

**Project: 6239 – Shell Eastfield, Rustington
Bypass, Littlehampton, West Sussex.**

Client: Bayliss Design Ltd

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1.0 Introduction

Background

- 1.1 Bayliss Design Ltd commissioned BCAL Consulting Ltd to undertake a review of the proposed Drainage Design Strategy carried by others, with a view to produce a Surface Water Management Plan (SWMP) for the proposed development site. The project particulars are as follows:

Aspect	
Site Address:	Shell Eastfield, Worthing Road, BN17 6LE
Site Location:	Ordnance Survey Grid Reference [E503845 N103340]
Local Planning Authority:	Arun District Council
Planning Application	LU/314/18/PL
Reference:	
Description of Development:	The Development works entail the demolition of sales building & plant room, LPG compound/ dispenser & canopy link removed, erection of new sales building, plant room, bin store, delivery bay, front-of store customer parking & Adblue facility to the HGV forecourt, block pavements to car forecourt replaced with liquid tight concrete & fuel dispensers replaced to main forecourt & HGV. The gross impermeable areas of the existing and proposed are 0.2612ha and 0.2921ha respectively, whereas the net impermeable areas are 0.2612ha and 0.2826ha respectively.

- 1.2 The SWMP, the subject of this report, is to facilitate the discharge of the following Pre-commencement Planning Conditions:

3. SURFACE WATER DRAINAGE: *Development shall not commence until full details of the proposed surface water drainage scheme have been submitted to and approved in writing by the Local Planning Authority.*

The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, the recommendations of the SUDS Manual produced by CIRIA.

Winter groundwater monitoring to establish highest annual ground water levels and Percolation testing to BRE 365, or similar approved, will be required to support the design of any Infiltration drainage.

Reason: To ensure that the proposed development is satisfactorily drained in accordance with policies W SP1, W DM1, W DM2 and W DM3 of the Arun Local Plan. This is required to be a pre-commencement condition because it is necessary to implement the surface water drainage system prior to commencing any building works.

Strategy for discharging Planning Condition No.3: The technical report herein including the appendices shall form the basis of evidence as well as provide the relevant support documentation necessary to discharge this planning condition.

4. SURFACE WATER DRAINAGE: The development shall not commence until formal consent has been approved in writing from the Lead Local Flood Authority (WSCC) or its agent (ADC) for the discharge of any flows to watercourses, or the culverting, diversion, infilling or obstruction of any watercourse on the site. Any discharge to a watercourse must be at a rate no greater than the pre-development run off values.

Strategy for discharging Planning Condition No.4: As there is no nearby watercourse to work with, the intent of the drainage strategy shall therefore be to connect to an existing sewer as an outfall. The connection point for the outfall is located along the north east corner of the development site as shown in the Drainage Strategy Drawing in **Appendix C**, for completeness. To this end, there will be no need for liaising with the LLFA or its agent ADC for approval as we are not discharging to a watercourse. Hence, this condition is deemed to be not applicable in this instance.

Aim

- 1.3 The aim of this SWMP Technical Report is to adopt a holistic strategy for the proposed development site, implementing a Sustainable Urban Drainage System (SUDS) concept using the best management practices (BMP's) as suggested in the CIRIA and EA publications.

Objective

- 1.4 The objective of the design requirement of this report is to:-
- Retain / reduce the quantity of surface water run-off leaving the development area to equal that, or less, of the Brownfield Run-off rate pre-development (i.e. site extension works) for all storms up to and including the in 100 year + 40% climate change event by source and site control measures.
 - Improve the quality of surface water run-off by filtration methods (via use of existing Fuel/ Oil Separators).
 - Separate the Non-contaminated Surface Water (NCSW) from the Contaminated Surface Water flows⁵.

2.0 Site Characteristics

- 2.1 **Topography** –The development site is located to the east of The Body Shop Roundabout and west of the Littlehampton Rustington Travel lodge. The north end of the site is the A259 dual carriageway and the along the south end is the B2187 single carriageway, Worthing Road.

The site is approximately 70m by 60m and is relatively steep with a gradient of 1:70 and generally comprises a combination of concrete hard standing, block pavements, and tarmac surfacing. The site is located approximately 5m AOD (Above Ordnance Datum).

2.2 Geology and Soils –

Bedrock Geology Description:

Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (undifferentiated) – chalk.

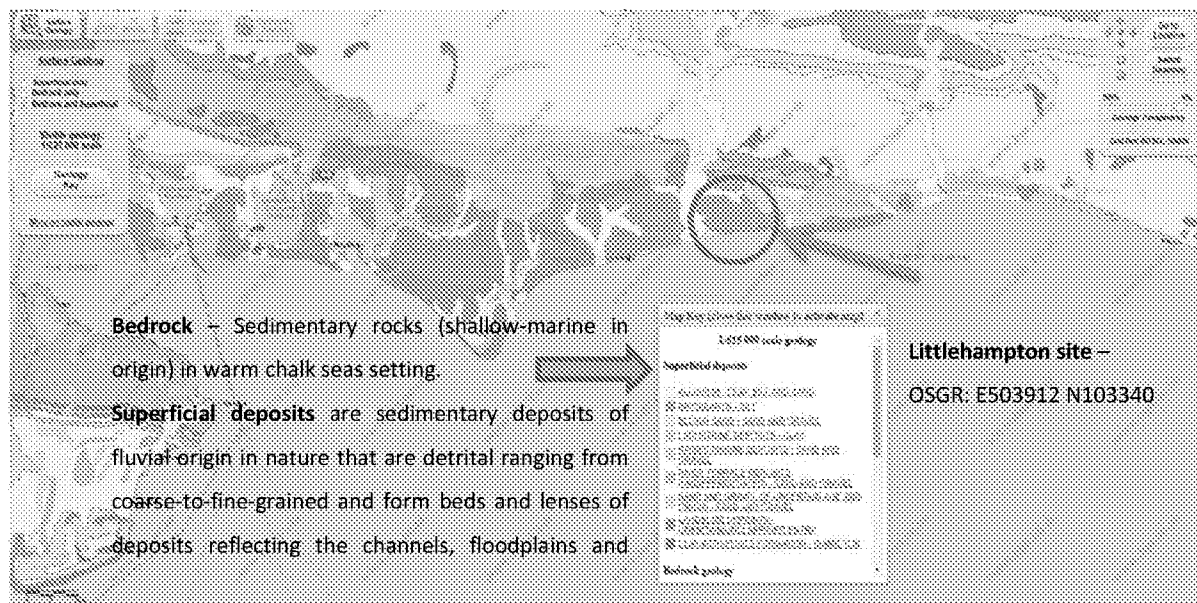
Sedimentary Bedrock formed approximately 72 to 94 million years ago in the Cretaceous Period. Local environment previously dominated by warm chalk seas.

Setting: Warm Chalk seas. These Sedimentary Rocks are shallow-marine in origin. They are biogenic and detrital, generally comprising carbonate material (coccoliths), forming distinctive beds of chalk.

Superficial deposits description:

River Terrace Deposits (undifferentiated) - Sand, Silt & Clay. Superficial Deposits formed up to 3 million years ago in the Quaternary Period. Local environment previously dominated by rivers (U).

Setting: rivers (U). These sedimentary deposits are fluvial in origin. They are detrital, ranging from coarse- to fine-grained and form beds and lenses of deposits reflecting the channels, floodplains and levees of a river or estuary (if in a coastal setting).



