Cairn Homes Properties Ltd.

Strategic Housing Development

Castletreasure

Services Infrastructure Report

April 2019

BARRY & PARTNERS
consulting engineers

CIVIL • STRUCTURAL • ENVIRONMENTAL • TRANSPORTATION

Document Control Sheet

Client:	**Cairn Homes Properties Ltd**
Project Title:	Strategic Housing Development Castletreasure
Document Title:	Services/Infrastructure Report
File Name:	18203-JBB-1B-XX-RP-C-0091_Services_Infrastructure

Table of Contents *(incl. Y/N)*	**List of Tables** *(incl. Y/N)*	**List of Figures** *(incl. Y/N)*	**Pages of Text** *(No.)*	**Appendices** *(No.)*
Y	N	N	8	4

Document Revision				**Document Verification**			
Issue Date *(DD/MM/YY)*	**Revision Code**	**Suitability Code**	**Author** *(Initials)*	**Checker** *(Initials)*	***Reviewer*** As Per PMP *(Initials)*	**Approver** *As Per PMP (Initials)*	**Peer Review** *(Initials or N/A)*
28/06/18	P01	S3	TF		PMC	TF	N/A
17/07/18	P02	S3	TF		PMC	TF	N/A
06/09/18	P03	S3	JF	JF	PMC	TF	N/A
12/09/18	P04	S4	JF	JF	PMC	TF	N/A
11/02/19	P05	S4	JF	PMcE	TF	TF	N/A
25/03/19	P06	S4	JF	PMcE	TF	TF	N/A
17/04/19	P07	S4	JF	PMcE	TF	TF	N/A
23/04/19	P08	S4	JF	PMcE	TF	TF	N/A
25/04/19	P09	S4	JF	PMcE	TF	TF	N/A

Table of Contents

SECTION 1: INTRODUCTION

This report is prepared in support of a planning application for the proposed development of 472 houses and apartments on a circa 21.9 hectare site at Castletreasure, Douglas, Co. Cork. This report outlines the proposed means of servicing the development with roads/access/parking along with foul sewers/stormwater sewers and stormwater attenuation/water supply and the “other” services required to serve a housing development.

An Environmental Impact Assessment Report (EIAR) is prepared in support of the planning application which sets out in detail the various services/infrastructure available on and in the vicinity of the site and assesses the impacts of the proposed development on this existing infrastructure. The EIAR should be consulted for more extensive information on existing services/infrastructure.

This Services/Infrastructure Report should be read in conjunction with the engineering drawings which illustrate and detail the servicing proposals, and with the submissions by other members of the Applicant’s design team.

SECTION 2: ROADS/TRAFFIC/TRANSPORT

The proposed development is to be accessed primarily via a new junction with the R609 (Carrs Hill) which runs along the eastern boundary of the site.

There will be a secondary access from the R609 to the eastern sector of the site where 98 apartment-type units are proposed. There will be no road link between this sector and the remainder of the site, but there will be pedestrian and cyclist connections.

A further access is proposed via the existing roads serving the Vicarage housing and Temple Grove apartment developments immediately to the north of the site. These developments are served by an existing, uncontrolled T-junction connection with the R609.

The proposed main access to/from the R609 is at an entrance already submitted for planning by the Department of Education and Skills for a new primary school along the R609 at the north-eastern boundary of the site. This primary school has been permitted under Cork County Council planning application ref. 18/5369/ An Bord Pleanála ref. ABP-302924-18. This access has been designed to accommodate access to the proposed school and the proposed housing development.

A signalised junction is proposed for this primary access point, with a right-turn lane for incoming and outgoing vehicles. The other two access points are proposed as uncontrolled junctions with the R609.

A bus set-down area has been provided for on the southern side of the R609 adjacent to the school site to facilitate public transport provision to the school and the housing development.

The proposed signalised junction has been assessed for capacity based on predicted trip generation due to the fully operational school and the completed housing development and has been shown to operate within capacity.

To achieve the primary access from the R609 to the development site requires a new bridge to be constructed to span over the Moneygurney Stream, which is in a deep valley, and the existing 1200mm diameter trunk watermain which runs on a line parallel to the stream, along the eastern side of the site. The bridge will be a two-span structure with spans of approximately 33m each and the bridge deck will be approximately 13m over the level of the stream below.

A public Greenway route along the line of the Moneygurney Stream is proposed to be developed in conjunction with Cork County Council, to tie-into the existing Greenway recently completed further to the north. This Greenway will provide pedestrian and cyclist linkages to and from the school and housing development site and ensure strong connectivity with Douglas Village and the immediate hinterland.

The development layout facilitates travel to and through the overall scheme, ensuring full permeability for vehicle, cycle and pedestrian traffic in the area.

Within the proposed development main access roads are to be 6.0m wide with 2.0m wide footpaths as shown on the attached drawings. In residential development pockets road widths are reduced, shared surface and pedestrian priority areas are introduced, in accordance with the recommendations of DMURS.

The layout of the development facilitates turning for service vehicles and ends of cul-de-sacs are provided with car-turning facilities.

Within the development road gradients will be in the range 8.3% (1 in 12) to 5.0% (1:20), to address existing challenging topography, and all houses will be accessible from roads and footpaths in accordance with the requirements of Part M of the Building Regulations.

Roads and house levels have been designed to be as close as possible to existing levels while respecting the requirement to achieve appropriate longitudinal gradients on roads and sewers and the need to provide

adequate cover to proposed sewers. Because of the challenging topography excavation will be required to achieve satisfactory gradients resulting in a requirement for retaining structures along some roads.

Car-parking is provided generally at a rate of 2 spaces per dwelling unit, located adjacent to each house/apartment.

Footpaths will be dished at all uncontrolled road crossing-points to facilitate ease of pedestrian movement, particularly for those with mobility impairment issues. Tactile paving and associated measures will be employed at all junction and crossing locations in accordance with best practise design standards.

A Traffic and Transport Assessment forms part of the EIAR document and assesses the impact of the proposed development on existing adjacent roads in the “Without M28 Motorway” and “With M28” scenarios.

SECTION 3: FOUL WATER COLLECTION & DISPOSAL

For that part of the development on the western side of the Moneygurney Stream, foul water collection will be via a network of 225mm and 150mm diameter gravity foul sewers discharging generally in a northerly direction to connect to existing foul sewers in the Vicarage and Templegrove developments.

For that part of the development on the eastern side of the Moneygurney Stream, foul water collection will be via a 225mm diameter gravity foul sewer connected to a proposed pumping station within the development at that location. Pumping of foul water from the 98 units in the eastern sector of the site will be required as the connection to the existing sewers will have to cross the Moneygurney stream, which prevents a gravity connection. The pumped main from the proposed pumping station will be attached to a pedestrian footbridge crossing the Moneygurney stream and connected to the gravity sewer network within the development on the western side of the stream.

Design calculation/output sheets from Microdrainage for the foul sewer designs are included in Appendix A.

These sewers are designed to ensure self-cleansing velocities will be achieved on all pipe runs.

Manholes will be constructed on all pipe-runs at changes in sewer direction, changes in gradients, at significant sewer connections, and, at a maximum spacing of 90m on all straight sections of pipework.

The gravity foul sewers are designed using Micro-Drainage WINDES design software.

A Pre-Connection Enquiry application was submitted to Irish Water. Subsequently, Irish Water issued a Confirmation of Feasibility confirming that the proposed development can be serviced by its existing foul sewer network in the area subject to Cairn PLC entering into a Project Works Services Agreement (PWSA) with Irish Water. This agreement concerns the undertaking of surveys of the existing foul sewer network in the area by Irish Water to confirm if local upgrades to their network are required. Copies of the Confirmation of Feasibility and the executed PWSA are included in this application.

A detailed design for the foul water system within the development was submitted to Irish Water for review arising from which Irish Water issued a Confirmation of Design Acceptance. A copy of the Confirmation of Design Acceptance is included in this application.

Details of the foul sewer layout within the development are illustrated on the following drawings:

- 18203-JBB-1A-XX-DR-C-0500
- 18203-JBB-1A-XX-DR-C-0501
- 18203-JBB-1A-XX-DR-C-0502
- 18203-JBB-1A-XX-DR-C-0503
- 18203-JBB-1A-XX-DR-C-0504
- 18203-JBB-1A-XX-DR-C-0505
- 18203-JBB-1A-XX-DR-C-0506

SECTION 4: STORMWATER COLLECTION & DISPOSAL

For that part of the development on the western side of the Moneygurney Stream, surface water collection will be via a network of gravity surface water drains discharging to proposed stormwater attenuation areas in the north-east and north-west corners of the site. Similarly, surface water in that part of the development on the eastern side of the Moneygurney Stream will be collected via a gravity surface water drains discharging to a proposed stormwater attenuation area at that location. Attenuated runoff from these areas will be directed to the Moneygurney Stream (on the east) and the Douglas Stream (on the west).

Within the development surface-water runoff from roads/footpaths/houses and other impermeable areas will be collected by a network of surface water sewers, as shown on the attached drawings, flowing to the attenuation areas. To reduce the runoff to the attenuation areas at source permeable paving and other SUDS measures will be employed.

The sizing of the pipework collection system has been prepared using Micro-Drainage WINDES software. Design calculations/output sheets for the stormwater collection systems are included in Appendix B.

Details of the storm sewer layout within the development are shown on the following drawings:

- 18203-JBB-1A-XX-DR-C-0500
- 18203-JBB-1A-XX-DR-C-0501
- 18203-JBB-1A-XX-DR-C-0502
- 18203-JBB-1A-XX-DR-C-0503
- 18203-JBB-1A-XX-DR-C-0504
- 18203-JBB-1A-XX-DR-C-0505
- 18203-JBB-1A-XX-DR-C-0506

These attenuation areas are sized to cater for a 100-year storm event with a controlled outflow equal to the runoff from the site in its greenfield condition in a 2-year storm event. Design calculations for attenuation storage volumes are included in Appendix C.

A hydrocarbon interceptor will be installed upstream of each of the attenuation storage areas and a hydrobrake flow-control device will be installed in each manhole immediately downstream of the attenuation areas to control the outflows to the agreed limited flow.

Grit-sumps will be incorporated into each of the manholes immediately upstream of the attenuation areas to ensure that the bulk of the grit suspended in runoff is settled out before the attenuation storage areas.

Attenuation storage will be provided by the use of Stormtech attenuation units or similar approved proprietary product.

SECTION 5: WATER SUPPLY

Irish Water have a number of watermains routed through the site. A 1,200mm trunk main is routed along the eastern side of the site over which there is a 30m wayleave which prevents development along this corridor. It is not proposed to connect to or interfere with this trunk main.

There is a 300mm watermain routed east to west through the middle section of the site over which there is a 10m wide wayleave. It will be necessary to re-locate this main to suit the proposed arrangement of roads and houses on the site. The route for this re-aligned main will generally be along new road corridors to connect to the existing main at the eastern and western boundaries of the site. The proposed route for this diverted 300mm main is shown on the attached drawing 18203-JBB-1A-XX-DR-C-0510.

The existing Vicarage development is served by a 150mm watermain served from the 300mm main and this 150mm main will also to be re-connected to suit the proposed layout.

The proposed development on the western side of the Moneygurney Stream will be served by a network of 100mm, 150mm and 200mm nominal bore watermains, connected to the re-aligned 300mm trunk main. That part of the development on the eastern side of the Moneygurney Stream will be served by a 150mm nominal bore watermain connected to an existing 400mm diameter watermain in the Carrigaline Road.

Fire hydrants will be provided such that each house will be within 45m of a hydrant and these hydrants will be provided so as to be fully accessible to the fire service.

Sluice valves will be installed on all principal watermain connections to ensure that sections of the development can be isolated for maintenance and repair as required.

A bulk water meter will be installed on each main connection to the Irish Water distribution network, subject to detailed agreement with Irish Water/Cork County Council, and domestic water meters will be installed on the service connections to each housing unit.

A Pre-Connection Enquiry application was submitted to Irish Water, arising from which Irish Water issued a Confirmation of Feasibility confirming that the proposed development can be serviced by its existing water supply network in the area. A copy of the Confirmation of Feasibility is included in this application.

A detailed design, including a hydraulic assessment of the water supply system within the development using the Epanet modelling software, was submitted to Irish Water for review arising from which Irish Water issued a Confirmation of Design Acceptance. A copy of the Confirmation of the Design Acceptance is included in this application.

Details of the water supply layout within the development are shown on the following drawings:

- 18203-JBB-1A-XX-DR-C-0510
- 18203-JBB-1A-XX-DR-C-0511
- 18203-JBB-1A-XX-DR-C-0512
- 18203-JBB-1A-XX-DR-C-0513
- 18203-JBB-1A-XX-DR-C-0514
- 18203-JBB-1A-XX-DR-C-0515
- 18203-JBB-1A-XX-DR-C-0516

SECTION 6: FLOOD RISK

A site specific Flood Risk Assessment (FRA) has been carried out for the site and is included along with the EIAR document prepared for the development.

The methodology used for the flood risk assessment for the proposed development is based on 'The Planning System and Flood Risk Management, Guidelines for Planning Authorities' (2009)'. The FRM Guidelines require the planning system at national, regional and local levels to:

- Avoid development in areas at risk of flooding, particularly floodplains, unless there are proven wider sustainability grounds that justify appropriate development;
- Adopt a sequential approach to flood risk management when assessing the location for new development based on avoidance, reduction and then mitigation of flood risk; and
- Incorporate flood risk assessment into the process of making decisions on planning applications and planning appeals.

The following is a summary of the findings of the flood risk assessment.

The proposed development consists of the construction of 472 no. residential dwellings and associated ancillary site works in Castletreasure, Co. Cork. The Douglas Stream flows along the western boundary of the site and the Moneygurney Stream flows along the eastern boundary of the site. These two streams meet to the North of the site and continue to flow through Douglas village as the Ballybrack Stream.

The PFRA flood extent map and the Ballincollig Carrigaline Municipal District LAP both indicate that a portion of the existing site lies within Flood Zone A. The national flooding website www.floodmaps.ie does not have any record of historic flooding at the site.

The type of development is defined as 'Highly Vulnerable Development (including essential infrastructure)'. Using the sequential approach mechanism, it is assessed that a justification test is required for the proposed development.

The proposed development was considered to be appropriately designated to the required zoned lands according to the Ballincollig Carrigaline Municipal District Local Area Plan.

It was identified that all proposed dwellings will be constructed outside of the 0.1% AEP fluvial flood extent. A small number of dwellings to the west of the site are within close proximity to the 0.1% AEP flood and the development was subject to a detailed flood risk assessment which has confirmed that all proposed dwellings will be constructed outside the 0.1% AEP fluvial flood extent.

The Ballincollig Carrigaline Municipal District LAP flood extent map was superimposed and overlaid onto the site layout plan and topographical survey of the site. Observation of this demonstrated that all proposed houses and essential infrastructure is to be outside of the 0.1% AEP flood extent. It was determined that the 0.1% AEP flood level of the Douglas Stream in this area is +40.5mOD.

All development, including highly essential infrastructure will be constructed at an elevation higher than the 1% AEP flood level with a suitable freeboard. The proposed FFL of buildings will also be greater than the 0.1% AEP flood level. Consequently, construction of the proposed development will not result in the loss of flood plain storage, and therefore will have no impact on the flood plain and on lands downstream of the site.

Appropriate SuDS measures will ensure there is no increase in surface runoff from the proposed development. Excess surface runoff arising from the development site will be attenuated and discharged at the greenfield discharge rate.

Following the procedures as set out in the FRM Guidelines it was deemed that the site satisfied all criteria and thus satisfied the Justification Test.

To protect the proposed development against flooding, it is recommended that the development is constructed with a finished floor level (FFL) above the 1% AEP fluvial flood event. The FFL should incorporate a freeboard of 1.0m and a further 0.5m allowance for the effects of climate change. Therefore, the minimum FFL should be (+40.5m OD + 1.0m + 0.5m) +42.0mOD. It is recommended that surface water runoff at the site is managed by applying appropriate SuDS measures.

To prevent any increased flooding at the downstream reach of the Ballybrack Stream from the proposed development, it is proposed to implement SuDS in order to limit the discharge from the site to the greenfield discharge rates. The implementation of these SuDS measures will not increase the risk of flooding elsewhere.

A copy of the FRA Report is available for information and reference purposes.

APPENDIX A

MICRODRAINAGE OUTPUT FOR FOUL WATER DESIGN

FOUL SEWERAGE DESIGN

Global Variables

Pipe Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.PIP
Manhole Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.MHS

Industrial Flow (l/s/ha)	0.00	Maximum Backdrop Height (m)	5.000
Industrial Peak Flow Factor	0.00	Min Cover Depth for Optimisation (m)	1.200
Flow Per Person (l/per/day)	150.00	Min Vel for Auto Design Only (m/s)	0.75
Persons per House	2.70	Min Slope for Optimisation (1:X)	300
Domestic (l/s/ha)	0.00	Minimum Outfall Invert (m)	44.110
Domestic Peak Flow Factor	6.00	Ground Level at Outfall (m)	45.820
O'flow Setting (*Foul only)	0	Outfall Manhole Name	F.A1
Add Flow / Climate Change (%)	0	Outfall Manhole Dia/Length (mm)	1200
Minimum Backdrop Height (m)	0.000	Outfall Manhole Width (mm)	0

Designed with Level Soffits

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Hse	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	24.50	0.408	60.0	0.000	4	2.9	0.600	o	150
1.001	45.50	1.042	43.7	0.000	13	0.0	0.600	o	150
1.002	17.00	0.940	18.1	0.000	0	0.0	0.600	o	150
2.000	12.00	0.200	60.0	0.000	3	0.0	0.600	o	150
2.001	30.00	0.500	60.0	0.000	1	0.0	0.600	o	150
1.003	26.50	0.540	49.1	0.000	4	0.0	0.600	o	225
1.004	17.00	0.517	32.9	0.000	1	0.0	0.600	o	225
1.005	11.50	0.243	47.3	0.000	1	0.0	0.600	o	225
1.006	34.00	0.670	50.7	0.000	4	0.0	0.600	o	225
1.007	30.00	0.560	53.6	0.000	0	0.0	0.600	o	225
3.000	21.50	0.790	27.2	0.000	4	0.0	0.600	o	150
3.001	10.00	0.460	21.7	0.000	1	0.0	0.600	o	150
3.002	18.00	0.670	26.9	0.000	2	0.0	0.600	o	150

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Hse	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	77.700	0.000	2.9	4	0.0	37	0.90	1.30	23.0	3.0
1.001	77.292	0.000	2.9	17	0.0	36	1.05	1.53	27.0	3.4
1.002	76.250	0.000	2.9	17	0.0	29	1.43	2.38	42.1	3.4
2.000	76.010	0.000	0.0	3	0.0	7	0.30	1.30	23.0	0.1
2.001	75.810	0.000	0.0	4	0.0	8	0.33	1.30	23.0	0.1
1.003	75.235	0.000	2.9	25	0.0	34	0.98	1.87	74.4	3.6
1.004	74.695	0.000	2.9	26	0.0	30	1.13	2.29	91.0	3.6
1.005	74.178	0.000	2.9	27	0.0	33	0.99	1.91	75.8	3.7
1.006	73.935	0.000	2.9	31	0.0	34	0.97	1.84	73.2	3.8
1.007	73.265	0.000	2.9	31	0.0	35	0.96	1.79	71.2	3.8
3.000	75.300	0.000	0.0	4	0.0	6	0.43	1.94	34.2	0.1
3.001	74.510	0.000	0.0	5	0.0	7	0.50	2.17	38.3	0.1
3.002	74.050	0.000	0.0	7	0.0	8	0.52	1.95	34.5	0.2

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Hse	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
3.003	13.00	0.600	21.7	0.000	2	0.0	0.600	o	150
1.008	15.00	0.320	46.9	0.000	0	0.0	0.600	o	225
4.000	28.00	1.400	20.0	0.000	4	0.0	0.600	o	150
1.009	30.00	0.750	40.0	0.000	0	0.0	0.600	o	225
1.010	38.00	0.253	150.2	0.000	6	0.0	0.600	o	225
1.011	18.00	0.120	150.0	0.000	1	0.0	0.600	o	225
1.012	39.00	0.260	150.0	0.000	3	0.0	0.600	o	225
1.013	11.00	0.074	148.6	0.000	0	0.0	0.600	o	225
1.014	15.00	0.100	150.0	0.000	2	0.0	0.600	o	225
1.015	25.50	0.190	134.4	0.000	3	0.0	0.600	o	225
5.000	45.00	1.750	25.7	0.000	12	0.0	0.600	o	150
5.001	55.00	1.630	33.7	0.000	12	0.0	0.600	o	225
5.002	61.00	0.450	135.5	0.000	11	0.0	0.600	o	225
1.016	22.00	0.147	149.7	0.000	0	0.0	0.600	o	225
6.000	18.00	0.510	35.3	0.000	3	0.0	0.600	o	150
6.001	10.00	0.290	34.5	0.000	1	0.0	0.600	o	150
6.002	27.50	0.740	37.2	0.000	9	0.0	0.600	o	150
1.017	23.00	0.153	150.3	0.000	0	0.0	0.600	o	225
1.018	18.00	0.120	150.0	0.000	2	0.0	0.600	o	225

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Hse	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
3.003	73.380	0.000	0.0	9	0.0	9	0.61	2.17	38.4	0.3
1.008	72.705	0.000	2.9	40	0.0	35	1.02	1.92	76.2	4.0
4.000	73.860	0.000	0.0	4	0.0	6	0.48	2.26	40.0	0.1
1.009	72.385	0.000	2.9	44	0.0	34	1.09	2.07	82.5	4.1
1.010	71.635	0.000	2.9	50	0.0	48	0.69	1.06	42.3	4.3
1.011	71.382	0.000	2.9	51	0.0	48	0.69	1.07	42.4	4.3
1.012	71.262	0.000	2.9	54	0.0	49	0.69	1.07	42.4	4.4
1.013	71.002	0.000	2.9	54	0.0	49	0.70	1.07	42.5	4.4
1.014	70.928	0.000	2.9	56	0.0	49	0.70	1.07	42.4	4.5
1.015	70.828	0.000	2.9	59	0.0	48	0.73	1.13	44.8	4.6
5.000	77.500	0.000	0.0	12	0.0	10	0.62	1.99	35.2	0.3
5.001	75.675	0.000	0.0	24	0.0	14	0.67	2.26	89.9	0.7
5.002	74.045	0.000	0.0	35	0.0	23	0.46	1.12	44.6	1.0
1.016	70.638	0.000	2.9	94	0.0	55	0.74	1.07	42.4	5.5
6.000	75.450	0.000	0.0	3	0.0	6	0.36	1.70	30.0	0.1
6.001	74.940	0.000	0.0	4	0.0	7	0.40	1.72	30.4	0.1
6.002	74.650	0.000	0.0	13	0.0	12	0.56	1.66	29.3	0.4
1.017	70.491	0.000	2.9	107	0.0	57	0.75	1.06	42.3	5.9
1.018	70.338	0.000	2.9	109	0.0	57	0.76	1.07	42.4	6.0

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Hse	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.019	13.00	0.087	149.4	0.000	0	0.0	0.600	o	225
1.020	40.00	0.267	149.8	0.000	4	0.0	0.600	o	225
7.000	13.00	0.217	59.9	0.000	2	0.0	0.600	o	150
7.001	40.00	0.667	60.0	0.000	5	0.0	0.600	o	150
7.002	44.50	0.986	45.1	0.000	3	0.0	0.600	o	150
7.003	28.00	0.430	65.1	0.000	2	0.0	0.600	o	150
7.004	45.00	1.340	33.6	0.000	6	0.0	0.600	o	150
7.005	66.00	2.790	23.7	0.000	14	0.0	0.600	o	225
7.006	26.00	0.192	135.6	0.000	1	0.0	0.600	o	225
1.021	17.00	0.289	58.8	0.000	0	0.0	0.600	o	225
8.000	25.00	0.417	60.0	0.000	5	0.0	0.600	o	150
1.022	25.00	1.225	20.4	0.000	0	0.0	0.600	o	225
1.023	20.00	0.148	135.2	0.000	0	0.0	0.600	o	225
1.024	53.00	2.650	20.0	0.000	0	0.0	0.600	o	225
1.025	12.50	0.625	20.0	0.000	1	0.0	0.600	o	225
1.026	52.00	2.600	20.0	0.000	9	0.0	0.600	o	225
1.027	38.50	1.925	20.0	0.000	4	0.0	0.600	o	225
1.028	27.00	1.350	20.0	0.000	2	0.0	0.600	o	225
1.029	10.00	0.430	23.3	0.000	0	0.0	0.600	o	225
1.030	20.00	1.000	20.0	0.000	0	0.0	0.600	o	225
1.031	38.00	1.860	20.4	0.000	4	0.0	0.600	o	225
1.032	20.00	0.148	135.0	0.000	2	0.0	0.600	o	225

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Hse	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.019	70.218	0.000	2.9	109	0.0	57	0.76	1.07	42.4	6.0
1.020	70.131	0.000	2.9	113	0.0	57	0.76	1.07	42.4	6.1
7.000	78.080	0.000	0.0	2	0.0	6	0.26	1.30	23.0	0.1
7.001	77.863	0.000	0.0	7	0.0	10	0.39	1.30	23.0	0.2
7.002	77.196	0.000	0.0	10	0.0	11	0.49	1.50	26.5	0.3
7.003	76.210	0.000	0.0	12	0.0	13	0.45	1.25	22.1	0.3
7.004	75.780	0.000	0.0	18	0.0	13	0.65	1.74	30.8	0.5
7.005	74.365	0.000	0.0	32	0.0	15	0.82	2.70	107.4	0.9
7.006	71.575	0.000	0.0	33	0.0	22	0.45	1.12	44.6	0.9
1.021	69.864	0.000	2.9	146	0.0	48	1.11	1.71	67.9	7.0
8.000	68.650	0.000	0.0	5	0.0	9	0.35	1.30	23.0	0.1
1.022	68.158	0.000	2.9	151	0.0	38	1.63	2.91	115.7	7.1
1.023	66.933	0.000	2.9	151	0.0	61	0.83	1.12	44.6	7.1
1.024	65.460	0.000	2.9	151	0.0	37	1.64	2.94	116.9	7.1
1.025	62.810	0.000	2.9	152	0.0	37	1.64	2.94	116.9	7.2
1.026	62.185	0.000	2.9	161	0.0	38	1.66	2.94	116.9	7.4
1.027	59.585	0.000	2.9	165	0.0	38	1.67	2.94	116.9	7.5
1.028	57.660	0.000	2.9	167	0.0	39	1.67	2.94	116.9	7.6
1.029	56.310	0.000	2.9	167	0.0	40	1.58	2.72	108.3	7.6
1.030	55.510	0.000	2.9	167	0.0	39	1.67	2.94	116.9	7.6
1.031	54.510	0.000	2.9	171	0.0	39	1.67	2.91	115.6	7.7
1.032	52.650	0.000	2.9	173	0.0	63	0.85	1.12	44.7	7.8

