

Gravesham Council

Planning Service
Civic Centre
Windmill Street
Gravesend
Kent
DA12 1AU

Date: 14 May 2024
Your Ref: 2021/0757
Our Ref: EC/2813/001_Rev.1
Email: elena@herringtonconsulting.co.uk

Discharge of Condition 7 for the proposed development at Custom House, The Terrace, Gravesend, DA12 2BW.

This letter has been prepared with reference to planning application reference 2021/0757 and is aimed at discharging planning condition 7 (herein referred to as 'Condition 7') for the proposed development at the above address. Condition 7 relates to the safe management of surface water runoff through the use of Sustainable Drainage Systems (SuDS).

Herrington Consulting Limited

The proposed development comprises the redevelopment of the site including;

- the demolition of the southern part of the workshop building and existing corridor link at first floor level, between Custom House and the outbuildings.
- the conversion of Custom House, the coach-house and outbuildings.
- extensions to the Old Boathouse and the Boathouse with external alterations.
- erection of a new three storey building to provide 27 residential units (6 x 1 bed, 15 x 2 bed and 6 x 3 bed) with associated landscaping and parking.

Canterbury Office

Unit 6 & 7
Barham Business Park
Elham Valley Road
Barham
Canterbury
Kent
CT4 6DQ
Tel 01227 833855

The details of Condition 7 are quoted below:

London Office

Unit 52.11
Woolyard
52 Bermondsey Street
London
SE1 3UD

Planning Condition 7

"No development approved by this permission shall be commenced until a detailed sustainable surface water drainage scheme for the site has been submitted to (and approved in writing by) the local planning authority. The detailed drainage scheme shall be based upon the Flood Risk Assessment and Drainage Strategy dated March 2023 prepared by Herrington Consulting Ltd and shall demonstrate that the surface water generated by this development (for all rainfall durations and intensities up to and including the climate change adjusted critical 100 year storm) can be accommodated and disposed of without increase to flood risk on or off-site.

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The drainage scheme shall also demonstrate (with reference to published guidance):

- *that silt and pollutants resulting from the site use can be adequately managed to ensure there is no pollution risk to receiving waters.*

- *appropriate operational, maintenance and access requirements for each drainage feature or SuDS component are adequately considered, including any proposed arrangements for future adoption by any public body or statutory undertaker.*

The drainage scheme shall be implemented in accordance with the approved details. Reason: To ensure the development is served by satisfactory arrangements for the disposal of surface water and to ensure that the development does not exacerbate the risk of on/off site flooding in accordance with Policies CS18 and CS19 of the Gravesham Local Plan Core Strategy (September 2014)."

Background and Policy

In accordance with the National Planning Policy Framework (NPPF, 2023), SuDS should be included within the proposed development scheme where it is practicable to do so. The proposed development must also maintain, or ideally reduce, the rate at which runoff is discharged offsite. This is to ensure that the offsite risk of surface water flooding is not increased by the development.

The Non-statutory Technical Standards for SuDS (NTSS) specify criteria to ensure sustainable drainage is included within development classified as 'major development' as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010. It is, however, recognised that SuDS should be designed to ensure that the maintenance and operation requirements are economically proportionate.

The proposed development includes more than 10 residential units. The NTSS will therefore apply and reference to the NTSS has been made throughout the following sections of this report to ensure the principles of sustainable drainage are considered.

It should also be noted that Herrington Consulting Limited (HCL) prepared a drainage strategy for this development in March 2023, which was submitted to support the planning application and is referenced in Condition 7. Therefore, the drainage design summarised in this report has been undertaken following the same principles already approved in the previous strategy.

Climate Change

The NPPF (2023) and supporting Planning Practice Guidance Suite (NPPG, 2022) state that residential development should be considered for a minimum of 100 years, but that the lifetime of a non-residential development depends on the characteristics of the development. The development that is the subject of this assessment is classified as residential, and therefore a design life of 100 years has been assumed.

The Environment Agency (EA) provides guidance regarding the application of the climate change allowances relating to peak rainfall intensity and how they should be applied to the planning process. Recognising that the impact of climate change will vary across the UK, the allowances were updated in May 2022 to show the anticipated changes to peak rainfall across a series of management catchments. The proposed development site is located in the Medway Management Catchment, as defined by the 'Peak Rainfall Allowance' maps, hosted by the Department for Environment, Food and Rural Affairs (DEFRA).

For this development, an increase of 45% has been applied to the hydraulic drainage model constructed to inform the drainage strategy. Where this allowance has been applied the abbreviation "+45%cc" has been used.

Existing Site Drainage

The existing site drainage is currently being surveyed in its entirety. A CCTV survey of the existing outfall was undertaken in October 2021 to confirm the connection from the site to the river is suitable. A copy of this survey has been appended to this letter.

Surface water runoff is currently discharged at an unrestricted rate from the existing site into the River Thames and this rate of discharge has been calculated for a range of rainfall events with varying return periods. These hydrological calculations have been undertaken using the Modified Rational Method, and synthetic rainfall data derived using the variables obtained from the Flood Estimation Handbook (FEH) online web service, and the routines within the Causeway Flow+ software. Greenfield runoff rates have been calculated using the FEH methodology. The results are summarised in Table 1 below.

Return Period (years)	Existing Greenfield Runoff Rate (l/s)	Peak runoff from the Existing Site (l/s)
QBar / 2	0.17	52
30	0.40	150
100	0.55	197

Table 1 - Summary of greenfield and brownfield peak runoff rates for the site.

The existing site is 90% impermeable and as the impermeable area of the proposed site will decrease, the discharge rates will also decrease.

Drainage Hierarchy and Opportunities for Managing Surface Water Runoff

The following opportunities for managing the surface water runoff discharged from the development site are listed in order of preference:

Infiltration – Reference to British Geological Survey (BGS) shows that the bedrock geology of the site is made up of Lewes Nodular Chalk Formation and Seaford Chalk Formation, with no superficial deposits. These strata are likely to have moderate permeability, capable of discharging surface water runoff. However, the close proximity to the river and the potential for elevated ground water levels at the site would restrict the use of infiltration SuDS. Infiltration is therefore not considered to be a suitable solution at this location.

Discharge to Tidal Waterbody – The existing site currently discharges directly into the River Thames to the north. Discharging surface water runoff into the River Thames via the existing outfall is considered to be the most appropriate option to manage runoff from the proposed development.

Discharge to Watercourses – There are no smaller watercourses within close proximity to the site in which to permit a direct connection and consequently, there is no opportunity to discharge surface water to an existing watercourse.

Discharge to Public Sewer System – As an alternative preferred solution is available for disposing of surface water runoff, a connection to the existing sewer will not be required.

Proposed Surface Water Drainage System

A drainage layout plan has been included within the enclosed documents, along with supporting calculations to demonstrate how the objectives set out in Condition 7 can be achieved. The following SuDS have been proposed:

Underground Storage (cellular storage crates) – Runoff draining from the roofs, roads and other areas of hardstanding, will be directed via underground pipes into a series of cellular storage crates located beneath the roads and parking area. The stored water will subsequently be discharged into the River Thames at an unrestricted rate, through the existing outfall. Runoff accumulated at the lowest point of the site, against the flood defence, will be collected via the existing french drains and connected into the drainage network.

This approach ensures that the drainage system can accommodate the rainfall generated under a 1 in 100 year return period event (including an allowance for climate change), discharging all of the water to the tidal River Thames.

Notwithstanding this, it is recognised that there is a risk that the outfall could become hydraulically locked by a rising tide, e.g., during an extreme event such as a tidal surge. Therefore, further analysis has been undertaken to ascertain the storage required to prevent uncontrolled flooding on the site if a blockage of the outfall was to coincide with an extreme pluvial event.

The analysis references the EA's coastal flood boundary condition database to determine the extreme water level for a 1 in 2 year return period event (T2), including an allowance for climate change for the year 2115 (a maximum still water level of 5.63m AODN). The storage tanks have been sized to store the runoff from a 1 in 30 year pluvial event, including a 45% allowance for climate change, for the duration that the outfall is blocked (under the 1 in 2 year tidal event, including an allowance for climate change). The river levels for this event have been included in the hydraulic model. This approach considers the fact that the system will be able to discharge water into the river even if the river level is higher than the invert level of the outfall, provided there is a sufficient difference in head between the drainage network and the river. The design also assumes a tidal flap valve will be fitted to the outfall pipe to prevent river water from entering the drainage system during a high tide.

A summary of the design parameters for the cellular storage crates are summarised in Table 2 below.

Parameter	Design (1:100yr+45%cc event)			
SuDS	Tank A	Tank B	Tank C	Tank D
Total area draining to cellular storage, including overflow a 10% allowance for urban creep	615 m ²	990 m ²	2940 m ² (combined)	
Dimensions	4.0 x 11.0 x 1.125 (d) m	6.5 x 6.0 x 1.125 (d) m	6.5 x 17.0 x 1.125 (d) m	5.0 x 7.5 x 1.125 (d) m
Porosity	95%	95%	95%	95%
Storage volume	47 m ³	42 m ³	118 m ³	40 m ³
Infiltration	Not permitted	Not permitted	Not permitted	Not permitted
Flow Control Device	20mm orifice	20mm orifice	-	-
Final Discharge point	225mm existing outfall Invert Level ~2.53m AODN			

Table 2 – Summary of the proposed drainage system, test for the design event 1:100+ 45%cc.

It is evident that, with the inclusion of the proposed SuDS, there is the potential to accommodate all the surface water runoff from the site up to, and including, the design rainfall event (1 in 30 year return period +45%cc) when the outfall is blocked by a the 1 in 2 year tidal event, including an allowance for climate change. If a pluvial event with a higher return period (i.e., 1 in 100 year return period + 45%cc) was to occur during the same tide locked scenario described in the text above, the system could surcharge. However, under this scenario water will be safely contained above ground in the garden and parking area to the north of the site, until such time that the water level in the river falls and water is able to re-enter the drainage system, discharging freely into the river once more.

Water Quality

The eastern pipe run, which runs along the Custom House outbuildings will be retained in its current configuration and there is limited opportunity to incorporate additional pollution control systems. However, it should be noted that this pipe run only drains roofs and a pedestrian access, where no vehicular traffic is allowed.

For the remainder of the site, a vortex separator (SDS Aqua Swirl or similar) has been proposed, to treat the runoff from the access road and parking area before it is discharged into the river via the existing outfall.

In accordance with guidance contained within Part E Section 26 of the CIRIA SuDS Manual (2015), the Simple Index Approach has been applied. The areas draining to the Vortex Separator have been classified as 'driveways, residential carparks and low traffic areas' which have a 'low' pollution hazard level.

The pollution hazard indices have been compared to the treatment mitigation indices for the Vortex Separator, provided by SDS. Both the pollution and treatment mitigation indices have been summarised in Table 3 below.

	Total Suspended solids (TSS)	Metals	Hydro-carbons
Pollution Hazard Indices	0.5	0.4	0.4
Mitigation Indices for the SDS Aqua Swirl Vortex Separator	0.7	0.6	0.7
Comparison	Sufficient Treatment	Sufficient Treatment	Sufficient Treatment

Table 3 – Simple Index Approach Summary.

From Table 3 above, it is evident that the Vortex Separator proposed will provide sufficient treatment for low pollution hazard level areas, in accordance with the CIRIA SuDS Manual.

Design Exceedance

It is necessary to ensure that the drainage proposals will not increase the risk of flooding if the drainage system becomes blocked, or if a rainfall event occurs which exceeds the design rainfall event.

Inspection of the topography across the site suggests that if the drainage network was to fail, water would flow towards the north of the site and away from the proposed buildings. Water will temporarily accumulate within the garden and car park to the north of the plot, until it is able to be discharged into the drainage system and to the River Thames via the outfall.