2.3 Percolation Tests – Local constraints preclude the use of infiltration techniques as listed below:

- Congested underground services (Electric, Gas, Water and Telecommunication cabling),
- Presence of fuel storage farm with numerous large tanks and underground pipe network,
- Presence of a Foul Water Network with associated piped network,
- Presence of large Fuel/ Oil Separators,
- Long lines of drainage channels criss-crossing the impermeable areas together with their associated underground piped connections.

Even though the underlying ground condition could possibly accommodate infiltration techniques such as soakaways, various utility service provisions are vying for underground space in a relatively small parcel of land. It is shown that it is physically not possible to accommodate/include surface water infiltration on site which can be located a minimum of 5.0m clear from existing/proposed structures, tree roots and road boundaries (Highway Boundaries). Refer to Drawing No. 6239-19 enclosed within **Appendix C**.

We therefore proposed a more practical method to attenuate the surface water volume on site with 2No. Geo-Cellular Storage Crate system wrapped with an impermeable geomembrane layer and has a combined storage volume of 22.64 m³. Refer to Drawings No. 6239-20 & 23 enclosed within **Appendix C**.

2.4 **Impermeable Areas** – An Impermeable Area, Drainage Strategy and Catchment Area Plans are included in **Appendix C** for reference.

The plans highlight impermeable areas derived from Roof Areas (Buildings, Canopy and Carwash facility), Patios, Bin Storage and Petrol Station Forecourt areas for light vehicle and heavy goods vehicles.

To model the network correctly, one must first determine the existing surface water network areas.

The existing catchment comprises two independent areas of collecting and conveying surface water runoff to the Outfall.

The First Area being referred to herein as the 'Non-contaminated' Surface Water Areas (NCSW) as they only collect, retain and convey water from non-trafficked areas, namely Roofs (Main & Rear and Car Wash Buildings), Main & Link Canopy and walkways around the immediate vicinity of the Main & Rear Buildings.

The trafficked areas with the potential to carry pollutants shall be referred to as Contaminated Surface Water Areas (CSW). These areas include forecourt and car wash areas.

The various Impermeable areas are deduced overleaf as follows:

Non-contaminated Surface Water (NCSW) - Existing		Non-contaminated Surface Water (NCSW) - Proposed	
Description	Area (m ²)	Description	Area (m ²)
Existing Roof of Main Building	113.459	Proposed Roof of Main Building	296.103
Existing Roof of Rear Building	23.952	Canopy - Main	218.106
Canopy - Main & Link (218.106+73.014 = 291.120m ²)	291.120	Patios	118.743
Car wash roof	67.489	Carwash Roof area	67.489
Walkway Patios (137.448-113.459 =23.989 m2)	23.989		
Total Existing Impermeable Catchment Area (m²) =	520.009	Total Proposed Impermeable Catchment Area (m²) =	700.441
Difference in area between existing and proposed (m ²) NCSW zones	180.432		
Percentage difference between existing and proposed (+value represents an increase and a -ve value a decrease)	35.0%		
Contaminated Surface Water (CSW) - Existing		Contaminated Surface Water (CSW) - Proposed	
Description	Area (m ²)	Description	Area (m ²)
Total Existing catchment area at Grade Level	2,611.811	Total Existing catchment area at Grade Level	2,921.233
Existing Roof of Car Wash facility	-67.489	Existing nearby area of Car Wash taken up by the Foul Network	-95.315
Existing Roof of Main & Rear Building	-137.411	Proposed Roofs of Main Building & car wash	-363.592
Existing Roof of Canopy (Main & Link)	-291.120	Canopy - Main	-218.106
Walkway Patios (137.448-113.459 =23.989)	-23.989	Patios	-118.743
Total Effective Existing Impermeable Catchment Area (m²) =	2,091.802	Total Effective Proposed Impermeable Catchment Area (m²) =	2,125.477
Difference in area between existing and proposed (m ²) CSW zones	33.675		
Percentage difference (+value represents an increase and a -ve value a decrease)	1.6%		
Net Impermeable Area:	2,611.811	Net Impermeable Area:	2,825.918
Gross Impermeable Area:	2,611.811	Gross Impermeable Area:	2,921.233

2.5 Catchment Areas – The Storm Water Network comprises two independent sub-networks (NCSW & CSW) that converge at the outfall at the northeast corner of the site.

Pipe flows for both the existing NCSW and CSW drainage systems are currently unrestricted.

However, as the NCSW network represents a 35% increase on the surface area of the existing development our design strategy for the proposed would be to mimic the existing brownfield conditions without putting extra load on the existing drainage system.

To achieve this intent we have provided 2 No. Geo-cellular storage crate systems, [each to be 2.10m wide by 7.57m long and 0.75m deep = 23.8m³ and allowing for 95% porosity yields a combined storage volume of 22.70m³, which is in touch with the initial storage estimate of 16m³ and 29m³ obtained from Micro-Drainage (Source Control)]. See **Appendix B**.

In addition, a hydro-brake device is provided within Manhole no. S10 (upstream of pipe 3.001) to ensure flows are limited to no more than 2l/s as they reach the outfall.

Since the surface area of the CSW network represents a small 1.6 % increase on the existing which is not restricted, we feel, there is no need for any online control measures.

The various catchment contributing areas per manhole and annotation of the control type are highlighted in the table overleaf and also detailed in the catchment area plan in **Appendix C**.

Pipe No.	Manhole		Comment	Contributing Catchment Areas (CA) in m ²				CA
	U/S	D/S		sub-catchment	sub-catchment	sub-catchment	Sub-Total	Hectares (ha)
1.000	S01	S02		0.000	0.000	153.785	153.785	0.015
1.001	S02	S04		0.000	0.000	381.093	381.093	0.038
1.002	S04	S05		0.000	0.000	188.616	188.616	0.019
1.003	S05	S06		108.064	95.816	0.000	203.880	0.020
1.004	S06	S07		0.000	0.000	0.000	0.000	0.000
1.005	S07	Outfall		0.000	0.000	0.000	0.000	0.000
2.000	S03	S04		0.000	891.998	306.126	1,198.124	0.120
3.000	S08	S10		148.053	118.743	0.000	266.796	0.027
3.001	S10	Outfall	Hydrobrake & Cellular crates	0.000	0.000	0.000	0.000	0.000
4.000	S09	S10		148.050	218.106	67.489	433.645	0.043
							2,825.939	0.283

3.0 Surface Water Management and Drainage Design

3.1 MANAGEMENT OF SURFACE WATER

- (a) Current Conditions: The site is largely comprised of impermeable areas with the fringes made of grass and earth bunds around the perimeter.



Picture 1: Showing an Aerial view of the site.

It is proposed that Surface water captured from the roofs of the Main Building, Car Wash, and Canopy together the patio areas would drain directly into the pipe networks 3.000 and 4.000 prior discharging to the outfall via pipe 3.001.

This represents the Non-contaminated Surface water (NCSW) sub-network and has a storage volume (i.e. cellular crates) and a vortex control device (i.e. Hydro-brake) attached to it to restrict flows to no more than 2l/s.

Surface water from the trafficked areas shall drain via the CSW sub-network. Water from the immediate vicinity of the car wash building as highlighted in the drainage catchment areas plan **(Appendix C)** shall drain to the proposed Foul Network, to be designed by others.

This catchment area (95.103m²) shall be deducted from the total proposed surface water catchment area of (2,921.233m²) to obtain the net proposed impermeable area of 2,825.918 m².

