0	7.5	8.5	9.3	11.9	15.0	17.1	20.1	22.9	25.0	28.4	31.1	33.3	N/A
15 mins	4.0	6.0	7.1	8.8	10.0	10.9	14.0	17.6	20.1	23.7	26.9	29.4	33.4	36.5	39.2	N/A
30 mins	5.3	7.8	9.2	11.3	12.8	14.0	17.9	22.4	25.5	29.9	33.8	37.0	41.8	45.7	48.9	N/A
1 hours	6.9	10.1	11.9	14.6	16.5	18.0	22.8	28.5	32.3	37.7	42.6	46.4	52.4	57.1	61.0	N/A
2 hours	9.1	13.2	15.4	18.9	21.2	23.1	29.2	36.2	40.9	47.6	53.6	58.3	65.6	71.4	76.2	N/A
3 hours	10.7	15.4	18.0	21.9	24.6	26.7	33.6	41.6	47.0	54.5	61.3	66.7	74.9	81.3	86.7	N/A
4 hours	11.9	17.2	20.0	24.4	27.3	29.6	37.2	46.0	51.8	60.1	67.5	73.3	82.2	89.2	95.1	N/A
6 hours	14.0	20.0	23.3	28.3	31.7	34.3	43.0	52.9	59.5	68.9	77.2	83.7	93.8	101.7	108.2	N/A
9 hours	16.4	23.4	27.2	32.8	36.7	39.7	49.6	60.9	68.3	78.9	88.3	95.7	107.0	115.9	123.2	N/A
12 hours	18.4	26.1	30.2	36.5	40.7	44.1	54.9	67.2	75.4	86.9	97.2	105.2	117.5	127.1	135.1	N/A
18 hours	21.6	30.4	35.2	42.4	47.2	51.0	63.3	77.3	86.6	99.6	111.2	120.2	134.1	144.8	153.8	N/A
24 hours	24.2	34.0	39.2	47.1	52.4	56.6	70.1	85.4	95.5	109.7	122.3	132.1	147.2	158.9	168.6	202.6
2 days	30.5	41.7	47.5	56.2	62.0	66.4	80.8	96.8	107.2	121.7	134.4	144.2	159.2	170.7	180.2	213.2
3 days	35.7	47.9	54.2	63.5	69.6	74.4	89.5	106.2	116.9	131.8	144.8	154.7	169.9	181.5	191.0	223.9
4 days	40.2	53.3	60.0	69.8	76.3	81.3	97.1	114.3	125.4	140.7	153.9	164.1	179.4	191.2	200.8	233.8
6 days	48.1	62.7	70.1	80.8	87.9	93.2	110.1	128.4	140.1	156.1	169.9	180.4	196.2	208.2	218.0	251.5
8 days	55.1	71.0	79.0	90.5	98.0	103.6	121.5	140.7	152.9	169.5	183.8	194.6	210.8	223.1	233.2	267.2
10 days	61.6	78.5	87.0	99.2	107.1	113.1	131.8	151.8	164.4	181.5	196.2	207.3	224.0	236.6	246.8	281.4
12 days	67.6	85.5	94.5	107.3	115.6	121.8	141.3	162.0	175.0	192.6	207.7	219.1	236.1	249.0	259.4	294.6
16 days	78.8	98.5	108.3	122.1	131.1	137.8	158.6	180.5	194.3	212.8	228.6	240.4	258.1	271.4	282.2	318.4
20 days	89.2	110.5	121.0	135.7	145.2	152.3	174.3	197.3	211.7	231.0	247.4	259.7	277.9	291.6	302.7	339.8
25 days	101.4	124.4	135.7	151.5	161.6	169.1	192.4	216.7	231.7	251.9	268.9	281.7	300.6	314.7	326.1	364.2

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

Print

Close Report

HR Wallingford Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Elena Dragoje
Site name:	Kingswood Ave Development
Site location:	Citywest Business Campus, D24

Site Details

Latitude:	53.29530° N
Longitude:	6.4195° W
Reference:	3717115054
Date:	Oct 10 2022 22:30

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.

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 2.16

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):	865	779.5
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?