The proposed drainage system has been designed for two potential scenarios:

1. an extreme rainfall event with a return period of 1 in 100 years, including a 45% increase in peak rainfall intensity (to account for the impacts of climate change), and
2. for a 1 in 30 year pluvial event with 45% allowance for climate change, coinciding with the 1 in 2 year tidal event including an allowance for climate change.

The 1 in 100yr+45%cc event, coincident with a 1 in 2 year tidal event, has been used to test how the proposed drainage system would respond to a larger event. Figure 1 below delineates the most likely path water would take during an event that exceeds the design storm and where water could be stored temporarily.



Figure 1 – Anticipated flow routes during an exceedance or blockage event.

Maintenance and Management

Typical maintenance schedules have been produced for the proposed SuDS systems and have been included within the enclosed documents. The SuDS at this site are communal and as such, the maintenance company that is responsible for maintaining the rest of the site will also be responsible for maintaining and inspecting the SuDS systems at this site. It should, however, be noted that it may be necessary to involve specialist contractors to undertake specific maintenance tasks that are required. The installation and maintenance guidance for the SDS Aqua Swirl Vortex Separator has also been attached.

The details of the company responsible for the maintenance and management are as follows:

Company Name: Custom House (Gravesend) Limited

Company Address: 27 Castle Street
Canterbury
Kent
CT1 2PX

During the construction of the proposed development, it will be necessary to manage the surface water runoff from the development site using a temporary drainage system. This system is to be managed through a Construction and Environmental Management Plan (CEMP), which will need to be in place to reduce the risk of surface water flooding to the surrounding area for this short period of time.

Prior to the decommissioning of the temporary drainage system, it will be necessary to ensure that the final proposed drainage system is installed prior to the completion of the construction phase. This is to ensure that there is always a suitable method available for discharging surface water in a sustainable manner.

Summary

The opportunities for draining surface water runoff from the proposed development at Custom House, Gravesend have been assessed, with the aim of discharging Condition 7. The analysis has shown that discharging surface water runoff from the proposed development to the River Thames, via the existing outfall, will present the most viable and sustainable solution for draining the site.

The use of SuDS has been assessed for the site and the use of a series of storage tanks has been proposed. The storage tanks have been designed to provide the necessary storage for the rainfall generated under a 1 in 30 year return period event, under a scenario whereby the outfall is hydraulically locked by the tide (i.e., during an extreme event with a 1 in 2 year return period). If a rainfall event with a higher return period (i.e., a 1 in 100 year event, including climate change) was to coincide with the outfall being blocked, the system has been designed to flood and water will be contained above ground in a controlled manner. This stored water would subsequently be discharged back into the river once the tide has fallen. Under normal circumstances, the water generated under a 1 in 100 year rainfall event (including an allowance for 100 years of climate change) will discharge into the river without any above ground flooding.

A maintenance schedule for various SuDS is enclosed and provides details on how the management company can maintain the drainage system, to ensure continued operation for the lifetime of the development.

The information contained within this document provides details to demonstrate how surface water runoff will be managed on site and I trust that this information will be sufficient to enable Condition 7 to be discharged in full.

Yours faithfully,

Elena Corchon MEng. MSc MCIWEM

Principal Drainage Engineer

Enclosed documents:

- Drainage Drawings
- Causeway Flow+ Calculations
- SuDS Maintenance Schedule
- SDS Aqua Swirl Installation & Maintenance Guide
- CCTV Survey

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KEY:

- 2250 1:500
CL: XX.XX
IL: XX.XX
- EXISTING SURFACE WATER SEWER
- EXISTING SURFACE WATER CHAMBER
- EXISTING GULLY
- 1000 1:500
CL: XX.XX
IL: XX.XX
- SURFACE WATER DRAIN
- SURFACE WATER CHAMBER
- RWP
- RAINWATER PIPE
- GULLY
- SURFACE WATER DRAINAGE CHANNEL
- FLOW CONTROL DEVICE
- GEOCELLULAR STORAGE

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Tel: 01227 833865
enquiries@herringtonconsulting.co.uk
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P8	Discharge of Conditions	EC	SMB	13/03/24
P7	Minor amendments	BW	SMB	07/10/22
P6	Minor amendments	EC	SMB	05/01/22
P5	Minor amendments	EC	SMB	22/12/21
P4	SWMS update following EA comments	EC	SMB	17/12/21
Rev	Description	Author	Checked	Date

CLIENT			
Mile Property Group			
PROJECT			
Custom House, The Terrace, Gravesend			
SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:200	2813	EC	SMB
HC DWG REF			
2813_DWG_r0			
DWG TITLE		DWG No.	
INDICATIVE SURFACE WATER DRAINAGE LAYOUT		HC-2813-501	



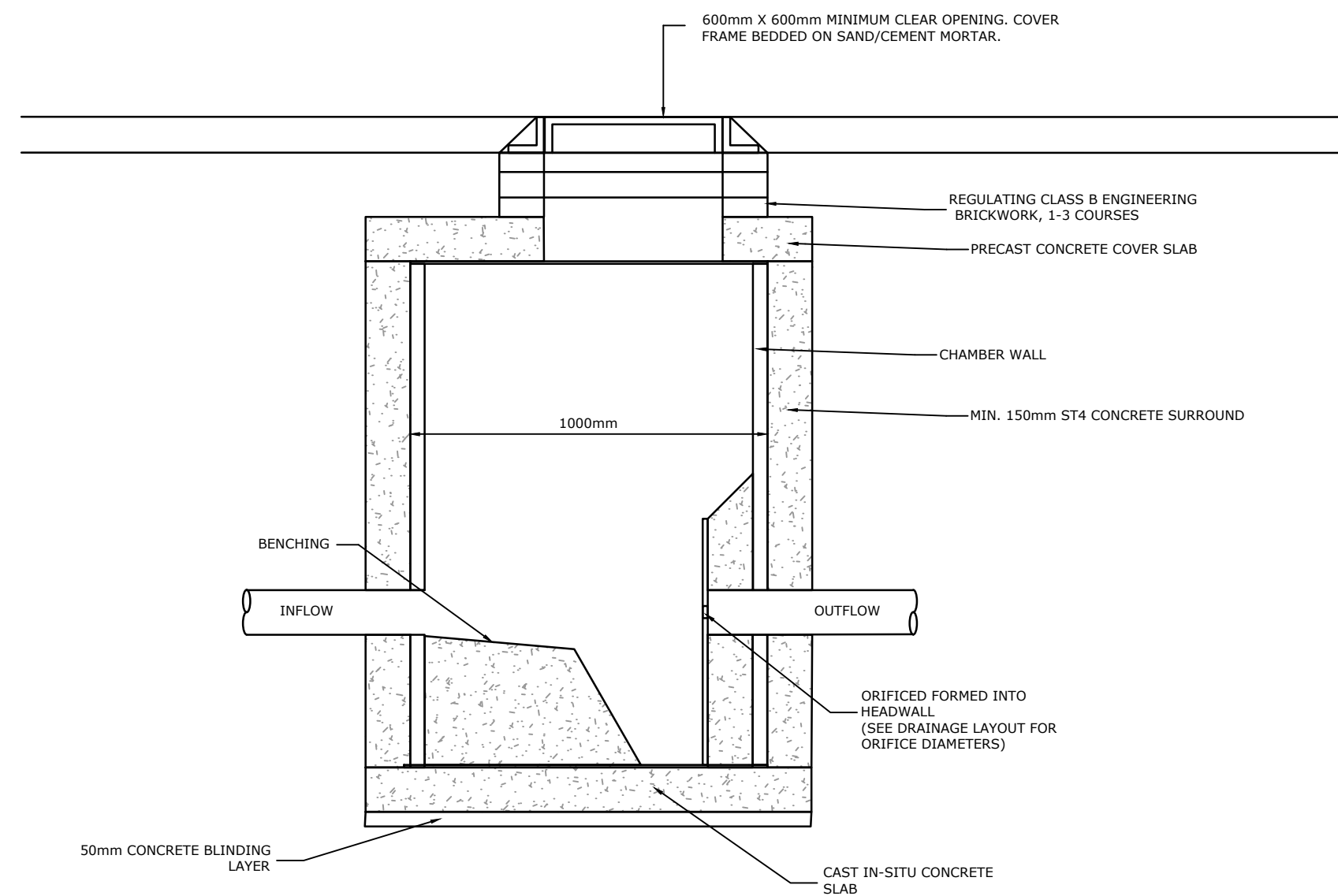
SCALE 1:200 @ A1
10 m 0 10 m



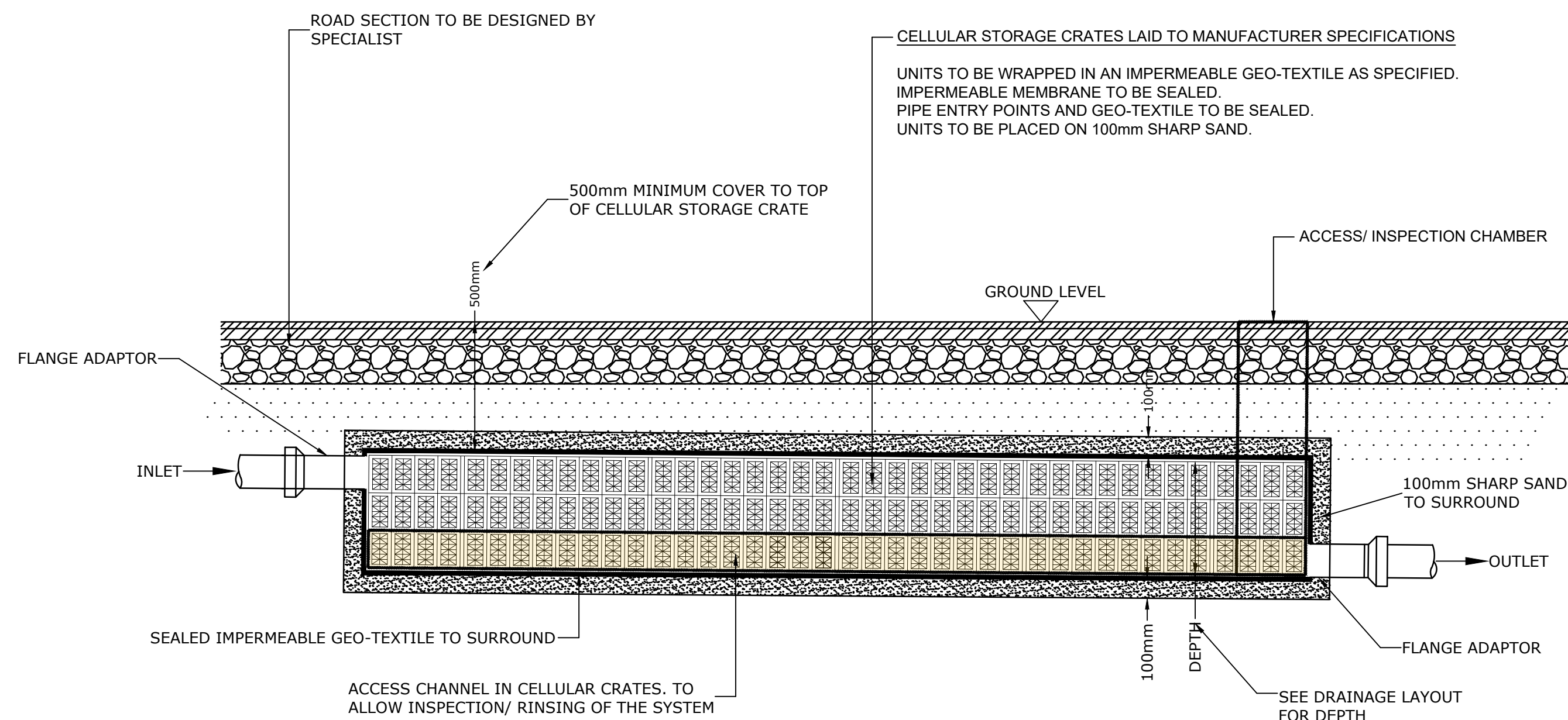
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FLOW CONTROL CHAMBER
SCALE 1:20