The reason for the deduction is that the hydraulic design for the foul network will be computed separately by others.

- (b) Surface Water Drainage Outfalls: It is a requirement of the Building Regulations (2015), Drainage and Waste Disposal, Approved Document H, to dispose of surface water collected within a development in the following list of priorities:-
- ✦ First Option – Infiltration systems where ground condition permit *[Not viable as discussed in section 2.3 (i.e. local constraints do not permit its use)]*
 - ✦ Second Option – To watercourses *[there are no watercourses nearby]*
 - ✦ Third Option – To sewers *[the nearest adopted surface water sewer is located within northeast end of the site. This will require a vortex control device (i.e. NCSW network) to throttle flows to no more than 2 l/s.*

3.4 PROPOSED DRAINAGE STRATEGY and DESIGN

- (a) The Surface water discharge rates will be restricted to Brownfield equivalent runoff rates to ensure that the rate of surface water run-off from the site does not increase as a result of the proposed development.
- (b) A 35% increase in the surface area of the proposed NCSW sub-network would warrant the use of 2No. underground storage systems (cellular crates – 2.10m wide by 7.57m long and 0.75m deep) and an online control (Hydro-brake) to limit flows to 2 l/s. An increase of 1.6% of the CSW sub-network means there is negligible impact on the existing condition and no online or storage volumes are required.
- (c) The DESIGN Criteria has been based upon the following publications and computer software.
- The SUDS Manual C753 by CIRIA
 - Sustainable Drainage Systems C609 by CIRIA
 - Design Guide - Permeable Pavements by Interpave
 - Micro-Drainage Software

- (d) Hydraulic Calculations shall be considered for the following storm events:
- 1 in 1 year return (*i.e. for site slopes greater than 1% – No surcharging above pipe soffit under pipe full condition*)
 - 1 in 30 years return (*No Flooding but surcharge permissible*)
 - 1 in 100 years return (*No internal Flooding*)
 - 1 in 100 years return plus 40 % climate change

(e) Existing Brownfield Conditions:

As the gross area of the site (0.2612ha) is less than 50ha the most appropriate hydraulic calculation technique is the ICP SuDS method, which was used to establish the existing greenfield runoff characteristics. The calculation results are in **Appendices A and B**.

- The brownfield runoff rate for the development site is as shown below:

Soil type	0.400
Standard Average Annual Rainfall (SAAR)	742 mm – obtained from FSR Parameters
Urban	0.50
Region number	6 & 7
Proposed Impermeable Area	0.283
Q_1	1.7 l/s
Q_{bar} (Mean Annual Flow from a rural catchment in l/s)	2.0 l/s
Q_{30}	3.7 l/s
Q_{100}	4.5 l/s

The Q_{bar} equivalent rate for the proposed development is 2.0 l/s. A maximum restriction flow rate of 2.0 l/s as required by Arun LLFA and in line with the Q_{bar} equivalent rate has been implemented.

(f) Attenuation Requirements:

The NCSW network shall make use of 2No. Geo-cellular storage crate systems with a combined volume of 23.8m³ (*i.e. each system to be 2.10mW x 7.57mL x 0.75mD x 0.95 (porosity)*).

The locations of the storage crate systems are shown in the Drainage Strategy Drawing reference 6239-20 enclosed in **Appendix C**.

The attenuation (via pipes and geo-cellular storage crates) has been designed to accommodate a 1 in 100 year event plus allowance of 40% for climate change. The proposed gross impermeable area of the development is 2,921.233m², of which is 700.441m² is taken up as the NCSW sub-network, 2125.477m³ as the CSW sub-network. The car wash area volume of 95.315m² will discharges into the Foul Network through a new oil interceptor.

Based on the proposed impermeable area and allowable discharge rate of 2.0 l/s, the storage requirement for the 1 in 100 year plus climate change event has been calculated utilising the following parameters. Full calculations are enclosed in **Appendix B**.

Rainfall Profile	Flood Studies Report (FSR)
Return Period	100 years
Climate Change	40% plus
Durations	15 to 10,080 minutes
Drained Area	0.07ha
Limit Flow to Outfall	2.0 l/s
Control	Hydro-brake
Total Storage Required	Between 16m ³ and 29m ³

(g) SUDs Methods

Piped Network: The Private surface water drainage within the site boundary is to be designed in accordance with Part H of the Building Regulations. All surface water sewers within the road network, concrete hardstanding and forecourt areas will be designed in accordance with the Sewers for Adoption - 7th Edition publication using the Micro-Drainage software.

The civil infrastructure in respects of roads will be owned and maintained privately and shall not be the subject of an adoption under a Section 38 Agreement.

4.0 Overland Flood Routes

- 4.1 The intent of the Drainage Strategy is to design the surface water drainage to accommodate the 1 in 100 year storm event, taking into account the predicted future effects of climate change (40% increase in intensity) .

A summary of the hydraulic design simulations for all storm events is contained in **Appendices A and B**. The critical storm event is the 15minute 100year Winter plus 40% climate change. Flooding occurs during the 100year + 40% cc within the existing system, upstream of pipe number's 1.001, 2.000 and 1.002. Total flooded volume of 21.193m³. This flooding is to be expected as the existing 100mm diameter pipes was never designed for such storm intensity.

There is a risk of this storm event being exceeded and in such an event, the proposed drainage systems will become overwhelmed and overland flows could occur, albeit the risk is considered very low.

This is because the overflow volume will spill across the forecourt and adjacent carriageway linking A259 with B2187.

There is no consequence of property damage as a result of the exceedance.

Overflow volumes will be directed to follow overland flow paths which currently flow and away from the proposed new Main Building with an elevated FFL (i.e. minimum of 150mm above the proposed grade level). Refer to **Appendix C** for details of the overland flow route plan.

5.0 Conclusions and Recommendations

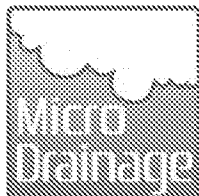
5.1 This report details a proposed Surface Water Management and Drainage Design Strategy which meets the requirements of Planning Condition 3 as it;

- (a) Provides a sustainable drainage solution that disposes of surface water responsibly. This is achieved through best management practice SuDs techniques including the use of Cellular Storage for flow attenuation and the use of separators (fuel/ oil) to improve water quality prior to being discharged to the wider sewer network. The said surface water management approach is the third option under the hierarchy of drainage outlined within the National Planning Policy Framework;
- (b) Is based on the 1 in 100 years return period plus climate change (i.e. 40%) rainfall event, results of which confirmed Flooding of approximately 21m³ within the existing system, which is only of diameter 100mm. This flooding is to be expected as the original pipe was not designed for a 100 year plus 40% cc storm event.
- (c) Prevents pollution by providing water quality treatment via the use of existing Fuel & Oil separators / interceptors;
- (d) Includes substantive Micro-Drainage calculations as well as other construction detailing.
- (e) Incorporates flood protection measures in case of extreme weather conditions by ensuring overland flow paths move away from the proposed Main Building. The Finished Floor Levels (FFL) of the main building should be set such that it is 150mm above the surrounding grade.