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Hse	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
9.000	30.00	0.500	60.0	0.000	8	0.0	0.600	o	150
9.001	17.00	0.113	150.4	0.000	6	0.0	0.600	o	150
9.002	9.00	0.060	150.0	0.000	1	0.0	0.600	o	150
9.003	9.00	0.060	150.0	0.000	0	0.0	0.600	o	150
9.004	43.00	0.287	149.8	0.000	3	0.0	0.600	o	150
9.005	40.00	0.299	133.8	0.000	7	0.0	0.600	o	225
9.006	20.00	0.149	133.9	0.000	0	0.0	0.600	o	225
9.007	14.00	0.110	127.3	0.000	2	0.0	0.600	o	225
1.033	16.00	0.800	20.0	0.000	0	0.0	0.600	o	225
1.034	16.00	0.800	20.0	0.000	0	0.0	0.600	o	225
10.000	47.50	1.310	36.3	0.000	14	0.0	0.600	o	150
10.001	39.00	1.890	20.6	0.000	6	0.0	0.600	o	150
10.002	27.50	1.000	27.5	0.000	0	2.0	0.600	o	150
10.003	37.00	0.570	64.9	0.000	4	0.0	0.600	o	225
10.004	19.00	0.950	20.0	0.000	12	0.0	0.600	o	225
10.005	14.50	0.450	32.2	0.000	4	0.0	0.600	o	225
10.006	49.00	1.950	25.1	0.000	0	0.0	0.600	o	225
10.007	50.00	2.200	22.7	0.000	0	0.0	0.600	o	225
10.008	6.00	0.040	150.0	0.000	0	0.0	0.600	o	225
10.009	39.00	0.260	150.0	0.000	40	0.0	0.600	o	225
10.010	8.00	0.053	150.9	0.000	0	0.0	0.600	o	225
11.000	16.00	0.400	40.0	0.000	13	0.0	0.600	o	150

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Hse	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
9.000	51.870	0.000	0.0	8	0.0	11	0.41	1.30	23.0	0.2
9.001	51.370	0.000	0.0	14	0.0	17	0.35	0.82	14.4	0.4
9.002	51.257	0.000	0.0	15	0.0	18	0.36	0.82	14.5	0.4
9.003	51.197	0.000	0.0	15	0.0	18	0.36	0.82	14.5	0.4
9.004	51.137	0.000	0.0	18	0.0	19	0.38	0.82	14.5	0.5
9.005	50.775	0.000	0.0	25	0.0	20	0.41	1.13	44.9	0.7
9.006	50.476	0.000	0.0	25	0.0	20	0.41	1.13	44.9	0.7
9.007	50.327	0.000	0.0	27	0.0	20	0.43	1.16	46.0	0.8
1.033	50.217	0.000	2.9	200	0.0	41	1.73	2.94	116.9	8.5
1.034	47.417	0.000	2.9	200	0.0	41	1.73	2.94	116.9	8.5
10.000	59.150	0.000	0.0	14	0.0	12	0.58	1.68	29.6	0.4
10.001	57.840	0.000	0.0	20	0.0	13	0.79	2.23	39.4	0.6
10.002	55.950	0.000	2.0	20	0.0	28	1.14	1.93	34.1	2.6
10.003	54.875	0.000	2.0	24	0.0	31	0.81	1.63	64.6	2.7
10.004	53.525	0.000	2.0	36	0.0	25	1.27	2.94	116.9	3.0
10.005	52.575	0.000	2.0	40	0.0	28	1.08	2.31	92.0	3.1
10.006	52.125	0.000	2.0	40	0.0	27	1.18	2.62	104.2	3.1
10.007	50.175	0.000	2.0	40	0.0	26	1.22	2.76	109.6	3.1
10.008	47.975	0.000	2.0	40	0.0	41	0.63	1.07	42.4	3.1
10.009	45.000	0.000	2.0	80	0.0	48	0.69	1.07	42.4	4.3
10.010	44.740	0.000	2.0	80	0.0	48	0.68	1.06	42.2	4.3
11.000	45.162	0.000	0.0	13	0.0	12	0.55	1.60	28.2	0.4

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Hse	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
10.011	8.00	0.054	148.1	0.000	1	0.0	0.600	o	225
1.035	6.00	0.040	150.0	0.000	0	0.0	0.600	o	225
1.036	37.00	0.408	90.7	0.000	0	0.0	0.600	o	225

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Hse	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
10.011	44.687	0.000	2.0	94	0.0	50	0.71	1.07	42.6	4.6
1.035	44.633	0.000	4.9	294	0.0	86	0.94	1.07	42.4	13.2
1.036	44.593	0.000	4.9	294	0.0	75	1.14	1.37	54.6	13.2

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	150	F.A37	79.050	77.700	1.200	1200
1.001	o	150	F.A36	79.080	77.292	1.638	1200
1.002	o	150	F.A35	77.600	76.250	1.200	1200
2.000	o	150	F.A34.2	77.360	76.010	1.200	1200
2.001	o	150	F.A35.1	77.260	75.810	1.300	1200
1.003	o	225	F.A35	77.130	75.235	1.670	1200
1.004	o	225	F.A34	76.120	74.695	1.200	1200
1.005	o	225	F.A33	75.603	74.178	1.200	1200
1.006	o	225	F.A32	75.360	73.935	1.200	1200
1.007	o	225	F.A31	74.690	73.265	1.200	1200
3.000	o	150	F.A30.4	76.650	75.300	1.200	1200
3.001	o	150	F.A30.3	75.960	74.510	1.300	1200
3.002	o	150	F.A30.2	75.500	74.050	1.300	1200
3.003	o	150	F.A30.1	75.060	73.380	1.530	1200
1.008	o	225	F.A30	74.130	72.705	1.200	1200
4.000	o	150	F.A29.1	75.600	73.860	1.590	1200
1.009	o	225	F.A29	73.810	72.385	1.200	1200
1.010	o	225	F.A28	73.060	71.635	1.200	1200
1.011	o	225	F.A27	73.430	71.382	1.823	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	24.50	60.0	F.A36	79.080	77.292	1.638	1200
1.001	45.50	43.7	F.A35	77.600	76.250	1.200	1200
1.002	17.00	18.1	F.A35	77.130	75.310	1.670	1200
2.000	12.00	60.0	F.A35.1	77.260	75.810	1.300	1200
2.001	30.00	60.0	F.A35	77.130	75.310	1.670	1200
1.003	26.50	49.1	F.A34	76.120	74.695	1.200	1200
1.004	17.00	32.9	F.A33	75.603	74.178	1.200	1200
1.005	11.50	47.3	F.A32	75.360	73.935	1.200	1200
1.006	34.00	50.7	F.A31	74.690	73.265	1.200	1200
1.007	30.00	53.6	F.A30	74.130	72.705	1.200	1200
3.000	21.50	27.2	F.A30.3	75.960	74.510	1.300	1200
3.001	10.00	21.7	F.A30.2	75.500	74.050	1.300	1200
3.002	18.00	26.9	F.A30.1	75.060	73.380	1.530	1200
3.003	13.00	21.7	F.A30	74.130	72.780	1.200	1200
1.008	15.00	46.9	F.A29	73.810	72.385	1.200	1200
4.000	28.00	20.0	F.A29	73.810	72.460	1.200	1200
1.009	30.00	40.0	F.A28	73.060	71.635	1.200	1200
1.010	38.00	150.2	F.A27	73.430	71.382	1.823	1200
1.011	18.00	150.0	F.A26	73.390	71.262	1.903	1200

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.012	o	225	F.A26	73.390	71.262	1.903	1200
1.013	o	225	F.A25	73.500	71.002	2.273	1200
1.014	o	225	F.A24	73.960	70.928	2.807	1200
1.015	o	225	F.A23	74.750	70.828	3.697	1200
5.000	o	150	F.A22.3	78.850	77.500	1.200	1200
5.001	o	225	F.A22.2	77.100	75.675	1.200	1200
5.002	o	225	F.A22.1	75.470	74.045	1.200	1200
1.016	o	225	F.A22	75.500	70.638	4.637	1200
6.000	o	150	F.A21.3	76.800	75.450	1.200	1200
6.001	o	150	F.A21.2	76.290	74.940	1.200	1200
6.002	o	150	F.A21.1	76.000	74.650	1.200	1200
1.017	o	225	F.A21	75.260	70.491	4.544	1200
1.018	o	225	F.A20	74.580	70.338	4.017	1200
1.019	o	225	F.A19	74.030	70.218	3.587	1200
1.020	o	225	F.A18	73.480	70.131	3.124	1200
7.000	o	150	F.A17.7	79.430	78.080	1.200	1200
7.001	o	150	F.A17.6	79.300	77.863	1.287	1200
7.002	o	150	F.A17.5	78.620	77.196	1.274	1200
7.003	o	150	F.A17.4	77.560	76.210	1.200	1200
7.004	o	150	F.A17.3	77.130	75.780	1.200	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.012	39.00	150.0	F.A25	73.500	71.002	2.273	1200
1.013	11.00	148.6	F.A24	73.960	70.928	2.807	1200
1.014	15.00	150.0	F.A23	74.750	70.828	3.697	1200
1.015	25.50	134.4	F.A22	75.500	70.638	4.637	1200
5.000	45.00	25.7	F.A22.2	77.100	75.750	1.200	1200
5.001	55.00	33.7	F.A22.1	75.470	74.045	1.200	1200
5.002	61.00	135.5	F.A22	75.500	73.595	1.680	1200
1.016	22.00	149.7	F.A21	75.260	70.491	4.544	1200
6.000	18.00	35.3	F.A21.2	76.290	74.940	1.200	1200
6.001	10.00	34.5	F.A21.1	76.000	74.650	1.200	1200
6.002	27.50	37.2	F.A21	75.260	73.910	1.200	1200
1.017	23.00	150.3	F.A20	74.580	70.338	4.017	1200
1.018	18.00	150.0	F.A19	74.030	70.218	3.587	1200
1.019	13.00	149.4	F.A18	73.480	70.131	3.124	1200
1.020	40.00	149.8	F.A17	71.730	69.864	1.641	1200
7.000	13.00	59.9	F.A17.6	79.300	77.863	1.287	1200
7.001	40.00	60.0	F.A17.5	78.620	77.196	1.274	1200
7.002	44.50	45.1	F.A17.4	77.560	76.210	1.200	1200
7.003	28.00	65.1	F.A17.3	77.130	75.780	1.200	1200
7.004	45.00	33.6	F.A17.2	75.790	74.440	1.200	1200

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
7.005	o	225	F.A17.2	75.790	74.365	1.200	1200
7.006	o	225	F.A17.1	73.000	71.575	1.200	1200
1.021	o	225	F.A17	71.730	69.864	1.641	1200
8.000	o	150	F.A16.1	70.000	68.650	1.200	1200
1.022	o	225	F.A16	71.000	68.158	2.617	1200
1.023	o	225	F.A15	69.860	66.933	2.702	1200
1.024	o	225	F.A14	68.340	65.460	2.655	1200
1.025	o	225	F.A13	64.160	62.810	1.125	1200
1.026	o	225	F.A12	63.550	62.185	1.140	1200
1.027	o	225	F.A11	61.000	59.585	1.190	1200
1.028	o	225	F.A10	59.200	57.660	1.315	1200
1.029	o	225	F.A9	57.880	56.310	1.345	1200
1.030	o	225	F.A8	57.230	55.510	1.495	1200
1.031	o	225	F.A7	55.860	54.510	1.125	1200
1.032	o	225	F.A6	54.000	52.650	1.125	1200
9.000	o	150	F.A5.8	53.220	51.870	1.200	1200
9.001	o	150	F.A5.7	53.420	51.370	1.900	1200
9.002	o	150	F.A5.6	53.650	51.257	2.243	1200
9.003	o	150	F.A5.5	53.600	51.197	2.253	1200
9.004	o	150	F.A5.4	53.560	51.137	2.273	1200
9.005	o	225	F.A5.3	53.570	50.775	2.570	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
7.005	66.00	23.7	F.A17.1	73.000	71.575	1.200	1200
7.006	26.00	135.6	F.A17	71.730	71.383	0.122	1200
1.021	17.00	58.8	F.A16	71.000	69.575	1.200	1200
8.000	25.00	60.0	F.A16	71.000	68.233	2.617	1200
1.022	25.00	20.4	F.A15	69.860	66.933	2.702	1200
1.023	20.00	135.2	F.A14	68.340	66.785	1.330	1200
1.024	53.00	20.0	F.A13	64.160	62.810	1.125	1200
1.025	12.50	20.0	F.A12	63.550	62.185	1.140	1200
1.026	52.00	20.0	F.A11	61.000	59.585	1.190	1200
1.027	38.50	20.0	F.A10	59.200	57.660	1.315	1200
1.028	27.00	20.0	F.A9	57.880	56.310	1.345	1200
1.029	10.00	23.3	F.A8	57.230	55.880	1.125	1200
1.030	20.00	20.0	F.A7	55.860	54.510	1.125	1200
1.031	38.00	20.4	F.A6	54.000	52.650	1.125	1200
1.032	20.00	135.0	F.A5	53.480	52.502	0.753	1200
9.000	30.00	60.0	F.A5.7	53.420	51.370	1.900	1200
9.001	17.00	150.4	F.A5.6	53.650	51.257	2.243	1200
9.002	9.00	150.0	F.A5.5	53.600	51.197	2.253	1200
9.003	9.00	150.0	F.A5.4	53.560	51.137	2.273	1200
9.004	43.00	149.8	F.A5.3	53.570	50.850	2.570	1200
9.005	40.00	133.8	F.A5.2	53.103	50.476	2.402	1200

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
9.006	o	225	F.A5.2	53.103	50.476	2.402	1200
9.007	o	225	F.A5.1	53.204	50.327	2.652	1200
1.033	o	225	F.A5	53.480	50.217	3.038	1200
1.034	o	225	F.A4	51.000	47.417	3.358	1200
10.000	o	150	F.A3.12	60.500	59.150	1.200	1200
10.001	o	150	F.A3.11	59.190	57.840	1.200	1200
10.002	o	150	F.A3.10	57.300	55.950	1.200	1200
10.003	o	225	F.A3.9	56.300	54.875	1.200	1200
10.004	o	225	F.A3.8	55.730	53.525	1.980	1200
10.005	o	225	F.A3.7	54.000	52.575	1.200	1200
10.006	o	225	F.A3.6	53.550	52.125	1.200	1200
10.007	o	225	F.A3.5	51.600	50.175	1.200	1200
10.008	o	225	F.A3.4	49.400	47.975	1.200	1200
10.009	o	225	F.A3.3	49.400	45.000	4.175	1200
10.010	o	225	F.A3.2	49.850	44.740	4.885	1200
11.000	o	150	F.A3.1.1	49.000	45.162	3.688	1200
10.011	o	225	F.A3.1	49.900	44.687	4.988	1200
1.035	o	225	F.A3	49.980	44.633	5.122	1200
1.036	o	225	F.A2	49.500	44.593	4.682	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
9.006	20.00	133.9	F.A5.1	53.204	50.327	2.652	1200
9.007	14.00	127.3	F.A5	53.480	50.217	3.038	1200
1.033	16.00	20.0	F.A4	51.000	49.417	1.358	1200
1.034	16.00	20.0	F.A3	49.980	46.617	3.138	1200
10.000	47.50	36.3	F.A3.11	59.190	57.840	1.200	1200
10.001	39.00	20.6	F.A3.10	57.300	55.950	1.200	1200
10.002	27.50	27.5	F.A3.9	56.300	54.950	1.200	1200
10.003	37.00	64.9	F.A3.8	55.730	54.305	1.200	1200
10.004	19.00	20.0	F.A3.7	54.000	52.575	1.200	1200
10.005	14.50	32.2	F.A3.6	53.550	52.125	1.200	1200
10.006	49.00	25.1	F.A3.5	51.600	50.175	1.200	1200
10.007	50.00	22.7	F.A3.4	49.400	47.975	1.200	1200
10.008	6.00	150.0	F.A3.3	49.400	47.935	1.240	1200
10.009	39.00	150.0	F.A3.2	49.850	44.740	4.885	1200
10.010	8.00	150.9	F.A3.1	49.900	44.687	4.988	1200
11.000	16.00	40.0	F.A3.1	49.900	44.762	4.988	1200
10.011	8.00	148.1	F.A3	49.980	44.633	5.122	1200
1.035	6.00	150.0	F.A2	49.500	44.593	4.682	1200
1.036	37.00	90.7	F.A1	45.820	44.185	1.410	1200

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
F.A37	79.050	1.350	1200	1.000	77.700	150			
F.A36	79.080	1.788	1200	1.001	77.292	150	1.000	77.292	150
F.A35	77.600	1.350	1200	1.002	76.250	150	1.001	76.250	150
F.A34.2	77.360	1.350	1200	2.000	76.010	150			
F.A35.1	77.260	1.450	1200	2.001	75.810	150	2.000	75.810	150
F.A35	77.130	1.895	1200	1.003	75.235	225	1.002	75.310	150
							2.001	75.310	150
F.A34	76.120	1.425	1200	1.004	74.695	225	1.003	74.695	225
F.A33	75.603	1.425	1200	1.005	74.178	225	1.004	74.178	225
F.A32	75.360	1.425	1200	1.006	73.935	225	1.005	73.935	225
F.A31	74.690	1.425	1200	1.007	73.265	225	1.006	73.265	225
F.A30.4	76.650	1.350	1200	3.000	75.300	150			
F.A30.3	75.960	1.450	1200	3.001	74.510	150	3.000	74.510	150
F.A30.2	75.500	1.450	1200	3.002	74.050	150	3.001	74.050	150
F.A30.1	75.060	1.680	1200	3.003	73.380	150	3.002	73.380	150
F.A30	74.130	1.425	1200	1.008	72.705	225	1.007	72.705	225
							3.003	72.780	150
F.A29.1	75.600	1.740	1200	4.000	73.860	150			
F.A29	73.810	1.425	1200	1.009	72.385	225	1.008	72.385	225
							4.000	72.460	150
F.A28	73.060	1.425	1200	1.010	71.635	225	1.009	71.635	225
F.A27	73.430	2.048	1200	1.011	71.382	225	1.010	71.382	225
F.A26	73.390	2.128	1200	1.012	71.262	225	1.011	71.262	225
F.A25	73.500	2.498	1200	1.013	71.002	225	1.012	71.002	225
F.A24	73.960	3.032	1200	1.014	70.928	225	1.013	70.928	225
F.A23	74.750	3.922	1200	1.015	70.828	225	1.014	70.828	225
F.A22.3	78.850	1.350	1200	5.000	77.500	150			
F.A22.2	77.100	1.425	1200	5.001	75.675	225	5.000	75.750	150
F.A22.1	75.470	1.425	1200	5.002	74.045	225	5.001	74.045	225
F.A22	75.500	4.862	1200	1.016	70.638	225	1.015	70.638	225
							5.002	73.595	225

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
F.A21.3	76.800	1.350	1200	6.000	75.450	150			
F.A21.2	76.290	1.350	1200	6.001	74.940	150	6.000	74.940	150
F.A21.1	76.000	1.350	1200	6.002	74.650	150	6.001	74.650	150
F.A21	75.260	4.769	1200	1.017	70.491	225	1.016	70.491	225
							6.002	73.910	150
F.A20	74.580	4.242	1200	1.018	70.338	225	1.017	70.338	225
F.A19	74.030	3.812	1200	1.019	70.218	225	1.018	70.218	225
F.A18	73.480	3.349	1200	1.020	70.131	225	1.019	70.131	225
F.A17.7	79.430	1.350	1200	7.000	78.080	150			
F.A17.6	79.300	1.437	1200	7.001	77.863	150	7.000	77.863	150
F.A17.5	78.620	1.424	1200	7.002	77.196	150	7.001	77.196	150
F.A17.4	77.560	1.350	1200	7.003	76.210	150	7.002	76.210	150
F.A17.3	77.130	1.350	1200	7.004	75.780	150	7.003	75.780	150
F.A17.2	75.790	1.425	1200	7.005	74.365	225	7.004	74.440	150
F.A17.1	73.000	1.425	1200	7.006	71.575	225	7.005	71.575	225
F.A17	71.730	1.866	1200	1.021	69.864	225	1.020	69.864	225
							7.006	71.383	225
F.A16.1	70.000	1.350	1200	8.000	68.650	150			
F.A16	71.000	2.842	1200	1.022	68.158	225	1.021	69.575	225
							8.000	68.233	150
F.A15	69.860	2.927	1200	1.023	66.933	225	1.022	66.933	225
F.A14	68.340	2.880	1200	1.024	65.460	225	1.023	66.785	225
F.A13	64.160	1.350	1200	1.025	62.810	225	1.024	62.810	225
F.A12	63.550	1.365	1200	1.026	62.185	225	1.025	62.185	225
F.A11	61.000	1.415	1200	1.027	59.585	225	1.026	59.585	225
F.A10	59.200	1.540	1200	1.028	57.660	225	1.027	57.660	225
F.A9	57.880	1.570	1200	1.029	56.310	225	1.028	56.310	225
F.A8	57.230	1.720	1200	1.030	55.510	225	1.029	55.880	225
F.A7	55.860	1.350	1200	1.031	54.510	225	1.030	54.510	225
F.A6	54.000	1.350	1200	1.032	52.650	225	1.031	52.650	225

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
F.A5.8	53.220	1.350	1200	9.000	51.870	150			
F.A5.7	53.420	2.050	1200	9.001	51.370	150	9.000	51.370	150
F.A5.6	53.650	2.393	1200	9.002	51.257	150	9.001	51.257	150
F.A5.5	53.600	2.403	1200	9.003	51.197	150	9.002	51.197	150
F.A5.4	53.560	2.423	1200	9.004	51.137	150	9.003	51.137	150
F.A5.3	53.570	2.795	1200	9.005	50.775	225	9.004	50.850	150
F.A5.2	53.103	2.627	1200	9.006	50.476	225	9.005	50.476	225
F.A5.1	53.204	2.877	1200	9.007	50.327	225	9.006	50.327	225
F.A5	53.480	3.263	1200	1.033	50.217	225	1.032	52.502	225
							9.007	50.217	225
F.A4	51.000	3.583	1200	1.034	47.417	225	1.033	49.417	225
F.A3.12	60.500	1.350	1200	10.000	59.150	150			
F.A3.11	59.190	1.350	1200	10.001	57.840	150	10.000	57.840	150
F.A3.10	57.300	1.350	1200	10.002	55.950	150	10.001	55.950	150
F.A3.9	56.300	1.425	1200	10.003	54.875	225	10.002	54.950	150
F.A3.8	55.730	2.205	1200	10.004	53.525	225	10.003	54.305	225
F.A3.7	54.000	1.425	1200	10.005	52.575	225	10.004	52.575	225
F.A3.6	53.550	1.425	1200	10.006	52.125	225	10.005	52.125	225
F.A3.5	51.600	1.425	1200	10.007	50.175	225	10.006	50.175	225
F.A3.4	49.400	1.425	1200	10.008	47.975	225	10.007	47.975	225
F.A3.3	49.400	4.400	1200	10.009	45.000	225	10.008	47.935	225
F.A3.2	49.850	5.110	1200	10.010	44.740	225	10.009	44.740	225
F.A3.1.1	49.000	3.838	1200	11.000	45.162	150			
F.A3.1	49.900	5.213	1200	10.011	44.687	225	10.010	44.687	225
							11.000	44.762	150
F.A3	49.980	5.347	1200	1.035	44.633	225	1.034	46.617	225
							10.011	44.633	225
F.A2	49.500	4.907	1200	1.036	44.593	225	1.035	44.593	225
F.A1	45.820	1.635	1200		OUTFALL		1.036	44.185	225

APPENDIX B

MICRODRAINAGE OUTPUT FOR STORMWATER DESIGN

STORM SEWER DESIGN by the Modified Rational Method

Global Variables

Pipe Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.PIP
Manhole Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.MHS

Location - Scotland & Ireland

Return Period (years)	1
M5-60 (mm)	18.800
Ratio R	0.250
Maximum Rainfall (mm/hr)	50
Foul Sewage (l/s/ha)	0.00
O'flow Setting (*Foul only)	0
Volumetric Runoff Coeff.	0.90
Add Flow / Climate Change (%)	10
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	5.000
Min Cover Depth for Optimisation (m)	1.500
Min Vel for Auto Design Only (m/s)	0.80
Min Slope for Optimisation (1:X)	300
Minimum Outfall Invert (m)	33.500
Ground Level at Outfall (m)	36.000
Outfall Manhole Name	Attenuation Tank
Outfall Manhole Dia/Length (mm)	0
Outfall Manhole Width (mm)	0

Designed with Level Soffits

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	24.00	0.400	60.0	0.078	4.00	0.0	0.060	o	225
1.001	45.00	1.200	37.5	0.210	0.00	0.0	0.600	o	225
1.002	16.50	0.165	100.0	0.037	0.00	0.0	0.600	o	300
2.000	14.50	0.313	46.3	0.060	4.00	0.0	0.600	o	225
2.001	10.00	0.216	46.3	0.063	0.00	0.0	0.600	o	225
2.002	22.50	0.486	46.3	0.040	0.00	0.0	0.600	o	225
1.003	25.00	0.585	42.7	0.099	0.00	0.0	0.600	o	300
1.004	17.00	0.350	48.6	0.042	0.00	0.0	0.600	o	300
1.005	12.00	0.240	50.0	0.038	0.00	0.0	0.600	o	300
1.006	34.00	0.700	48.6	0.080	0.00	0.0	0.600	o	300
1.007	40.00	0.770	51.9	0.016	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	46.7	4.2	77.145	0.078	0.0	0.0	1.2	2.14	85.1	13.0
1.001	45.5	4.5	76.745	0.288	0.0	0.0	4.3	2.14	85.2	46.8
1.002	44.9	4.7	74.772	0.325	0.0	0.0	4.7	1.57	111.1	52.2
2.000	46.9	4.1	75.625	0.060	0.0	0.0	0.9	1.93	76.6	10.1
2.001	46.6	4.2	75.312	0.123	0.0	0.0	1.9	1.93	76.6	20.5
2.002	45.9	4.4	75.096	0.163	0.0	0.0	2.4	1.93	76.6	26.8
1.003	44.4	4.9	74.535	0.587	0.0	0.0	8.5	2.41	170.5	93.1
1.004	44.0	5.0	73.950	0.629	0.0	0.0	9.0	2.26	159.9	98.9
1.005	43.7	5.1	73.600	0.667	0.0	0.0	9.5	2.23	157.5	104.3
1.006	43.0	5.4	73.360	0.747	0.0	0.0	10.4	2.26	159.9	114.8
1.007	42.2	5.7	72.660	0.763	0.0	0.0	10.5	2.19	154.5	115.0