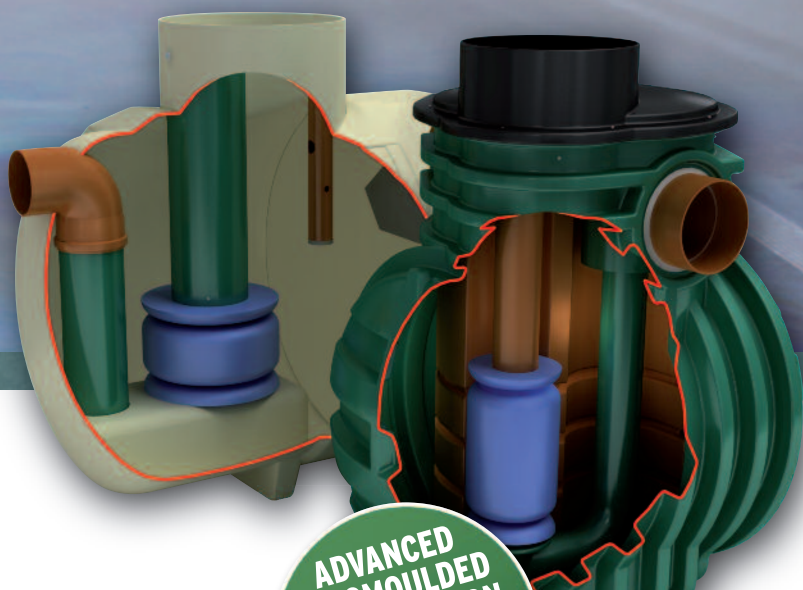
Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	5.04	4.46
1 in 1 year (l/s):	4.29	3.79
1 in 30 years (l/s):	10.74	9.51
1 in 100 year (l/s):	13.16	11.65
1 in 200 years (l/s):	14.42	12.77

Kingspan Klargester

SEPARATORS

A RANGE OF FUEL/OIL SEPARATORS FOR PEACE OF MIND



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Kingspan Environmental

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.

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

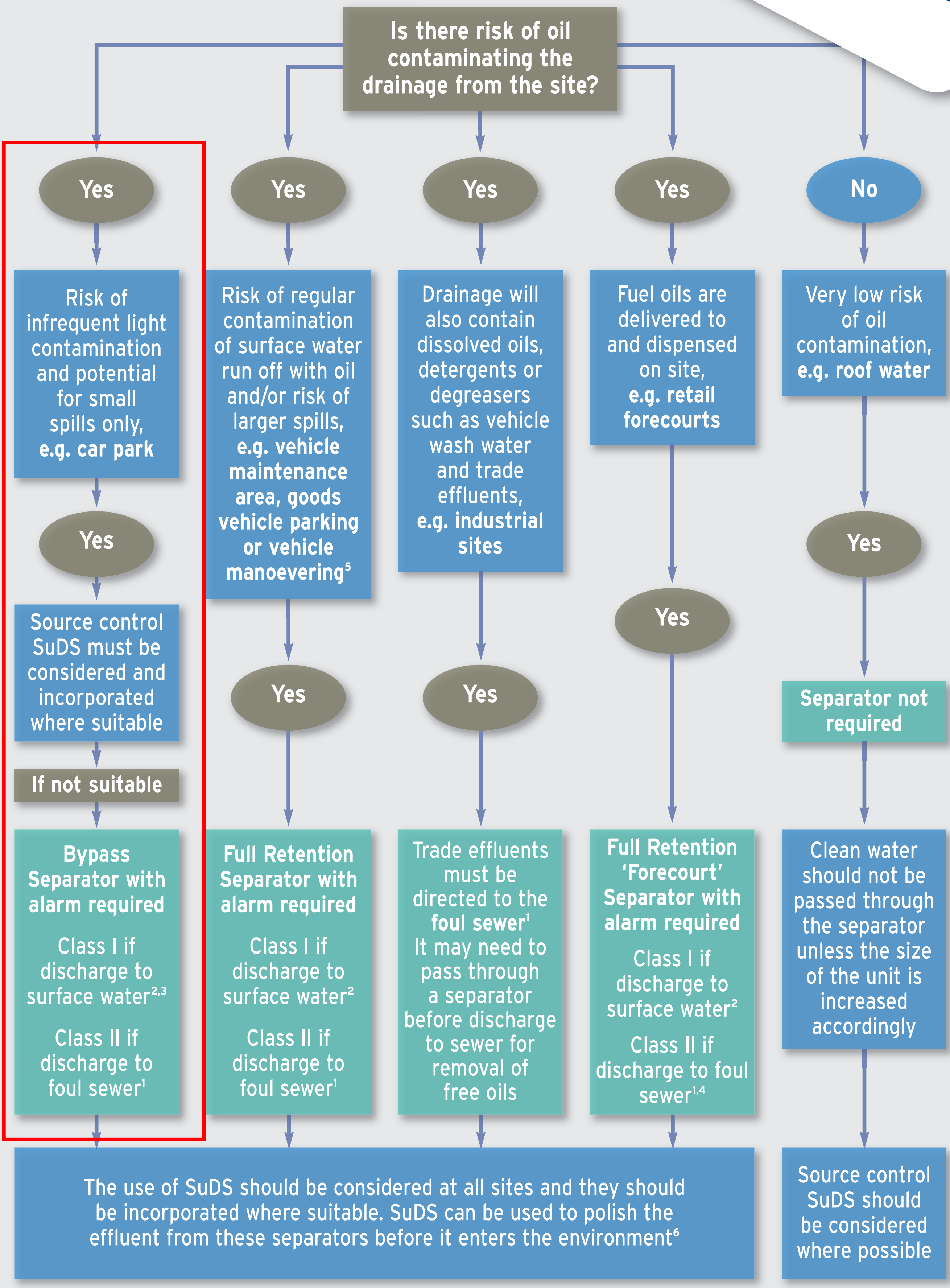
Forecourt separators are full retention separators specified to retain on site the maximum spillage likely to occur on a petrol filling station. They are required for both safety and environmental reasons and will treat spillages occurring during vehicle refuelling and road tanker delivery. The size 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.