APPENDIX A

NETWORK CALCULATIONS

(Including Micro-Drainage Calculations)

BCAL Consulting		Page 0
Orient House Church Way Wellingborough NN8 4HJ	6239 Shell Eastfield, Rustington Littlehampton, West Sussex	
Date 08/05/2019 17:39 File FINAL SIMULATION OUTPUT_...	Designed by Amadou Dampha Checked by Barry King	
Micro Drainage		Network 2017.1.2

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.100	Add Flow / Climate Change (%)	0
Ratio R	0.346	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	99	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Surface Network 1 at outfall Outfall 1 (pipe 1.005)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.154	4-8	0.056

Total Area Contributing (ha) = 0.210

Total Pipe Volume (m³) = 2.121

Time Area Diagram at outfall Outfall 2 (pipe 3.001)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.043	4-8	0.026

Total Area Contributing (ha) = 0.069

Total Pipe Volume (m³) = 1.336

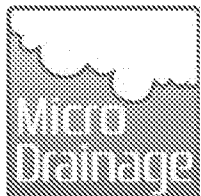
Network Design Table for Surface Network 1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	15.595	0.104	150.0	0.015	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL E (m)	I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	47.38	5.32	4.654	0.015	0.0	0.0	0.0	0.82	14.5	1.9

BCAL Consulting		Page 1
Orient House Church Way Wellingborough NN8 4HJ	6239 Shell Eastfield, Rustington Littlehampton, West Sussex	
Date 08/05/2019 17:39 File FINAL SIMULATION OUTPUT_...	Designed by Amadou Dampha Checked by Barry King	
Micro Drainage		Network 2017.1.2

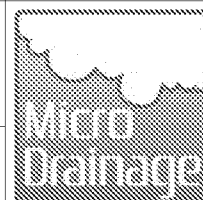
Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.001	40.502	0.380	106.6	0.038	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	26.439	0.780	33.9	0.119	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	7.893	0.130	60.7	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	5.464	0.160	34.2	0.020	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	3.162	0.100	31.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	8.916	0.100	89.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	21.232	0.225	94.4	0.026	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	20.635	0.280	73.7	0.043	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	33.748	0.320	105.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

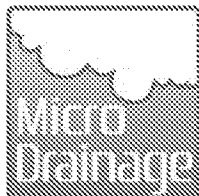
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	I.Area (ha)	Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.001	44.91	6.01	4.850	0.053	0.0	0.0	0.0	0.97	17.2	6.4
2.000	47.33	5.33	5.000	0.119	0.0	0.0	0.0	1.33	10.4	15.3
1.002	44.57	6.11	4.170	0.190	0.0	0.0	0.0	1.29	22.9	22.9
1.003	44.40	6.17	4.040	0.210	0.0	0.0	0.0	1.73	30.5	25.3
1.004	44.31	6.20	3.880	0.210	0.0	0.0	0.0	1.80	31.8	25.3
1.005	44.02	6.28	3.780	0.210	0.0	0.0	0.0	1.67	117.8	25.3
3.000	47.29	5.34	4.225	0.026	0.0	0.0	0.0	1.03	18.3	3.3
4.000	47.47	5.29	4.280	0.043	0.0	0.0	0.0	1.17	20.7	5.5
3.001	45.23	5.92	4.000	0.069	0.0	0.0	0.0	0.98	17.3	8.5

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Manhole Schedules for Surface Network 1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	5.860	1.146	Open Manhole	1200	1.000	4.654	150				
S2	5.580	1.000	Open Manhole	1200	1.001	4.580	150	1.000	4.550	150	
S3	5.750	0.750	Open Manhole	1200	2.000	5.000	300				
S4	5.170	1.000	Open Manhole	1200	1.002	4.170	150	1.001	4.170	150	
								2.000	4.220	100	
S5	5.340	1.300	Open Manhole	1200	1.003	4.040	150	1.002	4.040	150	
S6	5.300	1.420	Open Manhole	1200	1.004	3.880	150	1.003	3.880	150	
S7	5.230	1.450	Open Manhole	1200	1.005	3.780	300	1.004	3.780	150	
Outfall 1	5.130	1.450	Open Manhole	1200		OUTFALL		1.005	3.680	300	
S8	5.800	1.575	Open Manhole	1200	3.000	4.225	150				
S9	5.580	1.300	Open Manhole	1200	4.000	4.380	150				
S10	5.410	1.410	Open Manhole	1200	3.001	4.000	150	3.000	4.000	150	
								4.000	4.000	150	
Outfall 2	5.130	1.450	Open Manhole	1200		OUTFALL		3.001	3.680	150	

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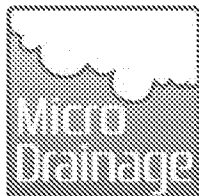
PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd	Diam	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
Sect	(mm)	Name	(m)	(m)	(m)	Connection	(mm)	
1.000	o 150	S1	5.800	4.634	0.996	Open Manhole	1200	
1.001	o 150	S2	5.550	4.550	0.350	Open Manhole	1200	
2.000	o 100	S3	5.750	5.000	0.650	Open Manhole	1200	
1.002	o 150	S4	5.170	4.170	0.850	Open Manhole	1200	
1.003	o 150	S5	5.340	4.040	1.150	Open Manhole	1200	
1.004	o 150	S6	5.300	3.880	1.270	Open Manhole	1200	
1.005	o 300	S7	5.230	3.780	1.150	Open Manhole	1200	
3.000	o 150	S8	5.800	4.225	1.425	Open Manhole	1200	
4.000	o 150	S9	5.580	4.280	1.150	Open Manhole	1200	
3.001	o 150	S10	5.410	4.000	1.260	Open Manhole	1200	

Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)	
1.000	15.595	150.0	S2	5.550	4.550	0.850	Open Manhole	1200
1.001	40.502	106.6	S4	5.170	4.170	0.850	Open Manhole	1200
2.000	26.439	33.9	S4	5.170	4.220	0.850	Open Manhole	1200
1.002	7.893	60.7	S5	5.340	4.040	1.150	Open Manhole	1200
1.003	5.464	34.2	S6	5.300	3.880	1.270	Open Manhole	1200
1.004	3.162	31.6	S7	5.230	3.780	1.300	Open Manhole	1200
1.005	8.916	89.2	Outfall 1	5.130	3.680	1.150	Open Manhole	1200
3.000	21.232	94.4	S10	5.410	4.000	1.260	Open Manhole	1200
4.000	20.635	73.7	S10	5.410	4.000	1.260	Open Manhole	1200
3.001	33.748	105.5	Outfall 2	5.130	3.680	1.300	Open Manhole	1200

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Area Summary for Surface Network 1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.015	0.015	0.015
1.001	-	-	100	0.038	0.038	0.038
2.000	-	-	100	0.119	0.119	0.119
1.002	-	-	100	0.018	0.018	0.018
1.003	-	-	100	0.020	0.020	0.020
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.026	0.026	0.026
4.000	-	-	100	0.043	0.043	0.043
3.001	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.279	0.279	0.279

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
---------------------	--------------	--------------	--------------	------------------	----------	--------

1.005	Outfall 1	5.130	3.680	3.680	1200	0
-------	-----------	-------	-------	-------	------	---

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
---------------------	--------------	--------------	--------------	------------------	----------	--------

3.001	Outfall 2	5.130	3.680	3.680	1200	0
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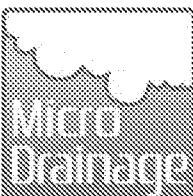
Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.100	Storm Duration (mins)	30
Ratio R	0.346		

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Online Controls for Surface Network 1