CELLULAR STORAGE CRATES

SCALE 1:20

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enquiries@herringtonconsulting.co.uk
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P0	First issue	EC	SMB	13/03/24
Rev	Description	Author	Checked	Date

CLIENT Mile Property Group

PROJECT Custom House, The Terrace, Gravesend

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:20	2813	EC	SMB

HC DWG REF: 2813_DWG_r0

DWG TITLE	DWG No.
SURFACE WATER STANDARD DETAILS	HC-2813-502



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KEY:

FLOW ROUTE DURING EXCEEDANCE OR BLOCKAGE SCENARIO

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Tel : 01227 833865
enquiries@herringtonconsulting.co.uk
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P0	First Issue	EC	SMB	13/03/24
Rev	Description	Author	Checked	Date

CLIENT

Mile Property Group

PROJECT

Custom House, The Terrace, Gravesend

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:200	2813	EC	SMB

HC DWG REF

2813_DWG_r0

DWG TITLE	DWG No.
EXCEEDANCE PLAN	HC-2813-503

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	100	Maximum Rainfall (mm/hr)	250.0	Include Intermediate Ground	✓
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.013	5.00	8.500	1200	565189.130	174310.473	1.350
2	0.008	5.00	8.190	300	565178.055	174312.649	1.350
3	0.001	5.00	8.360		565183.447	174318.072	1.300
4	0.003	5.00	8.320		565179.993	174318.746	1.320
5			8.000	600	565173.554	174319.701	1.350
6	0.016	5.00	7.400	600	565174.643	174328.715	1.350
7_Tank A	0.015	5.00	6.710	1000	565188.317	174338.608	1.710
8	0.005	5.00	6.740		565182.934	174340.626	1.300
9	0.004	5.00	6.530		565184.023	174344.640	1.300
10			6.530	400	565185.367	174344.503	1.323
11	0.005	5.00	6.240		565184.656	174350.139	1.300
12			6.200	400	565186.403	174351.693	1.350
13	0.009	5.00	6.100	600	565190.210	174353.440	1.350
14	0.003	5.00	4.860		565185.513	174363.132	0.650
15_Tank B	0.008	5.00	5.300	1200	565192.195	174365.219	1.700
16	0.002	5.00	4.810		565178.069	174359.304	0.650
17	0.007	5.00	4.000	400	565181.309	174385.099	0.380
18	0.006	5.00	4.830		565186.328	174369.408	0.650
19			4.320	600	565188.249	174384.371	1.020
20_Tank C	0.014	5.00	4.400	1000	565194.792	174384.120	1.575
21	0.022	5.00	4.020		565186.200	174393.242	0.450
22		5.00	4.090		565205.150	174390.558	0.320
23			4.120	600	565204.986	174389.453	0.742
24_Tank D	0.021	5.00	4.450	1200	565203.921	174382.273	1.718

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
25	0.003	5.00	4.550	600	565212.538	174386.048	1.874
26	0.012	5.00	6.990	600	565184.731	174326.357	1.350
27			6.800	600	565195.037	174328.323	1.800
28	0.029	5.00	6.240	600	565201.764	174329.759	1.960
29	0.008	5.00	5.270		565206.884	174346.252	1.300
30	0.001	5.00	5.260	600	565205.620	174347.898	1.670
31	0.005	5.00	5.200		565209.467	174349.191	1.300
32	0.006	5.00	5.200	400	565203.837	174350.568	1.300
33	0.009	5.00	5.190		565206.342	174350.769	1.613
34	0.006	5.00	4.640	600	565198.017	174375.216	1.300
35	0.008	5.00	4.650		565207.396	174372.444	1.300
36	0.009	5.00	4.580	600	565212.629	174375.743	1.720
37	0.009	5.00	4.500	600	565215.362	174387.396	1.850
37_OUT			4.140	1200	565225.723	174405.602	1.614

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	11.287	0.600	7.150	6.840	0.310	36.4	150	5.11	168.5
1.001	2	5	8.366	0.600	6.840	6.650	0.190	44.0	150	5.20	167.6
2.000	3	4	3.519	0.600	7.060	7.000	0.060	58.7	100	5.06	169.1
2.001	4	5	6.509	0.600	7.000	6.700	0.300	21.7	100	5.12	168.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.673	29.6	11.2	1.200	1.200	0.013	0.0	64	1.562
1.001	1.520	26.9	18.1	1.200	1.200	0.021	0.0	91	1.631
2.000	1.007	7.9	0.8	1.200	1.220	0.001	0.0	21	0.643
2.001	1.665	13.1	3.0	1.220	1.200	0.004	0.0	33	1.365

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.002	5	6	9.080	0.600	6.650	6.050	0.600	15.1	150	5.26	166.9
1.003	6	7_Tank A	6.500	0.600	6.050	5.360	0.690	9.4	150	5.30	166.6
1.004	7_Tank A	13	14.952	0.600	5.000	4.750	0.250	59.8	150	5.49	164.6
3.000	8	10	4.577	0.600	5.440	5.207	0.233	19.6	100	5.04	169.3
4.000	9	10	1.351	0.600	5.230	5.207	0.023	58.7	100	5.02	169.5
3.001	10	12	7.264	0.600	5.207	4.900	0.307	23.7	100	5.12	168.4
5.000	11	12	2.338	0.600	4.940	4.900	0.040	58.5	100	5.04	169.3
3.002	12	13	4.189	0.600	4.850	4.750	0.100	41.9	150	5.16	168.0
1.005	13	15_Tank B	9.000	0.600	4.750	4.570	0.180	50.0	150	5.59	163.4
6.000	14	15_Tank B	7.000	0.600	4.210	4.000	0.210	33.3	100	5.09	168.8
1.006	15_Tank B	20_Tank C	2.000	0.600	3.600	3.580	0.020	100.0	150	5.62	163.1
7.000	16	17	26.016	0.600	4.160	3.620	0.540	48.2	100	5.39	165.6
7.001	17	19	7.017	0.600	3.620	3.550	0.070	100.0	150	5.51	164.3
8.000	18	19	15.314	0.600	4.180	3.550	0.630	24.3	100	5.16	168.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.002	2.602	46.0	21.1	1.200	1.200	0.025	0.0	71	2.546
1.003	3.302	58.3	34.8	1.200	1.200	0.041	0.0	83	3.443
1.004	1.303	23.0	46.5	1.560	1.200	0.056	0.0	150	1.327
3.000	1.750	13.7	4.0	1.200	1.223	0.005	0.0	37	1.521
4.000	1.007	7.9	3.8	1.200	1.223	0.004	0.0	49	0.997
3.001	1.593	12.5	7.7	1.223	1.200	0.009	0.0	57	1.674
5.000	1.009	7.9	4.0	1.200	1.200	0.005	0.0	50	1.006
3.002	1.559	27.6	11.6	1.200	1.200	0.014	0.0	68	1.497
1.005	1.426	25.2	65.0	1.200	0.580	0.079	0.0	150	1.453
6.000	1.340	10.5	2.5	0.550	1.200	0.003	0.0	33	1.099
1.006	1.005	17.8	74.0	1.550	0.670	0.090	0.0	150	1.023
7.000	1.113	8.7	1.6	0.550	0.280	0.002	0.0	29	0.852
7.001	1.005	17.8	7.8	0.230	0.620	0.009	0.0	69	0.972
8.000	1.572	12.3	4.9	0.550	0.670	0.006	0.0	43	1.475

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
7.002	19	20_Tank C	6.548	0.600	3.300	3.235	0.065	100.0	150	5.61	163.2
1.007	20_Tank C	24_Tank D	9.314	0.600	2.825	2.732	0.093	100.0	300	5.72	162.0
9.000	21	23	19.164	0.600	3.570	3.378	0.192	100.0	225	5.24	167.1
10.000	22	23	1.117	0.600	3.770	3.378	0.392	2.8	100	5.00	169.7
9.001	23	24_Tank D	7.259	0.600	3.378	3.305	0.073	100.0	225	5.34	166.1
1.008	24_Tank D	25	9.408	0.600	2.732	2.676	0.056	168.0	225	5.88	160.4
1.009	25	37	3.129	0.600	2.676	2.650	0.026	120.4	225	5.92	159.9
11.000	26	27	10.492	0.600	5.640	5.450	0.190	55.2	150	5.13	168.3
11.001	27	28	6.879	0.600	5.000	4.890	0.110	62.5	150	5.22	167.4
11.002	28	30	18.544	0.600	4.280	3.740	0.540	34.3	150	5.40	165.5
12.000	29	30	2.075	0.600	3.970	3.790	0.180	11.5	100	5.02	169.6
11.003	30	33	2.960	0.600	3.590	3.577	0.013	227.7	300	5.45	165.0
13.000	31	33	3.501	0.600	3.900	3.777	0.123	28.5	100	5.04	169.3
14.000	32	33	2.538	0.600	3.900	3.777	0.123	20.6	100	5.02	169.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
7.002	1.005	17.8	12.5	0.870	1.015	0.015	0.0	93	1.087
1.007	1.572	111.1	97.4	1.275	1.418	0.119	0.0	219	1.764
9.000	1.307	52.0	18.6	0.225	0.517	0.022	0.0	93	1.200
10.000	4.616	36.3	0.0	0.220	0.642	0.000	0.0	0	0.000
9.001	1.307	52.0	18.5	0.517	0.920	0.022	0.0	93	1.200
1.008	1.006	40.0	131.5	1.493	1.649	0.162	0.0	225	1.024
1.009	1.190	47.3	133.6	1.649	1.625	0.165	0.0	225	1.212
11.000	1.356	24.0	10.6	1.200	1.200	0.012	0.0	69	1.312
11.001	1.274	22.5	10.5	1.650	1.200	0.012	0.0	72	1.250
11.002	1.723	30.5	35.1	1.810	1.370	0.042	0.0	150	1.755
12.000	2.288	18.0	6.6	1.200	1.370	0.008	0.0	42	2.111
11.003	1.037	73.3	42.3	1.370	1.313	0.051	0.0	164	1.074
13.000	1.452	11.4	4.5	1.200	1.313	0.005	0.0	44	1.374
14.000	1.707	13.4	4.9	1.200	1.313	0.006	0.0	42	1.574

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
11.004	33	36	25.753	0.600	3.577	3.080	0.497	51.8	300	5.64	162.9
15.000	34	36	14.622	0.600	3.340	2.985	0.355	41.2	100	5.20	167.6
16.000	35	36	6.186	0.600	3.350	3.246	0.104	59.5	100	5.10	168.6
11.005	36	37	11.969	0.600	2.860	2.650	0.210	57.0	225	5.76	161.7
1.010	37	37_OUT	20.948	0.600	2.650	2.526	0.124	168.9	225	6.27	156.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
11.004	2.189	154.7	58.4	1.313	1.200	0.071	0.0	127	2.040
15.000	1.205	9.5	4.8	1.200	1.495	0.006	0.0	50	1.209
16.000	1.000	7.9	7.1	1.200	1.234	0.008	0.0	75	1.132
11.005	1.736	69.0	77.0	1.495	1.625	0.094	0.0	225	1.768
1.010	1.003	39.9	212.2	1.625	1.389	0.268	0.0	225	1.021