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
3.000	10.00	0.600	16.7	0.050	4.00	0.0	0.600	o	225
3.001	43.50	2.060	21.1	0.195	0.00	0.0	0.600	o	225
1.008	33.50	0.290	115.5	0.096	0.00	0.0	0.600	o	375
1.009	37.00	0.300	123.3	0.090	0.00	0.0	0.600	o	375
1.010	15.00	0.130	115.4	0.048	0.00	0.0	0.600	o	375
1.011	41.00	0.410	100.0	0.086	0.00	0.0	0.600	o	375
1.012	10.00	0.100	100.0	0.007	0.00	0.0	0.600	o	375
1.013	19.00	0.190	100.0	0.050	0.00	0.0	0.600	o	375
1.014	21.00	0.210	100.0	0.049	0.00	0.0	0.600	o	375
4.000	43.00	2.810	15.3	0.230	4.00	0.0	0.600	o	225
4.001	52.50	0.525	100.0	0.211	0.00	0.0	0.600	o	300
4.002	63.00	1.330	47.4	0.263	0.00	0.0	0.600	o	300
1.015	19.00	0.190	100.0	0.016	0.00	0.0	0.600	o	450
5.000	14.00	0.490	28.6	0.055	4.00	0.0	0.600	o	225
5.001	39.00	1.220	32.0	0.195	0.00	0.0	0.600	o	225
1.016	20.00	0.200	100.0	0.027	0.00	0.0	0.600	o	525
1.017	18.50	0.185	100.0	0.018	0.00	0.0	0.600	o	525
1.018	13.00	0.130	100.0	0.031	0.00	0.0	0.600	o	525
1.019	48.50	0.485	100.0	0.082	0.00	0.0	0.600	o	525
6.000	15.00	0.140	107.1	0.082	4.00	0.0	0.600	o	225
6.001	39.50	0.710	55.6	0.111	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
3.000	47.2	4.1	74.500	0.050	0.0	0.0	0.8	3.22	128.1	8.4
3.001	46.3	4.3	73.900	0.245	0.0	0.0	3.7	2.86	113.7	40.5
1.008	41.3	6.0	71.690	1.104	0.0	0.0	14.8	1.68	186.1	162.9
1.009	40.3	6.4	71.400	1.194	0.0	0.0	15.7	1.63	180.1	172.2
1.010	40.0	6.5	71.100	1.242	0.0	0.0	16.1	1.69	186.2	177.6
1.011	39.1	6.9	70.970	1.328	0.0	0.0	16.9	1.81	200.1	185.8
1.012	38.9	7.0	70.560	1.335	0.0	0.0	16.9	1.81	200.1	185.8
1.013	38.6	7.2	70.460	1.385	0.0	0.0	17.4	1.81	200.1	190.9
1.014	38.1	7.3	70.270	1.434	0.0	0.0	17.8	1.81	200.1	195.5
4.000	46.6	4.2	76.810	0.230	0.0	0.0	3.5	3.36	133.7	38.3
4.001	44.7	4.8	73.925	0.441	0.0	0.0	6.4	1.57	111.1	70.5
4.002	43.4	5.2	73.400	0.704	0.0	0.0	9.9	2.29	161.9	109.1
1.015	37.8	7.5	69.985	2.154	0.0	0.0	26.5	2.03	323.4	291.2
5.000	47.0	4.1	74.870	0.055	0.0	0.0	0.8	2.46	97.7	9.2
5.001	46.0	4.4	74.380	0.250	0.0	0.0	3.7	2.32	92.3	41.1
1.016	37.5	7.7	69.720	2.431	0.0	0.0	29.6	2.24	484.9	326.1
1.017	37.3	7.8	69.520	2.449	0.0	0.0	29.6	2.24	484.9	326.1
1.018	37.1	7.9	69.335	2.480	0.0	0.0	29.9	2.24	484.9	328.6
1.019	36.4	8.2	69.205	2.562	0.0	0.0	30.3	2.24	484.9	333.2
6.000	46.7	4.2	77.500	0.082	0.0	0.0	1.2	1.26	50.2	13.7
6.001	45.4	4.6	77.360	0.193	0.0	0.0	2.8	1.76	69.9	31.3

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
6.002	45.50	1.230	37.0	0.075	0.00	0.0	0.600	o	225
6.003	27.00	0.340	79.4	0.068	0.00	0.0	0.600	o	225
6.004	41.00	1.250	32.8	0.111	0.00	0.0	0.600	o	225
6.005	64.00	1.940	33.0	0.248	0.00	0.0	0.600	o	300
6.006	29.00	0.430	67.4	0.028	0.00	0.0	0.600	o	300
1.020	16.00	0.160	100.0	0.034	0.00	0.0	0.600	o	525
7.000	29.00	0.290	100.0	0.084	4.00	0.0	0.600	o	225
1.021	20.00	0.200	100.0	0.020	0.00	0.0	0.600	o	525
1.022	20.00	0.200	100.0	0.020	0.00	0.0	0.600	o	525
1.023	20.00	0.200	100.0	0.020	0.00	0.0	0.600	o	525
1.024	29.00	0.290	100.0	0.384	0.00	0.0	0.600	o	525
1.025	12.00	0.120	100.0	0.038	0.00	0.0	0.600	o	525
1.026	51.00	0.510	100.0	0.163	0.00	0.0	0.600	o	600
1.027	36.50	0.365	100.0	0.092	0.00	0.0	0.600	o	600
1.028	25.00	0.250	100.0	0.062	0.00	0.0	0.600	o	600
1.029	27.00	0.270	100.0	0.028	0.00	0.0	0.600	o	600
1.030	49.00	0.490	100.0	0.050	0.00	0.0	0.600	o	600
1.031	27.00	0.270	100.0	0.025	0.00	0.0	0.600	o	600
8.000	38.00	0.900	42.2	0.167	4.00	0.0	0.600	o	225
8.001	40.00	1.680	23.8	0.143	0.00	0.0	0.600	o	225
8.002	32.50	1.490	21.8	0.100	0.00	0.0	0.600	o	225
8.003	41.00	1.000	41.0	0.413	0.00	0.0	0.600	o	300
8.004	16.50	0.275	60.0	0.026	0.00	0.0	0.600	o	300
8.005	19.00	0.280	67.9	0.007	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
6.002	44.3	4.9	76.650	0.268	0.0	0.0	3.9	2.16	85.8	42.4
6.003	43.3	5.2	75.420	0.336	0.0	0.0	4.7	1.47	58.4	52.1
6.004	42.5	5.5	75.080	0.447	0.0	0.0	6.2	2.29	91.1	67.9
6.005	41.5	5.9	72.830	0.695	0.0	0.0	9.4	2.75	194.2	103.0
6.006	40.8	6.2	70.000	0.723	0.0	0.0	9.6	1.92	135.5	105.5
1.020	36.2	8.4	68.200	3.319	0.0	0.0	39.0	2.24	484.9	429.1
7.000	46.0	4.4	68.000	0.084	0.0	0.0	1.3	1.31	52.0	13.8
1.021	35.9	8.5	67.410	3.423	0.0	0.0	39.9	2.24	484.9	439.3
1.022	35.6	8.7	66.500	3.443	0.0	0.0	39.9	2.24	484.9	439.3
1.023	35.4	8.8	64.400	3.463	0.0	0.0	39.9	2.24	484.9	439.3
1.024	35.0	9.0	62.200	3.847	0.0	0.0	43.8	2.24	484.9	481.6
1.025	34.9	9.1	61.310	3.885	0.0	0.0	44.0	2.24	484.9	484.3
1.026	34.3	9.5	59.100	4.048	0.0	0.0	45.1	2.44	688.6	496.5
1.027	33.9	9.7	57.190	4.140	0.0	0.0	45.6	2.44	688.6	502.1
1.028	33.7	9.9	55.800	4.202	0.0	0.0	46.0	2.44	688.6	505.7
1.029	33.4	10.1	54.450	4.230	0.0	0.0	46.0	2.44	688.6	505.7
1.030	32.9	10.4	52.680	4.280	0.0	0.0	46.0	2.44	688.6	505.7
1.031	32.6	10.6	51.590	4.305	0.0	0.0	46.0	2.44	688.6	505.7
8.000	46.2	4.3	58.500	0.167	0.0	0.0	2.5	2.02	80.3	27.6
8.001	45.4	4.6	57.600	0.310	0.0	0.0	4.6	2.69	107.1	50.3
8.002	44.8	4.8	55.920	0.410	0.0	0.0	6.0	2.81	111.9	65.6
8.003	43.9	5.0	53.530	0.823	0.0	0.0	11.8	2.46	174.1	129.3
8.004	43.5	5.2	52.150	0.849	0.0	0.0	12.0	2.03	143.7	132.1
8.005	43.1	5.3	51.875	0.856	0.0	0.0	12.0	1.91	135.1	132.1

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.032	19.50	0.190	102.6	0.020	0.00	0.0	0.600	o	600
1.033	25.00	0.250	100.0	0.025	0.00	0.0	0.600	o	600
1.034	20.00	0.200	100.0	0.107	0.00	0.0	0.600	o	600
1.035	10.50	0.100	105.0	0.000	0.00	0.0	0.600	o	600
1.036	35.00	0.350	100.0	0.087	0.00	0.0	0.600	o	600
9.000	26.00	0.173	150.3	0.087	4.00	0.0	0.600	o	225
9.001	40.50	0.405	100.0	0.112	0.00	0.0	0.600	o	225
9.002	18.00	0.980	18.4	0.043	0.00	0.0	0.600	o	225
9.003	10.00	0.100	100.0	0.031	0.00	0.0	0.600	o	225
10.000	15.00	0.355	42.3	0.045	4.00	0.0	0.600	o	225
10.001	17.00	0.665	25.6	0.036	0.00	0.0	0.600	o	225
10.002	15.00	0.540	27.8	0.038	0.00	0.0	0.600	o	225
10.003	11.00	0.510	21.6	0.000	0.00	0.0	0.600	o	225
9.004	20.00	1.000	20.0	0.014	0.00	0.0	0.600	o	225
9.005	20.00	0.725	27.6	0.059	0.00	0.0	0.600	o	225
9.006	8.00	0.053	150.9	0.026	0.00	0.0	0.600	o	300
9.007	40.00	0.400	100.0	0.225	0.00	0.0	0.600	o	300
9.008	29.00	0.290	100.0	0.000	0.00	0.0	0.600	o	300
1.037	35.00	5.000	7.0	0.000	0.00	0.0	0.600	o	600
1.038	32.00	0.320	100.0	0.000	0.00	0.0	0.600	o	675
1.039	44.00	0.440	100.0	0.000	0.00	0.0	0.600	o	675
1.040	65.00	0.250	260.0	0.000	0.00	0.0	0.600	o	750
1.041	20.00	0.100	200.0	0.000	0.00	0.0	0.600	o	750

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.032	32.5	10.7	51.295	5.181	0.0	0.0	54.7	2.40	679.7	601.3
1.033	32.2	10.9	49.800	5.206	0.0	0.0	54.7	2.44	688.6	601.3
1.034	32.0	11.0	48.000	5.313	0.0	0.0	55.3	2.44	688.6	608.7
1.035	32.0	11.1	44.800	5.313	0.0	0.0	55.3	2.38	671.9	608.7
1.036	31.6	11.4	44.400	5.400	0.0	0.0	55.5	2.44	688.6	610.9
9.000	45.9	4.4	52.095	0.087	0.0	0.0	1.3	1.06	42.3	14.3
9.001	44.3	4.9	51.922	0.199	0.0	0.0	2.9	1.31	52.0	31.5
9.002	44.0	5.0	51.517	0.242	0.0	0.0	3.5	3.07	122.0	38.0
9.003	43.6	5.1	50.537	0.273	0.0	0.0	3.9	1.31	52.0	42.5
10.000	46.9	4.1	53.100	0.045	0.0	0.0	0.7	2.02	80.2	7.5
10.001	46.5	4.2	52.245	0.081	0.0	0.0	1.2	2.60	103.3	13.5
10.002	46.2	4.3	51.000	0.119	0.0	0.0	1.8	2.49	99.1	19.6
10.003	46.0	4.4	50.460	0.119	0.0	0.0	1.8	2.83	112.5	19.6
9.004	43.3	5.3	49.500	0.406	0.0	0.0	5.7	2.94	116.9	62.8
9.005	42.9	5.4	47.500	0.465	0.0	0.0	6.5	2.50	99.4	71.3
9.006	42.6	5.5	46.700	0.491	0.0	0.0	6.8	1.28	90.3	74.7
9.007	41.4	5.9	46.647	0.716	0.0	0.0	9.6	1.57	111.1	106.1
9.008	40.7	6.2	44.640	0.716	0.0	0.0	9.6	1.57	111.1	106.1
1.037	31.6	11.4	44.050	6.116	0.0	0.0	62.7	9.24	2612.9	690.1
1.038	31.3	11.6	37.500	6.116	0.0	0.0	62.7	2.62	938.0	690.1
1.039	31.0	11.9	35.580	6.116	0.0	0.0	62.7	2.62	938.0	690.1
1.040	30.2	12.5	34.500	6.116	0.0	0.0	62.7	1.73	764.7	690.1
1.041	30.0	12.7	34.250	6.116	0.0	0.0	62.7	1.98	872.6	690.1

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.042	12.00	0.060	200.0	0.000	0.00	0.0	0.600	o	750
1.043	3.00	0.015	200.0	0.000	0.00	0.0	0.600	o	750

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.042	29.9	12.8	34.150	6.116	0.0	0.0	62.7	1.98	872.6	690.1
1.043	29.9	12.8	34.090	6.116	0.0	0.0	62.7	1.98	872.6	690.1

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	225	S.A43	78.920	77.145	1.550	1200
1.001	o	225	S.A42	79.070	76.745	2.100	1200
1.002	o	300	S.A41	77.570	74.772	2.498	1200
2.000	o	225	S.A40.3	77.400	75.625	1.550	1200
2.001	o	225	S.A40.2	77.280	75.312	1.743	1200
2.002	o	225	S.A40.1	77.200	75.096	1.879	1200
1.003	o	300	S.A40	77.030	74.535	2.195	1200
1.004	o	300	S.A39	76.060	73.950	1.810	1200
1.005	o	300	S.A38	75.650	73.600	1.750	1200
1.006	o	300	S.A37	75.410	73.360	1.750	1200
1.007	o	300	S.A36	74.710	72.660	1.750	1200
3.000	o	225	S.A35.2	76.600	74.500	1.875	1200
3.001	o	225	S.A35.1	76.000	73.900	1.875	1200
1.008	o	375	S.A35	73.940	71.690	1.875	1350
1.009	o	375	S.A34	73.650	71.400	1.875	1350
1.010	o	375	S.A33	73.350	71.100	1.875	1350
1.011	o	375	S.A32	73.220	70.970	1.875	1350
1.012	o	375	S.A31	73.550	70.560	2.615	1350
1.013	o	375	S.A30	73.940	70.460	3.105	1350
1.014	o	375	S.A29	74.680	70.270	4.035	1350
4.000	o	225	S.A28.3	78.810	76.810	1.775	1200
4.001	o	300	S.A28.2	77.000	73.925	2.775	1200
4.002	o	300	S.A28.1	76.830	73.400	3.130	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	24.00	60.0	S.A42	79.070	76.745	2.100	1200
1.001	45.00	37.5	S.A41	77.570	75.545	1.800	1200
1.002	16.50	100.0	S.A40	77.030	74.607	2.123	1200
2.000	14.50	46.3	S.A40.2	77.280	75.312	1.743	1200
2.001	10.00	46.3	S.A40.1	77.200	75.096	1.879	1200
2.002	22.50	46.3	S.A40	77.030	74.610	2.195	1200
1.003	25.00	42.7	S.A39	76.060	73.950	1.810	1200
1.004	17.00	48.6	S.A38	75.650	73.600	1.750	1200
1.005	12.00	50.0	S.A37	75.410	73.360	1.750	1200
1.006	34.00	48.6	S.A36	74.710	72.660	1.750	1200
1.007	40.00	51.9	S.A35	73.940	71.890	1.750	1350
3.000	10.00	16.7	S.A35.1	76.000	73.900	1.875	1200
3.001	43.50	21.1	S.A35	73.940	71.840	1.875	1350
1.008	33.50	115.5	S.A34	73.650	71.400	1.875	1350
1.009	37.00	123.3	S.A33	73.350	71.100	1.875	1350
1.010	15.00	115.4	S.A32	73.220	70.970	1.875	1350
1.011	41.00	100.0	S.A31	73.550	70.560	2.615	1350
1.012	10.00	100.0	S.A30	73.940	70.460	3.105	1350
1.013	19.00	100.0	S.A29	74.680	70.270	4.035	1350
1.014	21.00	100.0	S.A28	75.500	70.060	5.065	1350
4.000	43.00	15.3	S.A28.2	77.000	74.000	2.775	1200
4.001	52.50	100.0	S.A28.1	76.830	73.400	3.130	1200
4.002	63.00	47.4	S.A28	75.500	72.070	3.130	1350

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.015	o	450	S.A28	75.500	69.985	5.065	1350
5.000	o	225	S.A27.2	76.870	74.870	1.775	1200
5.001	o	225	S.A27.1	76.380	74.380	1.775	1200
1.016	o	525	S.A27	75.160	69.720	4.915	1500
1.017	o	525	S.A26	74.630	69.520	4.585	1500
1.018	o	525	S.A25	74.030	69.335	4.170	1500
1.019	o	525	S.A24	73.500	69.205	3.770	1500
6.000	o	225	S.A23.7	79.500	77.500	1.775	1200
6.001	o	225	S.A23.6	79.360	77.360	1.775	1200
6.002	o	225	S.A23.5	78.650	76.650	1.775	1200
6.003	o	225	S.A23.4	77.420	75.420	1.775	1200
6.004	o	225	S.A23.3	77.080	75.080	1.775	1200
6.005	o	300	S.A23.2	75.830	72.830	2.700	1200
6.006	o	300	S.A23.1	73.000	70.000	2.700	1200
1.020	o	525	S.A23	71.670	68.200	2.945	1500
7.000	o	225	S.A22.1	70.000	68.000	1.775	1200
1.021	o	525	S.A22	71.000	67.410	3.065	1500
1.022	o	525	S.A21	70.000	66.500	2.975	1500
1.023	o	525	S.A20	68.400	64.400	3.475	1500
1.024	o	525	S.A19	66.700	62.200	3.975	1500
1.025	o	525	S.A18	64.250	61.310	2.415	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.015	19.00	100.0	S.A27	75.160	69.795	4.915	1500
5.000	14.00	28.6	S.A27.1	76.380	74.380	1.775	1200
5.001	39.00	32.0	S.A27	75.160	73.160	1.775	1500
1.016	20.00	100.0	S.A26	74.630	69.520	4.585	1500
1.017	18.50	100.0	S.A25	74.030	69.335	4.170	1500
1.018	13.00	100.0	S.A24	73.500	69.205	3.770	1500
1.019	48.50	100.0	S.A23	71.670	68.720	2.425	1500
6.000	15.00	107.1	S.A23.6	79.360	77.360	1.775	1200
6.001	39.50	55.6	S.A23.5	78.650	76.650	1.775	1200
6.002	45.50	37.0	S.A23.4	77.420	75.420	1.775	1200
6.003	27.00	79.4	S.A23.3	77.080	75.080	1.775	1200
6.004	41.00	32.8	S.A23.2	75.830	73.830	1.775	1200
6.005	64.00	33.0	S.A23.1	73.000	70.890	1.810	1200
6.006	29.00	67.4	S.A23	71.670	69.570	1.800	1500
1.020	16.00	100.0	S.A22	71.000	68.040	2.435	1500
7.000	29.00	100.0	S.A22	71.000	67.710	3.065	1500
1.021	20.00	100.0	S.A21	70.000	67.210	2.265	1500
1.022	20.00	100.0	S.A20	68.400	66.300	1.575	1500
1.023	20.00	100.0	S.A19	66.700	64.200	1.975	1500
1.024	29.00	100.0	S.A18	64.250	61.910	1.815	1500
1.025	12.00	100.0	S.A17	63.600	61.190	1.885	1500

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.026	o	600	S.A17	63.600	59.100	3.900	1500
1.027	o	600	S.A17	61.000	57.190	3.210	1500
1.028	o	600	S.A16	59.200	55.800	2.800	1500
1.029	o	600	S.A15	58.000	54.450	2.950	1500
1.030	o	600	S.A14	56.650	52.680	3.370	1500
1.031	o	600	S.A13	54.720	51.590	2.530	1500
8.000	o	225	S.A12.6	60.500	58.500	1.775	1200
8.001	o	225	S.A12.5	59.600	57.600	1.775	1200
8.002	o	225	S.A12.4	57.920	55.920	1.775	1200
8.003	o	300	S.A12.3	56.430	53.530	2.600	1200
8.004	o	300	S.A12.2	54.680	52.150	2.230	1200
8.005	o	300	S.A12.1	54.000	51.875	1.825	1200
1.032	o	600	S.A12	53.720	51.295	1.825	1500
1.033	o	600	S.A11	53.000	49.800	2.600	1500
1.034	o	600	S.A10	51.750	48.000	3.150	1500
1.035	o	600	S.A9	50.000	44.800	4.600	1500
1.036	o	600	S.A8	46.500	44.400	1.500	1500
9.000	o	225	S.A7.9	54.120	52.095	1.800	1200
9.001	o	225	S.A7.8	54.280	51.922	2.133	1200
9.002	o	225	S.A7.7	53.320	51.517	1.578	1200
9.003	o	225	S.A7.6	52.420	50.537	1.658	1200
10.000	o	225	S.A7.5.4	55.630	53.100	2.305	1200
10.001	o	225	S.A7.5.3	54.800	52.245	2.330	1200
10.002	o	225	S.A7.5.2	53.610	51.000	2.385	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.026	51.00	100.0	S.A17	61.000	58.590	1.810	1500
1.027	36.50	100.0	S.A16	59.200	56.825	1.775	1500
1.028	25.00	100.0	S.A15	58.000	55.550	1.850	1500
1.029	27.00	100.0	S.A14	56.650	54.180	1.870	1500
1.030	49.00	100.0	S.A13	54.720	52.190	1.930	1500
1.031	27.00	100.0	S.A12	53.720	51.320	1.800	1500
8.000	38.00	42.2	S.A12.5	59.600	57.600	1.775	1200
8.001	40.00	23.8	S.A12.4	57.920	55.920	1.775	1200
8.002	32.50	21.8	S.A12.3	56.430	54.430	1.775	1200
8.003	41.00	41.0	S.A12.2	54.680	52.530	1.850	1200
8.004	16.50	60.0	S.A12.1	54.000	51.875	1.825	1200
8.005	19.00	67.9	S.A12	53.720	51.595	1.825	1500
1.032	19.50	102.6	S.A11	53.000	51.105	1.295	1500
1.033	25.00	100.0	S.A10	51.750	49.550	1.600	1500
1.034	20.00	100.0	S.A9	50.000	47.800	1.600	1500
1.035	10.50	105.0	S.A8	46.500	44.700	1.200	1500
1.036	35.00	100.0	S.A7	45.550	44.050	0.900	1500
9.000	26.00	150.3	S.A7.8	54.280	51.922	2.133	1200
9.001	40.50	100.0	S.A7.7	53.320	51.517	1.578	1200
9.002	18.00	18.4	S.A7.6	52.420	50.537	1.658	1200
9.003	10.00	100.0	S.A7.5	52.070	50.437	1.408	1200
10.000	15.00	42.3	S.A7.5.3	54.800	52.745	1.830	1200
10.001	17.00	25.6	S.A7.5.2	53.610	51.580	1.805	1200
10.002	15.00	27.8	S.A7.5.1	52.500	50.460	1.815	1200

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
10.003	o	225	S.A7.5.1	52.500	50.460	1.815	1200
9.004	o	225	S.A7.5	52.070	49.500	2.345	1200
9.005	o	225	S.A7.4	50.600	47.500	2.875	1200
9.006	o	300	S.A7.3	48.800	46.700	1.800	1200
9.007	o	300	S.A7.2	48.800	46.647	1.853	1200
9.008	o	300	S.A7.1	48.800	44.640	3.860	1200
1.037	o	600	S.A7	45.550	44.050	0.900	1500
1.038	o	675	S.A6	40.400	37.500	2.225	1500
1.039	o	675	S.A5	38.800	35.580	2.545	1500
1.040	o	750	S.A4	36.700	34.500	1.450	1800
1.041	o	750	S.A3	38.300	34.250	3.300	1800
1.042	o	750	S.A2	36.000	34.150	1.100	1800
1.043	o	750	S.A1	36.000	34.090	1.160	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
10.003	11.00	21.6	S.A7.5	52.070	49.950	1.895	1200
9.004	20.00	20.0	S.A7.4	50.600	48.500	1.875	1200
9.005	20.00	27.6	S.A7.3	48.800	46.775	1.800	1200
9.006	8.00	150.9	S.A7.2	48.800	46.647	1.853	1200
9.007	40.00	100.0	S.A7.1	48.800	46.247	2.253	1200
9.008	29.00	100.0	S.A7	45.550	44.350	0.900	1500
1.037	35.00	7.0	S.A6	40.400	39.050	0.750	1500
1.038	32.00	100.0	S.A5	38.800	37.180	0.945	1500
1.039	44.00	100.0	S.A4	36.700	35.140	0.885	1800
1.040	65.00	260.0	S.A3	38.300	34.250	3.300	1800
1.041	20.00	200.0	S.A2	36.000	34.150	1.100	1800
1.042	12.00	200.0	S.A1	36.000	34.090	1.160	1800
1.043	3.00	200.0	Attenuation Tank	36.000	34.075	1.175	0

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
S.A43	78.920	1.775	1200	1.000	77.145	225			
S.A42	79.070	2.325	1200	1.001	76.745	225	1.000	76.745	225
S.A41	77.570	2.798	1200	1.002	74.772	300	1.001	75.545	225
S.A40.3	77.400	1.775	1200	2.000	75.625	225			
S.A40.2	77.280	1.968	1200	2.001	75.312	225	2.000	75.312	225
S.A40.1	77.200	2.104	1200	2.002	75.096	225	2.001	75.096	225
S.A40	77.030	2.495	1200	1.003	74.535	300	1.002	74.607	300
							2.002	74.610	225
S.A39	76.060	2.110	1200	1.004	73.950	300	1.003	73.950	300
S.A38	75.650	2.050	1200	1.005	73.600	300	1.004	73.600	300
S.A37	75.410	2.050	1200	1.006	73.360	300	1.005	73.360	300
S.A36	74.710	2.050	1200	1.007	72.660	300	1.006	72.660	300
S.A35.2	76.600	2.100	1200	3.000	74.500	225			
S.A35.1	76.000	2.100	1200	3.001	73.900	225	3.000	73.900	225
S.A35	73.940	2.250	1350	1.008	71.690	375	1.007	71.890	300
							3.001	71.840	225
S.A34	73.650	2.250	1350	1.009	71.400	375	1.008	71.400	375
S.A33	73.350	2.250	1350	1.010	71.100	375	1.009	71.100	375
S.A32	73.220	2.250	1350	1.011	70.970	375	1.010	70.970	375
S.A31	73.550	2.990	1350	1.012	70.560	375	1.011	70.560	375
S.A30	73.940	3.480	1350	1.013	70.460	375	1.012	70.460	375
S.A29	74.680	4.410	1350	1.014	70.270	375	1.013	70.270	375
S.A28.3	78.810	2.000	1200	4.000	76.810	225			
S.A28.2	77.000	3.075	1200	4.001	73.925	300	4.000	74.000	225
S.A28.1	76.830	3.430	1200	4.002	73.400	300	4.001	73.400	300
S.A28	75.500	5.515	1350	1.015	69.985	450	1.014	70.060	375
							4.002	72.070	300
S.A27.2	76.870	2.000	1200	5.000	74.870	225			
S.A27.1	76.380	2.000	1200	5.001	74.380	225	5.000	74.380	225
S.A27	75.160	5.440	1500	1.016	69.720	525	1.015	69.795	450
							5.001	73.160	225
S.A26	74.630	5.110	1500	1.017	69.520	525	1.016	69.520	525
S.A25	74.030	4.695	1500	1.018	69.335	525	1.017	69.335	525