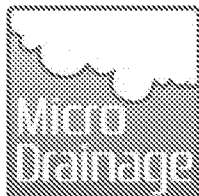
Hydro-Brake® Optimum Manhole: S10, DS/PN: 3.001, Volume (m³): 2.3

Unit Reference	MD-SHE-0062-2000-1350-2000
Design Head (m)	1.350
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	62
Invert Level (m)	4.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.350	2.0	Kick-Flo®	0.557	1.3
Flush-Flo™	0.274	1.6	Mean Flow over Head Range	-	1.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.4	0.800	1.6	2.000	2.4	4.000	3.3	7.000	4.3
0.200	1.6	1.000	1.7	2.200	2.5	4.500	3.5	7.500	4.4
0.300	1.6	1.200	1.9	2.400	2.6	5.000	3.7	8.000	4.6
0.400	1.6	1.400	2.0	2.600	2.7	5.500	3.8	8.500	4.7
0.500	1.5	1.600	2.2	3.000	2.9	6.000	4.0	9.000	4.8
0.600	1.4	1.800	2.3	3.500	3.1	6.500	4.1	9.500	4.9

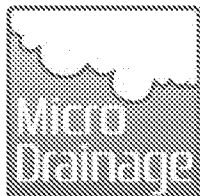
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Micro Drainage		Network 2017.1.2

Storage Structures for Surface Network 1

Cellular Storage Manhole: S10, DS/PN: 3.001

Invert Level (m) 4.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	29.8	29.8	0.800	29.8	47.9	0.801	0.0	47.9

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Micro Drainage		Network 2017.1.2

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

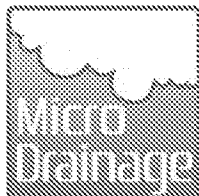
Rainfall Model FSR M5-60 (mm) 19.100 Cv (Summer) 0.750
Region England and Wales Ratio R 0.346 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960,
1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

									Water	Surcharged
US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)
1.000	S1	15 Winter		1	+0%	30/15 Summer			4.692	-0.112
1.001	S2	15 Winter		1	+0%	30/15 Summer	100/15 Winter		4.612	-0.088
2.000	S3	15 Winter		1	+0%	1/15 Summer	30/15 Summer		5.246	0.146
1.002	S4	15 Winter		1	+0%	30/15 Summer	100/15 Winter		4.285	-0.035
1.003	S5	15 Winter		1	+0%	30/15 Summer			4.144	-0.046
1.004	S6	15 Winter		1	+0%	1/15 Winter			4.031	0.001
1.005	S7	15 Winter		1	+0%				3.884	-0.196
3.000	S8	15 Winter		1	+0%	30/60 Winter			4.269	-0.106
4.000	S9	15 Winter		1	+0%	100/15 Summer			4.334	-0.096
3.001	S10	60 Winter		1	+0%	30/15 Summer			4.139	-0.011

		Flooded		Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded
1.000	S1	0.000	0.14		1.9	OK	
1.001	S2	0.000	0.35		5.8	OK	1
2.000	S3	0.000	1.09		11.0	SURCHARGED	17
1.002	S4	0.000	0.94		18.5	OK	1
1.003	S5	0.000	0.82		20.5	OK	
1.004	S6	0.000	1.02		20.2	SURCHARGED	
1.005	S7	0.000	0.26		20.3	OK	
3.000	S8	0.000	0.19		3.2	OK	
4.000	S9	0.000	0.27		5.4	OK	
3.001	S10	0.000	0.09		1.5	OK	

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Micro Drainage		Network 2017.1.2

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.100 Cv (Summer) 0.750
Region England and Wales Ratio R 0.346 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960,
1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

									Water	Surcharged	
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth
PN	Name	Storm	Period	Change		Surcharge	Flood	Overflow	Act.	(m)	(m)
1.000	S1	15 Winter	30	+0%	30/15 Summer					4.878	0.074
1.001	S2	15 Winter	30	+0%	30/15 Summer	100/15 Winter				4.865	0.165
2.000	S3	15 Winter	30	+0%	1/15 Summer	30/15 Summer				5.755	0.655
1.002	S4	15 Winter	30	+0%	30/15 Summer	100/15 Winter				4.678	0.358
1.003	S5	15 Winter	30	+0%	30/15 Summer					4.435	0.245
1.004	S6	15 Winter	30	+0%	1/15 Winter					4.175	0.145
1.005	S7	15 Winter	30	+0%						3.911	-0.169
3.000	S8	120 Winter	30	+0%	30/60 Winter					4.414	0.039
4.000	S9	120 Winter	30	+0%	100/15 Summer					4.416	-0.014
3.001	S10	120 Winter	30	+0%	30/15 Summer					4.411	0.261

		Flooded		Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded
1.000	S1	0.000	0.29		3.9	SURCHARGED	
1.001	S2	0.000	0.75		12.5	SURCHARGED	1
2.000	S3	4.545	1.36		13.8	FLOOD	17
1.002	S4	0.000	1.38		27.4	SURCHARGED	1
1.003	S5	0.000	1.26		31.5	SURCHARGED	
1.004	S6	0.000	1.59		31.5	SURCHARGED	
1.005	S7	0.000	0.40		31.5	OK	
3.000	S8	0.000	0.16		2.8	SURCHARGED	
4.000	S9	0.000	0.23		4.6	OK	
3.001	S10	0.000	0.09		1.6	SURCHARGED	

APPENDIX B

BROWNFIELD CONDITIONS

(Including Micro-Drainage Calculations)

6239 Drainage Storage Calculations: FSR 100 Year Return Plus 40% Climate Change

Variables

Results

Design

Overview 2D

Overview 3D

VR

FSR Rainfall

Return Period (years)

Region

Map

100

England and Wales

15-60 (mm)

19 100

Ratio R

5.345

Cv (Summer)

5.750

Cv (Winter)

9.340

Impervious Area (ha)

0.570

Maximum Allowable Discharge (l/s)

5.0

Infiltration Coefficient (m/hr)

5.00000

Safety Factor

2.0

Climate Change (%)

40

Analyse

OK

Cancel

Help

Enter Climate Change between -100 and 600

Variables

Results

Design

Overview 2D

Overview 3D

VR

Global Variables require approximate storage of between 16 m³ and 29 m³.

These values are estimates only and should not be used for design purposes.

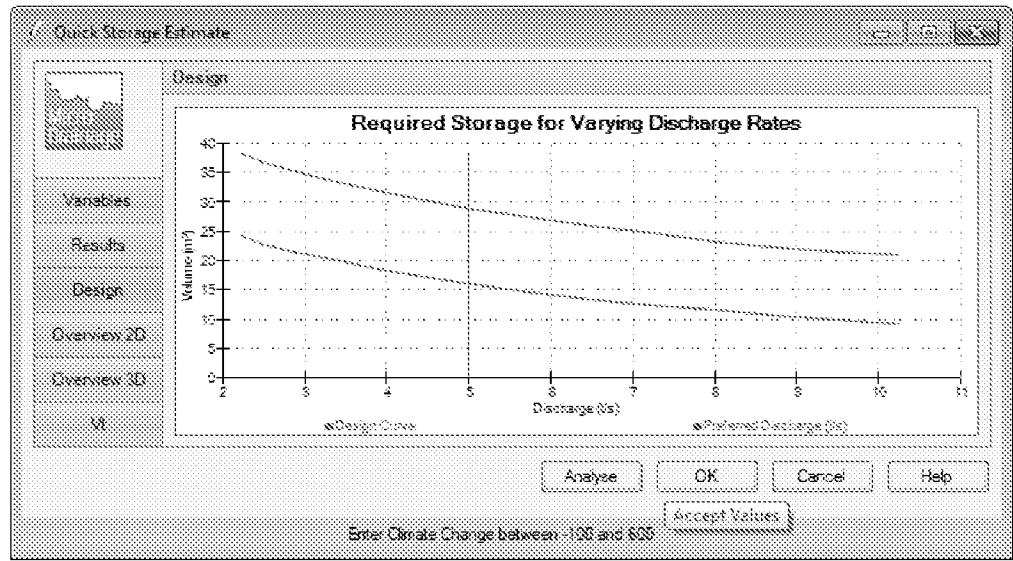
Analyse

OK

Cancel

Help

Enter Climate Change between -100 and 600



6119 Drainage Storage Calculations: FEH 30 Year Return Plus 0% Climate Change

Quick Storage Estimate

Variables

FSR Rainfall: [Dropdown]