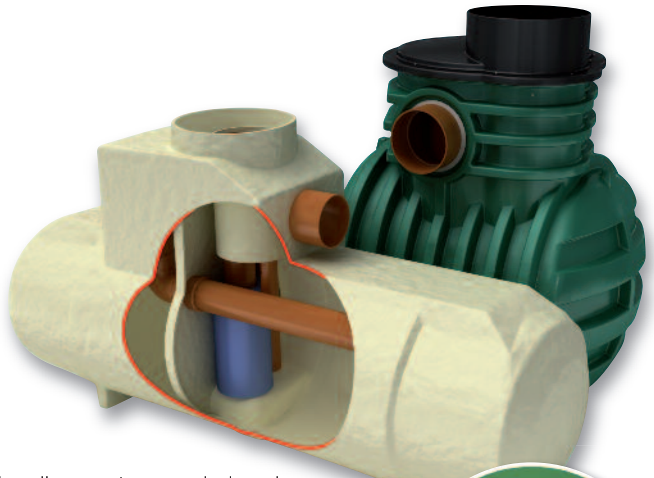
For further detailed information, please consult the Environment Agency Pollution Prevention Guideline 03 (PPG 3) 'Use and design of oil separators in surface water drainage systems' available from their website.

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.
- Silt storage capacity.
- Oil storage volume.
- 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 (m^2)	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.*

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.

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- **PUMPSTOR24** PUMPING SYSTEMS
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- OIL/WATER SEPARATORS
- BELOW GROUND STORAGE TANKS
- GREASE & SILT TRAPS

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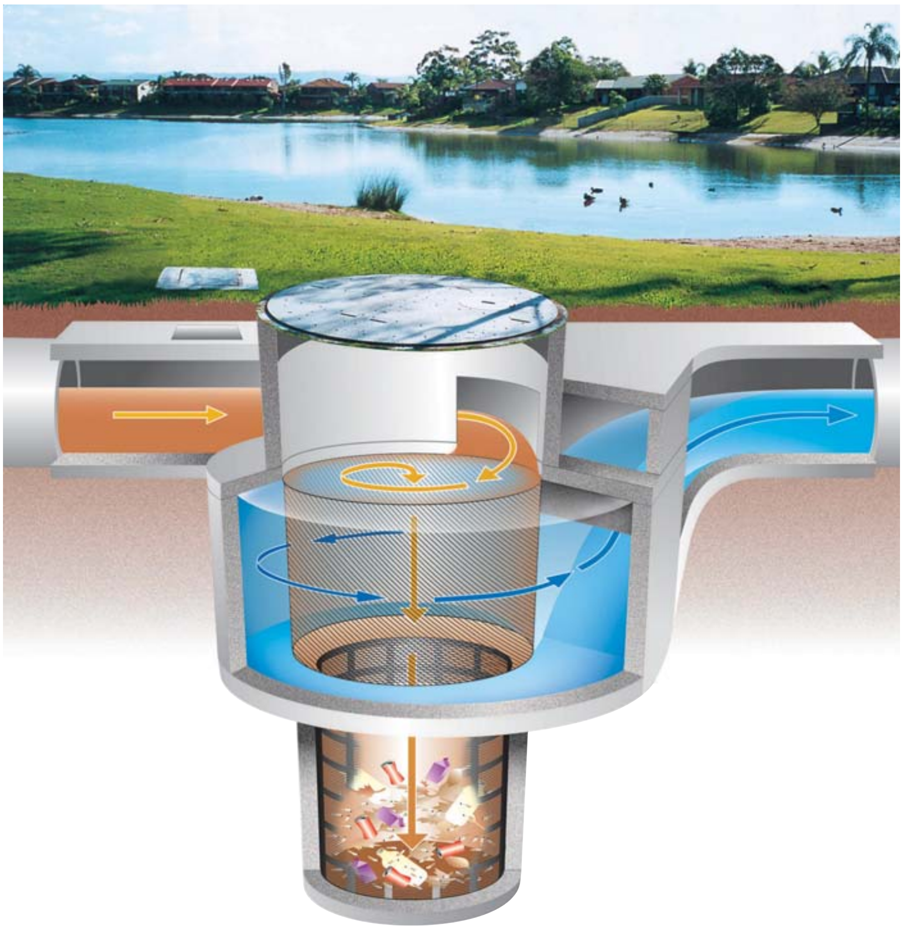
BRITISH WATER UK GREEN BUILDING COUNCIL Founding Member