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	11.287	36.4	150	Circular	8.500	7.150	1.200	8.190	6.840	1.200
1.001	8.366	44.0	150	Circular	8.190	6.840	1.200	8.000	6.650	1.200
2.000	3.519	58.7	100	Circular	8.360	7.060	1.200	8.320	7.000	1.220
2.001	6.509	21.7	100	Circular	8.320	7.000	1.220	8.000	6.700	1.200
1.002	9.080	15.1	150	Circular	8.000	6.650	1.200	7.400	6.050	1.200

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1200	Manhole	Adoptable	2	300	Manhole	Adoptable
1.001	2	300	Manhole	Adoptable	5	600	Manhole	Adoptable
2.000	3		Junction		4		Junction	
2.001	4		Junction		5	600	Manhole	Adoptable
1.002	5	600	Manhole	Adoptable	6	600	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.003	6.500	9.4	150	Circular	7.400	6.050	1.200	6.710	5.360	1.200
1.004	14.952	59.8	150	Circular	6.710	5.000	1.560	6.100	4.750	1.200
3.000	4.577	19.6	100	Circular	6.740	5.440	1.200	6.530	5.207	1.223
4.000	1.351	58.7	100	Circular	6.530	5.230	1.200	6.530	5.207	1.223
3.001	7.264	23.7	100	Circular	6.530	5.207	1.223	6.200	4.900	1.200
5.000	2.338	58.5	100	Circular	6.240	4.940	1.200	6.200	4.900	1.200
3.002	4.189	41.9	150	Circular	6.200	4.850	1.200	6.100	4.750	1.200
1.005	9.000	50.0	150	Circular	6.100	4.750	1.200	5.300	4.570	0.580
6.000	7.000	33.3	100	Circular	4.860	4.210	0.550	5.300	4.000	1.200
1.006	2.000	100.0	150	Circular	5.300	3.600	1.550	4.400	3.580	0.670
7.000	26.016	48.2	100	Circular	4.810	4.160	0.550	4.000	3.620	0.280
7.001	7.017	100.0	150	Circular	4.000	3.620	0.230	4.320	3.550	0.620
8.000	15.314	24.3	100	Circular	4.830	4.180	0.550	4.320	3.550	0.670
7.002	6.548	100.0	150	Circular	4.320	3.300	0.870	4.400	3.235	1.015
1.007	9.314	100.0	300	Circular	4.400	2.825	1.275	4.450	2.732	1.418

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.003	6	600	Manhole	Adoptable	7_Tank A	1000	Manhole	Adoptable
1.004	7_Tank A	1000	Manhole	Adoptable	13	600	Manhole	Adoptable
3.000	8		Junction		10	400	Manhole	Adoptable
4.000	9		Junction		10	400	Manhole	Adoptable
3.001	10	400	Manhole	Adoptable	12	400	Manhole	Adoptable
5.000	11		Junction		12	400	Manhole	Adoptable
3.002	12	400	Manhole	Adoptable	13	600	Manhole	Adoptable
1.005	13	600	Manhole	Adoptable	15_Tank B	1200	Manhole	Adoptable
6.000	14		Junction		15_Tank B	1200	Manhole	Adoptable
1.006	15_Tank B	1200	Manhole	Adoptable	20_Tank C	1000	Manhole	Adoptable
7.000	16		Junction		17	400	Manhole	Adoptable
7.001	17	400	Manhole	Adoptable	19	600	Manhole	Adoptable
8.000	18		Junction		19	600	Manhole	Adoptable
7.002	19	600	Manhole	Adoptable	20_Tank C	1000	Manhole	Adoptable
1.007	20_Tank C	1000	Manhole	Adoptable	24_Tank D	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
9.000	19.164	100.0	225	Circular	4.020	3.570	0.225	4.120	3.378	0.517
10.000	1.117	2.8	100	Circular	4.090	3.770	0.220	4.120	3.378	0.642
9.001	7.259	100.0	225	Circular	4.120	3.378	0.517	4.450	3.305	0.920
1.008	9.408	168.0	225	Circular	4.450	2.732	1.493	4.550	2.676	1.649
1.009	3.129	120.4	225	Circular	4.550	2.676	1.649	4.500	2.650	1.625
11.000	10.492	55.2	150	Circular	6.990	5.640	1.200	6.800	5.450	1.200
11.001	6.879	62.5	150	Circular	6.800	5.000	1.650	6.240	4.890	1.200
11.002	18.544	34.3	150	Circular	6.240	4.280	1.810	5.260	3.740	1.370
12.000	2.075	11.5	100	Circular	5.270	3.970	1.200	5.260	3.790	1.370
11.003	2.960	227.7	300	Circular	5.260	3.590	1.370	5.190	3.577	1.313
13.000	3.501	28.5	100	Circular	5.200	3.900	1.200	5.190	3.777	1.313
14.000	2.538	20.6	100	Circular	5.200	3.900	1.200	5.190	3.777	1.313
11.004	25.753	51.8	300	Circular	5.190	3.577	1.313	4.580	3.080	1.200
15.000	14.622	41.2	100	Circular	4.640	3.340	1.200	4.580	2.985	1.495
16.000	6.186	59.5	100	Circular	4.650	3.350	1.200	4.580	3.246	1.234

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
9.000	21		Junction		23	600	Manhole	Adoptable
10.000	22		Junction		23	600	Manhole	Adoptable
9.001	23	600	Manhole	Adoptable	24_Tank D	1200	Manhole	Adoptable
1.008	24_Tank D	1200	Manhole	Adoptable	25	600	Manhole	Adoptable
1.009	25	600	Manhole	Adoptable	37	600	Manhole	Adoptable
11.000	26	600	Manhole	Adoptable	27	600	Manhole	Adoptable
11.001	27	600	Manhole	Adoptable	28	600	Manhole	Adoptable
11.002	28	600	Manhole	Adoptable	30	600	Manhole	Adoptable
12.000	29		Junction		30	600	Manhole	Adoptable
11.003	30	600	Manhole	Adoptable	33		Junction	
13.000	31		Junction		33		Junction	
14.000	32	400	Manhole	Adoptable	33		Junction	
11.004	33		Junction		36	600	Manhole	Adoptable
15.000	34	600	Manhole	Adoptable	36	600	Manhole	Adoptable
16.000	35		Junction		36	600	Manhole	Adoptable

Pipeline Schedule

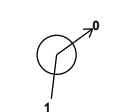
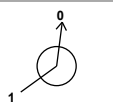
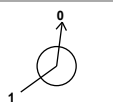
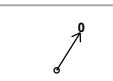
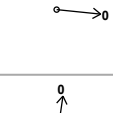
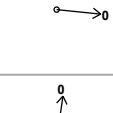
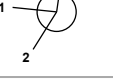
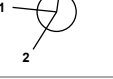
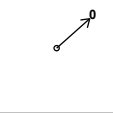
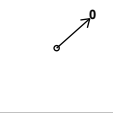
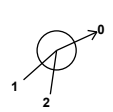
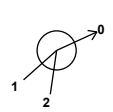
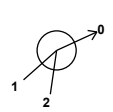
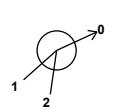
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
11.005	11.969	57.0	225	Circular	4.580	2.860	1.495	4.500	2.650	1.625
1.010	20.948	168.9	225	Circular	4.500	2.650	1.625	4.140	2.526	1.389

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
11.005	36	600	Manhole	Adoptable	37	600	Manhole	Adoptable
1.010	37	600	Manhole	Adoptable	37_OUT	1200	Manhole	Adoptable

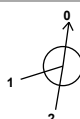
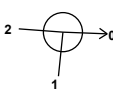
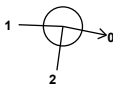
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Node Type	MH Type	Connections	Link	IL (m)	Dia (mm)	Link Type	
1	565189.130	174310.473	8.500	1.350	1200	Manhole	Adoptable		0	1.000	7.150	150	Circular
2	565178.055	174312.649	8.190	1.350	300	Manhole	Adoptable		1	1.000	6.840	150	Circular
								0	1.001	6.840	150	Circular	
3	565183.447	174318.072	8.360	1.300		Junction			0	2.000	7.060	100	Circular
4	565179.993	174318.746	8.320	1.320		Junction			1	2.000	7.000	100	Circular
								0	2.001	7.000	100	Circular	
5	565173.554	174319.701	8.000	1.350	600	Manhole	Adoptable		1	2.001	6.700	100	Circular
								2	1.001	6.650	150	Circular	
								0	1.002	6.650	150	Circular	

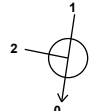
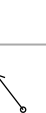
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Node Type	MH Type	Connections	Link	IL (m)	Dia (mm)	Link Type	
6	565174.643	174328.715	7.400	1.350	600	Manhole	Adoptable		1	1.002	6.050	150	Circular
7_Tank A	565188.317	174338.608	6.710	1.710	1000	Manhole	Adoptable		1	1.003	6.050	150	Circular
									0	1.004	5.000	150	Circular
8	565182.934	174340.626	6.740	1.300		Junction							
9	565184.023	174344.640	6.530	1.300		Junction							
									0	3.000	5.440	100	Circular
10	565185.367	174344.503	6.530	1.323	400	Manhole	Adoptable		1	4.000	5.207	100	Circular
									2	3.000	5.207	100	Circular
11	565184.656	174350.139	6.240	1.300		Junction							
									0	5.000	4.940	100	Circular
12	565186.403	174351.693	6.200	1.350	400	Manhole	Adoptable		1	5.000	4.900	100	Circular
									2	3.001	4.900	100	Circular
13	565190.210	174353.440	6.100	1.350	600	Manhole	Adoptable		0	3.002	4.850	150	Circular
									1	3.002	4.750	150	Circular
									2	1.004	4.750	150	Circular
									0	1.005	4.750	150	Circular

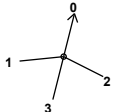
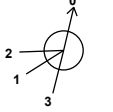
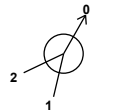
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Node Type	MH Type	Connections	Link	IL (m)	Dia (mm)	Link Type	
14	565185.513	174363.132	4.860	0.650		Junction							
								0	6.000	4.210	100	Circular	
15_Tank B	565192.195	174365.219	5.300	1.700	1200	Manhole	Adoptable		1	6.000	4.000	100	Circular
								2	1.005	4.570	150	Circular	
								0	1.006	3.600	150	Circular	
16	565178.069	174359.304	4.810	0.650		Junction							
								0	7.000	4.160	100	Circular	
17	565181.309	174385.099	4.000	0.380	400	Manhole	Adoptable		1	7.000	3.620	100	Circular
								0	7.001	3.620	150	Circular	
18	565186.328	174369.408	4.830	0.650		Junction							
								0	8.000	4.180	100	Circular	
19	565188.249	174384.371	4.320	1.020	600	Manhole	Adoptable		1	8.000	3.550	100	Circular
								2	7.001	3.550	150	Circular	
								0	7.002	3.300	150	Circular	
20_Tank C	565194.792	174384.120	4.400	1.575	1000	Manhole	Adoptable		1	7.002	3.235	150	Circular
								2	1.006	3.580	150	Circular	
								0	1.007	2.825	300	Circular	
21	565186.200	174393.242	4.020	0.450		Junction							
								0	9.000	3.570	225	Circular	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Node Type	MH Type	Connections	Link	IL (m)	Dia (mm)	Link Type	
22	565205.150	174390.558	4.090	0.320		Junction							
23	565204.986	174389.453	4.120	0.742	600	Manhole	Adoptable		1	10.000	3.770	100	Circular
								2	9.000	3.378	225	Circular	
								0	9.001	3.378	225	Circular	
24_Tank D	565203.921	174382.273	4.450	1.718	1200	Manhole	Adoptable		1	9.001	3.305	225	Circular
								2	1.007	2.732	300	Circular	
								0	1.008	2.732	225	Circular	
25	565212.538	174386.048	4.550	1.874	600	Manhole	Adoptable		1	1.008	2.676	225	Circular
									0	1.009	2.676	225	Circular
26	565184.731	174326.357	6.990	1.350	600	Manhole	Adoptable		0	11.000	5.640	150	Circular
									1	11.000	5.450	150	Circular
27	565195.037	174328.323	6.800	1.800	600	Manhole	Adoptable		0	11.001	5.000	150	Circular
									1	11.001	4.890	150	Circular
28	565201.764	174329.759	6.240	1.960	600	Manhole	Adoptable		0	11.002	4.280	150	Circular
29	565206.884	174346.252	5.270	1.300		Junction							
									0	12.000	3.970	100	Circular