Return Period (years): 30

Region: England and Wales

Map: M5-B0 (mm): 19.100

Ratio R: 0.046

Cv (Summer): 0.750

Cv (Winter): 0.840

Impermeable Area (ha): 0.070

Maximum Allowable Discharge (l/s): 5.0

Infiltration Coefficient (m/hr): 0.00000

Safety Factor: 2.0

Climate Change (%): 0

Analyse OK Cancel Help

Enter Climate Change between -100 and 500

Quick Storage Estimate

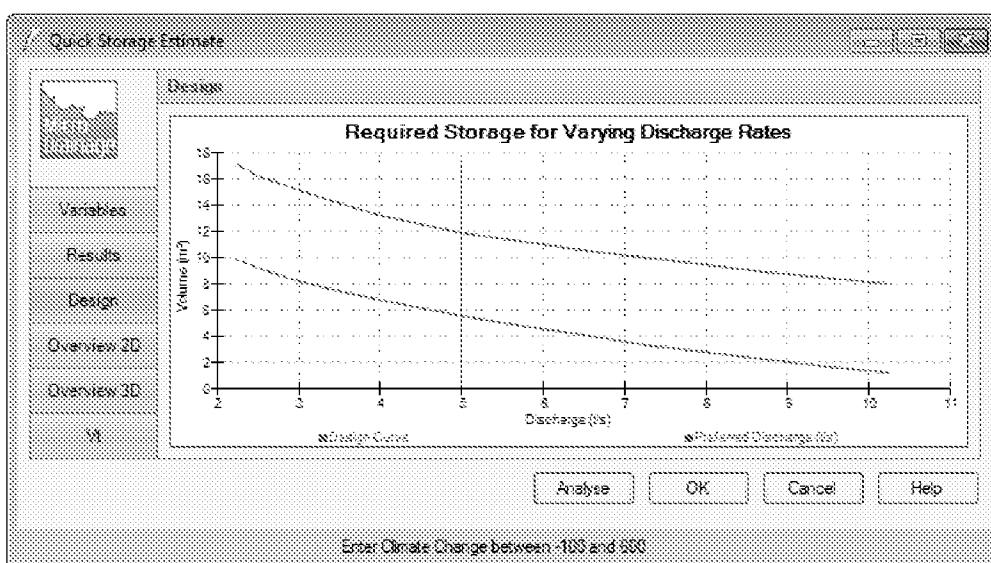
Results

Global Variables require approximate storage of between 5.6 m³ and 12 m³.

These values are estimates only and should not be used for design purposes.

Analyse OK Cancel Help

Enter Climate Change between -100 and 500



6239 Existing Brownfield Runoff Rates

Rural Runoff Calculator

ICP SUDS

ICP SUDS Input (FSR Method)

Return Period (Years)

Area (ha)

SAAR (mm)

Soil

Growth Curve

Partly Urbanised Catchment (QBAR)

Urban

Region

Results

QBAR rural (l/s)

QBAR urban (l/s)

Return Period Flood

Region	QBAR (l/s)	Q (30 yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	2.0	3.2	1.7	3.2	3.7
Region 2	2.0	3.2	1.7	3.2	3.8
Region 3	2.0	3.1	1.7	3.1	3.4
Region 4	2.0	3.3	1.8	3.3	3.9
Region 5	2.0	3.8	1.7	3.8	4.8
Region 6/Region 7	2.0	3.7	1.7	3.7	4.5
Region 8	2.0	3.3	1.5	3.3	3.7
Region 9	2.0	3.1	1.7	3.1	3.5
Region 10	2.0	3.0	1.7	3.0	3.3
Ireland National	2.0	2.9	1.7	2.9	3.1
Ireland East	2.0	2.9	1.7	2.9	3.2
Ireland South	2.0	2.9	1.7	2.9	3.1
Ireland West	2.0	2.8	1.7	2.8	3.0
Ireland Greater Dublin	2.0	3.7	1.7	3.7	4.1

OK Cancel Help

Enter Return Period between 1 and 1000

6239 SIMULATION RESULTS

Critical Summary of Results by Maximum Level (Rank 1)

Pipe Number	US/RH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	S1	15 minute 100 year Winter I+40%	5.800	5.297	0.647	0.000	0.34		7.3	SURCHARGED
1.001	S2	15 minute 100 year Winter I+40%	5.550	5.274	0.891	0.000	0.87		19.5	FLOOD RISK
2.000	S3	30 minute 100 year Winter I+40%	5.750	5.768	1.268	17.956	1.79		15.6	FLOOD
1.002	S4	15 minute 100 year Winter I+40%	5.170	4.756	1.140	0.000	3.18		37.7	SURCHARGED
1.003	S5	15 minute 100 year Winter I+40%	5.340	4.288	0.869	0.000	4.03		45.6	SURCHARGED
1.004	S6	15 minute 100 year Winter I+40%	5.300	3.738	0.502	0.000	4.38		45.6	SURCHARGED
1.005	S7	15 minute 100 year Winter I+40%	5.230	3.110	-0.107	0.000	0.74		45.4	OK
3.000	S8	60 minute 100 year Winter I+40%	5.800	5.038	0.388	0.000	0.29		8.0	SURCHARGED
4.000	S9	60 minute 100 year Winter I+40%	5.580	5.045	0.615	0.000	0.53		11.7	SURCHARGED
3.001	S10	60 minute 100 year Winter I+40%	5.410	5.029	0.951	0.000	0.26		5.8	SURCHARGED