Issue No. 20: August 2014

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

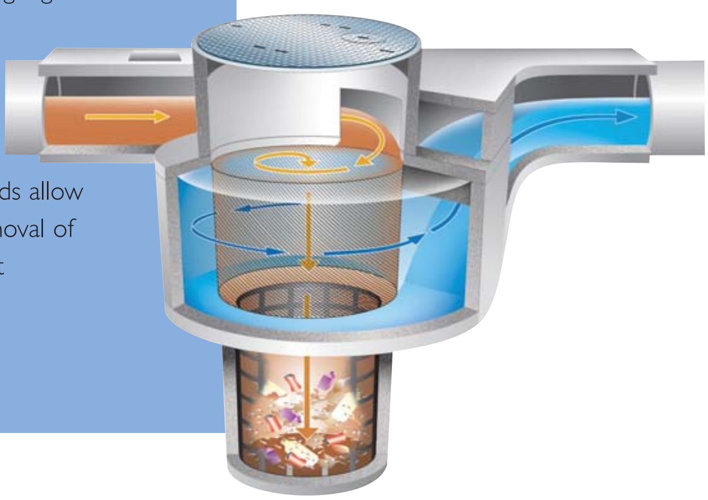
Field evaluations to determine pollutant mobilization have found that the vast majority of pollutants are mobilized in flows that are well below the design capacity' for the conveyance facility - typically known as the 'first flush'.

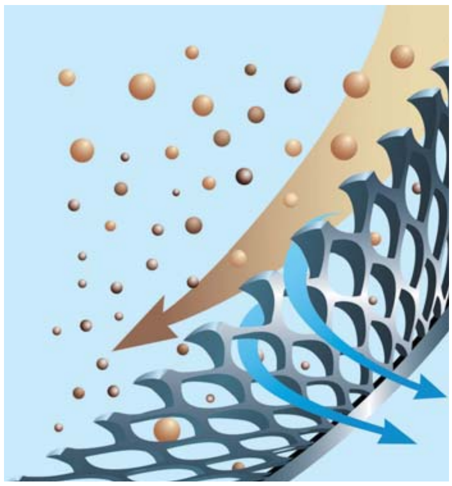
Therefore it is typical not to design the *SurfSep* models to process the conveyance system's maximum flow in order to achieve a very high level of pollutant removal.

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.