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
S.A24	73.500	4.295	1500	1.019	69.205	525	1.018	69.205	525
S.A23.7	79.500	2.000	1200	6.000	77.500	225			
S.A23.6	79.360	2.000	1200	6.001	77.360	225	6.000	77.360	225
S.A23.5	78.650	2.000	1200	6.002	76.650	225	6.001	76.650	225
S.A23.4	77.420	2.000	1200	6.003	75.420	225	6.002	75.420	225
S.A23.3	77.080	2.000	1200	6.004	75.080	225	6.003	75.080	225
S.A23.2	75.830	3.000	1200	6.005	72.830	300	6.004	73.830	225
S.A23.1	73.000	3.000	1200	6.006	70.000	300	6.005	70.890	300
S.A23	71.670	3.470	1500	1.020	68.200	525	1.019	68.720	525
							6.006	69.570	300
S.A22.1	70.000	2.000	1200	7.000	68.000	225			
S.A22	71.000	3.590	1500	1.021	67.410	525	1.020	68.040	525
							7.000	67.710	225
S.A21	70.000	3.500	1500	1.022	66.500	525	1.021	67.210	525
S.A20	68.400	4.000	1500	1.023	64.400	525	1.022	66.300	525
S.A19	66.700	4.500	1500	1.024	62.200	525	1.023	64.200	525
S.A18	64.250	2.940	1500	1.025	61.310	525	1.024	61.910	525
S.A17	63.600	4.500	1500	1.026	59.100	600	1.025	61.190	525
S.A17	61.000	3.810	1500	1.027	57.190	600	1.026	58.590	600
S.A16	59.200	3.400	1500	1.028	55.800	600	1.027	56.825	600
S.A15	58.000	3.550	1500	1.029	54.450	600	1.028	55.550	600
S.A14	56.650	3.970	1500	1.030	52.680	600	1.029	54.180	600
S.A13	54.720	3.130	1500	1.031	51.590	600	1.030	52.190	600
S.A12.6	60.500	2.000	1200	8.000	58.500	225			
S.A12.5	59.600	2.000	1200	8.001	57.600	225	8.000	57.600	225
S.A12.4	57.920	2.000	1200	8.002	55.920	225	8.001	55.920	225
S.A12.3	56.430	2.900	1200	8.003	53.530	300	8.002	54.430	225
S.A12.2	54.680	2.530	1200	8.004	52.150	300	8.003	52.530	300
S.A12.1	54.000	2.125	1200	8.005	51.875	300	8.004	51.875	300
S.A12	53.720	2.425	1500	1.032	51.295	600	1.031	51.320	600
							8.005	51.595	300
S.A11	53.000	3.200	1500	1.033	49.800	600	1.032	51.105	600
S.A10	51.750	3.750	1500	1.034	48.000	600	1.033	49.550	600

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
S.A9	50.000	5.200	1500	1.035	44.800	600	1.034	47.800	600
S.A8	46.500	2.100	1500	1.036	44.400	600	1.035	44.700	600
S.A7.9	54.120	2.025	1200	9.000	52.095	225			
S.A7.8	54.280	2.358	1200	9.001	51.922	225	9.000	51.922	225
S.A7.7	53.320	1.803	1200	9.002	51.517	225	9.001	51.517	225
S.A7.6	52.420	1.883	1200	9.003	50.537	225	9.002	50.537	225
S.A7.5.4	55.630	2.530	1200	10.000	53.100	225			
S.A7.5.3	54.800	2.555	1200	10.001	52.245	225	10.000	52.745	225
S.A7.5.2	53.610	2.610	1200	10.002	51.000	225	10.001	51.580	225
S.A7.5.1	52.500	2.040	1200	10.003	50.460	225	10.002	50.460	225
S.A7.5	52.070	2.570	1200	9.004	49.500	225	9.003 10.003	50.437 49.950	225 225
S.A7.4	50.600	3.100	1200	9.005	47.500	225	9.004	48.500	225
S.A7.3	48.800	2.100	1200	9.006	46.700	300	9.005	46.775	225
S.A7.2	48.800	2.153	1200	9.007	46.647	300	9.006	46.647	300
S.A7.1	48.800	4.160	1200	9.008	44.640	300	9.007	46.247	300
S.A7	45.550	1.500	1500	1.037	44.050	600	1.036 9.008	44.050 44.350	600 300
S.A6	40.400	2.900	1500	1.038	37.500	675	1.037	39.050	600
S.A5	38.800	3.220	1500	1.039	35.580	675	1.038	37.180	675
S.A4	36.700	2.200	1800	1.040	34.500	750	1.039	35.140	675
S.A3	38.300	4.050	1800	1.041	34.250	750	1.040	34.250	750
S.A2	36.000	1.850	1800	1.042	34.150	750	1.041	34.150	750
S.A1	36.000	1.910	1800	1.043	34.090	750	1.042	34.090	750
Attenuation Tank	36.000	1.925	0		OUTFALL		1.043	34.075	750

STORM SEWER DESIGN by the Modified Rational Method

Global Variables

Pipe Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.PIP
Manhole Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.MHS

Location - Scotland & Ireland

Return Period (years)	1	Maximum Backdrop Height (m)	4.000
M5-60 (mm)	18.800	Min Cover Depth for Optimisation (m)	1.200
Ratio R	0.250	Min Vel for Auto Design Only (m/s)	1.00
Maximum Rainfall (mm/hr)	50	Min Slope for Optimisation (1:X)	500
Foul Sewage (l/s/ha)	0.00	Minimum Outfall Invert (m)	36.137
O'flow Setting (*Foul only)	0	Ground Level at Outfall (m)	39.000
Volumetric Runoff Coeff.	0.90	Outfall Manhole Name	Attenuation
Add Flow / Climate Change (%)	10	Outfall Manhole Dia/Length (mm)	0
Minimum Backdrop Height (m)	0.000	Outfall Manhole Width (mm)	0

Designed with Level Soffits

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	21.00	0.880	23.9	0.026	4.00	0.0	0.600	o	225
1.001	23.00	1.000	23.0	0.017	0.00	0.0	0.600	o	225
1.002	19.00	0.840	22.6	0.015	0.00	0.0	0.600	o	225
1.003	15.00	0.700	21.4	0.013	0.00	0.0	0.600	o	225
1.004	15.00	0.650	23.1	0.046	0.00	0.0	0.600	o	225
1.005	30.50	1.350	22.6	0.087	0.00	0.0	0.600	o	225
1.006	55.00	2.480	22.2	0.134	0.00	0.0	0.600	o	225
1.007	18.00	0.225	80.0	0.000	0.00	0.0	0.600	o	225
1.008	12.00	0.200	60.0	0.000	0.00	0.0	0.600	o	225
2.000	65.00	0.433	150.1	0.139	4.00	0.0	0.600	o	225
2.001	58.00	0.464	125.0	0.147	0.00	0.0	0.600	o	225
2.002	58.00	0.580	100.0	0.048	0.00	0.0	0.600	o	225
1.009	9.00	0.075	120.0	0.000	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	46.9	4.1	67.775	0.026	0.0	0.0	0.4	2.69	106.9	4.4
1.001	46.4	4.3	66.895	0.043	0.0	0.0	0.6	2.74	108.9	7.1
1.002	46.0	4.4	65.895	0.058	0.0	0.0	0.9	2.76	109.9	9.5
1.003	45.7	4.5	65.055	0.071	0.0	0.0	1.1	2.84	112.9	11.6
1.004	45.4	4.6	63.755	0.117	0.0	0.0	1.7	2.74	108.8	19.0
1.005	44.8	4.7	63.105	0.204	0.0	0.0	3.0	2.76	109.9	32.7
1.006	43.8	5.1	61.755	0.338	0.0	0.0	4.8	2.79	111.0	52.9
1.007	43.2	5.3	58.275	0.338	0.0	0.0	4.8	1.46	58.2	52.9
1.008	42.9	5.4	57.705	0.338	0.0	0.0	4.8	1.69	67.3	52.9
2.000	44.0	5.0	56.185	0.139	0.0	0.0	2.0	1.06	42.3	21.9
2.001	41.7	5.8	55.752	0.286	0.0	0.0	3.9	1.17	46.4	42.6
2.002	39.8	6.6	55.288	0.334	0.0	0.0	4.3	1.31	52.0	47.6
1.009	39.6	6.7	54.633	0.672	0.0	0.0	8.6	1.43	101.4	95.1

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.010	8.00	0.067	119.4	0.000	0.00	0.0	0.600	o	300
1.011	11.00	0.100	110.0	0.000	0.00	0.0	0.600	o	300
1.012	20.00	0.200	100.0	0.000	0.00	0.0	0.600	o	300
1.013	20.00	0.700	28.6	0.000	0.00	0.0	0.600	o	300
3.000	40.00	1.010	39.6	0.158	4.00	0.0	0.600	o	225
3.001	33.00	1.650	20.0	0.165	0.00	0.0	0.600	o	225
1.014	24.00	0.230	104.3	0.000	0.00	0.0	0.600	o	375
4.000	17.00	0.200	85.0	0.085	4.00	0.0	0.600	o	225
4.001	28.00	0.360	77.8	0.120	0.00	0.0	0.600	o	225
4.002	23.00	1.100	20.9	0.042	0.00	0.0	0.600	o	225
4.003	36.00	2.000	18.0	0.029	0.00	0.0	0.600	o	225
4.004	14.00	0.500	28.0	0.009	0.00	0.0	0.600	o	225
4.005	26.00	1.000	26.0	0.060	0.00	0.0	0.600	o	225
1.015	24.00	0.270	88.9	0.109	0.00	0.0	0.600	o	375
1.016	26.00	0.260	100.0	0.013	0.00	0.0	0.600	o	375
1.017	19.00	0.190	100.0	0.010	0.00	0.0	0.600	o	375
1.018	17.00	0.170	100.0	0.009	0.00	0.0	0.600	o	375
1.019	10.00	0.100	100.0	0.005	0.00	0.0	0.600	o	375
1.020	4.00	0.040	100.0	0.000	0.00	0.0	0.600	o	375
1.021	23.00	0.230	100.0	0.055	0.00	0.0	0.600	o	375
1.022	17.00	0.205	82.9	0.040	0.00	0.0	0.600	o	375
1.023	7.00	0.070	100.0	0.000	0.00	0.0	0.600	o	450

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.010	39.4	6.8	54.558	0.672	0.0	0.0	8.6	1.44	101.6	95.1
1.011	39.1	6.9	52.100	0.672	0.0	0.0	8.6	1.50	105.9	95.1
1.012	38.6	7.1	50.500	0.672	0.0	0.0	8.6	1.57	111.1	95.1
1.013	38.4	7.2	48.000	0.672	0.0	0.0	8.6	2.95	208.7	95.1
3.000	46.2	4.3	50.035	0.158	0.0	0.0	2.4	2.09	82.9	26.1
3.001	45.6	4.5	49.025	0.323	0.0	0.0	4.8	2.94	116.9	52.6
1.014	37.9	7.5	46.225	0.995	0.0	0.0	12.3	1.77	195.9	134.9
4.000	46.7	4.2	51.635	0.085	0.0	0.0	1.3	1.42	56.4	14.2
4.001	45.6	4.5	51.435	0.205	0.0	0.0	3.0	1.48	59.0	33.4
4.002	45.1	4.6	51.075	0.247	0.0	0.0	3.6	2.87	114.3	39.8
4.003	44.5	4.8	49.975	0.276	0.0	0.0	4.0	3.10	123.2	43.9
4.004	44.2	4.9	47.975	0.285	0.0	0.0	4.1	2.48	98.7	45.1
4.005	43.7	5.1	47.475	0.345	0.0	0.0	4.9	2.58	102.4	53.9
1.015	37.5	7.7	45.000	1.449	0.0	0.0	17.7	1.92	212.3	194.3
1.016	37.0	7.9	43.000	1.462	0.0	0.0	17.7	1.81	200.1	194.3
1.017	36.7	8.1	41.175	1.472	0.0	0.0	17.7	1.81	200.1	194.3
1.018	36.4	8.2	39.985	1.481	0.0	0.0	17.7	1.81	200.1	194.3
1.019	36.2	8.3	39.000	1.486	0.0	0.0	17.7	1.81	200.1	194.3
1.020	36.2	8.4	37.900	1.486	0.0	0.0	17.7	1.81	200.1	194.3
1.021	35.8	8.6	37.860	1.541	0.0	0.0	17.9	1.81	200.1	197.2
1.022	35.6	8.7	37.630	1.581	0.0	0.0	18.3	1.99	219.9	201.0
1.023	35.5	8.8	37.350	1.581	0.0	0.0	18.3	2.03	323.4	201.0

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
5.000	38.00	0.380	100.0	0.163	4.00	0.0	0.600	o	225
6.000	7.00	0.070	100.0	0.030	4.00	0.0	0.600	o	225
5.001	19.00	0.113	167.9	0.000	0.00	0.0	0.600	o	225
1.024	10.00	0.100	100.0	0.000	0.00	0.0	0.600	o	450
1.025	2.00	0.020	100.0	0.000	0.00	0.0	0.600	o	450

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
5.000	45.7	4.5	36.975	0.163	0.0	0.0	2.4	1.31	52.0	26.6
6.000	47.1	4.1	36.975	0.030	0.0	0.0	0.5	1.31	52.0	5.0
5.001	44.6	4.8	36.595	0.193	0.0	0.0	2.8	1.01	40.0	30.8
1.024	35.3	8.9	36.257	1.774	0.0	0.0	20.4	2.03	323.4	224.0
1.025	35.3	8.9	36.157	1.774	0.0	0.0	20.4	2.03	323.4	224.0

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	225	S.B26	69.200	67.775	1.200	1200
1.001	o	225	S.B25	68.320	66.895	1.200	1200
1.002	o	225	S.B24	67.320	65.895	1.200	1200
1.003	o	225	S.B23	66.480	65.055	1.200	1200
1.004	o	225	S.B22	65.780	63.755	1.800	1200
1.005	o	225	S.B21	65.130	63.105	1.800	1200
1.006	o	225	S.B20	63.780	61.755	1.800	1200
1.007	o	225	S.B19	61.300	58.275	2.800	1200
1.008	o	225	S.B18	60.200	57.705	2.270	1200
2.000	o	225	S.B17.3	58.210	56.185	1.800	1200
2.001	o	225	S.B17.2	58.250	55.752	2.273	1200
2.002	o	225	S.B17.1	58.250	55.288	2.737	1200
1.009	o	300	S.B17	58.500	54.633	3.567	1200
1.010	o	300	S.B16	58.000	54.558	3.142	1200
1.011	o	300	S.B15	56.250	52.100	3.850	1200
1.012	o	300	S.B14	53.500	50.500	2.700	1200
1.013	o	300	S.B13	52.000	48.000	3.700	1200
3.000	o	225	S.B12.2	52.060	50.035	1.800	1200
3.001	o	225	S.B12.1	51.050	49.025	1.800	1200
1.014	o	375	S.B12	49.400	46.225	2.800	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	21.00	23.9	S.B25	68.320	66.895	1.200	1200
1.001	23.00	23.0	S.B24	67.320	65.895	1.200	1200
1.002	19.00	22.6	S.B23	66.480	65.055	1.200	1200
1.003	15.00	21.4	S.B22	65.780	64.355	1.200	1200
1.004	15.00	23.1	S.B21	65.130	63.105	1.800	1200
1.005	30.50	22.6	S.B20	63.780	61.755	1.800	1200
1.006	55.00	22.2	S.B19	61.300	59.275	1.800	1200
1.007	18.00	80.0	S.B18	60.200	58.050	1.925	1200
1.008	12.00	60.0	S.B17	58.500	57.505	0.770	1200
2.000	65.00	150.1	S.B17.2	58.250	55.752	2.273	1200
2.001	58.00	125.0	S.B17.1	58.250	55.288	2.737	1200
2.002	58.00	100.0	S.B17	58.500	54.708	3.567	1200
1.009	9.00	120.0	S.B16	58.000	54.558	3.142	1200
1.010	8.00	119.4	S.B15	56.250	54.491	1.459	1200
1.011	11.00	110.0	S.B14	53.500	52.000	1.200	1200
1.012	20.00	100.0	S.B13	52.000	50.300	1.400	1200
1.013	20.00	28.6	S.B12	49.400	47.300	1.800	1350
3.000	40.00	39.6	S.B12.1	51.050	49.025	1.800	1200
3.001	33.00	20.0	S.B12	49.400	47.375	1.800	1350
1.014	24.00	104.3	S.B11	48.170	45.995	1.800	1350

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
4.000	o	225	S.B11.6	53.660	51.635	1.800	1200
4.001	o	225	S.B11.5	53.460	51.435	1.800	1200
4.002	o	225	S.B11.4	53.100	51.075	1.800	1200
4.003	o	225	S.B11.3	52.000	49.975	1.800	1200
4.004	o	225	S.B11.2	50.000	47.975	1.800	1200
4.005	o	225	S.B11.1	49.500	47.475	1.800	1200
1.015	o	375	S.B11	48.170	45.000	2.795	1350
1.016	o	375	S.B10	47.000	43.000	3.625	1350
1.017	o	375	S.B9	44.920	41.175	3.370	1350
1.018	o	375	S.B8	43.160	39.985	2.800	1350
1.019	o	375	S.B7	41.900	39.000	2.525	1350
1.020	o	375	S.B6	41.000	37.900	2.725	1350
1.021	o	375	S.B5	41.000	37.860	2.765	1350
1.022	o	375	S.B4	39.500	37.630	1.495	1350
1.023	o	450	S.B3	39.000	37.350	1.200	1350
5.000	o	225	S.B2.2	39.000	36.975	1.800	1200
6.000	o	225	S.B2.1.1	39.000	36.975	1.800	1200
5.001	o	225	S.B2.1	39.000	36.595	2.180	1200
1.024	o	450	S.B2	39.000	36.257	2.293	1350
1.025	o	450	S.B1	39.000	36.157	2.393	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
4.000	17.00	85.0	S.B11.5	53.460	51.435	1.800	1200
4.001	28.00	77.8	S.B11.4	53.100	51.075	1.800	1200
4.002	23.00	20.9	S.B11.3	52.000	49.975	1.800	1200
4.003	36.00	18.0	S.B11.2	50.000	47.975	1.800	1200
4.004	14.00	28.0	S.B11.1	49.500	47.475	1.800	1200
4.005	26.00	26.0	S.B11	48.170	46.475	1.470	1350
1.015	24.00	88.9	S.B10	47.000	44.730	1.895	1350
1.016	26.00	100.0	S.B9	44.920	42.740	1.805	1350
1.017	19.00	100.0	S.B8	43.160	40.985	1.800	1350
1.018	17.00	100.0	S.B7	41.900	39.815	1.710	1350
1.019	10.00	100.0	S.B6	41.000	38.900	1.725	1350
1.020	4.00	100.0	S.B5	41.000	37.860	2.765	1350
1.021	23.00	100.0	S.B4	39.500	37.630	1.495	1350
1.022	17.00	82.9	S.B3	39.000	37.425	1.200	1350
1.023	7.00	100.0	S.B2	39.000	37.280	1.270	1350
5.000	38.00	100.0	S.B2.1	39.000	36.595	2.180	1200
6.000	7.00	100.0	S.B2.1	39.000	36.905	1.870	1200
5.001	19.00	167.9	S.B2	39.000	36.482	2.293	1350
1.024	10.00	100.0	S.B1	39.000	36.157	2.393	1350
1.025	2.00	100.0	Attenuation	39.000	36.137	2.413	0

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
S.B26	69.200	1.425	1200	1.000	67.775	225			
S.B25	68.320	1.425	1200	1.001	66.895	225	1.000	66.895	225
S.B24	67.320	1.425	1200	1.002	65.895	225	1.001	65.895	225
S.B23	66.480	1.425	1200	1.003	65.055	225	1.002	65.055	225
S.B22	65.780	2.025	1200	1.004	63.755	225	1.003	64.355	225
S.B21	65.130	2.025	1200	1.005	63.105	225	1.004	63.105	225
S.B20	63.780	2.025	1200	1.006	61.755	225	1.005	61.755	225
S.B19	61.300	3.025	1200	1.007	58.275	225	1.006	59.275	225
S.B18	60.200	2.495	1200	1.008	57.705	225	1.007	58.050	225
S.B17.3	58.210	2.025	1200	2.000	56.185	225			
S.B17.2	58.250	2.498	1200	2.001	55.752	225	2.000	55.752	225
S.B17.1	58.250	2.962	1200	2.002	55.288	225	2.001	55.288	225
S.B17	58.500	3.867	1200	1.009	54.633	300	1.008	57.505	225
							2.002	54.708	225
S.B16	58.000	3.442	1200	1.010	54.558	300	1.009	54.558	300
S.B15	56.250	4.150	1200	1.011	52.100	300	1.010	54.491	300
S.B14	53.500	3.000	1200	1.012	50.500	300	1.011	52.000	300
S.B13	52.000	4.000	1200	1.013	48.000	300	1.012	50.300	300
S.B12.2	52.060	2.025	1200	3.000	50.035	225			
S.B12.1	51.050	2.025	1200	3.001	49.025	225	3.000	49.025	225
S.B12	49.400	3.175	1350	1.014	46.225	375	1.013	47.300	300
							3.001	47.375	225
S.B11.6	53.660	2.025	1200	4.000	51.635	225			
S.B11.5	53.460	2.025	1200	4.001	51.435	225	4.000	51.435	225
S.B11.4	53.100	2.025	1200	4.002	51.075	225	4.001	51.075	225
S.B11.3	52.000	2.025	1200	4.003	49.975	225	4.002	49.975	225
S.B11.2	50.000	2.025	1200	4.004	47.975	225	4.003	47.975	225
S.B11.1	49.500	2.025	1200	4.005	47.475	225	4.004	47.475	225
S.B11	48.170	3.170	1350	1.015	45.000	375	1.014	45.995	375
							4.005	46.475	225

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
S.B10	47.000	4.000	1350	1.016	43.000	375	1.015	44.730	375
S.B9	44.920	3.745	1350	1.017	41.175	375	1.016	42.740	375
S.B8	43.160	3.175	1350	1.018	39.985	375	1.017	40.985	375
S.B7	41.900	2.900	1350	1.019	39.000	375	1.018	39.815	375
S.B6	41.000	3.100	1350	1.020	37.900	375	1.019	38.900	375
S.B5	41.000	3.140	1350	1.021	37.860	375	1.020	37.860	375
S.B4	39.500	1.870	1350	1.022	37.630	375	1.021	37.630	375
S.B3	39.000	1.650	1350	1.023	37.350	450	1.022	37.425	375
S.B2.2	39.000	2.025	1200	5.000	36.975	225			
S.B2.1.1	39.000	2.025	1200	6.000	36.975	225			
S.B2.1	39.000	2.405	1200	5.001	36.595	225	5.000 6.000	36.595 36.905	225 225
S.B2	39.000	2.743	1350	1.024	36.257	450	1.023 5.001	37.280 36.482	450 225
S.B1	39.000	2.843	1350	1.025	36.157	450	1.024	36.157	450
Attenuation	39.000	2.863	0		OUTFALL		1.025	36.137	450

STORM SEWER DESIGN by the Modified Rational Method

Global Variables

Pipe Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.PIP
Manhole Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.MHS

Location - Scotland & Ireland

Return Period (years)	1	Maximum Backdrop Height (m)	3.500
M5-60 (mm)	18.800	Min Cover Depth for Optimisation (m)	1.200
Ratio R	0.250	Min Vel for Auto Design Only (m/s)	0.75
Maximum Rainfall (mm/hr)	50	Min Slope for Optimisation (1:X)	500
Foul Sewage (l/s/ha)	0.00	Minimum Outfall Invert (m)	49.693
O'flow Setting (*Foul only)	0	Ground Level at Outfall (m)	52.250
Volumetric Runoff Coeff.	0.90	Outfall Manhole Name	Attenuation
Add Flow / Climate Change (%)	10	Outfall Manhole Dia/Length (mm)	0
Minimum Backdrop Height (m)	0.000	Outfall Manhole Width (mm)	0

Designed with Level Soffits

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	18.00	0.180	100.0	0.044	4.00	0.0	0.060	o	225
1.001	32.00	0.320	100.0	0.110	0.00	0.0	0.060	o	225
1.002	32.00	0.320	100.0	0.128	0.00	0.0	0.060	o	225
1.003	24.00	0.400	60.0	0.227	0.00	0.0	0.060	o	225
1.004	10.00	0.167	59.9	0.000	0.00	0.0	0.060	o	225
1.005	2.00	0.033	60.6	0.000	0.00	0.0	0.060	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	46.7	4.2	52.150	0.044	0.0	0.0	0.7	1.64	65.2	7.3
1.001	45.6	4.5	50.900	0.154	0.0	0.0	2.3	1.64	65.2	25.1
1.002	44.5	4.8	50.580	0.282	0.0	0.0	4.1	1.64	65.2	44.9
1.003	44.0	5.0	50.260	0.509	0.0	0.0	7.3	2.14	85.1	80.0
1.004	43.7	5.1	49.860	0.509	0.0	0.0	7.3	2.14	85.2	80.0
1.005	43.7	5.1	49.693	0.509	0.0	0.0	7.3	2.13	84.7	80.0

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	225	S.C6	54.900	52.150	2.525	1200
1.001	o	225	S.C5	54.000	50.900	2.875	1200
1.002	o	225	S.C4	52.630	50.580	1.825	1200
1.003	o	225	S.C3	52.380	50.260	1.895	1200
1.004	o	225	S.C2	52.350	49.860	2.265	1200
1.005	o	225	S.C1	52.350	49.693	2.432	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	18.00	100.0	S.C5	54.000	51.970	1.805	1200
1.001	32.00	100.0	S.C4	52.630	50.580	1.825	1200
1.002	32.00	100.0	S.C3	52.380	50.260	1.895	1200
1.003	24.00	60.0	S.C2	52.350	49.860	2.265	1200
1.004	10.00	59.9	S.C1	52.350	49.693	2.432	1200
1.005	2.00	60.6	Attenuation	52.250	49.660	2.365	0