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Node Type	MH Type	Connections	Link	IL (m)	Dia (mm)	Link Type	
30	565205.620	174347.898	5.260	1.670	600	Manhole	Adoptable		1 2 0	12.000 11.002 11.003	3.790 3.740 3.590	100 150 300	Circular Circular Circular
31	565209.467	174349.191	5.200	1.300		Junction			0	13.000	3.900	100	Circular
32	565203.837	174350.568	5.200	1.300	400	Manhole	Adoptable		0	14.000	3.900	100	Circular
33	565206.342	174350.769	5.190	1.613		Junction			1 2 3 0	14.000 13.000 11.003 11.004	3.777 3.777 3.577 3.577	100 100 300 300	Circular Circular Circular Circular
34	565198.017	174375.216	4.640	1.300	600	Manhole	Adoptable		0	15.000	3.340	100	Circular
35	565207.396	174372.444	4.650	1.300		Junction			0	16.000	3.350	100	Circular
36	565212.629	174375.743	4.580	1.720	600	Manhole	Adoptable		1 2 3 0	16.000 15.000 11.004 11.005	3.246 2.985 3.080 2.860	100 100 300 225	Circular Circular Circular Circular
37	565215.362	174387.396	4.500	1.850	600	Manhole	Adoptable		1 2 0	11.005 1.009 1.010	2.650 2.650 2.650	225 225 225	Circular Circular Circular

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Node Type	MH Type	Connections	Link	IL (m)	Dia (mm)	Link Type
37_OUT	565225.723	174405.602	4.140	1.614	1200	Manhole	Adoptable	1	1.010	2.526	225	Circular



Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	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 %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	30	45	10	0
30	0	0	0	100	45	10	0

Node 37_OUT Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		

Applies to All storms

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	-1.473	60	-0.047	120	1.177	180	2.493	240	3.099	300	2.595	360	1.283	420	-0.039
15	-1.066	75	0.260	135	1.582	195	2.696	255	2.999	315	2.293	375	0.978	435	-0.446
30	-0.760	90	0.566	150	1.887	210	2.897	270	2.898	330	1.990	390	0.573	450	-0.753
45	-0.353	105	0.872	165	2.190	225	2.999	285	2.797	345	1.687	405	0.267	465	-1.060

Node 7 Tank A Online Orifice Control

Flap Valve	x	Invert Level (m)	5.000	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.020		

Node 15 Tank B Online Orifice Control

Flap Valve	x	Invert Level (m)	3.600	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.020		

Node 7 Tank A Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Pit Width (m)	4.000	Inf Depth (m)	
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	5.000	Pit Length (m)	11.000	Number Required	1
Safety Factor	2.0	Time to half empty (mins)		Depth (m)	1.125		

Node 15 Tank B Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Pit Width (m)	6.500	Inf Depth (m)	
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	3.600	Pit Length (m)	6.000	Number Required	1
Safety Factor	2.0	Time to half empty (mins)		Depth (m)	1.125		

Node 20 Tank C Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Pit Width (m)	6.500	Inf Depth (m)	
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.825	Pit Length (m)	17.000	Number Required	1
Safety Factor	2.0	Time to half empty (mins)	56	Depth (m)	1.125		

Node 24 Tank D Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Pit Width (m)	5.000	Inf Depth (m)	
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.732	Pit Length (m)	7.500	Number Required	1
Safety Factor	2.0	Time to half empty (mins)	88	Depth (m)	1.125		

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	7.178	0.028	2.3	0.0319	0.0000	OK
15 minute summer	2	10	6.880	0.040	3.7	0.0029	0.0000	OK
15 minute summer	3	11	7.071	0.011	0.2	0.0000	0.0000	OK
15 minute summer	4	10	7.015	0.015	0.7	0.0000	0.0000	OK
15 minute summer	5	10	6.681	0.031	4.3	0.0088	0.0000	OK
15 minute summer	6	10	6.087	0.037	7.1	0.0106	0.0000	OK
360 minute summer	7_Tank A	272	5.201	0.201	2.2	8.5419	0.0000	SURCHARGED
15 minute summer	8	11	5.456	0.016	0.8	0.0000	0.0000	OK
15 minute summer	9	10	5.252	0.022	0.8	0.0000	0.0000	OK
15 minute summer	10	10	5.232	0.025	1.6	0.0031	0.0000	OK
15 minute summer	11	11	4.962	0.022	0.8	0.0000	0.0000	OK
15 minute summer	12	11	4.880	0.030	2.3	0.0038	0.0000	OK
15 minute summer	13	11	4.793	0.043	4.1	0.0120	0.0000	OK
15 minute winter	14	11	4.225	0.015	0.5	0.0000	0.0000	OK
480 minute winter	15_Tank B	368	3.799	0.199	1.1	7.5956	0.0000	SURCHARGED

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 summer	1	1.000	2	2.3	0.756	0.077	0.0343	
15 minute summer	2	1.001	5	3.7	1.147	0.136	0.0268	
15 minute summer	3	2.000	4	0.2	0.333	0.025	0.0021	
15 minute summer	4	2.001	5	0.7	0.861	0.050	0.0049	
15 minute summer	5	1.002	6	4.3	1.429	0.093	0.0274	
15 minute summer	6	1.003	7_Tank A	7.0	2.150	0.121	0.0213	
360 minute summer	7_Tank A	Orifice	13	0.4				
15 minute summer	8	3.000	10	0.8	0.711	0.058	0.0053	
15 minute summer	9	4.000	10	0.8	0.552	0.098	0.0019	
15 minute summer	10	3.001	12	1.5	1.063	0.124	0.0106	
15 minute summer	11	5.000	12	0.8	0.634	0.101	0.0030	
15 minute summer	12	3.002	13	2.4	0.715	0.086	0.0139	
15 minute summer	13	1.005	15_Tank B	4.1	1.021	0.161	0.0358	
15 minute winter	14	6.000	15_Tank B	0.5	0.685	0.047	0.0051	
480 minute winter	15_Tank B	Orifice	20_Tank C	0.4				

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	16	12	4.173	0.013	0.3	0.0000	0.0000	OK
15 minute summer	17	10	3.651	0.031	1.6	0.0039	0.0000	OK
15 minute summer	18	10	4.199	0.019	1.0	0.0000	0.0000	OK
15 minute summer	19	11	3.340	0.040	2.5	0.0113	0.0000	OK
480 minute winter	20_Tank C	392	3.077	0.252	3.1	26.6667	0.0000	OK
15 minute summer	21	10	3.611	0.041	3.8	0.0000	0.0000	OK
15 minute summer	22	1	3.770	0.000	0.0	0.0000	0.0000	OK
15 minute summer	23	11	3.420	0.042	3.8	0.0120	0.0000	OK
480 minute winter	24_Tank D	392	3.076	0.344	21.4	12.6259	0.0000	SURCHARGED
480 minute winter	25	384	3.072	0.396	32.2	0.1121	0.0000	SURCHARGED
15 minute summer	26	10	5.671	0.031	2.1	0.0087	0.0000	OK
15 minute summer	27	10	5.032	0.032	2.1	0.0090	0.0000	OK
15 minute summer	28	10	4.331	0.051	7.1	0.0143	0.0000	OK
15 minute summer	29	10	3.989	0.019	1.3	0.0000	0.0000	OK
15 minute summer	30	10	3.658	0.068	8.6	0.0193	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 summer	16	7.000	17	0.3	0.251	0.034	0.0342	
15 minute summer	17	7.001	19	1.5	0.605	0.087	0.0178	
15 minute summer	18	8.000	19	1.0	0.930	0.078	0.0159	
15 minute summer	19	7.002	20_Tank C	2.5	0.689	0.141	0.0238	
480 minute winter	20_Tank C	1.007	24_Tank D	21.2	0.637	0.191	0.6223	
15 minute summer	21	9.000	23	3.8	0.744	0.072	0.0968	
15 minute summer	22	10.000	23	0.0	0.000	0.000	0.0018	
15 minute summer	23	9.001	24_Tank D	3.7	0.741	0.071	0.0364	
480 minute winter	24_Tank D	1.008	25	32.2	0.901	0.806	0.3742	
480 minute winter	25	1.009	37	32.8	0.936	0.693	0.1244	
15 minute summer	26	11.000	27	2.1	0.819	0.086	0.0265	
15 minute summer	27	11.001	28	2.0	0.775	0.091	0.0182	
15 minute summer	28	11.002	30	7.1	1.379	0.232	0.0950	
15 minute summer	29	12.000	30	1.3	1.294	0.072	0.0021	
15 minute summer	30	11.003	33	8.5	0.805	0.116	0.0315	

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	31	11	3.919	0.019	0.9	0.0000	0.0000	OK
15 minute summer	32	10	3.919	0.019	1.0	0.0024	0.0000	OK
15 minute summer	33	11	3.634	0.057	12.0	0.0000	0.0000	OK
15 minute summer	34	10	3.362	0.022	1.0	0.0062	0.0000	OK
15 minute summer	35	11	3.379	0.029	1.4	0.0000	0.0000	OK
480 minute winter	36	384	3.079	0.219	2.0	0.0619	0.0000	OK
480 minute winter	37	384	3.081	0.431	33.0	0.1221	0.0000	SURCHARGED
240 minute summer	37_OUT	240	5.625	3.099	32.0	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 summer	31	13.000	33	0.9	0.866	0.079	0.0036	
15 minute summer	32	14.000	33	1.0	0.974	0.073	0.0026	
15 minute summer	33	11.004	36	12.0	1.307	0.077	0.2356	
15 minute summer	34	15.000	36	1.0	0.767	0.101	0.0182	
15 minute summer	35	16.000	36	1.4	0.748	0.178	0.0116	
480 minute winter	36	11.005	37	1.9	0.253	0.028	0.4740	
480 minute winter	37	1.010	37_OUT	34.3	0.945	0.859	0.8331	49.9

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	7.196	0.046	6.0	0.0517	0.0000	OK
15 minute summer	2	10	6.908	0.068	9.7	0.0049	0.0000	OK
30 minute summer	3	19	7.075	0.015	0.4	0.0000	0.0000	OK
15 minute summer	4	10	7.024	0.024	1.6	0.0000	0.0000	OK
15 minute summer	5	10	6.701	0.051	11.2	0.0144	0.0000	OK
15 minute summer	6	10	6.114	0.064	18.5	0.0181	0.0000	OK
480 minute summer	7_Tank A	352	5.470	0.470	3.9	20.0185	0.0000	SURCHARGED
15 minute summer	8	10	5.466	0.026	2.1	0.0000	0.0000	OK
15 minute summer	9	10	5.268	0.038	2.0	0.0000	0.0000	OK
15 minute summer	10	10	5.248	0.041	4.1	0.0052	0.0000	OK
15 minute summer	11	10	4.977	0.037	2.1	0.0000	0.0000	OK
15 minute summer	12	10	4.903	0.053	6.1	0.0067	0.0000	OK
15 minute summer	13	10	4.822	0.072	10.4	0.0205	0.0000	OK
15 minute summer	14	11	4.234	0.024	1.3	0.0000	0.0000	OK
1440 minute winter	15_Tank B	1080	4.099	0.499	1.3	19.0385	0.0000	SURCHARGED