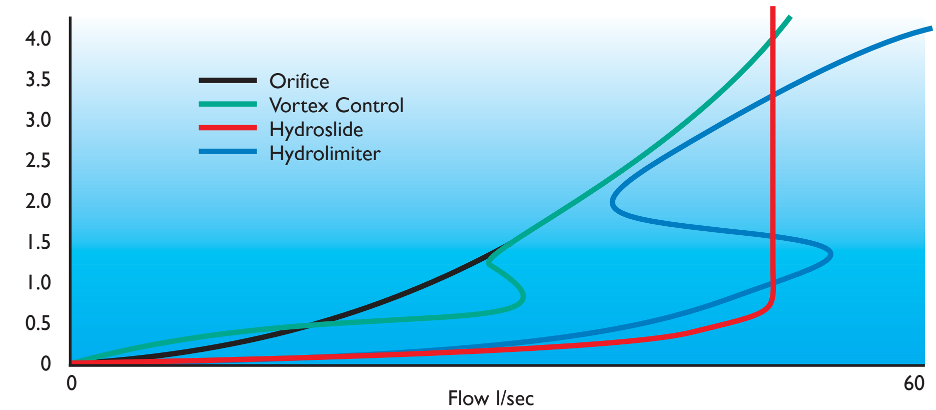
Typical SurfSep installation

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

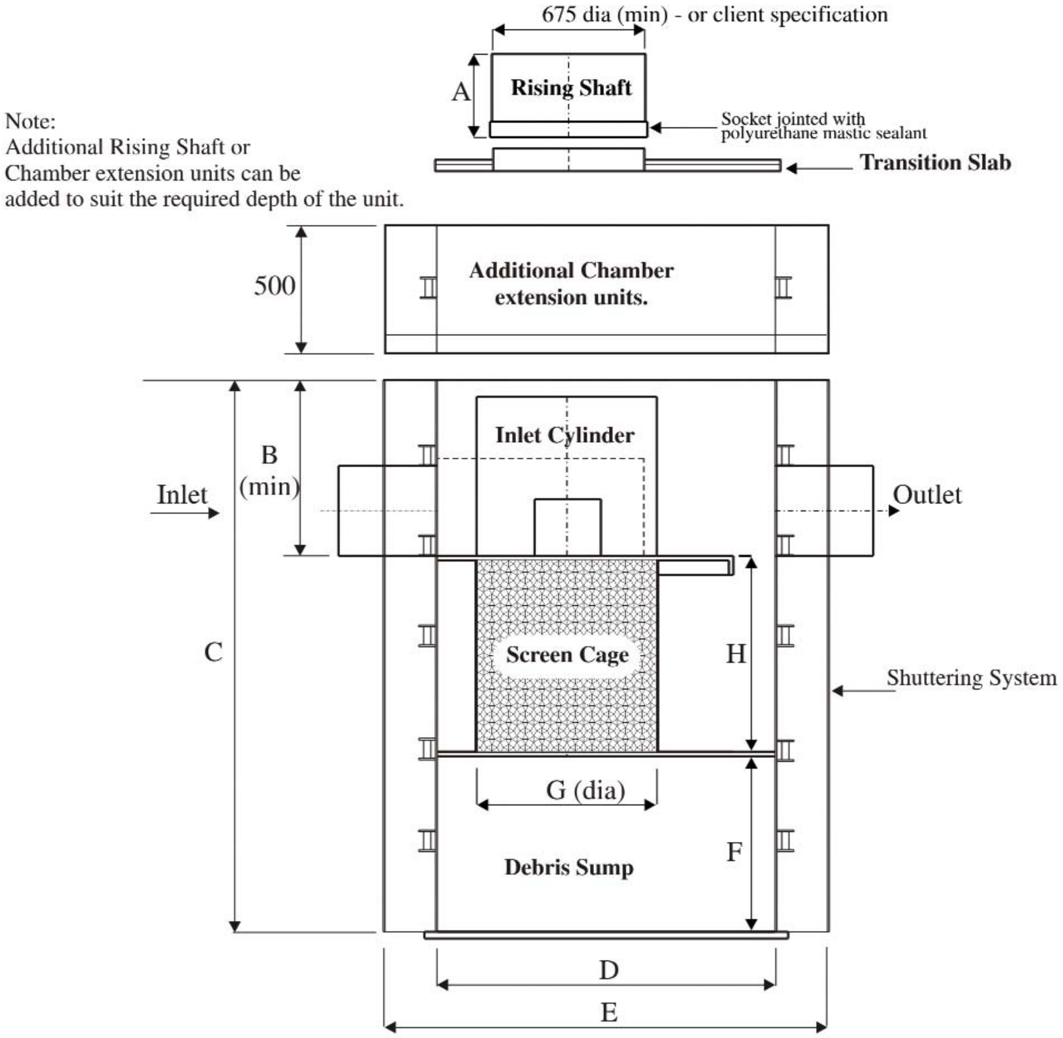
- Eduction (Suction)
- Basket Removal
- Mechanical Grab

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.