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
S.C6	54.900	2.750	1200	1.000	52.150	225			
S.C5	54.000	3.100	1200	1.001	50.900	225	1.000	51.970	225
S.C4	52.630	2.050	1200	1.002	50.580	225	1.001	50.580	225
S.C3	52.380	2.120	1200	1.003	50.260	225	1.002	50.260	225
S.C2	52.350	2.490	1200	1.004	49.860	225	1.003	49.860	225
S.C1	52.350	2.657	1200	1.005	49.693	225	1.004	49.693	225
Attenuation	52.250	2.590	0		OUTFALL		1.005	49.660	225

APPENDIX C

ATTENUATION CALCULATIONS

DESIGNED:	**PMcE**
FILE	
JOB NUMBER:	18203
DOC REF:	18203-JBB-1A-XX-CA-C-0053_Surface_Water_Attenuation_for_Network_A_P01
DATE:	25/03/2019
PROJECT:	Strategic Housing Development Castletreasure
DESCRIPTION:	**Design flood estimation - Network A**

Method:

1 Estimate the Qbar (Mean AnnualFlood) using the catchment characteristics in the IoH-124 (1994) 3-variable equations
2 Multiply the estimated Qbar by an appropriate regional growth factor (XT) of a required return period T
(refer to Table 2.39 (page 173) of FSR Report no. 1),
for T = 100, 50 and 25 years, XT = 1.96, 1.77 and 1.6 respectively
3 Multiply the estimated QT by an appropriate design (standard error) factor to get the design QT (DF = 1.65 here)
4 Multiply the above design QT by an appropriate factor to accommodate the effects of future climate change in Ireland

1. Calculation of Q_{bar}

Qbar = **$C . (AREA)^{0.89} . (SAAR)^{1.17} . (SOIL)^{2.17}$** **0.0299** m^3/s

Qbar =	Mean annual flood (m^3/sec), calculated using catchment characteristics		
C =	A regional coefficient with values as indicated on IoH Report No. 124	**0.00108**	Constant
Area =	Catchment area in square kilometres	0.096	km^2
	If less than 50 heactares, use 50 hectares in the formula and factor the result based on the actual site area and the applied area i.e. 50ha.	0.5	km^2
	Ratio of actual area to area applied in formual	0.192	
SOIL	Soil index, which is based on a soil classification derived from the Soil Surveys in Ireland. It is a composite index, derived from the formula, $S=(0.15S_1+0.3S_2+0.4S_3+0.45S_4+0.5S_5)/(S_1+S_2+S_3+S_4+S_5)$ S_1….S_5 denote the proportions of the catchment covered by each of the soil classes 1-5. Refer to Figure 4.18 (I), FSR Volume V.	0.3	S1 = 0 % S2 = 100 % S3 = 0 % S4 = 0 % S5 = 0 % Total = 100 (total = 100 %)
SAAR	Standard period average annual rainfall, the standard period being 1931 to 1960 in Ireland). SAAR is obtained from Figure II.3.1 (I), FSR Volume V.	1,106.50	mm

	T (yrs)	Factor	Q_T (m^3/s)
Peak flows @ 1 in 100year return period (current scenario) -->	100	1.96	**0.06**
	50	2.33	**0.07**
	25	2.1	**0.06**
	20	1.96	**0.06**
	15	1.8	**0.05**
	10	1.67	**0.05**
	5	1.37	**0.04**
	2	0.95	**0.03**
	1	0.85	**0.03**
Design 1 in 2 year flood including standard error factor of 1.65		1.65	0.05
Design flood including Climate Change Factor of 1.2 and SER (1.65)		1.2	**0.06**

Project Title:	Strategic Housing Development Castletreasure	**Date:**	25/03/19
Report Title:	Rainfall Intensity Calculations	**Project No.**	18203
Client:	Cairn Homes Properties Ltd.		
Doc Ref:	18203-JBB-1A-XX-CA-C-0053_Surface_Water_Attenuation_for_Network_A_P01		
Author(s)	PMcE	**Approved:**	TF

Based on data from the Flood Studies Report

2-Day R5 | 75 | mm | Return Period | 100 | Yrs

r | 25 | %

r %	1 min.	2 min.	5 min.	10 min.	15 min.	30 min.	60 min.	2 hr.	3 hr.	4 hr.	5 hr.	6 hr.	12 hr.	24 hr.	48 hr.
24	2.5	4.3	7.6	11.0	13.3	18.1	24.0	31.0	36.0	41.0	44.5	48.0	63.0	81.0	106.0
27	3.0	5.0	9.0	12.9	15.5	20.7	27.0	35.0	39.5	44.0	47.5	51.0	65.0	83.0	106.0
25	2.7	4.5	8.1	11.6	14.0	19.0	25.0	32.3	37.2	42.0	45.5	49.0	63.7	81.7	106.0

Duration, D (min./ hrs)	DR_5 (mm)	Return Period, T (years)	Growth Factor	DR_T (mm)	Duration, D (min.)	Rainfall Intensity (mm/hr)
1 min.	2.0	100	1.750	3.5	1	**210.58**
2 min.	3.4	100	1.802	6.1	2	**184.26**
5 min.	6.1	100	1.883	11.4	5	**137.10**
10min.	8.7	100	1.942	17.0	10	**101.96**
15 min.	10.6	100	1.970	20.8	15	**83.15**
30 min.	14.3	100	1.968	28.1	30	**56.15**
60 min.	18.8	100	1.939	36.5	60	**36.46**
2 hr.	24.3	100	1.895	46.1	120	**23.04**
3 hr.	27.9	100	1.866	52.2	180	**17.39**
4 hrs	31.6	100	1.837	58.0	240	**14.51**
5 hr.	34.2	100	1.816	62.1	300	**12.43**
6 hr.	36.8	100	1.795	66.2	360	**11.03**
12 hr.	47.9	100	1.731	82.9	720	**6.90**
24 hr.	61.4	100	1.674	102.8	1440	**4.28**
48 hr.	79.7	100	1.605	127.9	2880	**2.67**

Available Return Periods (yrs) :
0.5, 1, 2, 5, 10, 20, 30, 50, 100, 1000 & 10000

Project Title:	Strategic Housing Development Castletreasure	**Date:**	25/03/19
Report Title:	Storm Water Attenuation Calculations - Network A	**Project No.**	18203
Client:	Cairn Homes Properties Ltd.		
Doc Ref:	18203-JBB-1A-XX-CA-C-0053_Surface_Water_Attenuation_for_Network_A_P01		
Author(s)	PMcE	**Approved:**	TF

Based on data from the Flood Studies Report

Percolation rate of soil 0 l/m^{2} l/s

% voids 100%

Attenutation Unit: StormTech MC4500

Design storm return period 1 in 100 yr

Site Area	12.360	Ha
Impermeable area	6.130	Ha
Greenfield runoff	56.23	l/s
Discharge through soil	0.000	l/s
Allowable runoff	56.23	l/s

Runoff from impermeable areas 80 %

Runoff from SOIL types

Soil Type	% Runoff
1	0.1
2	0.3
3	0.37
4	0.47
5	0.53

Duration	Duration	Rainfall	Rainfall Intensity	Impermeable Areas	Other Areas	Run off from Imp. Area	other Run Off	Total Runoff	Allowable discharge	Storage Required	
Hrs	mins	mm	mm/hr	Ha	Ha	m^3	m^3	m^3	m^3	m^3	
	1	3.51	210.58	6.13	6.23	172	2	174	3	171.05	
	2	6.14	184.26	6.13	6.23	301	4	305	7	297.98	
	5	11.43	137.10	6.13	6.23	560	5	565	17	548.31	
	10	16.99	101.96	6.13	6.23	833	5	839	34	805.00	
0.25	15	20.79	83.15	6.13	6.23	1019	5	1025	51	974.18	
0.5	30	28.07	56.15	6.13	6.23	1377	5	1382	101	1280.43	
1	60	36.46	36.46	6.13	6.23	1788	4	1792	202	1589.48	
2	120	46.09	23.04	6.13	6.23	2260	3	2263	405	1858.60	
3	180	52.16	17.39	6.13	6.23	2558	3	2561	607	1953.70	
4	240	58.03	14.51	6.13	6.23	2846	3	2848	810	2038.70	**Max. Storage Required**
5	300	62.15	12.43	6.13	6.23	3048	2	3050	1012	2037.87	
6	360	66.15	11.03	6.13	6.23	3244	2	3246	1215	2031.69	
12	720	82.86	6.90	6.13	6.23	4063	2	4065	2429	1635.93	
24	1440	102.83	4.28	6.13	6.23	5043	1	5044	4858	185.69	
48	2880	127.93	2.67	6.13	6.23	6274	1	6275	9717	-3441.84	

DESIGNED:	**PMcE**
FILE	
JOB NUMBER:	18203
DOC REF:	18203-JBB-1A-XX-CA-C-0064_Surface_Water_Attenuation_for_Network_B_P01
DATE:	25/03/2019
PROJECT:	Strategic Housing Development Castletreasure
DESCRIPTION:	**Design flood estimation - Network B**

Method:

1 Estimate the Qbar (Mean AnnualFlood) using the catchment characteristics in the IoH-124 (1994) 3-variable equations
2 Multiply the estimated Qbar by an appropriate regional growth factor (XT) of a required return period T
(refer to Table 2.39 (page 173) of FSR Report no. 1),
for T = 100, 50 and 25 years, XT = 1.96, 1.77 and 1.6 respectively
3 Multiply the estimated QT by an appropriate design (standard error) factor to get the design QT (DF = 1.65 here)
4 Multiply the above design QT by an appropriate factor to accommodate the effects of future climate change in Ireland

1. Calculation of Q_{bar}

Qbar = $\mathbf{C \cdot (AREA)^{0.89} \cdot (SAAR)^{1.17} \cdot (SOIL)^{2.17}}$ **0.0180** m^3/s

Qbar =	Mean annual flood (m^3/sec), calculated using catchment characteristics				
C =	A regional coefficient with values as indicated on IoH Report No. 124	**0.00108**	Constant		
Area =	Catchment area in square kilometres	0.0577	km^2		
	If less than 50 heactares, use 50 hectares in the formula and factor the result based on the actual site area and the applied area i.e. 50ha.	0.5			
	Ratio of actual area to area applied in formual	0.1154			
SOIL	Soil index, which is based on a soil classification derived from the Soil Surveys in Ireland.	0.3	S1 =	0	%
	It is a composite index, derived from the formula,		S2 =	100	%
			S3 =	0	%
	$S=(0.15S_1+0.3S_2+0.4S_3+0.45S_4+0.5S_5)/(S_1+S_2+S_3+S_4+S_5)$		S4 =	0	%
			S5 =	0	%
			Total =	100	(total = 100 %)
	$S_1 \ldots S_5$ denote the proportions of the catchment covered by each of the soil classes 1-5. Refer to Figure 4.18 (I), FSR Volume V.				
SAAR	Standard period average annual rainfall, the standard period being 1931 to 1960 in Ireland). SAAR is obtained from Figure II.3.1 (I), FSR Volume V.	1,106.50	mm		

	T (yrs)	Factor	Q_T (m^3/s)
Peak flows @ 1 in 100year return period (current scenario) -->	100	1.96	**0.0352**
	50	2.33	**0.0419**
	25	2.1	**0.0377**
	20	1.96	**0.0352**
	15	1.8	**0.0323**
	10	1.67	**0.0300**
	5	1.37	**0.0246**
	2	0.95	**0.0171**
Design 1 in 2 year flood including standard error factor of 1.65		1.65	0.0282
Design flood including Climate Change Factor of 1.2 and SER (1.65)		1.2	**0.0338**

Project Title:	Strategic Housing Development Castletreasure	**Date:**	25/03/19
Report Title:	Rainfall Intensity Calculations	**Project No.**	18203
Client:	Cairn Homes Properties Ltd.		
Doc Ref:	18203-JBB-1A-XX-CA-C-0064_Surface_Water_Attenuation_for_Network_B_P01		
Author(s)	PMcE	**Approved:**	TF

Based on data from the Flood Studies Report

2-Day R5 | 75 | mm | Return Period | 100 | Yrs

r | 25 | %

r %	1 min.	2 min.	5 min.	10 min.	15 min.	30 min.	60 min.	2 hr.	3 hr.	4 hr.	5 hr.	6 hr.	12 hr.	24 hr.	48 hr.
24	2.5	4.3	7.6	11.0	13.3	18.1	24.0	31.0	36.0	41.0	44.5	48.0	63.0	81.0	106.0
27	3.0	5.0	9.0	12.9	15.5	20.7	27.0	35.0	39.5	44.0	47.5	51.0	65.0	83.0	106.0
25	2.7	4.5	8.1	11.6	14.0	19.0	25.0	32.3	37.2	42.0	45.5	49.0	63.7	81.7	106.0

Duration, D (min./ hrs)	DR_5 (mm)	Return Period, T (years)	Growth Factor	DR_T (mm)	Duration, D (min.)	Rainfall Intensity (mm/hr)
1 min.	2.0	100	1.750	3.5	1	**210.58**
2 min.	3.4	100	1.802	6.1	2	**184.26**
5 min.	6.1	100	1.883	11.4	5	**137.10**
10min.	8.7	100	1.942	17.0	10	**101.96**
15 min.	10.6	100	1.970	20.8	15	**83.15**
30 min.	14.3	100	1.968	28.1	30	**56.15**
60 min.	18.8	100	1.939	36.5	60	**36.46**
2 hr.	24.3	100	1.895	46.1	120	**23.04**
3 hr.	27.9	100	1.866	52.2	180	**17.39**
4 hrs	31.6	100	1.837	58.0	240	**14.51**
5 hr.	34.2	100	1.816	62.1	300	**12.43**
6 hr.	36.8	100	1.795	66.2	360	**11.03**
12 hr.	47.9	100	1.731	82.9	720	**6.90**
24 hr.	61.4	100	1.674	102.8	1440	**4.28**
48 hr.	79.7	100	1.605	127.9	2880	**2.67**

Available Return Periods (yrs) :
0.5, 1, 2, 5, 10, 20, 30, 50, 100, 1000 & 10000

Project Title:	Strategic Housing Development Castletreasure	**Date:**	25/03/19
Report Title:	Design flood estimation - Network B	**Project No.**	18203
Client:	Cairn Homes Properties Ltd.		
Doc Ref:	18203-JBB-1A-XX-CA-C-0064_Surface_Water_Attenuation_for_Network_B_P01		
Author(s)	PMcE	**Approved:**	TF

Based on data from the Flood Studies Report

Percolation rate of soil 0 $l/m^{2\ l/s}$

% voids 100%

Attenutation Unit: StormTech MC4500

Design storm return period 1 in 100 yr

Site Area	3.145	Ha
Impermeable area	1.774	Ha
Greenfield runoff	33.80	l/s
Discharge through soil	0.000	l/s
Allowable runoff	33.80	l/s

Runoff from impermeable areas 80 %

Runoff from SOIL types

Soil Type	% Runoff
1	0.1
2	0.3
3	0.37
4	0.47
5	0.53

Duration	Duration	Rainfall	Rainfall Intensity	Impermeable Areas	Other Areas	Run off from Imp. Area	other Run Off	Total Runoff	Allowable discharge	Storage Required	
Hrs	mins	mm	mm/hr	Ha	Ha	m^3	m^3	m^3	m^3	m^3	
	1	3.51	210.58	1.77	1.37	50	1	50	2	48.29	
	2	6.14	184.26	1.77	1.37	87	1	88	4	83.89	
	5	11.43	137.10	1.77	1.37	162	1	163	10	153.08	
	10	16.99	101.96	1.77	1.37	241	1	242	20	222.08	
0.25	15	20.79	83.15	1.77	1.37	295	1	296	30	265.78	
0.5	30	28.07	56.15	1.77	1.37	398	1	400	61	338.67	
1	60	36.46	36.46	1.77	1.37	517	1	518	122	396.62	
2	120	46.09	23.04	1.77	1.37	654	1	655	243	411.47	**Max. Storage Required**
3	180	52.16	17.39	1.77	1.37	740	1	741	365	375.94	
4	240	58.03	14.51	1.77	1.37	824	1	824	487	337.46	
5	300	62.15	12.43	1.77	1.37	882	1	882	608	274.15	
6	360	66.15	11.03	1.77	1.37	939	0	939	730	209.29	
12	720	82.86	6.90	1.77	1.37	1176	0	1176	1460	-283.73	
24	1440	102.83	4.28	1.77	1.37	1459	0	1460	2920	-1460.43	
48	2880	127.93	2.67	1.77	1.37	1816	0	1816	5840	-4024.28	

DESIGNED:	**PMcE**
FILE	
JOB NUMBER:	18203
DOC REF:	18203-JBB-1A-XX-CA-C-0102_Surface_Water_Attenuation_for_Network_C_P01
DATE:	25/03/2019
PROJECT:	Strategic Housing Development Castletreasure
DESCRIPTION:	**Design flood estimation - Network C**

Method:

1 Estimate the Qbar (Mean AnnualFlood) using the catchment characteristics in the IoH-124 (1994) 3-variable equations
2 Multiply the estimated Qbar by an appropriate regional growth factor (XT) of a required return period T
(refer to Table 2.39 (page 173) of FSR Report no. 1),
for T = 100, 50 and 25 years, XT = 1.96, 1.77 and 1.6 respectively
3 Multiply the estimated QT by an appropriate design (standard error) factor to get the design QT (DF = 1.65 here)
4 Multiply the above design QT by an appropriate factor to accommodate the effects of future climate change in Ireland

1. Calculation of Q_{bar}

Qbar = $C \cdot (AREA)^{0.89} \cdot (SAAR)^{1.17} \cdot (SOIL)^{2.17}$ **0.001588** m^3/s

Qbar =	Mean annual flood (m^3/sec), calculated using catchment characteristics				
C =	A regional coefficient with values as indicated on IoH Report No. 124	**0.00108**	Constant		
Area =	Catchment area in square kilometres	0.0051	km^2		
	If less than 50 heactares, use 50 hectares in the formula and factor the result based on the actual site area and the applied area i.e. 50ha.	0.5	km^2		
	Ratio of actual area to area applied in formual	0.0102			
SOIL	Soil index, which is based on a soil classification derived from the Soil Surveys in Ireland.	0.3	S1 =	0	%
	It is a composite index, derived from the formula,		S2 =	100	%
			S3 =	0	%
	$S=(0.15S_1+0.3S_2+0.4S_3+0.45S_4+0.5S_5)/(S_1+S_2+S_3+S_4+S_5)$		S4 =	0	%
			S5 =	0	%
			Total =	100	
	$S_1 \ldots S_5$ denote the proportions of the catchment covered by each of the soil classes 1-5. Refer to Figure 4.18 (I), FSR Volume V.			(total = 100 %)	
SAAR	Standard period average annual rainfall, the standard period being 1931 to 1960 in Ireland). SAAR is obtained from Figure II.3.1 (I), FSR Volume V.	1,106.50	mm		

	T (yrs)	Factor	Q_T (m^3/s)
Peak flows @ 1 in 100year return period (current scenario) -->	100	1.96	**0.003113**
	50	2.33	**0.003700**
	25	2.1	**0.003335**
	20	1.96	**0.003113**
	15	1.8	**0.002859**
	10	1.67	**0.002652**
	5	1.37	**0.002176**
	2	0.95	**0.001509**
Design 1 in 2 year flood including standard error factor of 1.65		1.65	0.002489
Design flood including Climate Change Factor of 1.2 and SER (1.65)		1.2	**0.002987**

Project Title:	Strategic Housing Development Castletreasure	**Date:**	25/03/19
Report Title:	Rainfall Intensity Calculations	**Project No.**	18203
Client:	Cairn Homes Properties Ltd.		
Doc Ref:	18203-JBB-1A-XX-CA-C-0102_Surface_Water_Attenuation_for_Network_C_P01		
Author(s)	PMcE	**Approved:**	TF

Based on data from the Flood Studies Report

2-Day R5 | 75 | mm | Return Period | 100 | Yrs

r | 25 | %

r %	1 min.	2 min.	5 min.	10 min.	15 min.	30 min.	60 min.	2 hr.	3 hr.	4 hr.	5 hr.	6 hr.	12 hr.	24 hr.	48 hr.
24	2.5	4.3	7.6	11.0	13.3	18.1	24.0	31.0	36.0	41.0	44.5	48.0	63.0	81.0	106.0
27	3.0	5.0	9.0	12.9	15.5	20.7	27.0	35.0	39.5	44.0	47.5	51.0	65.0	83.0	106.0
25	2.7	4.5	8.1	11.6	14.0	19.0	25.0	32.3	37.2	42.0	45.5	49.0	63.7	81.7	106.0

Duration, D (min./ hrs)	DR_5 (mm)	Return Period, T (years)	Growth Factor	DR_T (mm)	Duration, D (min.)	Rainfall Intensity (mm/hr)
1 min.	2.0	100	1.750	3.5	1	**210.58**
2 min.	3.4	100	1.802	6.1	2	**184.26**
5 min.	6.1	100	1.883	11.4	5	**137.10**
10min.	8.7	100	1.942	17.0	10	**101.96**
15 min.	10.6	100	1.970	20.8	15	**83.15**
30 min.	14.3	100	1.968	28.1	30	**56.15**
60 min.	18.8	100	1.939	36.5	60	**36.46**
2 hr.	24.3	100	1.895	46.1	120	**23.04**
3 hr.	27.9	100	1.866	52.2	180	**17.39**
4 hrs	31.6	100	1.837	58.0	240	**14.51**
5 hr.	34.2	100	1.816	62.1	300	**12.43**
6 hr.	36.8	100	1.795	66.2	360	**11.03**
12 hr.	47.9	100	1.731	82.9	720	**6.90**
24 hr.	61.4	100	1.674	102.8	1440	**4.28**
48 hr.	79.7	100	1.605	127.9	2880	**2.67**

Available Return Periods (yrs) :
0.5, 1, 2, 5, 10, 20, 30, 50, 100, 1000 & 10000

Project Title:	Strategic Housing Development Castletreasure	**Date:**	08/05/18
Report Title:	Storm Water Attenuation Calculations	**Project No.**	18203
Client:	Cairn Homes Properties Ltd.		
Doc Ref:	18203-JBB-1A-XX-CA-C-0102_Surface_Water_Attenuation_for_Network_C_P01		
Author(s)	PMcE	**Approved:**	TF

Based on data from the Flood Studies Report

Percolation rate of soil 0 $l/m^{2\ l/s}$

% voids 100%

Design storm return period 1 in 100 yr

Site Area	0.510	Ha
Impermeable area	1.350	Ha
Greenfield runoff	2.99	l/s
Discharge through soil	0.000	l/s
Allowable runoff	2.99	l/s

Runoff from impermeable areas 80 %

Runoff from SOIL types

Soil Type	% Runoff
1	0.1
2	0.3
3	0.37
4	0.47
5	0.53

Duration	Duration	Rainfall	Rainfall Intensity	Impermeable Areas	Other Areas	Run off from Imp. Area	other Run Off	Total Runoff	Allowable discharge	Storage Required	
Hrs	mins	mm	mm/hr	Ha	Ha	m^3	m^3	m^3	m^3	m^3	
	1	3.51	210.58	0.51	0.00	14	0	14	0	14.14	
	2	6.14	184.26	0.51	0.00	25	0	25	0	24.70	
	5	11.43	137.10	0.51	0.00	47	0	47	1	45.72	
	10	16.99	101.96	0.51	0.00	69	0	69	2	67.54	
0.25	15	20.79	83.15	0.51	0.00	85	0	85	3	82.12	
0.5	30	28.07	56.15	0.51	0.00	115	0	115	5	109.16	
1	60	36.46	36.46	0.51	0.00	149	0	149	11	137.98	
2	120	46.09	23.04	0.51	0.00	188	0	188	22	166.53	
3	180	52.16	17.39	0.51	0.00	213	0	213	32	180.57	
4	240	58.03	14.51	0.51	0.00	237	0	237	43	193.75	
5	300	62.15	12.43	0.51	0.00	254	0	254	54	199.78	
6	360	66.15	11.03	0.51	0.00	270	0	270	65	205.37	
12	720	82.86	6.90	0.51	0.00	338	0	338	129	209.01	Max. Storage Required
24	1440	102.83	4.28	0.51	0.00	420	0	420	258	161.44	
48	2880	127.93	2.67	0.51	0.00	522	0	522	516	5.76	

APPENDIX D

DETAILS OF ATTENUATION, INTERCEPTOR AND HYDROBRAKE SYSTEMS

StormTech® Product Catalogue

*The Most **Advanced** Name in Drainage Systems®*

StormTech® a product of ADS Europe

StormTech Subsurface Stomwater Management

Table of Contents

StormTech has well over ten thousand chamber systems in service throughout the world. All StormTech chambers are designed to meet the most stringent industry performance standards for superior structural integrity. The StormTech system is designed primarily to be used under car parks, roadways and heavy earth loads saving valuable land and protecting water resources for commercial and municipal applications. In our continuing desire to answer designers' challenges, StormTech has expanded the family of products providing engineers, developers, regulators and contractors with additional site specific flexibility.

Advanced Structural Performance for Greater Long-Term Reliability

StormTech developed a state of the art chamber design through:

- Collaboration with world-renowned experts of buried drainage structures to develop and evaluate the structural testing program and product design
- Designing chambers to meet and exceed various European standards for both dynamic and long-term static loads.
- Subjecting the chambers to rigorous full-scale, third party testing, under severe loading conditions to verify their performance both under dynamic loads as well as long term static loads.

Our Chambers Provide...

- Extremely *efficient transportation.* Stacking of the chambers results in lower cost per m^3 installed volume while being more eco-friendly.
- A *remarkably quick installation.* For example: Ten of the MC-3500 chambers, providing a total installed storage of over 55 m^3, can be easily installed in 10 minutes. When installing the same 55 m^3 using box type systems you would need to install 125 to 250 boxes, taking significantly more time!
- The *strength* of concrete tanks, but at a very competitive price.
- A robust, *continuous, true elliptical arch design* which effectively transfers loads into the surrounding backfill providing the long-term safety factor required by various local standards. This offers developers a cost-effective underground system that will perform as designed for decades.
- A *design in accordance with various local European design specifications* providing engineers with a structural performance standard for live and long-term dead loads.
- Innovative *polypropylene and polyethylene* resins which have been tested using international standards to ensure long and short-term structural properties.
- Uniform wall thickness and repeatable quality due to *injection mold production.*
- Third party *tested and patented Isolator® Row* for less frequent maintenance, water quality, and long-term performance.
- *Traditional manifold/header designs* using conventional hydraulic equations that can easily verify flow equalization and scour velocity.
- *Open chamber design* requiring only one chamber model to construct each row assuring ease of construction and no repeating end walls to obstruct access or flow.