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 summer	1	1.000	2	6.0	0.970	0.202	0.0697	
15 minute summer	2	1.001	5	9.6	1.470	0.357	0.0547	
30 minute summer	3	2.000	4	0.4	0.387	0.051	0.0038	
15 minute summer	4	2.001	5	1.6	1.109	0.120	0.0092	
15 minute summer	5	1.002	6	11.1	1.795	0.242	0.0565	
15 minute summer	6	1.003	7_Tank A	18.4	2.743	0.316	0.0437	
480 minute summer	7_Tank A	Orifice	13	0.6				
15 minute summer	8	3.000	10	2.1	0.896	0.152	0.0107	
15 minute summer	9	4.000	10	2.0	0.682	0.250	0.0039	
15 minute summer	10	3.001	12	4.0	1.369	0.322	0.0214	
15 minute summer	11	5.000	12	2.1	0.819	0.262	0.0059	
15 minute summer	12	3.002	13	6.1	0.874	0.220	0.0292	
15 minute summer	13	1.005	15_Tank B	10.3	1.296	0.410	0.0719	
15 minute summer	14	6.000	15_Tank B	1.3	0.903	0.123	0.0101	
1440 minute winter	15_Tank B	Orifice	20_Tank C	0.6				

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	16	10	4.181	0.021	0.9	0.0000	0.0000	OK
15 minute summer	17	10	3.672	0.052	4.3	0.0066	0.0000	OK
15 minute summer	18	10	4.211	0.031	2.6	0.0000	0.0000	OK
360 minute summer	19	376	3.406	0.106	1.4	0.0300	0.0000	OK
360 minute summer	20_Tank C	376	3.406	0.581	11.7	61.4293	0.0000	SURCHARGED
15 minute summer	21	10	3.637	0.067	10.0	0.0000	0.0000	OK
15 minute summer	22	1	3.770	0.000	0.0	0.0000	0.0000	OK
15 minute summer	23	10	3.449	0.071	9.9	0.0202	0.0000	OK
360 minute summer	24_Tank D	376	3.406	0.674	30.6	24.7684	0.0000	SURCHARGED
360 minute summer	25	376	3.406	0.730	40.4	0.2065	0.0000	SURCHARGED
15 minute summer	26	10	5.692	0.052	5.6	0.0146	0.0000	OK
15 minute summer	27	10	5.054	0.054	5.6	0.0153	0.0000	OK
15 minute summer	28	10	4.370	0.090	18.9	0.0255	0.0000	OK
15 minute summer	29	10	4.002	0.032	3.5	0.0000	0.0000	OK
15 minute summer	30	10	3.703	0.113	22.7	0.0320	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 summer	16	7.000	17	0.9	0.327	0.098	0.0697	
15 minute summer	17	7.001	19	4.1	0.790	0.233	0.0368	
15 minute summer	18	8.000	19	2.6	1.233	0.208	0.0320	
360 minute summer	19	7.002	20_Tank C	1.4	0.584	0.078	0.1012	
360 minute summer	20_Tank C	1.007	24_Tank D	30.6	0.667	0.275	0.6559	
15 minute summer	21	9.000	23	9.9	0.959	0.191	0.1982	
15 minute summer	22	10.000	23	0.0	0.000	0.000	0.0033	
15 minute summer	23	9.001	24_Tank D	9.8	0.961	0.188	0.0739	
360 minute summer	24_Tank D	1.008	25	40.4	1.016	1.010	0.3742	
360 minute summer	25	1.009	37	40.7	1.023	0.860	0.1244	
15 minute summer	26	11.000	27	5.6	1.073	0.232	0.0544	
15 minute summer	27	11.001	28	5.5	1.009	0.245	0.0377	
15 minute summer	28	11.002	30	18.8	1.756	0.616	0.1981	
15 minute summer	29	12.000	30	3.5	1.686	0.194	0.0043	
15 minute summer	30	11.003	33	22.7	1.057	0.309	0.0635	

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	31	10	3.931	0.031	2.4	0.0000	0.0000	OK
15 minute summer	32	10	3.931	0.031	2.6	0.0040	0.0000	OK
15 minute summer	33	10	3.670	0.093	31.7	0.0000	0.0000	OK
360 minute summer	34	376	3.407	0.067	0.5	0.0189	0.0000	OK
360 minute summer	35	376	3.405	0.055	0.7	0.0000	0.0000	OK
360 minute summer	36	376	3.406	0.546	8.2	0.1544	0.0000	SURCHARGED
360 minute summer	37	376	3.406	0.756	41.3	0.2139	0.0000	SURCHARGED
15 minute winter	37_OUT	240	5.625	3.099	43.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	31	13.000	33	2.4	1.148	0.209	0.0073	
15 minute summer	32	14.000	33	2.6	1.274	0.193	0.0052	
15 minute summer	33	11.004	36	31.4	1.718	0.203	0.4719	
360 minute summer	34	15.000	36	0.5	0.592	0.052	0.0979	
360 minute summer	35	16.000	36	0.7	0.613	0.089	0.0380	
360 minute summer	36	11.005	37	8.0	0.441	0.116	0.4760	
360 minute summer	37	1.010	37_OUT	41.9	1.085	1.051	0.8331	101.4

Results for 30 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	7.208	0.058	9.5	0.0660	0.0000	OK
15 minute summer	2	10	6.932	0.092	15.5	0.0065	0.0000	OK
15 minute summer	3	11	7.080	0.020	0.7	0.0000	0.0000	OK
15 minute summer	4	10	7.031	0.031	2.6	0.0000	0.0000	OK
15 minute summer	5	10	6.717	0.067	17.9	0.0189	0.0000	OK
15 minute summer	6	10	6.137	0.087	29.7	0.0245	0.0000	OK
480 minute winter	7_Tank A	384	5.797	0.797	4.2	33.9512	0.0000	SURCHARGED
15 minute summer	8	10	5.474	0.034	3.4	0.0000	0.0000	OK
15 minute summer	9	10	5.282	0.052	3.2	0.0000	0.0000	OK
15 minute summer	10	10	5.262	0.055	6.6	0.0070	0.0000	OK
15 minute summer	11	10	4.988	0.048	3.3	0.0000	0.0000	OK
15 minute summer	12	10	4.923	0.073	9.8	0.0091	0.0000	OK
15 minute summer	13	10	4.848	0.098	16.6	0.0277	0.0000	OK
2160 minute winter	14	1620	4.453	0.243	0.1	0.0000	0.0000	SURCHARGED
2160 minute winter	15_Tank B	1620	4.453	0.853	1.4	32.5833	0.0000	SURCHARGED

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 summer	1	1.000	2	9.5	1.075	0.320	0.0993	
15 minute summer	2	1.001	5	15.3	1.628	0.571	0.0788	
15 minute summer	3	2.000	4	0.7	0.450	0.088	0.0056	
15 minute summer	4	2.001	5	2.6	1.274	0.197	0.0132	
15 minute summer	5	1.002	6	17.9	1.975	0.388	0.0822	
15 minute summer	6	1.003	7_Tank A	29.5	3.040	0.506	0.0631	
480 minute winter	7_Tank A	Orifice	13	0.7				
15 minute summer	8	3.000	10	3.4	1.003	0.246	0.0155	
15 minute summer	9	4.000	10	3.2	0.747	0.402	0.0058	
15 minute summer	10	3.001	12	6.5	1.535	0.519	0.0307	
15 minute summer	11	5.000	12	3.3	0.919	0.414	0.0083	
15 minute summer	12	3.002	13	9.7	0.943	0.353	0.0432	
15 minute summer	13	1.005	15_Tank B	16.4	1.434	0.652	0.1032	
2160 minute winter	14	6.000	15_Tank B	0.1	0.421	0.009	0.0548	
2160 minute winter	15_Tank B	Orifice	20_Tank C	0.8				

Results for 30 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	16	10	4.187	0.027	1.4	0.0000	0.0000	OK
360 minute winter	17	360	3.728	0.108	0.9	0.0136	0.0000	OK
15 minute summer	18	10	4.221	0.041	4.2	0.0000	0.0000	OK
360 minute winter	19	360	3.728	0.428	1.4	0.1211	0.0000	SURCHARGED
360 minute winter	20_Tank C	360	3.728	0.903	11.9	95.5229	0.0000	SURCHARGED
360 minute winter	21	360	3.729	0.159	2.0	0.0000	0.0000	OK
15 minute summer	22	1	3.770	0.000	0.0	0.0000	0.0000	OK
360 minute winter	23	360	3.729	0.351	2.0	0.0992	0.0000	SURCHARGED
360 minute winter	24_Tank D	360	3.728	0.996	34.1	36.6218	0.0000	SURCHARGED
360 minute winter	25	360	3.728	1.052	45.6	0.2976	0.0000	SURCHARGED
15 minute summer	26	10	5.708	0.068	9.0	0.0191	0.0000	OK
15 minute summer	27	10	5.071	0.071	8.9	0.0202	0.0000	OK
15 minute summer	28	10	4.414	0.134	30.2	0.0380	0.0000	OK
15 minute summer	29	10	4.012	0.042	5.5	0.0000	0.0000	OK
15 minute summer	30	10	3.737	0.147	36.3	0.0416	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 summer	16	7.000	17	1.4	0.370	0.156	0.0962	
360 minute winter	17	7.001	19	0.9	0.519	0.051	0.1095	
15 minute summer	18	8.000	19	4.2	1.404	0.336	0.0453	
360 minute winter	19	7.002	20_Tank C	1.4	0.587	0.079	0.1153	
360 minute winter	20_Tank C	1.007	24_Tank D	34.1	0.609	0.307	0.6559	
360 minute winter	21	9.000	23	2.0	0.621	0.038	0.6688	
15 minute summer	22	10.000	23	0.0	0.000	0.000	0.0042	
360 minute winter	23	9.001	24_Tank D	2.0	0.622	0.038	0.2887	
360 minute winter	24_Tank D	1.008	25	45.6	1.146	1.140	0.3742	
360 minute winter	25	1.009	37	45.9	1.154	0.970	0.1244	
15 minute summer	26	11.000	27	8.9	1.210	0.372	0.0774	
15 minute summer	27	11.001	28	8.9	1.134	0.394	0.0538	
15 minute summer	28	11.002	30	29.9	1.869	0.981	0.3173	
15 minute summer	29	12.000	30	5.5	1.888	0.305	0.0060	
15 minute summer	30	11.003	33	36.2	1.212	0.494	0.0896	

Results for 30 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	31	10	3.940	0.040	3.8	0.0000	0.0000	OK
15 minute summer	32	10	3.941	0.041	4.2	0.0052	0.0000	OK
360 minute winter	33	360	3.729	0.152	6.4	0.0000	0.0000	OK
360 minute winter	34	360	3.729	0.389	0.5	0.1101	0.0000	SURCHARGED
360 minute winter	35	360	3.731	0.381	0.8	0.0000	0.0000	SURCHARGED
360 minute winter	36	360	3.728	0.868	8.6	0.2458	0.0000	SURCHARGED
360 minute winter	37	360	3.730	1.080	46.6	0.3057	0.0000	SURCHARGED
480 minute summer	37_OUT	240	5.625	3.099	48.5	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)
15 minute summer	31	13.000	33	3.8	1.303	0.331	0.0101	
15 minute summer	32	14.000	33	4.2	1.442	0.312	0.0074	
360 minute winter	33	11.004	36	6.4	1.042	0.041	1.3686	
360 minute winter	34	15.000	36	0.5	0.592	0.053	0.1144	
360 minute winter	35	16.000	36	0.8	0.639	0.102	0.0484	
360 minute winter	36	11.005	37	8.0	0.519	0.116	0.4760	
360 minute winter	37	1.010	37_OUT	47.2	1.187	1.183	0.8331	158.1