Surface Water Treatment

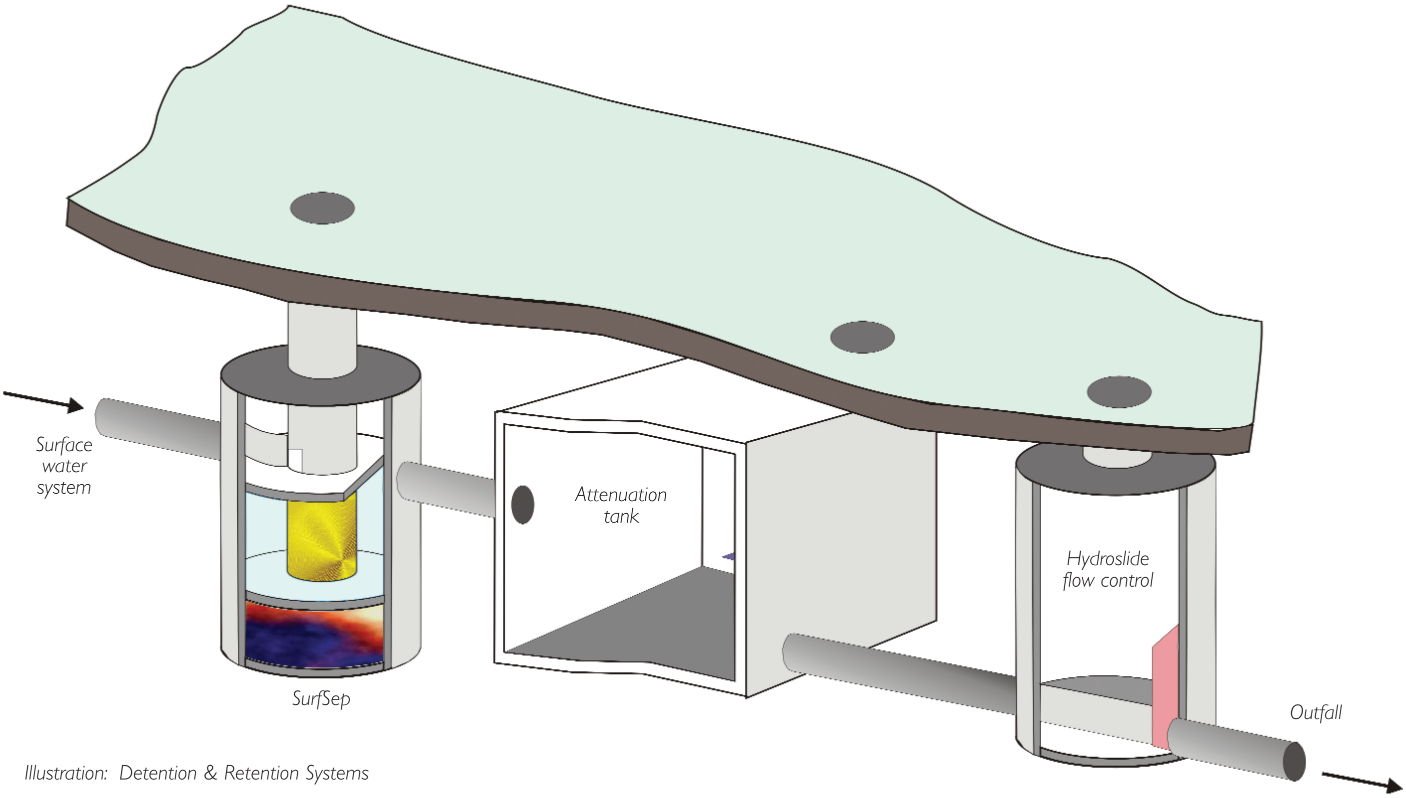


Illustration: Detention & Retention Systems

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 - 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.

Hydro-Brake® Flow Control *Modelling Guide*

Unit Selection Design Guide

Overview

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

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

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

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

STH Range of Hydro-Brake® Flow Controls

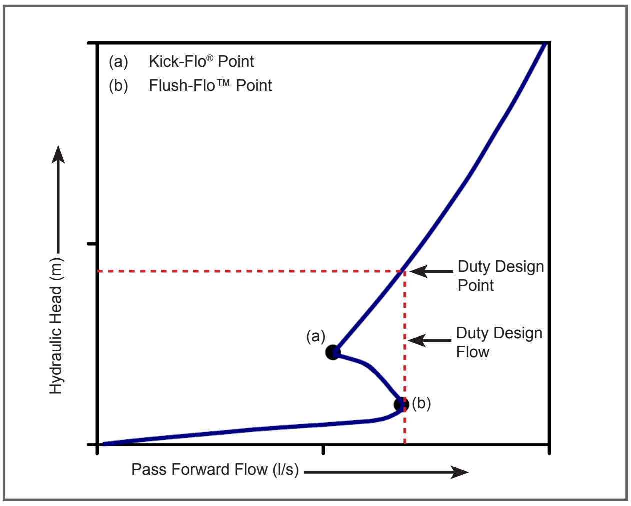
BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4599

See back cover for details.

Hydraulic Characteristics and Specification

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

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



Typical Hydro-Brake® Head Versus Flow Characteristics

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

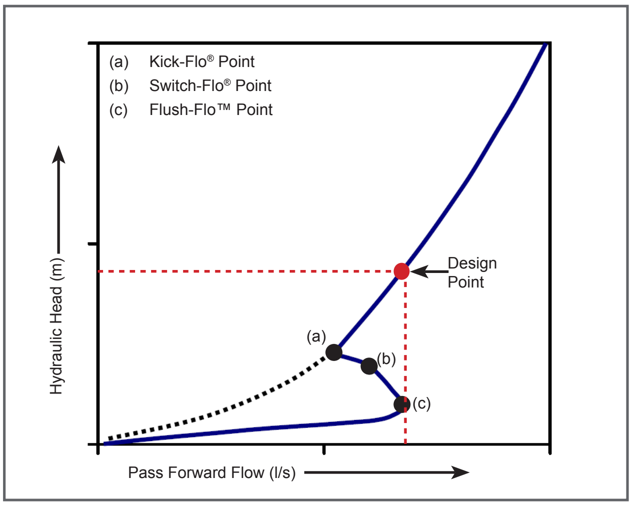
- outlet size and model of Hydro-Brake® Flow Control
- definition of the duty/design point (head and flow)
- definition of the Flush-Flo™ point (head and flow)
- definition of the Kick-Flo® point (head and flow)

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

STH Type Hydro-Brake® Flow Control with BBA Approval

Now included in WinDes® W.12.6!

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



Typical STH Head Versus Flow Characteristics

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

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

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

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4599
STH Range of Hydro-Brake® Flow Controls

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

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

www.hrdtec.com

Take a Look at Our New Stormwater Web Resource

Engineering Nature's Way™

www.engineeringnaturesway.co.uk

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

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

turning water around ...®

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

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 IRL HBFC Modelling Guide A1211

Project: D1736 - Sub catchment C#2 Attenuation Storage rev.CL1

StormTech® Detention • Retention • Water Quality
A division of ADS

Chamber Model -	SC-740	
Units -	**Metric**	Click Here for Imperial
Number of chambers -	260	
Voids in the stone (porosity) -	43	%
Base of Stone Elevation -	95.80	m
Amount of Stone Above Chambers -	360	mm
Amount of Stone Below Chambers -	280	mm
Area of system -	830	sq.meters