APPENDIX C

LAYOUT PLANS & CONSTRUCTION DETAILS

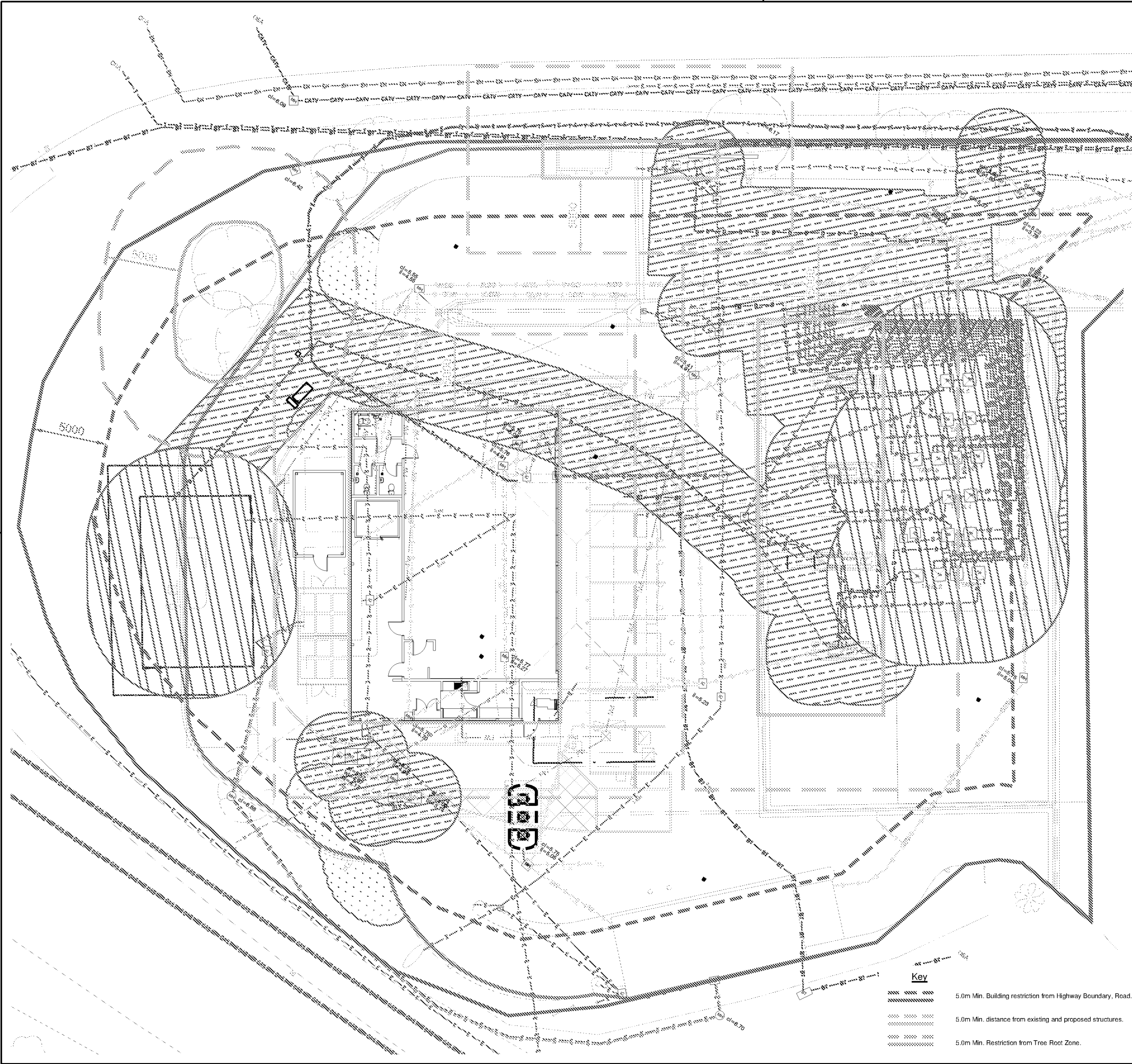
SEVICES PLAN

DRAINAGE STRATEGY

IMPERMEABLE AREAS

DRAINAGE CATCHMENT AREAS

STANDARD CONSTRUCTION DETAILS



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NOTES

Services Data taken from "Subscan" Drawing No. Eastfield_URS_10019507_Subscan_v2004, dated May 2011.

No	Description	Date	By	Chk

Revisions to this Drawing

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Drawn By:	LL	Date:	08/05/2019	Checked:	BK
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Client

BAYLISS DESIGN LTD

Project

**SHELL EASTFIELD
RUSTINGTON**
Littlehampton, West Sussex

Org. Title

SERVICES PLAN

Scales @ A1

1:125

Drawing No.

6239-19

Rev.

1

Status

INFORMATION

Key

=====	5.0m Min. Building restriction from Highway Boundary, Road.
-----	5.0m Min. distance from existing and proposed structures.
-----	5.0m Min. Restriction from Tree Root Zone.

KEY

=====	FUEL LINE - PETROL
=====	FUEL LINE - DIESEL, KERO OR PARAFFIN
=====	ELECTRICITY CABLE
=====	HIGH VOLTAGE ELECTRICITY CABLE
=====	TANK GAUGE LINE OR COMMS CABLE
=====	OFF-SET FILL
=====	VENT PIPE
=====	OIL PIPE
=====	TELECOM CABLE
=====	BT CABLE
=====	CABLE TELEVISION
=====	GAS
=====	WATER SUPPLY PIPE
=====	FOUL WATER DRAIN
=====	SURFACE WATER DRAIN
=====	COMBINED DRAIN
=====	UNIDENTIFIED - SEE NOTES
=====	END OF TRACE
=====	HISTORICAL DATA(REMOVED/ABANDONED)
=====	BUILDING
=====	CANOPY OUTLINE
=====	MANHOLE
=====	PILLAR
=====	PUMP
=====	DO NOT DRILL
=====	CRITICAL AREA
=====	CHANGE OF SURFACE
=====	TANK
=====	STATION LOCATION
=====	POTENTIAL DRILLING POSITION
=====	INSPECTION COVER
=====	GULLY
=====	CHANGE OF GROUND LEVEL
=====	SCAR OUTLINE
=====	W=FOAM
=====	U=UNKNOWN
=====	C=CONCRETE
=====	P=PRODUCT

TRACE CODES

TFS	Trace is From Source to destination with visual evidence to confirm
SDC	Source and/or destination are Concealed
WS	Visual Assessment (line of site perhaps scarring)
LA	Logical Assumed (source & destination exist, line added without trace)
TR	Taken From Records
AEE	Anything Else Encountered

ABBREVIATIONS

AB	Abandoned	FP	Fence Post	S/A	Soakaway
A/C	Air Conditioner	GV	Gas Valve	SP	Sign Post
AG	Above Ground	GU	Gully	ST	Steel
AR	Assumed Route	HV	High Voltage	SV	Sluice Valve
BOL	Bollard	IC	Inspection Cover	SVP	Soil Vent Pipe
BH	Borehole	INT	Interceptor	SVS	Soil Vapour Sample
BL	Base Level	IL	Invert Level	TK	Tank
BTB	British Telecom Box	LC	Lighting Column	TL	Traffic Light
BT	British Telecom Cover	LP	Lamp Post	TP	Telegraph Pole
C	Cable	LV	Low Voltage	UI	Unidentified
CR	Cable Riser	MH	Manhole Cover	UTL	Unable to Locate
CTV	Cable TV	MW	Monitoring Well	UTS	Unable to Raise
CP	Catch Pit	NB	Noise Band	UTS	Unable to Survey
Co	Concrete	OH	Overhead	UTT	Unable to Trace
CL	Cover Level	OF	Offset Fill	VR	Vapour Recovery
CWS	Combined Water Sewer	OSM	Ordnance Survey Benchmark	VP	Vent Pipe
D	Ductile Iron	OSA	Off Survey Area	WL	Water Level
DP	Down Pipe	PC	Pilot Cable	WM	Water Meter
DGB	Drains Control Box	PE	Polyethylene	WO	Wash Out
ER	Earth Rod	PR	Pipe Riser	LP	Low Pressure
EIC	Electricity IC	PM	Phone Mast	M/P	Medium Pressure
EDT	End of Trace	RWP	Rain Water Pipe	H/P	High Pressure
EP	Electricity Pole	RS	Road Sign		
FH	Fire Hydrant	RE	Rodding Eye		