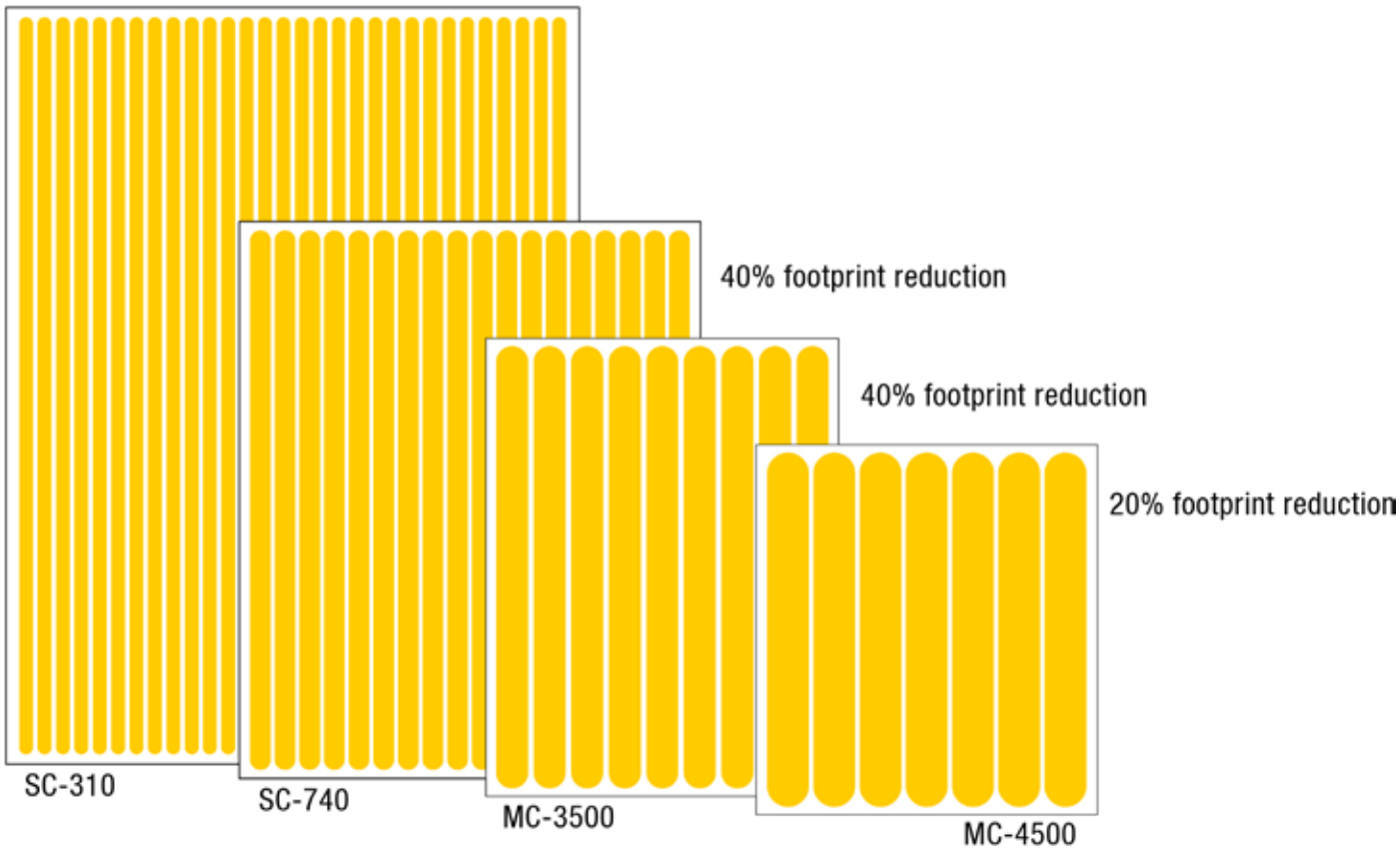
StormTech offers a variety of chamber sizes (SC-310, SC-740, DC-780, MC-3500 and MC-4500) so the consulting design engineer can choose the chamber that is best suited for the site conditions and regulatory requirements. StormTech has well over ten thousand chamber systems in service worldwide. We provide plan layout and cost estimate services at no charge for consulting engineers and developers.

StormTech Specifications and Product Comparison

PRODUCT SPECIFICATIONS	SC-310	SC-740	DC-780	MC-3500	MC-4500
Height, mm	405	760	760	1140	1525
Width, mm	865	1295	1295	1955	2540
Length, mm	2300	2300	2300	2285	1320
Installed Length, mm	2170	2170	2170	2185	1230
Bare Chamber Storage, m^3	0.42	1.30	1.30	3.11	3.01
Stone above, mm	150	150	150	300	300
Foundation Stone, mm*	150	150	230	230	230
Row Spacing, mm	150	150	150	150	230
Minimum Installed Storage, m^3	**0.88**	**2.12**	**2.22**	**5.06**	**4.60**
Storage Per Unit Area, m^3	0.39	0.67	0.70	1.06	1.35

**Please refer to the design manual.*

Example: Footprint Comparison - 1000m^3 Project



StormTech BREEAM® Credits

List of BREEAM Credits that StormTech may contribute toward:

LAND USE AND ECOLOGY

- **Credit LE3 Ecological Value of Site and Protection of Ecological Features**
  Utilizing StormTech System beneath roadways, surface parking, walkways, etc. may reduce overall site disturbance.
- **Credit LE4 Mitigating Ecological Impact**
  Utilizing StormTech System beneath roadways, surface parking, walkways, etc. may reduce overall site disturbance.

WATER

- **Credit Wat 5 Water Recycling**
  Utilize StormTech System to store captured rainwater to reduce potable water demand.
- **Credit Wat 6 Irrigation Systems**
  Utilize StormTech System to store captured rainwater for landscape irrigation.

MATERIALS

- **Credit Wst 2 Recycled Aggregates**
  Utilize recycled concrete as the backfill material for the StormTech System.

POLLUTION

- **Credit Pol 5 Flood Risk**
  Utilize StormTech System to reduce the impact of flooding on buildings with a medium-to-high risk of flooding.
- **Credit Pol 6 Minimizing Water Course Pollution**
  Utilize StormTech System to reduce potential for silt, heavy metals, chemicals or oil pollution to natural watercourses from surface water run-off from buildings and hard surfaces.

INNOVATION

- **Credit Inn 1 Innovation**
  Utilize StormTech System to substantially exceed a performance credit.

MANAGEMENT

- **Credit Man 11 Ease of Maintenance**
  Utilize StormTech System to meet this performance credit which is to recognize and encourage the specification of a building and building services that can be easily maintained during their lifecycle.

StormTech LEED® Credits

List of LEED Credits that StormTech may contribute toward:

SUSTAINABLE SITES

- **SS Credit 5.1 Site Development: Protect or Restore Habitat**
  Utilizing StormTech System beneath roadways, surface parking, walkways, etc. may reduce overall site disturbance.
- **SS Credit 5.2 Site Development: Maximize Open Space**
  Utilizing StormTech System can increase overall open space and may reduce overall site disturbance.
- **SS Credit 6.1 Stormwater Design: Quantity Control**
  Design StormTech System per local or LEED stormwater quantity requirements, whichever is more stringent.
- **SS Credit 6.2 Stormwater Design: Quality Control**
  Use of Isolator Row provides sediment removal, and can also promote infiltration and groundwater recharge.
- **SS Credit 7.1 Heat Island Effect: Non-Roof**
  Use of StormTech System may eliminate need for above ground detention ponds, thus reducing thermal impacts of stormwater runoff.

WATER EFFICIENCY

- **WE Credit 1 Water Efficient Landscaping**
  Utilize StormTech System to store captured rainwater for landscape irrigation.
- **WE Credit 2 Innovative Water Technologies**
  Utilize StormTech System to store captured rainwater to reduce potable water demand.
- **WE Credit 3 Water Use Reduction**
  Utilize StormTech System to store captured rainwater and allow reuse for non-potable applications.

MATERIALS

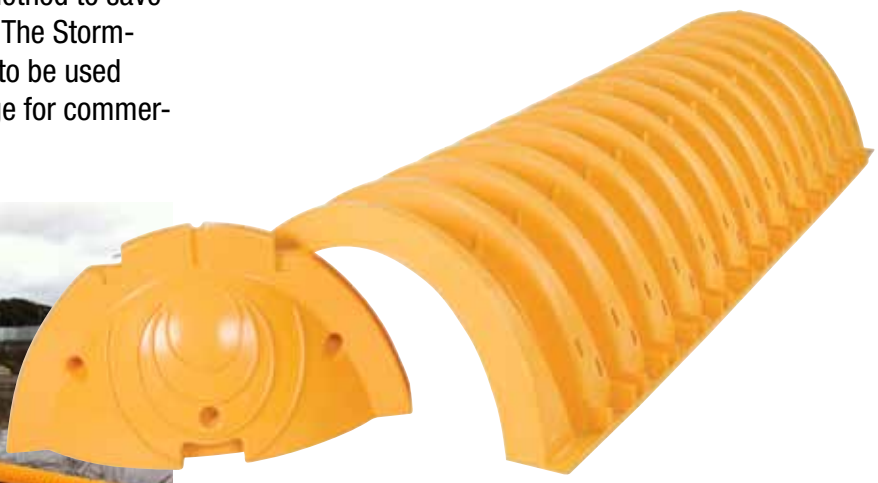
- **MR Credit 4 Recycled Content**
  Utilize recycled concrete as the backfill material for the StormTech System.
- **MR Credit 5 Regional Materials**
  Stone backfill material for the StormTech System will apply if extracted within 500 miles of project site.

INNOVATION & DESIGN

- **ID Credit 1 Innovation in Design**
  Utilize StormTech System to substantially exceed a performance credit.

StormTech SC-310 Chamber Specifications

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 SC-310 system is designed primarily to be used under car parks thus maximizing land usage for commercial and municipal applications.



StormTech SC-310 Chamber (not to scale)

Nominal Chamber Specifications

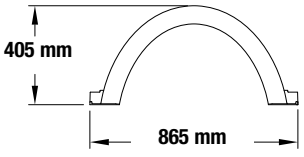
Size (L x W x H)	2170 x 865 x 405 mm
Chamber Storage	0.42 m^3
Min. Installed Storage*	0.88 m^3
Weight	17.5 kg

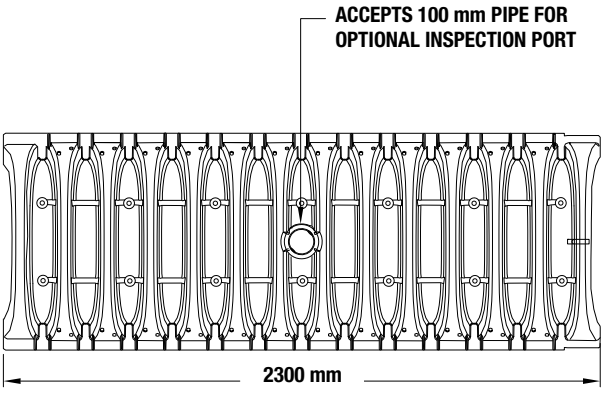
**Assumes 150 mm stone above, below and between chambers and 40% stone porosity.*

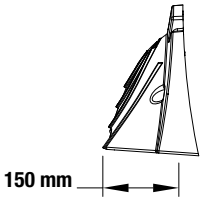
Transportation:

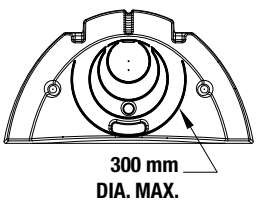
656 chambers per truck

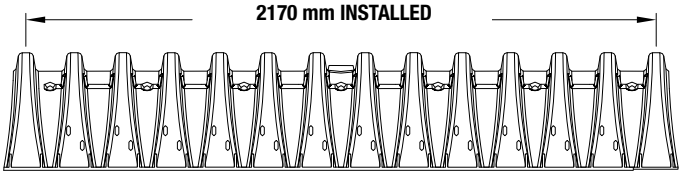
(over 580 m^3 storage per truck)



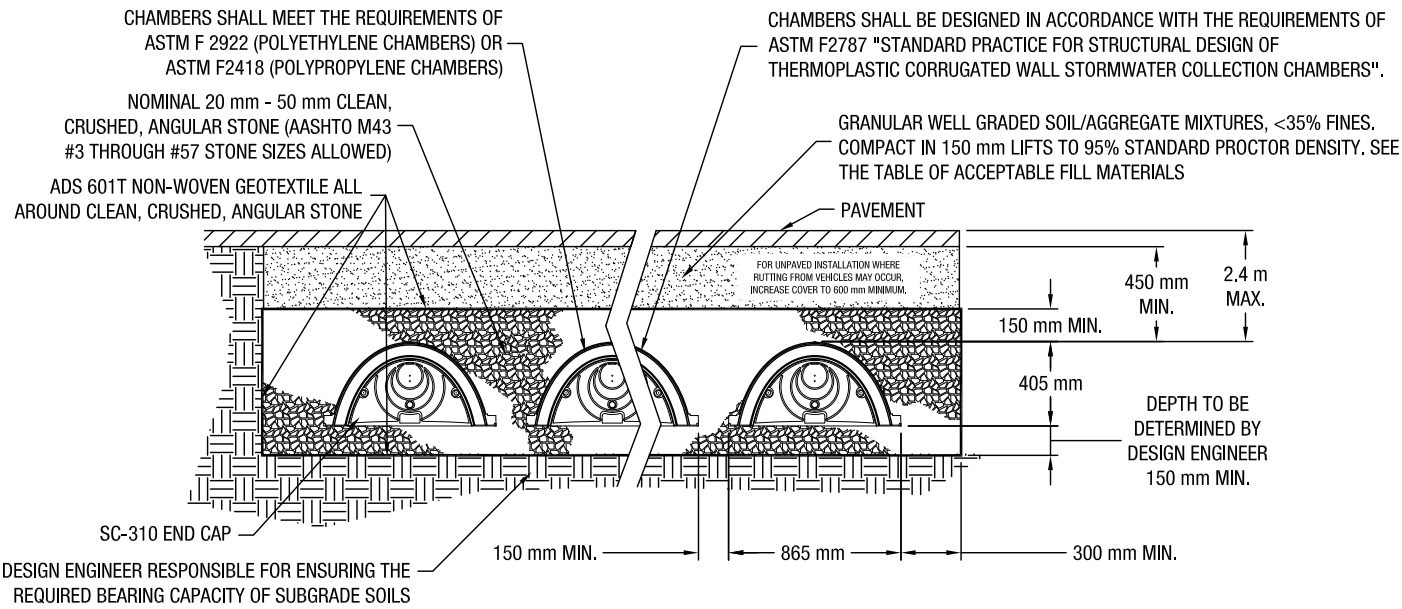








StormTech SC-310 Chamber Specifications



THIS CROSS SECTION DETAILS THE REQUIREMENTS NECESSARY TO SATISFY THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR EARTH AND LIVE LOADS USING STORMTECH CHAMBERS.

StormTech SC-740 Chamber Specifications

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 SC-740 system is designed primarily to be used under car parks thus maximizing land usage for commercial and municipal applications.

StormTech SC-740 Chamber (not to scale)

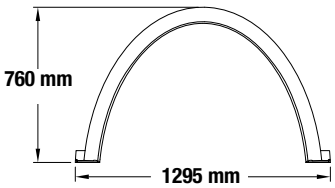
Nominal Chamber Specifications

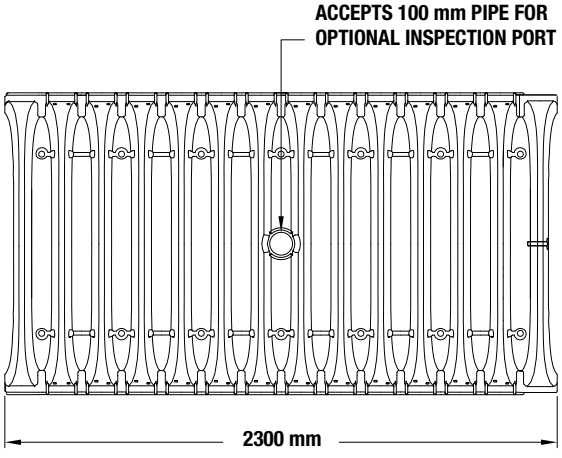
Size (L x W x H)	2170 x 1295 x 760 mm
Chamber Storage	1.30 m^3
Min. Installed Storage*	2.12 m^3
Weight	35.5 kg

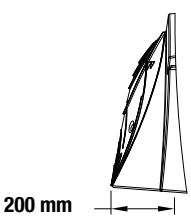
**Assumes 150 mm stone above, below and between chambers and 40% stone porosity.*

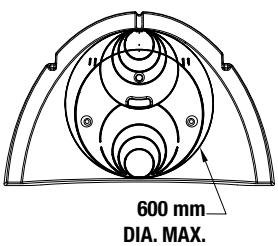
Transportation:

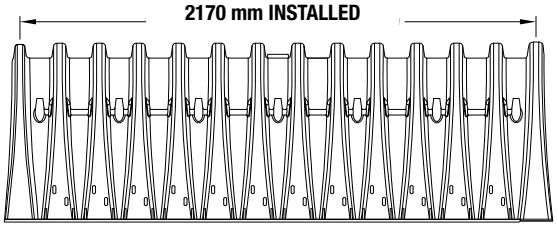
300 chambers per truck
(635 m^3 storage per truck)



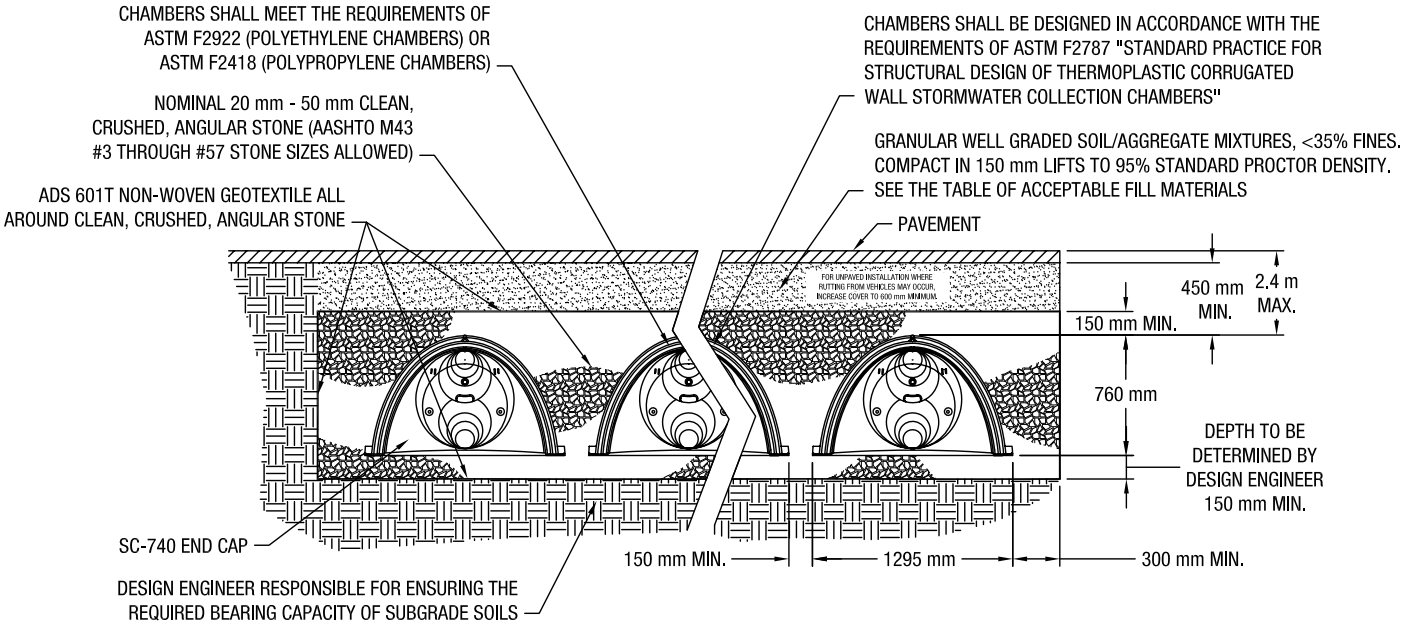








StormTech SC-740 Chamber Specifications

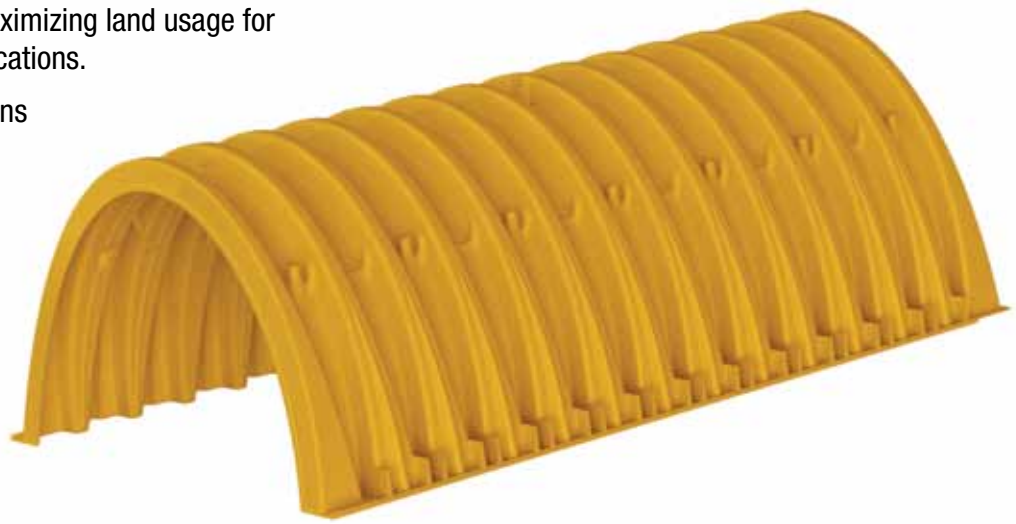


THIS CROSS SECTION DETAILS THE REQUIREMENTS NECESSARY TO SATISFY THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS USING STORMTECH CHAMBERS

StormTech DC-780 Chamber Specifications

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 DC-780 system is designed specifically to be used for deep cover applications thus maximizing land usage for commercial and municipal applications.

- 3.7 m Deep Cover applications



StormTech DC-780 Chamber (not to scale)

Nominal Chamber Specifications

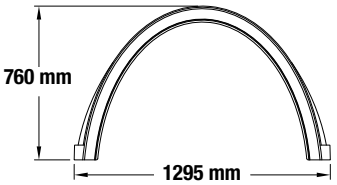
Size (L x W x H)	2170 x 1295 x 760 mm
Chamber Storage	1.30 m^3
Min. Installed Storage*	2.20 m^3

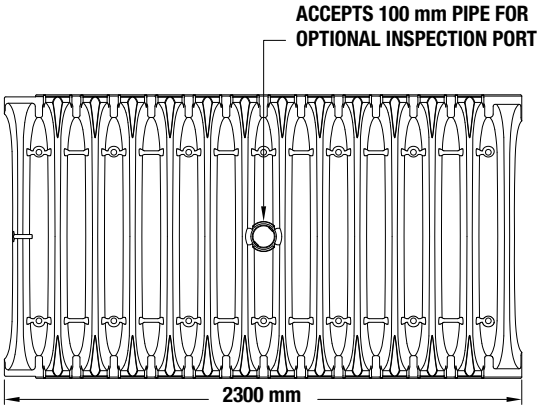
**Assumes 230 mm stone below, 150 mm stone above, and 150 mm row-spacing chambers and 40% stone porosity.*

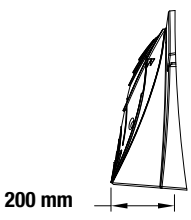
Transportation:

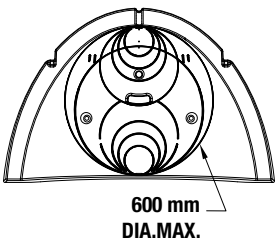
240 chambers per truck

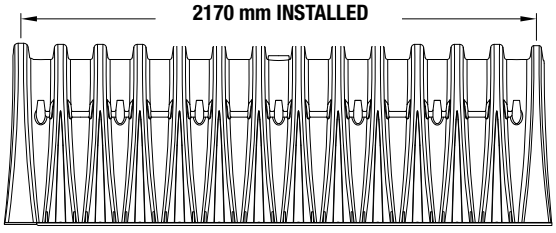
(530 m^3 storage per truck)



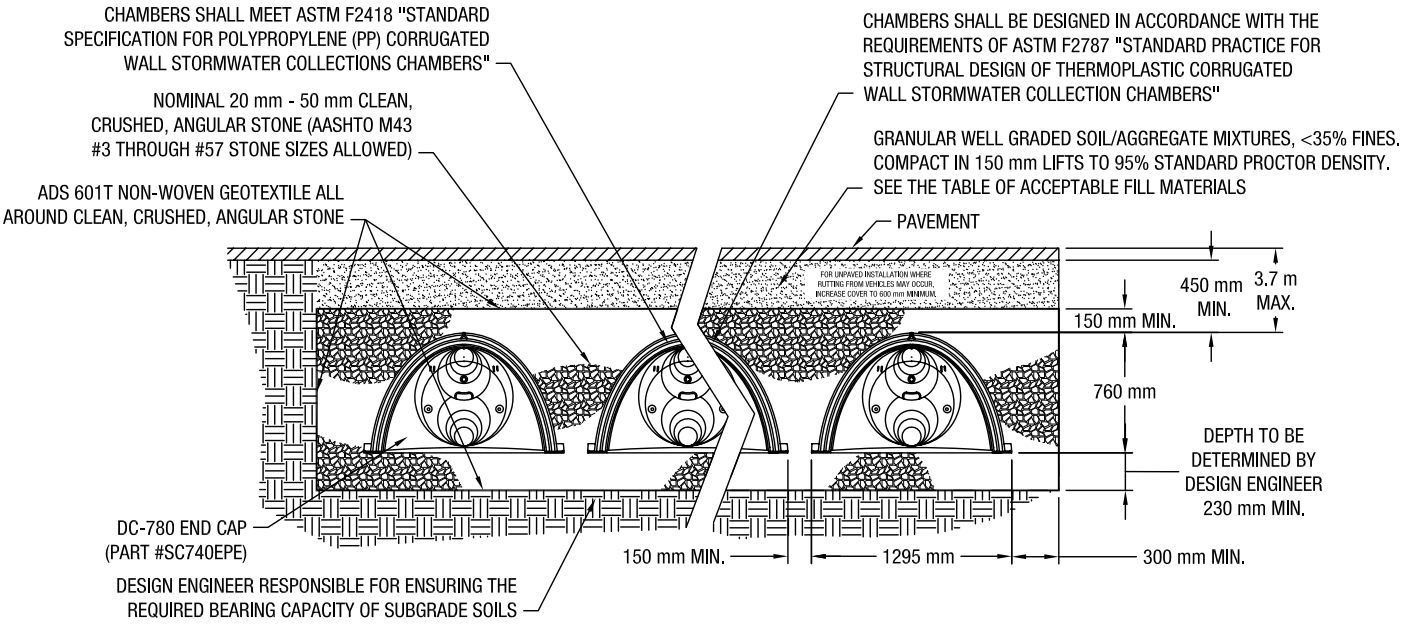








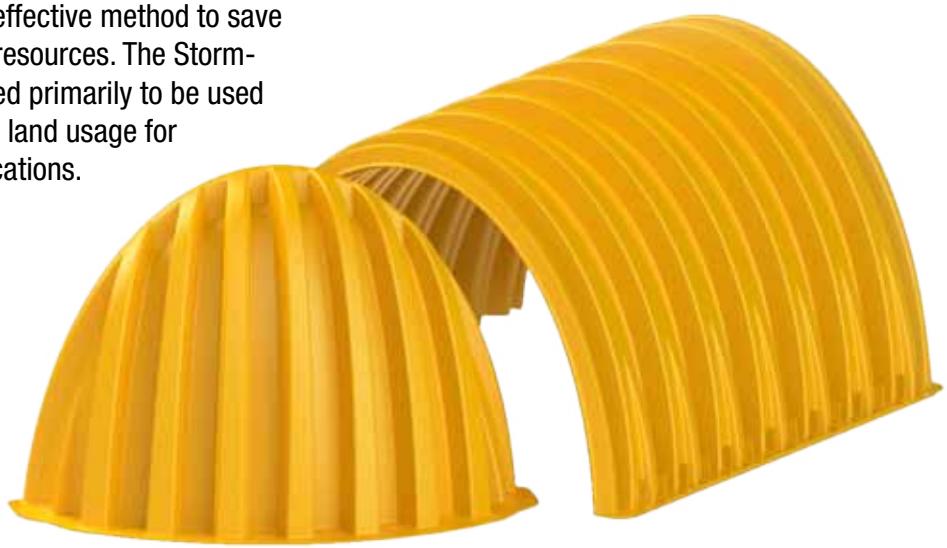
StormTech DC-780 Chamber Specifications



THIS CROSS SECTION DETAILS THE REQUIREMENTS NECESSARY TO SATISFY THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS USING STORMTECH CHAMBERS

StormTech MC-3500 Chamber Specifications

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 MC-3500 system is designed primarily to be used under car parks thus maximizing land usage for commercial and municipal applications.