☑ Include Perimeter Stone in Calculations

Min. Area - 816.533 sq.meter

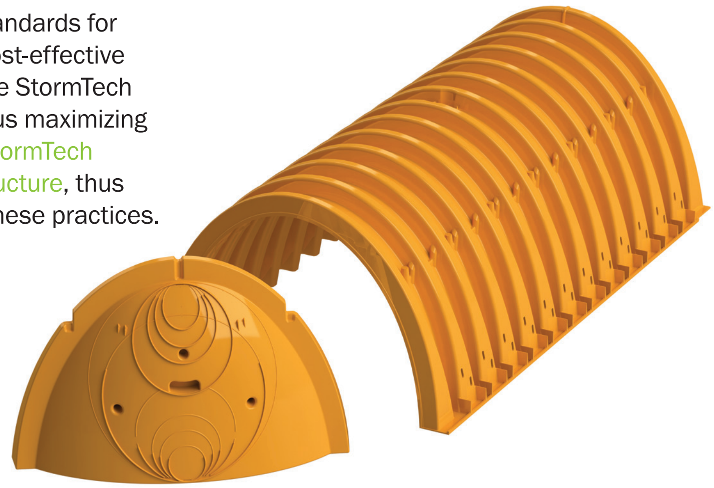
StormTech SC-740 Cumulative Storage Volumes

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)*
1397	0.00	0.00	9.07	9.07	691.422	97.20
1372	0.00	0.00	9.07	9.07	682.357	97.17
1346	0.00	0.00	9.07	9.07	673.292	97.15
1321	0.00	0.00	9.07	9.07	664.227	97.12
1295	0.00	0.00	9.07	9.07	655.161	97.10
1270	0.00	0.00	9.07	9.07	646.096	97.07
1245	0.00	0.00	9.07	9.07	637.031	97.04
1219	0.00	0.00	9.07	9.07	627.966	97.02
1194	0.00	0.00	9.07	9.07	618.900	96.99
1168	0.00	0.00	9.07	9.07	609.835	96.97
1143	0.00	0.00	9.07	9.07	600.770	96.94
1118	0.00	0.00	9.07	9.07	591.705	96.92
1092	0.00	0.00	9.07	9.07	582.640	96.89
1067	0.00	0.00	9.07	9.07	573.574	96.87
1041	0.00	0.40	8.89	9.30	564.509	96.84
1016	0.00	1.20	8.55	9.75	555.213	96.82
991	0.01	2.08	8.17	10.25	545.464	96.79
965	0.02	4.45	7.15	11.60	535.216	96.77
940	0.02	5.90	6.53	12.43	523.616	96.74
914	0.03	7.00	6.06	13.05	511.186	96.71
889	0.03	7.91	5.66	13.57	498.132	96.69
864	0.03	8.69	5.33	14.02	484.557	96.66
838	0.04	9.32	5.06	14.38	470.538	96.64
813	0.04	9.98	4.78	14.75	456.161	96.61
787	0.04	10.71	4.46	15.17	441.410	96.59
762	0.04	11.23	4.24	15.46	426.242	96.56
737	0.04	11.65	4.06	15.71	410.778	96.54
711	0.05	12.09	3.87	15.96	395.073	96.51
686	0.05	12.51	3.68	16.20	379.116	96.49
660	0.05	12.91	3.52	16.42	362.918	96.46
635	0.05	13.27	3.36	16.63	346.497	96.44
610	0.05	13.66	3.19	16.85	329.866	96.41
584	0.05	13.94	3.07	17.01	313.016	96.38
559	0.05	14.24	2.94	17.18	296.007	96.36
533	0.06	14.54	2.81	17.35	278.825	96.33
508	0.06	14.80	2.70	17.50	261.472	96.31
483	0.06	15.06	2.59	17.65	243.972	96.28
457	0.06	15.28	2.50	17.77	226.325	96.26
432	0.06	15.50	2.40	17.90	208.552	96.23
406	0.06	15.70	2.32	18.01	190.653	96.21
381	0.06	15.86	2.25	18.10	172.642	96.18
356	0.06	16.03	2.17	18.20	154.538	96.16
330	0.06	16.19	2.11	18.29	136.336	96.13
305	0.06	16.25	2.08	18.33	118.046	96.10
279	0.00	0.00	9.07	9.07	99.717	96.08
254	0.00	0.00	9.07	9.07	90.652	96.05

229	0.00	0.00	9.07	9.07	81.587	96.03
203	0.00	0.00	9.07	9.07	72.522	96.00
178	0.00	0.00	9.07	9.07	63.457	95.98
152	0.00	0.00	9.07	9.07	54.391	95.95
127	0.00	0.00	9.07	9.07	45.326	95.93
102	0.00	0.00	9.07	9.07	36.261	95.90
76	0.00	0.00	9.07	9.07	27.196	95.88
51	0.00	0.00	9.07	9.07	18.130	95.85
25	0.00	0.00	9.07	9.07	9.065	95.83