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	7.217	0.067	12.2	0.0760	0.0000	OK
15 minute summer	2	10	6.949	0.109	19.8	0.0078	0.0000	OK
15 minute summer	3	11	7.083	0.023	0.9	0.0000	0.0000	OK
15 minute summer	4	10	7.035	0.035	3.3	0.0000	0.0000	OK
15 minute summer	5	10	6.728	0.078	23.0	0.0220	0.0000	OK
960 minute summer	6	660	6.306	0.256	3.8	0.0725	0.0000	SURCHARGED
960 minute summer	7_Tank A	660	6.306	1.306	5.1	48.0711	0.0000	SURCHARGED
15 minute summer	8	10	5.478	0.038	4.3	0.0000	0.0000	OK
15 minute summer	9	10	5.292	0.062	4.1	0.0000	0.0000	OK
15 minute summer	10	10	5.272	0.065	8.3	0.0082	0.0000	OK
960 minute winter	11	900	5.102	0.162	0.3	0.0000	0.0000	SURCHARGED
960 minute winter	12	900	5.102	0.252	0.9	0.0317	0.0000	SURCHARGED
960 minute winter	13	900	5.102	0.352	2.2	0.0995	0.0000	SURCHARGED
720 minute winter	14	705	4.860	0.650	0.2	0.0000	0.0000	FLOOD RISK
960 minute winter	15_Tank B	900	5.101	1.501	2.8	43.3978	0.0000	FLOOD RISK

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 summer	1	1.000	2	12.1	1.126	0.411	0.1208	
15 minute summer	2	1.001	5	19.7	1.705	0.733	0.0961	
15 minute summer	3	2.000	4	0.9	0.484	0.114	0.0067	
15 minute summer	4	2.001	5	3.3	1.360	0.251	0.0157	
15 minute summer	5	1.002	6	22.9	2.056	0.498	0.1010	
960 minute summer	6	1.003	7_Tank A	3.8	1.551	0.065	0.1144	
960 minute summer	7_Tank A	Orifice	13	1.0				
15 minute summer	8	3.000	10	4.3	1.053	0.311	0.0187	
15 minute summer	9	4.000	10	4.1	0.776	0.513	0.0071	
15 minute summer	10	3.001	12	8.3	1.613	0.660	0.0372	
960 minute winter	11	5.000	12	0.3	0.478	0.038	0.0183	
960 minute winter	12	3.002	13	0.9	0.492	0.033	0.0737	
960 minute winter	13	1.005	15_Tank B	2.2	0.856	0.085	0.1584	
720 minute winter	14	6.000	15_Tank B	0.2	0.520	0.019	0.0548	
960 minute winter	15_Tank B	Orifice	20_Tank C	1.0				

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	16	10	4.191	0.031	1.8	0.0000	0.0000	OK
360 minute winter	17	320	4.000	0.380	4.7	0.0479	9.0141	FLOOD
15 minute summer	18	10	4.226	0.046	5.3	0.0000	0.0000	OK
480 minute winter	19	352	4.011	0.711	6.0	0.2013	0.0000	SURCHARGED
480 minute winter	20_Tank C	352	4.021	1.196	12.6	119.0886	0.0000	SURCHARGED
480 minute winter	21	352	4.020	0.450	2.2	0.0000	0.0000	FLOOD RISK
480 minute winter	22	352	4.021	0.251	0.5	0.0000	0.0000	FLOOD RISK
480 minute winter	23	352	4.022	0.644	2.2	0.1822	0.0000	FLOOD RISK
480 minute winter	24_Tank D	352	4.020	1.288	36.4	41.5526	0.0000	SURCHARGED
480 minute winter	25	352	4.024	1.348	48.6	0.3814	0.0000	SURCHARGED
15 minute summer	26	10	5.718	0.078	11.5	0.0222	0.0000	OK
15 minute summer	27	10	5.083	0.083	11.4	0.0236	0.0000	OK
15 minute summer	28	11	4.841	0.561	38.7	0.1589	0.0000	SURCHARGED
480 minute winter	29	352	4.023	0.053	0.8	0.0000	0.0000	OK
480 minute winter	30	352	4.023	0.433	5.0	0.1226	0.0000	SURCHARGED

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 summer	16	7.000	17	1.8	0.398	0.202	0.1135	
360 minute winter	17	7.001	19	-4.5	0.549	-0.254	0.1235	
15 minute summer	18	8.000	19	5.3	1.493	0.426	0.0539	
480 minute winter	19	7.002	20_Tank C	-5.8	0.574	-0.324	0.1153	
480 minute winter	20_Tank C	1.007	24_Tank D	35.6	0.655	0.320	0.6559	
480 minute winter	21	9.000	23	2.2	0.644	0.042	0.7622	
480 minute winter	22	10.000	23	-0.5	-0.061	-0.013	0.0087	
480 minute winter	23	9.001	24_Tank D	2.1	0.621	0.040	0.2887	
480 minute winter	24_Tank D	1.008	25	48.5	1.219	1.212	0.3742	
480 minute winter	25	1.009	37	48.9	1.230	1.034	0.1244	
15 minute summer	26	11.000	27	11.4	1.283	0.476	0.0933	
15 minute summer	27	11.001	28	11.3	1.200	0.503	0.0649	
15 minute summer	28	11.002	30	37.5	2.129	1.231	0.3264	
480 minute winter	29	12.000	30	0.8	1.128	0.045	0.0125	
480 minute winter	30	11.003	33	5.0	0.692	0.068	0.2084	

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	31	352	4.024	0.124	0.5	0.0000	0.0000	SURCHARGED
480 minute winter	32	352	4.024	0.124	0.6	0.0156	0.0000	SURCHARGED
480 minute winter	33	352	4.024	0.447	7.0	0.0000	0.0000	SURCHARGED
480 minute winter	34	352	4.023	0.683	0.6	0.1932	0.0000	SURCHARGED
480 minute winter	35	352	4.022	0.672	0.8	0.0000	0.0000	SURCHARGED
480 minute winter	36	352	4.023	1.163	9.0	0.3290	0.0000	SURCHARGED
480 minute winter	37	352	4.020	1.370	51.4	0.3877	0.0000	SURCHARGED
480 minute summer	37_OUT	240	5.625	3.099	51.7	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)
480 minute winter	31	13.000	33	0.5	0.728	0.044	0.0274	
480 minute winter	32	14.000	33	0.6	0.847	0.045	0.0199	
480 minute winter	33	11.004	36	7.0	0.994	0.045	1.8135	
480 minute winter	34	15.000	36	0.5	0.541	0.053	0.1144	
480 minute winter	35	16.000	36	0.8	0.615	0.102	0.0484	
480 minute winter	36	11.005	37	8.7	0.490	0.126	0.4760	
480 minute winter	37	1.010	37_OUT	52.0	1.309	1.305	0.8331	221.0

Operation and Maintenance Schedule – Geo-Cellular Storage System

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months then annually
	Remove debris and sediment from the catchment surface, wherever it presents a risk to the performance of the drainage system,	Monthly, or as required based on inspection frequencies.
	Remove sediment from pre-treatment structures (e.g. sediment traps) and from internal forebays	Annually or as required based on inspection frequencies
Remedial Actions	Repair; inlets, outlets, overflow pipes, and vent mechanisms	As required, based on inspections
	Replace tank or geotextile if significant damage is observed or geotextile is torn.	As required
Monitoring	Inspect and check all inlets, outlets, vents, and overflows to ensure that they are in good condition and operating as designed.	Following installation, and annually hereafter
	Survey inside of tank, and at any sediment trap mechanisms, for sediment build-up and remove sediment if necessary. Use inspections to develop a regular maintenance and inspection procedure for sediment removal.	Every 5 years, or as required if inspections show high siltation rates.

General Operation and Maintenance Table for Geo-Cellular Storage Systems



Installation & Maintenance

SDS Aqua Swirl™ Hydrodynamic Separator

Aqua-Swirl™ systems are fabricated from high performance HDPE materials; they are durable lightweight and can be installed without use of heavy lifting equipment.

Lifting support Straps are provided to allow easy off loading and installation, resulting in significantly reduced installation costs.

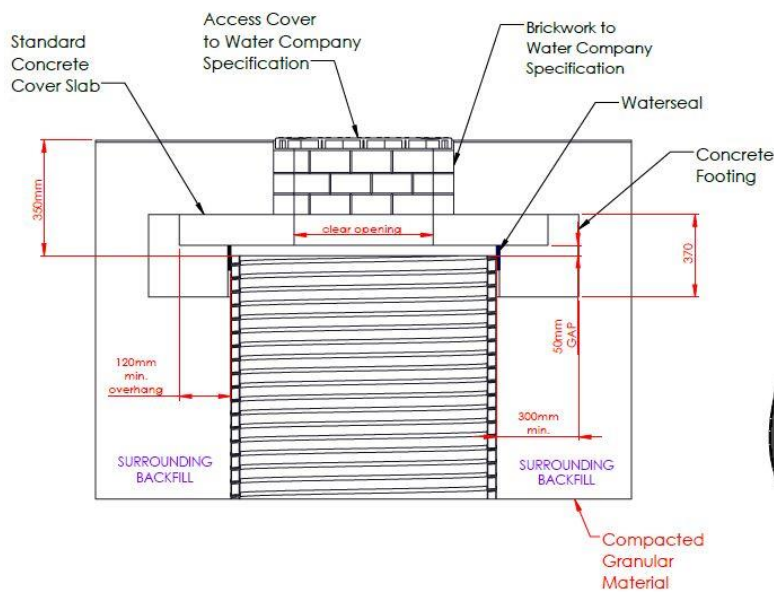
Installation:

- 1) Excavation to required size and depth allowing for 600mm around each side of the unit
- 2) Prepare the bed with 20-40mm clean stone to a depth of 300mm
- 3) Compacted in 150mm layers to ASTM D 2321 to a proctor density of 95%
- 4) Install the unit and backfill with 20-40mm clean stone in 150mm layers to ASTM D 2321 enough backfill should be placed over components prior to using heavy compaction or construction equipment to prevent damage.
- 5) Connect to drainage network pipework with rubber couplings like Fernco, Flex Seal or Band Seal.
- 6) The Aqua Swirl has a round base box section plate extending 100mm from the outside diameter to provide mitigation against buoyancy, concrete can be poured directly over and into the base plate if required to provide additional resistive force.
- 7) Aqua Swirls of AS-6 and above have both a base plate and top plate
- 8) The riser pipe is supplied to the required length to allow for a standard UK man hole installation detail and can be cut to size on site to the required depth.
- 9) Where traffic loading is required a reinforced concrete pad must be placed over the entire Aqua swirl as per design calculated by engineer.
- 10) If traffic loading is not required, it's recommended that bollards are placed around access risers in non-traffic areas to prevent inadvertent loadings by maintenance vehicles.