StormTech MC-3500 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	2285 x 1955 x 1145 mm
Chamber Storage	3.11 m^3
Min. Installed Storage*	5.06 m^3
Weight	56.5 kg

**Assumes a minimum of 305 mm of stone above, 230 mm of stone below, chambers, 230 mm of stone between chambers/end caps, and 40% stone porosity.*

StormTech MC-3500 End Cap (not to scale)

Nominal End Cap Specifications

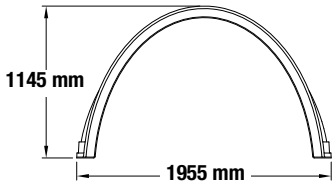
Size (L x W x H)	675 x 1805 x 1145 mm
End Cap Storage	0.44 m^3
Min. Installed Storage*	1.33 m^3
Weight	19.5 kg

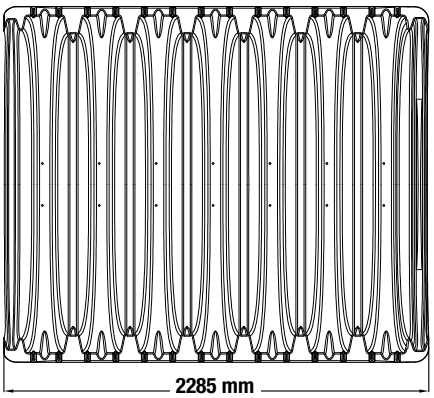
**Assumes a minimum of 305 mm stone above, 230 mm stone below, 150 mm stone perimeter, 230 mm of stone between chambers/end caps, and 40% stone porosity.*

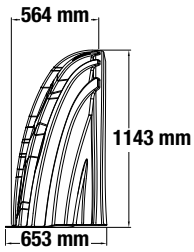
Transportation:

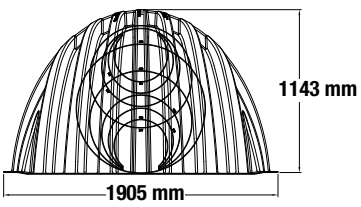
135 chambers per truck

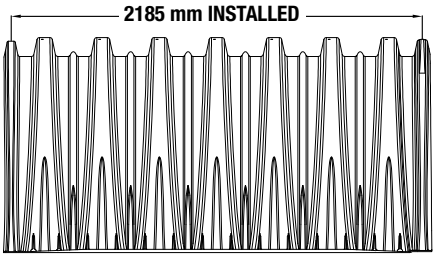
(over 685 m^3 storage per truck)



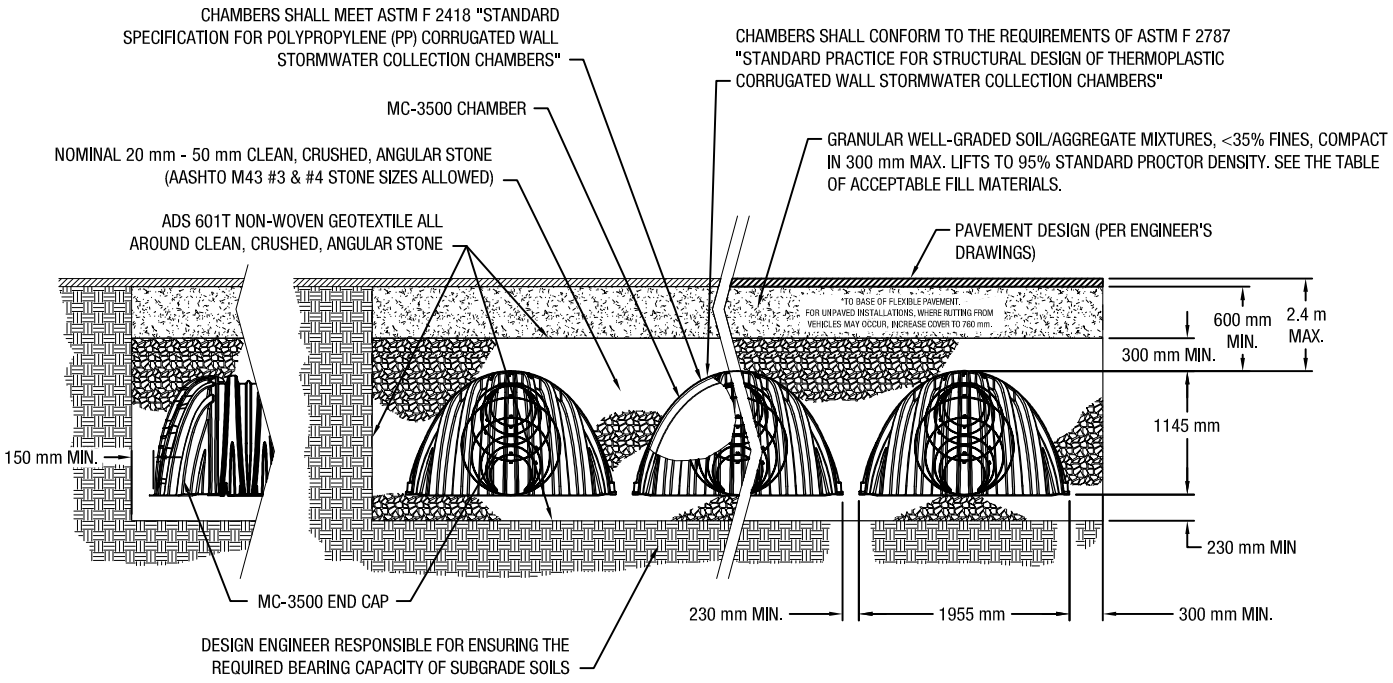






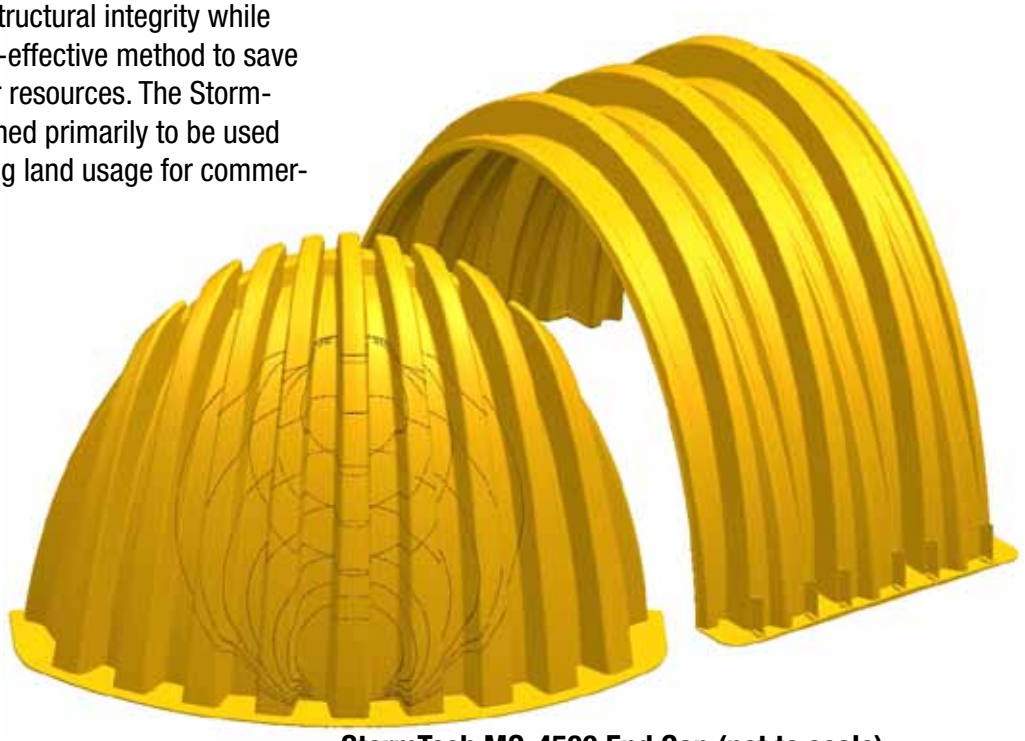


StormTech MC-3500 Chamber Specifications



StormTech MC-4500 Chamber Specifications

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 MC-4500 system is designed primarily to be used under car parks thus maximizing land usage for commercial and municipal applications.



StormTech MC-4500 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	1320 x 2540 x 1525 mm
Chamber Storage	3.01 m^3
Min. Installed Storage*	4.60 m^3
Nominal Weight	53.5 kg

**Assumes a minimum of 300 mm of stone above, 230 mm of stone below chambers, 230 mm of stone between chambers/end caps, and 40% stone porosity.*

StormTech MC-4500 End Cap (not to scale)

Nominal End Cap Specifications

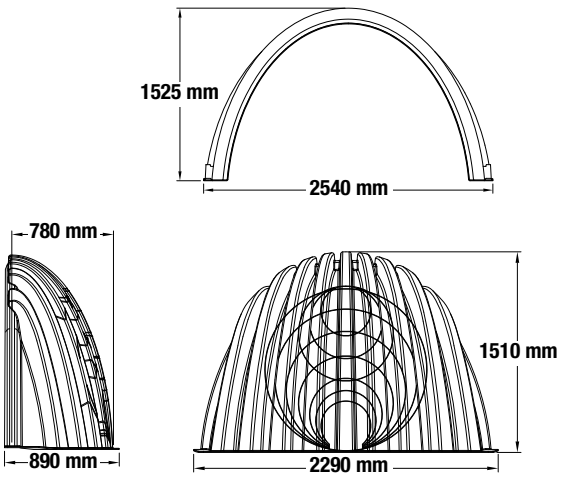
Size (L x W x H)	890 x 2290 x 1510 mm
End Cap Storage	1.01 m^3
Min. Installed Storage*	3.08 m^3
Nominal Weight	53.5 kg

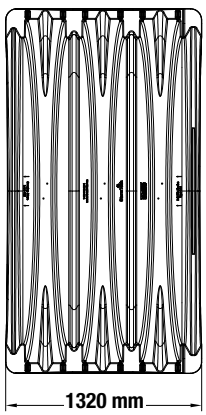
**Assumes a minimum of 300 mm of stone above, 230 mm of stone below, 305 mm of stone perimeter, 230 mm of stone between chambers/end caps, and 40% stone porosity.*

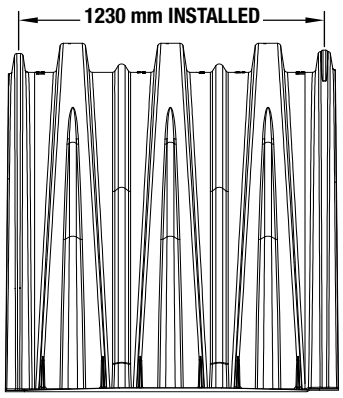
Transportation:

84 chambers per truck

(over 385 m^3 storage per truck)







StormTech MC-4500 Chamber Specifications

CHAMBERS SHALL MEET ASTM F2418 "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS."

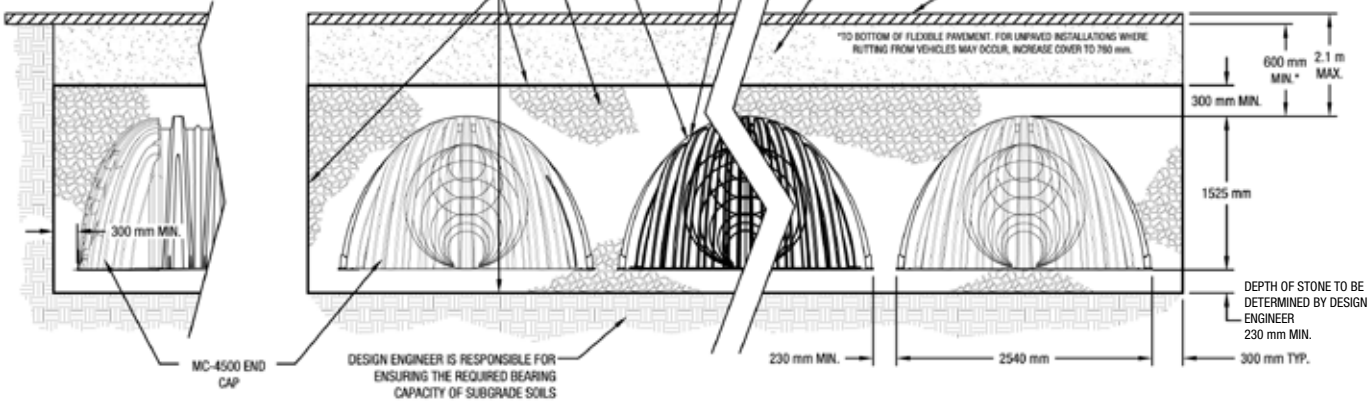
NOMINAL 20 mm - 50 mm CLEAN, CRUSHED, ANGULAR STONE (AASHTO M43 #3 & #4 STONE SIZES ALLOWED)

ADS 601T NON-WOVEN GEOTEXTILE ALL AROUND CLEAN, CRUSHED, ANGULAR STONE

CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLAXTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS."

GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES, COMPACT IN 300 mm MAX. LIFTS TO 95% STANDARD PROCTOR DENSITY. SEE THE TABLE OF ACCEPTABLE FILL MATERIALS.

PAVEMENT DESIGN (PER ENGINEER'S DRAWINGS)



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

StormTech Isolator® Row

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patented technique to inexpensively improve stormwater quality and provide easy access for inspection and maintenance. By using the StormTech Isolator Row a TSS removal of 80%, a hydrocarbon (diesel) removal of 90%, a total Zinc removal of 53% and a total Phosphorus removal of 49% can be achieved.*

The Isolator Row is a row of StormTech chambers that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as stormwater rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310 and SC-740 models) allow stormwater to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row, protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for stormwater filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the “first flush” and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row, but typically includes a high flow weir such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row crest the weir and discharge through a manifold to the other chambers.

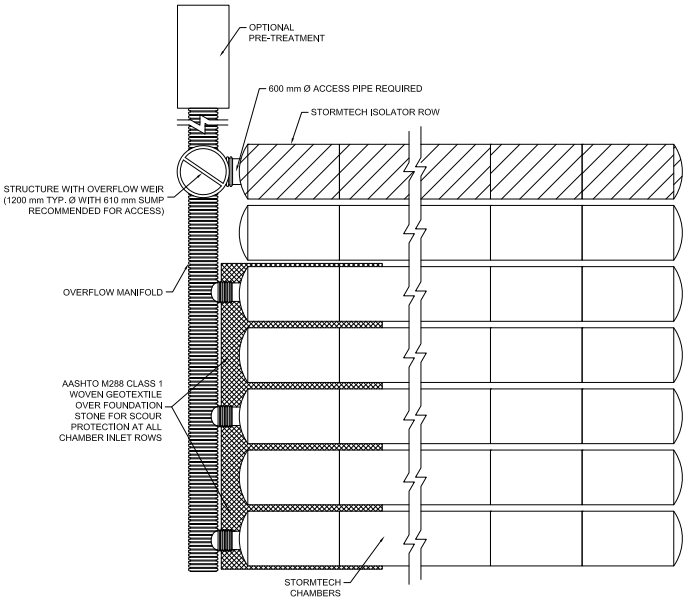
The Isolator Row may also be part of a treatment train. By treating stormwater prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins and oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

*Based on independent university testing.

StormTech Isolator Row with Overflow Spillway

(not to scale)



StormTech Isolator Row

Inspection

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

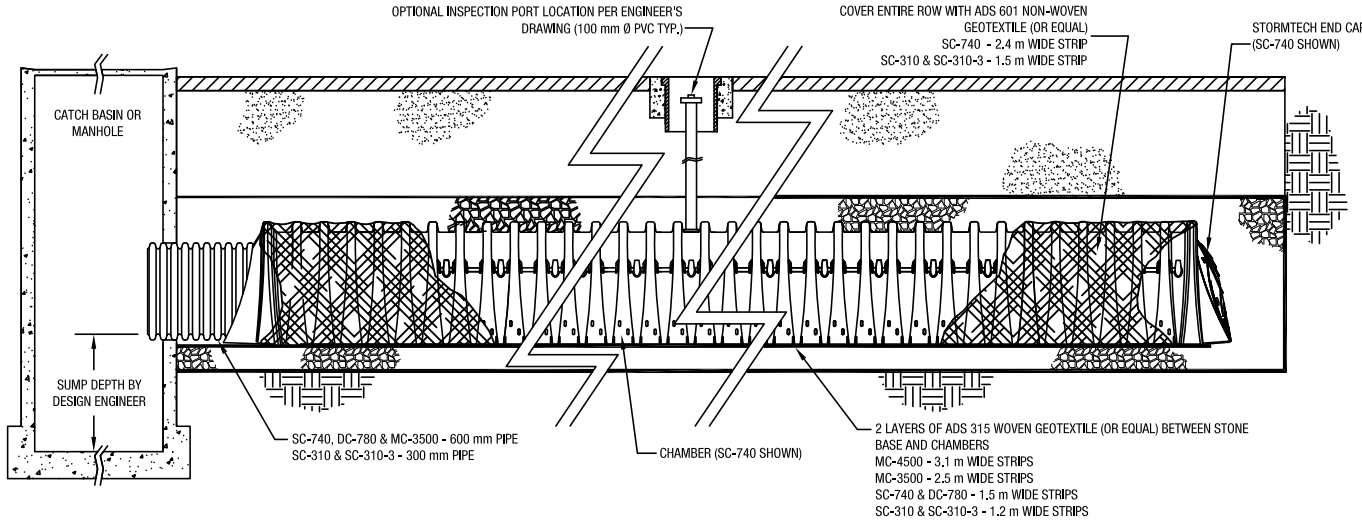
If, upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 8 cm throughout the length of the Isolator Row, clean-out should be performed.

Maintenance

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow the applicable rules and regulations for a confined space entries.

Maintenance is accomplished by jetting the Isolator Row. The jetting process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/jetting combination vehicles. Selection of an appropriate jetting nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45° are best. Most jetting reels have 120 meters of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The jetting process shall only be performed on StormTech Isolator Rows that have the correct woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

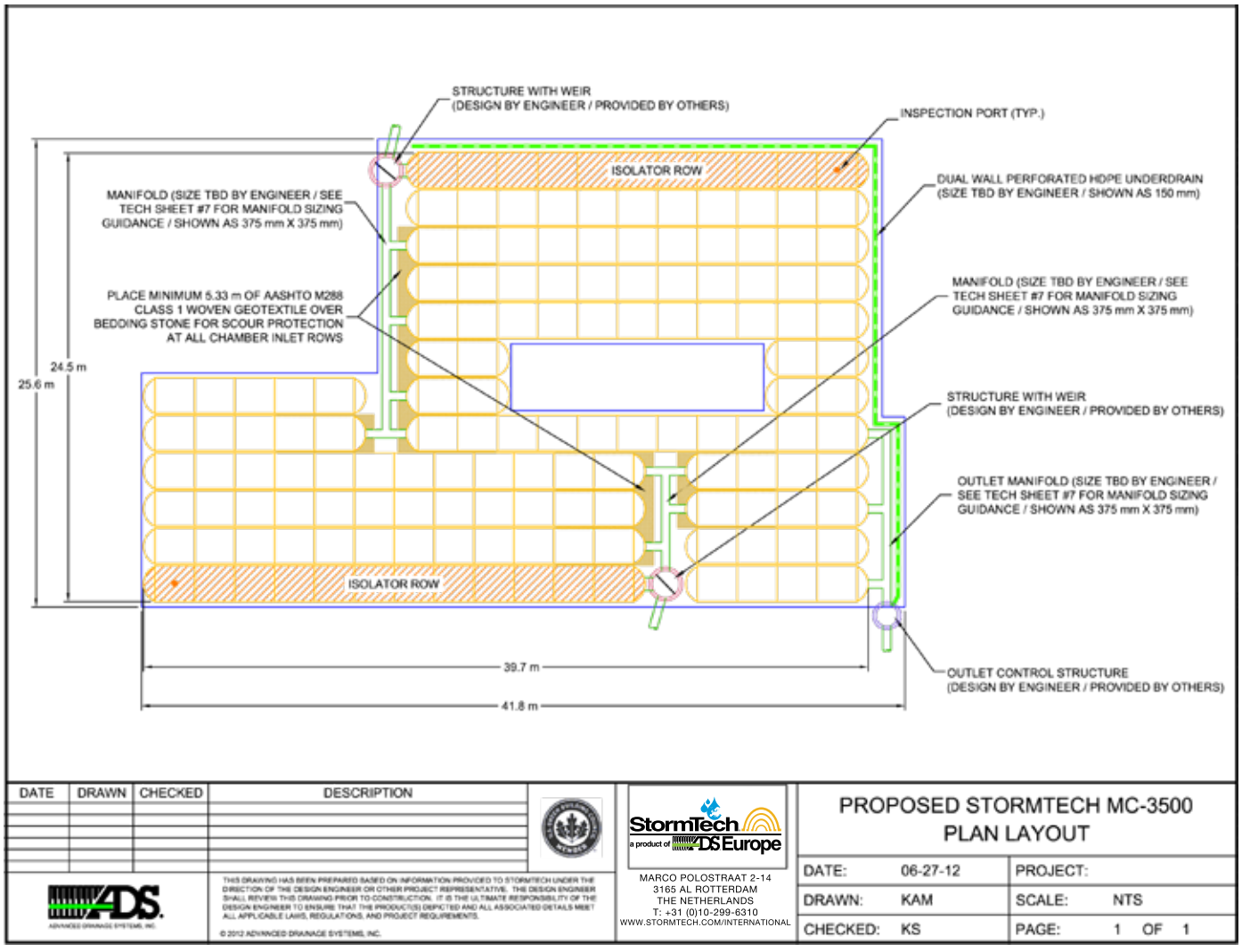


NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

A Family of Products and Services

- SC-310 Chambers and End Caps
- SC-740 Chambers and End Caps
- DC-780 Chambers and End Caps
- MC-3500 Chambers and End Caps
- MC-4500 Chambers and End Caps
- SC, DC and MC Fabricated End Caps
- Fabricated Manifold Fittings
- Patented Isolator Row for Maintenance and Water Quality
- In-House System Layout Assistance
- On-Site Educational Seminars
- Worldwide Technical Sales Group
- Centralized Product Applications Department
- Research and Development Team
- Technical Literature, O&M Manuals and Detailed CAD drawings all downloadable via our website at **www.stormtech.com/international**

"Interested in using StormTech products in your design? We would be glad to help you. StormTech provides plan layout and cost estimate services at no additional charge for consulting engineers and developers."