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

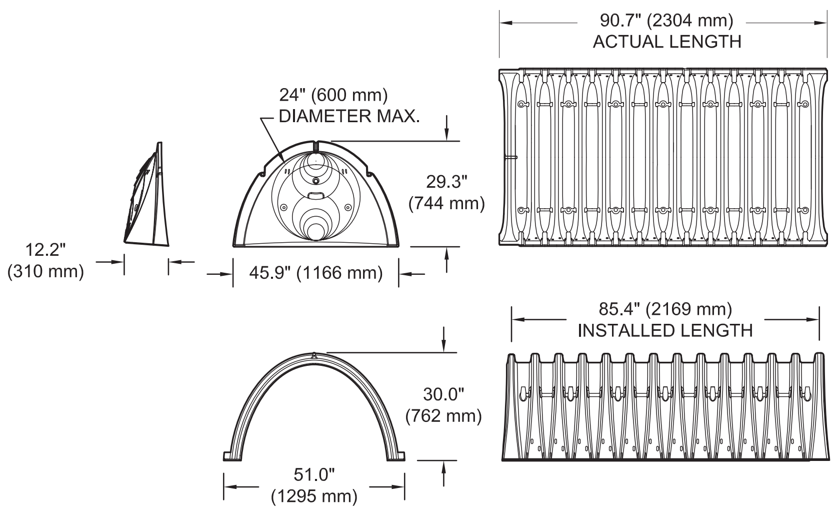
Chamber Storage
45.9 ft³ (1.30 m³)

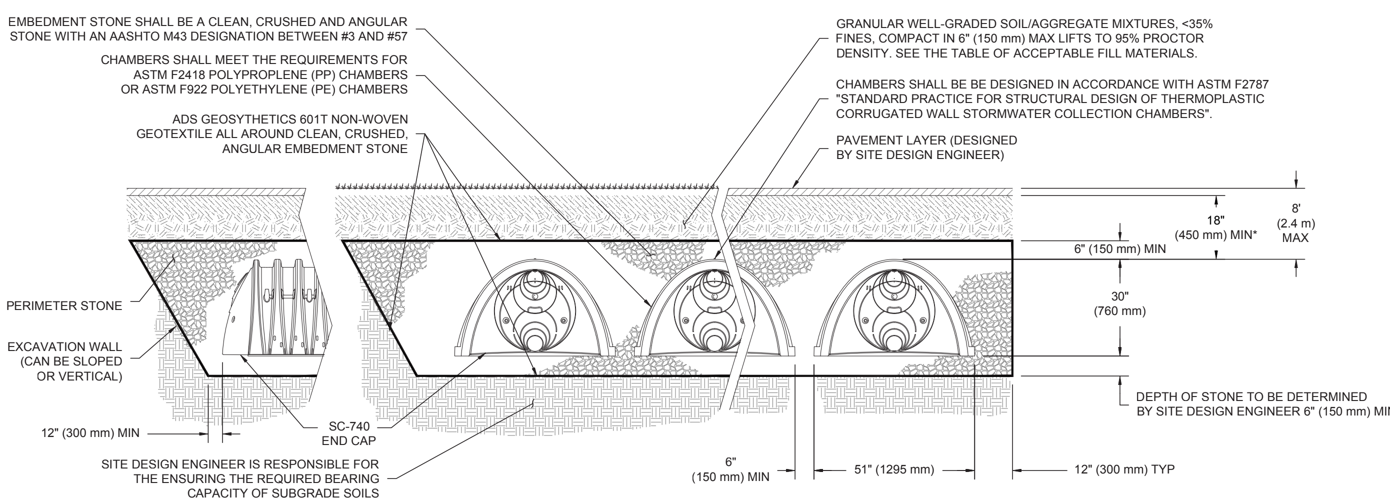
Min. Installed Storage*
74.9 ft³ (2.12 m³)

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)	45.90 (1.300)	74.90 (2.121)
41 (1041)	45.90 (1.300)	73.77 (2.089)
40 (1016)	Stone 45.90 (1.300)	72.64 (2.057)
39 (991)	Cover 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)	0 (0)	6.76 (0.191)
5 (127)	0 (0)	5.63 (0.160)
4 (102)	Stone 0 (0)	4.51 (0.128)
3 (76)	Foundation 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

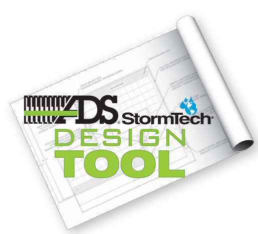
ENGLISH TONS (yds³)	Stone Foundation Depth		
	6"	12"	16"
SC-740	3.8 (2.8)	4.6 (3.3)	5.5 (3.9)
METRIC KILOGRAMS (m³)	150 mm	300 mm	450 mm
SC-740	3,450 (2.1)	4,170 (2.5)	4,490 (3.0)

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.



Working on a project?
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

*THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™*

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