Product illustration:



Manhole Detail



BBA HAPAS Approval:

- 11) Aqua Swirls & Filters are made from a structured wall HDPE pipe. The pipes are produced by extrusion of a hollow box section in polyethylene which is continuously wound onto a mandrel; successive turns being welded together by hot polyethylene melt supplied by an auxiliary extruder. Weholite is a Kitemarked product, license number KM 560128 which, is backed up with a quality management system to BS EN ISO 9000 : 2008, Certificate No. FM 12306. The HDPE pipe is manufactured in accordance with BS EN 13476 -2 : 2007 and carry BSI Kitemark and WRC accreditation to this standard. All fittings are manufactured from the same material and in the same stiffness as the pipes, in accordance with BS EN 13476 – 2:2007. Weholite pipes, fittings and fabrication (systems) have BBA HAPAS certification (18/H283).

System Operation:

The Aqua-Swirl®

Can be installed in an “off-line” configuration. Or, depending on local regulations, an “in-line” (on-line) conveyance flow diversion system can be used. The CFD model allows simple installation by connecting directly to the existing storm conveyance pipe thereby providing full treatment of the “first flush,” while the peak design storm is diverted and channelled through the main conveyance pipe

The patented Aqua-Swirl® Stormwater Treatment System provides a highly effective means for the removal of sediment, floating debris, and free oil. Swirl technology, or vortex separation, is a proven form of treatment utilized in the Stormwater industry to accelerate gravitational separation.

The treatment operation begins when Stormwater enters the Aqua-Swirl® through a tangential inlet pipe that produces a circular (or vortex) flow pattern that causes contaminants to settle to the base of the unit. Since Stormwater flow is intermittent by nature, the Aqua-Swirl® retains water between storm events providing both dynamic and quiescent settling of solids. The dynamic settling occurs during each storm event while the quiescent settling takes place between successive storms.

A combination of gravitational and hydrodynamic drag forces encourages the solids to drop out of the flow and migrate to the center of the chamber where velocities are the lowest.

The treated flow then exits the Aqua-Swirl® behind the arched outer baffle. The top of the baffle is sealed across the treatment channel, thereby eliminating floatable pollutants from escaping the system. A vent pipe is extended up the riser to expose the backside of the baffle to atmospheric conditions, preventing a siphon from forming at the bottom of the baffle.

Maintenance:

Long term performance of the Aqua Swirl or any other device depends on inspection and maintenance program.

Recommended schedule in line with Ciria C753 guidance

On hand over – 3 months -6 months -12 months and then annually or as deemed necessary from details obtain from previous inspections.

Each site sediment loadings will be different and at its highest just after the build phase, hence why a more frequent visit is required at the start of the programme.

The Aqua-Swirl® has been designed to minimize and simplify the inspection and maintenance process. The single chamber system can be inspected and maintained entirely from the surface thereby eliminating the need for confined space entry. Furthermore, the entire structure (specifically, the floor) is accessible for visual inspection from the surface. There are no areas of the structure that are blocked from visual inspection or periodic cleaning. Inspection of any free- floating oil and floatable debris can be directly observed and maintained through the manhole access provided directly over the swirl chamber.

Inspection:

To inspect the Aqua-Swirl[®], remove the manhole cover.

The only tools needed to inspect the Aqua-Swirl[®] system are a flashlight and a measuring device such as a stadia rod or pole. Given the easy and direct accessibility provided, floating oil and debris can be observed directly from the surface. Sediment depths can easily be determined by lowering a measuring device to the top of the sediment pile and to the surface of the water. When the sediment pile is within 42 to 48 inches of the water surface (or sediment pile thickness is 18 to 24 inches as measured from the base), the system should be maintained. The maximum

Sediment storage capacity of the Aqua-Swirl[®] is reached when the sediment pile is within 30 inches of the water surface (or sediment accumulation is 36 inches thick as measured from the base).

It should be noted that to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile. Keep in mind that the finer sediment at the top of the pile may offer less resistance to the measuring device than the larger particles which typically occur deeper within the sediment pile.

The Aqua-Swirl[®] design allows for the sediment to accumulate in a semi-conical fashion as illustrated above. That is, the depth to sediment as measured below the water surface may be less in the center of the swirl chamber; and likewise, may be greater at the edges of the swirl chamber.

Removal:

Cleaning the Aqua-Swirl[®] is simple and quick. Free-floating oil and floatable debris can be observed and removed directly through the 750mm service access riser provided. A vacuum truck is typically used to remove the accumulated sediment and debris. An advantage of the

Aqua-Swirl[®] design is that the entire sediment storage area can be reached with a vacuum hose from the surface (reaching all the sides). Since there are no multiple or limited (hidden or "blind") chambers in the Aqua-Swirl[®], there are no restrictions to impede on-site maintenance tasks.

Disposal:

All removed products should be disposed of in line with local council requirements



247 DRAINAGEUK LTD
 1 BLACHINGTON ROAD
 HOVE
 Tel: 01273 257 352
 Fax:
 Email: info@247drainageuk.com

Project-information

Project name :
Custom House

Project Number :

Contact :

Date :
15/10/2021

Client: **Mile Property Group**

Contact Name:

Department:

Road:

Town:

County:

Telephone:

Fax:

Mobile:

E-mail:

Site: **Custom House**

Contact Name:

Department:

Road: **The Terrace**

Town: **Gravesend**

County: **Kent, DA12 2BW**

Telephone:

Fax:

Mobile:

E-mail:

Contractor **247 DRAINAGEUK LTD**

Contact Name:

Department:

Road: **1 BLACHINGTON ROAD**

Town: **HOVE**

County:

Telephone: **01273 257 352**

Fax:

Mobile:

E-mail: **info@247drainageuk.com**

Defect Grade Description

Project Name :
Custom House

Project number :

Contact :

Date :
15/10/2021

1:

Brick: No Structural Defects
 Pipe: No Structural Defects

Acceptable Structural Condition

2:

Brick: Minor cracking, Surface mortar loss, Spalling slight, wear slight
 Pipe: Circumfrential crack, Moderate joint defects, Spalling slight, Wear slight

Minor collapse risk in short term but potential for further deterioration

3:

Brick: Total mortorloss without other defects, single brick displaced, Deformation up to 5%, Spalling medium, Wear medium
 Pipe: Fractures with deformation up tp 5%, Longitudinal cracking or mulitlpe cracking, Minor loss of level, More severe joint

! Collapse unlikely in near future but future deterioration likely !

4:

Brick: Total mortorloss with deformation greater than 10%, Deformation up to 10% and fractured, Displaced/hanging brickwork, Small number of missing bricks
 Pipe: Broken, Deformation up to 10% and broken,, Fractured with deformation 5 - 10%, Multipl

!! Collapse likely in foreseeable future !!

5:

Brick: Already Collapsed, Missing invert, Deformation over 10% and fractured, Displaced/hanging brickwork and deformation over 10%, Extensive missing bricks
 Pipe: Already collapsed, Deformation over 10% and broken, Extensive areas of fabric missin

!!! Collapsed or collapse imminent !!!

Place:



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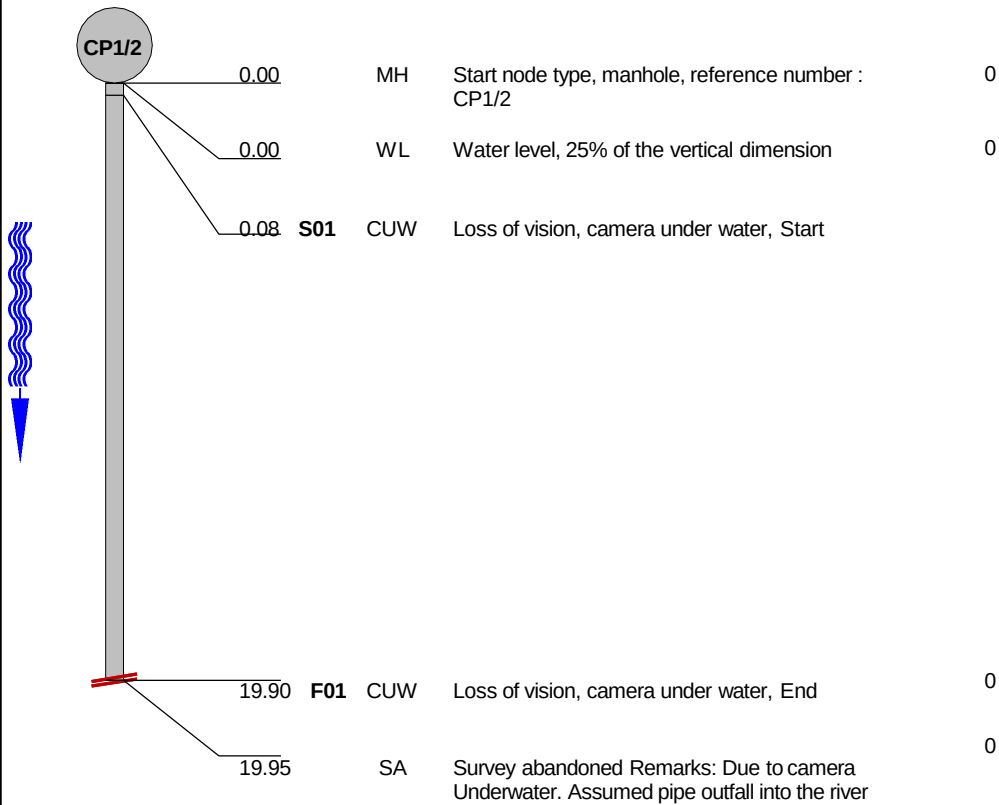
Inspection report

Date : 06/10/2021	Job number :	Weather : no rain or snow	Operator : JF PD	Section number : 1	PLR SUFFIX: X
Weather no rain or snow	Vehicle :	Camera : Push Rod	Preset :	Cleaned :	Operator : JF PD

Place : Road : Location Inspection	Gravesend Custom House, The Terrace Other (state in comments) CP1/2 (D/S) Outlet	Location details: Catchment: Tape number : Pipe Length	U/S MH : U/S Depth : D/S MH : D/S Depth :	CP1/2 3.2 Outlet
Direction Use: Year laid : Purpose : Total length :	Surface water Z Sample survey to determine asset condition 19.95 m	Pipe shape : Pipe size : Pipe material : Lining :	Circular 225 mm Vitrified clay	

Comment :

1:50 Position Code Observation Grade
Depth: 3.2



STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Place:



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ΣØ / Main sections and Site map

Project name :
Custom House

Project number :

Contact :

Date :
15/10/2021

Nr.	US MH	DS MH	Date	Road	Tape No.	Material	m	(m)
1	CP1/2	Outlet	06/10/2021	Custom House, The Terrace		Vitrified clay	19.95	19.95

Pipe size: CIRCULAR 225

Site map showing approximate location of CP1/2



Place :



247 DRAINAGEUK LTD
 1 BLACHINGTON ROAD
 HOVE
 Tel: 01273 257 352
 Fax:
 Email: info@247drainageuk.com

Service / Operational Defects (SRM 4)

Project name :
Custom House

Project Number :

Contact :

Date :
15/10/2021

No.	PLR	Dir.	Use	Shape / Size	Date	Mat.	Total Length	Insp. Length	Peak HWG	Peak Score	Grade	Mean Score	Total Score
1	CP1/2X	D	S	C 225	06/10/2021	VC	19.95	19.95	-	0	1	0	0

Place :



247 DRAINAGEUK LTD
 1 BLACHINGTON ROAD
 HOVE
 Tel: 01273 257 352
 Fax:
 Email: info@247drainageuk.com

Structural Defects (SRM 4)

Project name :
Custom House

Project Number :

Contact :

Date :
15/10/2021

No.	PLR	Dir.	Use	Shape / Size	Date	Mat.	Total Length	Insp. Length	Peak HWG	Peak Score	Grade	Mean Score	Total Score
1	CP1/2X	D	S	C 225	06/10/2021	VC	19.95	19.95	-	0	1	0	0