StormTech Customer Support

Please contact one of our inside Technical Service professionals or Engineered Product Managers (EPMs) to discuss your particular application. A wide variety of technical support material is available from our website at **www.stormtech.com/international.** For any questions, please call StormTech at **+31 (0)10 2996410.**

- SC-310, SC-740, and DC-780 Design Manual
- MC-3500 and MC-4500 Design Manual
- SC-310, SC740, and DC-780 Installation Instructions
- MC-3500 and MC-4500 Installation Videos
- Infiltrator Row Informational Video
- CAD Drawings
- Technical Sheets
- Site Calculator Spreadsheets
- Installation Guidelines and Industry Standards
- Industry Links
- Free Layout Assistance
- Pre-construction Meetings
- Case Studies

Advanced Drainage Systems, Inc.
Marco Polostraat 2-14, 3165 AL, Rotterdam, The Netherlands
+31 (0) 10-299-6410
www.stormtech.com/international

*The Most **Advanced** Name in Drainage Systems®*

StormTech®
a product of ADS Europe

SEPARATORS

A RANGE OF FUEL/OIL SEPARATORS
FOR PEACE OF MIND

Kingspan

Klargester

60 YEARS OF
Expertise &
1955–2015 Innovation

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 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

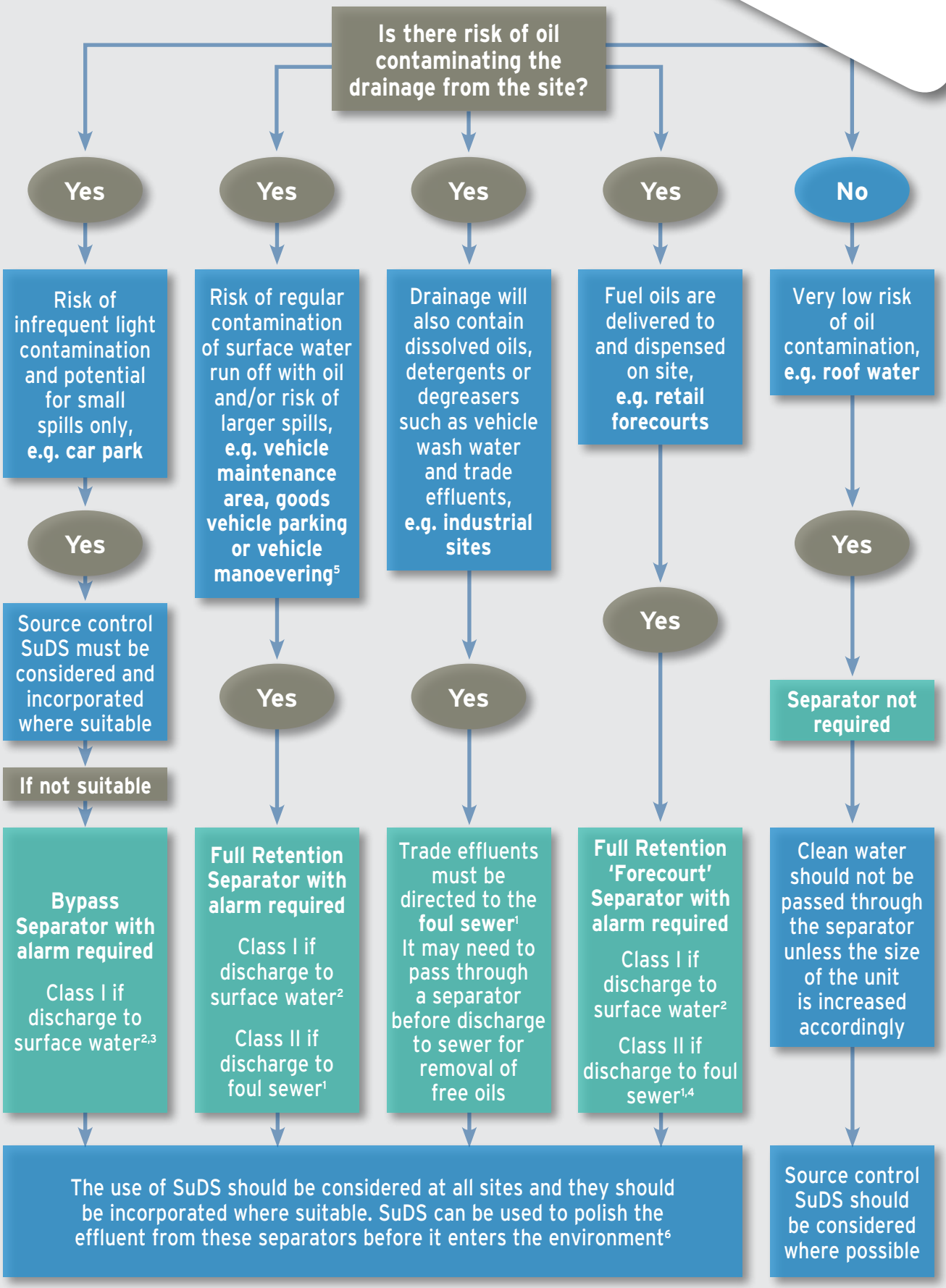
Forecourt separators are full retention separators specified to retain on site the maximum spillage likely to occur on a petrol filling station. They are required for both safety and environmental reasons and will treat spillages occurring during vehicle refuelling and road tanker delivery. The size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

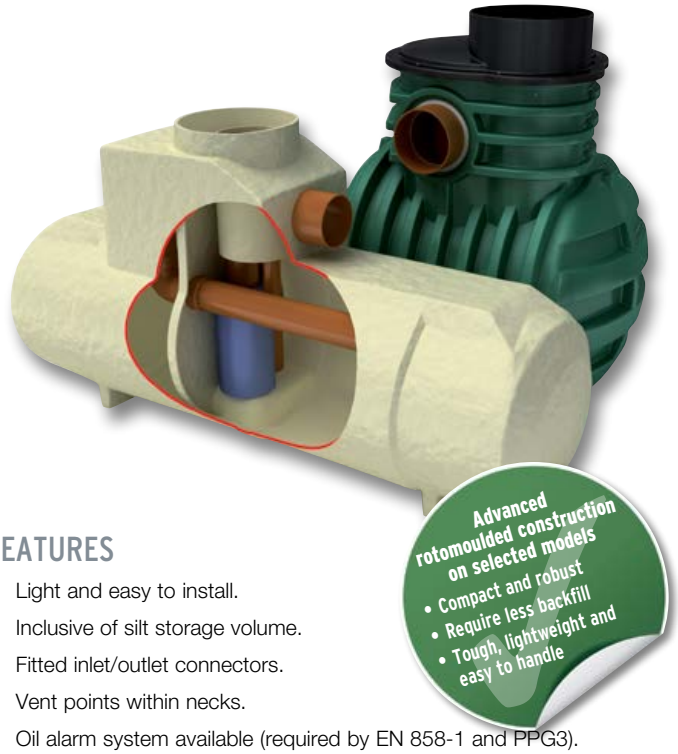
For further detailed information, please consult the Environment Agency Pollution Prevention Guideline 03 (PPG 3) 'Use and design of oil separators in surface water drainage systems' available from their website.

Kingspan 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 Kingspan Klargester Bypass separators and certified their performance in relation to their flow and process performance assessing the effluent qualities to the requirements of EN 858-1. Klargester bypass separator designs follow the parameters determined during the testing of the required range of bypass separators.

Each bypass separator design includes the necessary volume requirements for:

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

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

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

FEATURES

- Light and easy to install.
- 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 drain invert inlet depth.
- Pipework type, size and orientation.

SIZES AND SPECIFICATIONS

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

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

Full Retention NSF RANGE

APPLICATION

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

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

PERFORMANCE

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

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

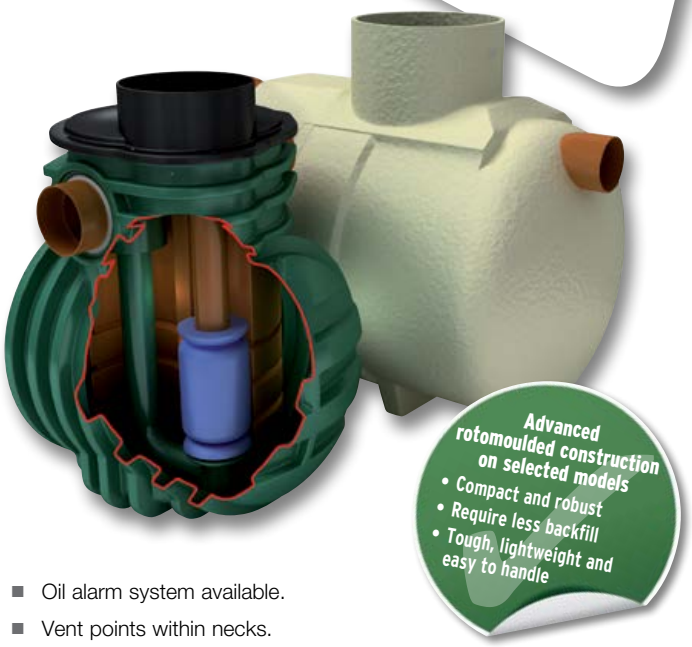
Each full retention separator design includes the necessary volume requirements for:

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

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

FEATURES

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



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

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

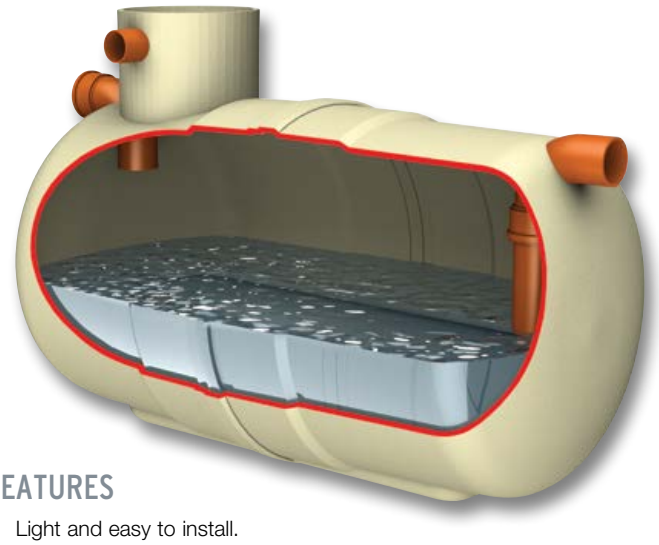
- The calculated flow rate for the drainage area served. Our designs are based on the assumption that any interconnecting pipework fitted elsewhere on site does not impede flow into or out of the separator and that the influent is not pumped.
- The required discharge standard. This will decide whether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

SIZES AND SPECIFICATIONS

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

Rotomoulded chamber construction GRP chamber construction

Washdown & Silt



APPLICATION

This unit can be used in areas such as car wash and other cleaning facilities that discharge directly into a foul drain, which feeds to a municipal treatment facility.

If emulsifiers are present the discharge must not be allowed to enter an NS Class I or Class II unit.

- Car wash.
- Tool hire depots.
- Truck cleansing.
- Construction compounds cleansing points.

PERFORMANCE

Such wash down facilities must not be allowed to discharge directly into surface water but must be directed to a foul connection leading to a municipal treatment works as they utilise emulsifiers, soaps and detergents, which can dissolve and disperse the oils.

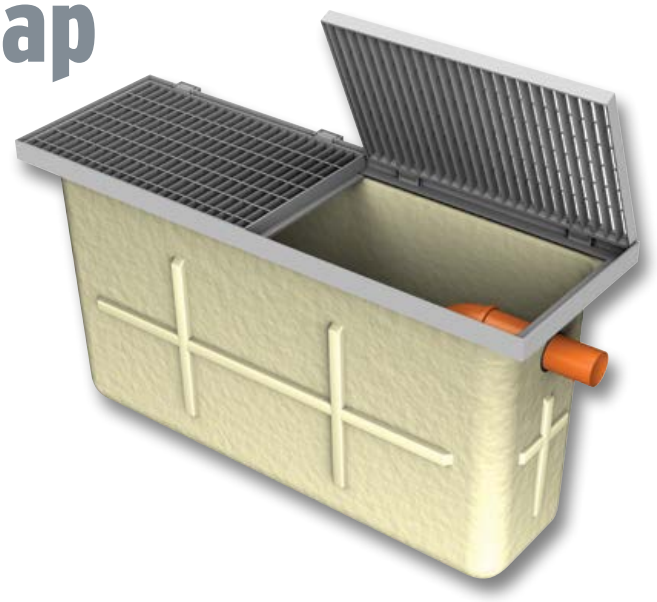
FEATURES

- Light and easy to install.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.
- Vent points within necks.
- Extension access shafts for deep inverts.
- Maintenance from ground level.

SIZES AND SPECIFICATIONS

REF.	TOTAL CAPACITY (litres)	MAX. REC. SILT	MAX. FLOW RATE (l/s)	LENGTH (mm)	DIAMETER (mm)	ACCESS SHAFT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT (mm)	STANDARD FALL ACROSS UNIT (mm)	MIN. INLET INVERT (mm)	STANDARD PIPEWORK DIA. (mm)	APPROX EMPTY (kg)
W1/010	1000	500	3	1123	1225	460	1150	1100	50	500	160	60
W1/020	2000	1000	5	2074	1225	460	1150	1100	50	500	160	120
W1/030	3000	1500	8	2952	1225	460	1150	1100	50	500	160	150
W1/040	4000	2000	11	3898	1225	460	1150	1100	50	500	160	180
W1/060	6000	3000	16	4530	1440	600	1360	1310	50	500	160	320
W1/080	8000	4000	22	3200	2020	600	2005	1955	50	500	160	585
W1/100	10000	5000	27	3915	2020	600	2005	1955	50	500	160	680
W1/120	12000	6000	33	4640	2020	600	2005	1955	50	500	160	770
W1/150	15000	7500	41	5435	2075	600	1940	1890	50	500	160	965
W1/190	19000	9500	52	6865	2075	600	1940	1890	50	500	160	1200

Car Wash Silt Trap



APPLICATION

Car Wash silt trap is designed for use before a separator in car wash applications to ensure effective silt removal.

FEATURES

- FACTA Class B covers.
- Light and easy to install.
- Maintenance from ground level.

Forecourt

APPLICATION

The forecourt separator is designed for installation in petrol filling station forecourts and similar applications. The function of the separator is to intercept hydrocarbon pollutants such as petroleum and oil and prevent their entry to the drainage system, thus protecting the environment against hydrocarbon contaminated surface water run-off and gross spillage.

PERFORMANCE

Operation ensures that the flow cannot exit the unit without first passing through the coalescer assembly.

In normal operation, the forecourt separator has sufficient capacity to provide storage for separated pollutants within the main chamber, but is also able to contain up to 7,600 litres of pollutant arising from the spillage of a fuel delivery tanker compartment on the petrol forecourt. The separator has been designed to ensure that oil cannot exit the separator in the event of a major spillage, subsequently the separator should be emptied immediately.

FEATURES

- Light and easy to install.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.
- Vent points within necks.
- Extension access shafts for deep inverts.
- Maintenance from ground level.
- Class I and Class II design.
- Oil storage volume.
- Coalescer (Class I unit only).
- Automatic closure device.
- Oil alarm system available.

INSTALLATION

The unit should be installed on a suitable concrete base slab and surrounded with concrete or pea gravel backfill. See sales drawing for installation.

If the separator is to be installed within a trafficked area, then a suitable cover slab must be designed to ensure that loads are not transmitted to the unit.

The separator should be installed and vented in accordance with Health and Safety Guidance Note HS(G)41 for filling stations, subject to Local Authority requirements.

SIZES AND SPECIFICATIONS

ENVIROCEPTOR CLASS	TOTAL CAP. (litres)	DRAINAGE AREA (m^2)	MAX. FLOW RATE (l/s)	LENGTH (mm)	DIAMETER (mm)	ACCESS SHAFT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT (mm)	STD. FALL ACROSS UNIT (mm)	MIN. INLET INVERT (mm)	STD. PIPEWORK (mm)	EMPTY WEIGHT (kg)
I	10000	555	10	3963	1920	600	2110	2060	50	400	160	500
II	10000	555	10	3963	1920	600	2110	2060	50	400	160	500
I	10000	1110	20	3963	1920	600	2110	2060	50	400	200	500
II	10000	1110	20	3963	1920	600	2110	2060	50	400	200	500

Alarm Systems

British European Standard EN 858-1 and Environment Agency Pollution Prevention Guideline PPG3 requires that all separators are to be fitted with an oil level alarm system and that it should be installed and calibrated by a suitably qualified technician so that it will respond to an alarm condition when the separator requires emptying.

- Easily fitted to existing tanks.
- Excellent operational range.
- Visual and audible alarm.
- Additional telemetry option.

PROFESSIONAL INSTALLERS

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

Services include :

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

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

www.kingspanenviro.com/klargester

Kingspan Klargester Accredited Installer

CARE & MAINTENANCE

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

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

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

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

0844 846 0500

or visit us online:
www.kingspanenvservice.com

Kingspan Environmental Services

Kingspan Klargester

COMMERCIAL WASTEWATER SOLUTIONS

- **BIODISC® & ENVIROSAFE**
  HIGH PERFORMANCE SEWAGE TREATMENT SYSTEMS
- PACKAGE PUMP STATIONS
- **PUMPSTOR24** PUMPING SYSTEMS
- OIL/WATER SEPARATORS
- BELOW GROUND STORAGE TANKS
- GREASE & SILT TRAPS

RAINWATER SOLUTIONS

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

Klargester
UK: College Road North, Aston Clinton, Aylesbury, Buckinghamshire HP22 5EW
Tel: +44 (0) 1296 633000 Fax: +44 (0) 1296 633001 Scottish Office: Tel: +44 (0) 1355 248484
email: klargester@kingspan.com

Ireland: Unit 1a, Derryboy Road, Carnbane Business Park, Newry, Co. Down BT35 6QH
NI Tel : +44 (0) 28 302 66799 Fax: +44 (0) 28 302 60046 ROI Tel: 048 302 66799 Fax: 048 302 60046
email: klargesterinfo@kingspan.com

Visit our website **www.kingspanenviro.com/klargester**

Part of Kingspan Environmental

bsi. ISO 9001 Quality Management
bsi. OHSAS 18001 Occupational Health and Safety Management
RIBA NETWORK · CPD PROVIDERS
BRITISH WATER
UK GREEN BUILDING COUNCIL Founding Member
CIBSE CPD

Issue No. 21: September 2015

Design Data

Hydro-Brake® Optimum

Vortex Flow Control Valve

Inspired by nature and engineered to deliver the perfect curve, the Hydro-Brake® Optimum is the most advanced vortex flow control valve available. There is no equivalent to the Hydro-Brake® Optimum when it comes to delivering the best possible hydraulic performance with a passive flow control.

With a wide range of configurations and options available, the Hydro-Brake® Optimum is able to provide precision flow control to suit the vast majority of applications.

Figure 1 - The Hydro-Brake® Optimum is designed and manufactured to deliver precise, repeatable flow control.

Precision Engineered Vortex Flow Controls

Each Hydro-Brake® Optimum is custom configured to suit the application and is manufactured under strict quality assurance procedures to deliver precise flow control to exacting requirements.

Every unit is backed by significant R&D investment to fine-tune the performance, meaning that the Hydro-Brake® Optimum is the only vortex flow control to have been independently certified by the BBA and WRc.

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

WRc Approved PT/329/0412

Benefits

- Manufactured from high grade stainless steel.
- Future proof – adjustable or replaceable inlet plates available to alter flow rates post-installation.
- Configurations available to suit a wide variety of installations.
- Large cross sectional area at all heads.
- Simple installation.
- Self-activating.
- No moving parts or external power requirement.

Versatile and Flexible

At Hydro International, we pride ourselves on providing solutions that meet your requirements, rather than providing a standard solution and asking you to compromize on your project needs.

The Hydro-Brake® Optimum offers designers options to precision-engineer a vortex flow control to:

- Minimize upstream storage volumes.
- Maximize internal (inlet & outlet) cross sectional areas to prevent blockages.
- Build-in a climate change factor to allow for future changes in flow rate.

Further, if you need to retrofit a flow control, our dedicated team of engineers can assist with providing a customized Hydro-Brake® Optimum suitable for installation into existing infrastructure.

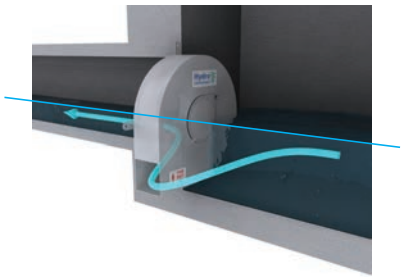
Design Data
Hydro-Brake® Optimum
Vortex Flow Control

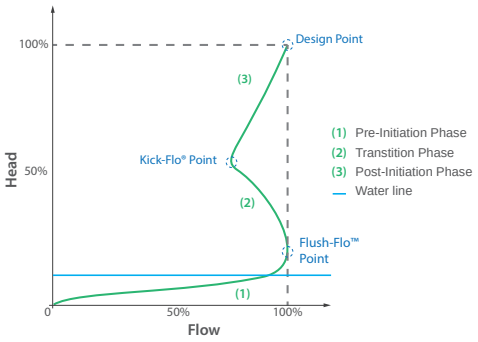
Operating Principles

The hydraulic behaviour of the Hydro-Brake® Optimum is described by its hydraulic characteristic curve, which relates the discharge flow from the unit to the hydraulic head acting upon that unit.

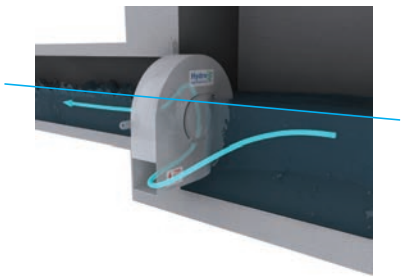
The hydraulic characteristic curve consists of three distinct sections, each corresponding to a different governing flow control regime:

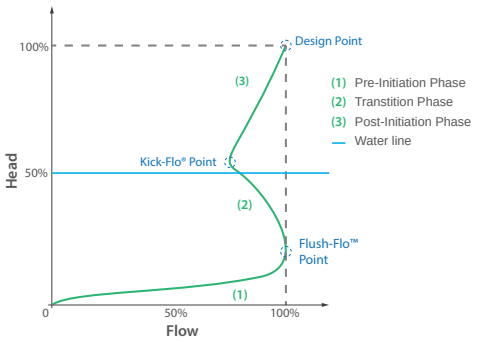
1. The pre-initiation phase – governed by orifice flow and defined on the characteristic curve as the region between the origin and the point at which the vortex begins to have a throttling effect (Flush-Flo™ point). In this region, the depth of water is below the soffit of the outlet orifice of the Hydro-Brake® Optimum.



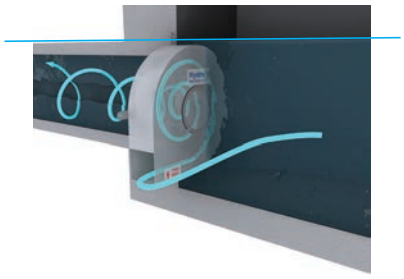


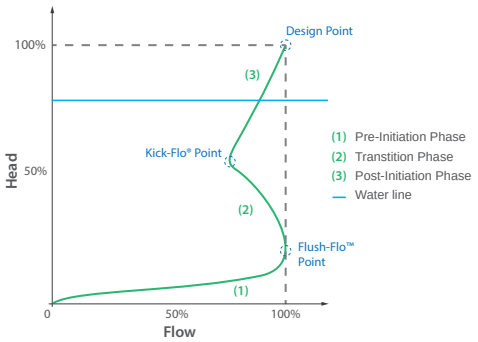
2. The transition phase – governed by vortex formation and defined on the characteristic curve as the region between the Flush-Flo™ and the point at which the vortex has fully initiated (Kick-Flo® point). In this region the vortex will continually form and collapse. A trapped volume of air inside the Hydro-Brake® Optimum will exert a backpressure and cause the discharge rate to reduce even though the hydraulic head continues to increase.





3. The post-initiation phase – governed by stable vortex flow and defined on the characteristic curve as the region above the Kick-Flo® point. A stable vortex is formed and sustained. An air filled core at the centre of the vortex acts as a pseudo-physical flow restriction by reducing the cross sectional area available for the passage of water.





Design Flexibility

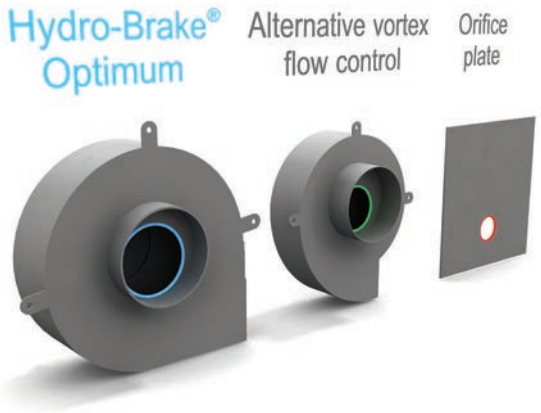
It is possible for the Design Point to be achieved using a number of different flow control configurations, each with a different hydraulic response or characteristic curve.

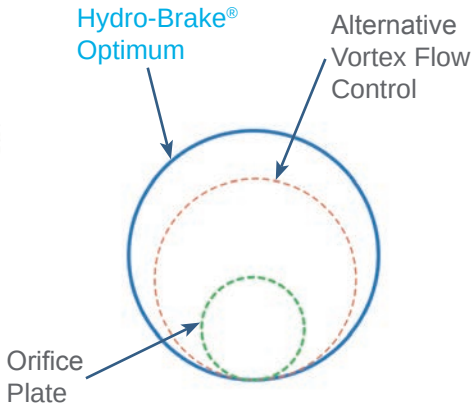
An in-depth understanding of the flow regimes and interactions at each stage of the hydraulic characteristic curve allows custom configuration of the Hydro-Brake® Optimum to achieve the hydraulic profile best suited to the site requirements.

Resilience by Design

Hydro-Brake® Optimum has outlets (clearances) up to 20% larger than competitor products to minimize the risk of blockages. All units are fitted with a pivoting bypass door to enable full access to the internal chamber and the outlet structure in the event that a blockage does occur.

All Hydro-Brake® Optimum units can also be supplied with an adjustable or replaceable inlet to future-proof the device, allowing flows to be altered post-installation, to account for site expansion or climate change.





Expert Design Support Services

Hydro International's professional engineers work with you to provide expert technical and aftersales support to ensure your projects meet exacting design requirements and deliver the very best hydraulic controls for your site.

With over 35 years' experience of flow control knowledge and experience, Hydro International's design support team is available to advise on any aspect of water flow management, including detailed modelling of vortex flow controls and composite outlet structures.

Hydro-Brake® Optimum Design Tool

Engineers have the flexibility to try out any number of flow control iterations and explore their impact on hydraulic performance.

The Hydro-Brake® Optimum Design Tool allows you to quickly and easily compare a number of different flow control options for your site to develop the most robust and sustainable drainage solution possible.

In just three simple steps you can obtain:

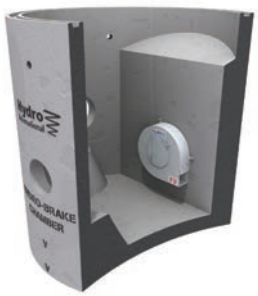
- Detailed dimensional drawings
- Hydraulic modelling data for direct import or copy/ paste into commercial hydraulic modelling software

www.hydrobrakeoptimum.com

Design Data
Hydro-Brake® Optimum
Vortex Flow Control

Easy to Install

Hydro-Brake® Optimum has a range of mounting options for ease of installation or can be fitted into a chamber (with or without a weir wall) for simple plug-and-play installation. There are no set-up or commissioning requirements.



The Hydro-Brake® Flow Control Series

As a brand leader for vortex flow controls for more than 30 years, Hydro International continues to set the standard in flow control management technologies.

At Hydro International, we pride ourselves on our engineering excellence and in developing a range of flow control solutions, we have invested in significant research & development to validate their performance.

Hydro-Brake® Orifice

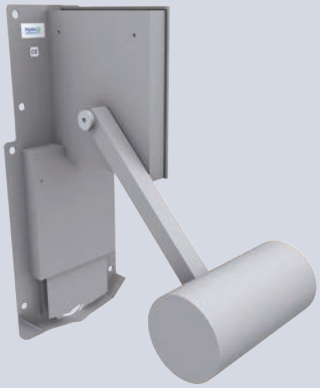
The low-cost option for unconstrainted sites (shown with optional screen).

Hydro-Brake® Optimum

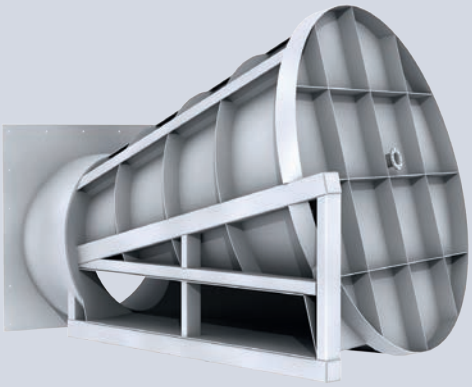
The vortex flow control with no equvalent, delivering Nature's Perfect Curve with no moving parts and independently verified by the BBA and WRc.

Hydro-Brake® Agile

Precision engineered flow control for highly constrained applications.



Hydro-Brake® Flood Alleviation



The vortex controlled solution to watercourse flooding.