INTERCEPTOR DETAILS

Type	Condition	Size	Material	Depth
3 STAGE	GOOD	---	PLASTIC	2.6 MTS
3 STAGE	GOOD	---	PLASTIC	1.7 MTS
1 STAGE	GOOD	---	PLASTIC	3.5 MTS

TANK DETAILS

Tank No.	Fuel Type	Capacity	Feed To Pumps
1	V-POWER	12,350 LTS	5/6/7/8
2	VP-DIESEL	2,350 LTS	5/6
3	DIESEL	24,700 LTS	3/4/7/8
4	UNLEADED	24,700 LTS	3/4/5/6
5	V-POWER	12,350 LTS	3/4
6	V-POWER	12,350 LTS	1/2
7	UNLEADED	24,700 LTS	1/2/7/8
8	DIESEL	24,700 LTS	1/2/9/10
9	LPG	9,000 LTS	11/12

NOTES:

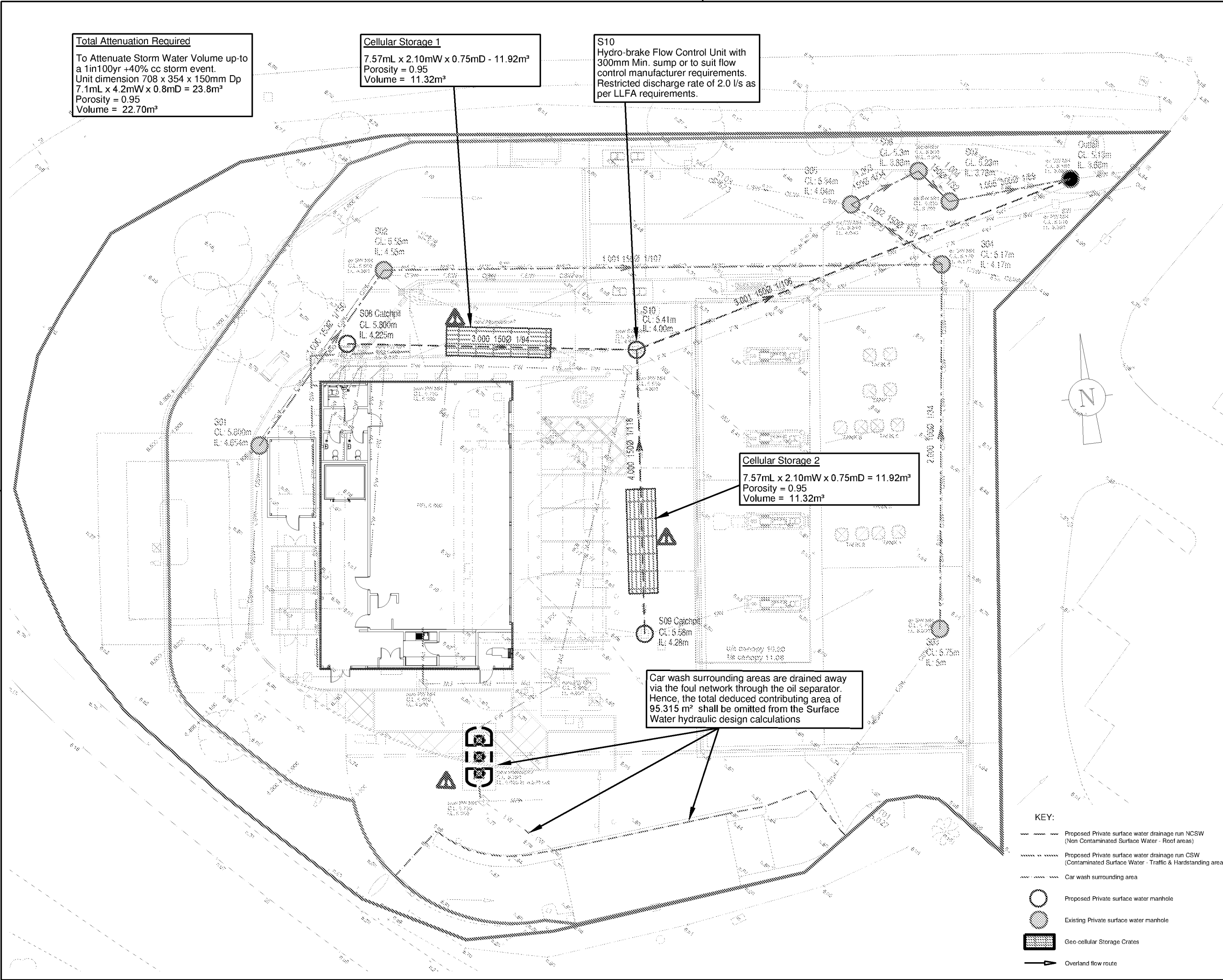
CANOPY HEIGHT IS 4.5 MTS.

WATER:

UNABLE TO TRACE WATER ON SITE.

GAUGE:

NO TRACE ON GAUGE LINES.



Total Attenuation Required
To Attenuate Storm Water Volume up-to a 1in100yr +40% cc storm event.
Unit dimension 708 x 354 x 150mm Dp
7.1mL x 4.2mW x 0.8mD = 23.8m³
Porosity = 0.95
Volume = 22.70m³

Cellular Storage 1
7.57mL x 2.10mW x 0.75mD - 11.92m³
Porosity = 0.95
Volume = 11.32m³

S10
Hydro-brake Flow Control Unit with 300mm Min. sump or to suit flow control manufacturer requirements. Restricted discharge rate of 2.0 l/s as per LLFA requirements.

Cellular Storage 2
7.57mL x 2.10mW x 0.75mD = 11.92m³
Porosity = 0.95
Volume = 11.32m³

Car wash surrounding areas are drained away via the foul network through the oil separator. Hence, the total deduced contributing area of 95.315 m² shall be omitted from the Surface Water hydraulic design calculations

- KEY:**
- Proposed Private surface water drainage run NCSW (Non Contaminated Surface Water - Roof areas)
 - Proposed Private surface water drainage run CSW (Contaminated Surface Water - Traffic & Hardstanding areas)
 - Car wash surrounding area
 - Proposed Private surface water manhole
 - Existing Private surface water manhole
 - Geo-cellular Storage Crates
 - Overland flow route

PROJECTS\AUTOCAD STANDARDS\BCAL DRAWING FRAMES\BCAL A1 Frame Rev A.DWG

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NOTES

- Drawing based on:
 - Topographical Survey by URS dated May 2011;
 - Architects layout ref 10019507 - (Drainage & Levels) Drain 19 dated February 2019.
- All drains to have Class S granular bed and surround, except where a, cover beneath roads or hardstanding is less than 0.9m b, cover beneath soft landscaping is less than 0.6m in which case class Z concrete bed and surround is required.
- Where pipes pass through the manhole wall a joint must be formed within 150mm of the wall.
- All pipes to enter manhole with soffits level.
- All chambers to have ductile iron, single seal lock down covers to grade D400 BS EN 124 in road or car park areas and B125 BS EN 124 in all other areas. Recessed covers to be used in areas of block paving. Covers are to be aligned parallel to kerbs, paving orientation or structures unless otherwise shown.

A	Drawing updated in line with Arun District Council's comments, dated 11/04/2019.	08.05.19	LL	BK
No	Description	Date	By	Chk

Revisions to this Drawing

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Drn By: AD Date: 29.03.19 Chkd: MB

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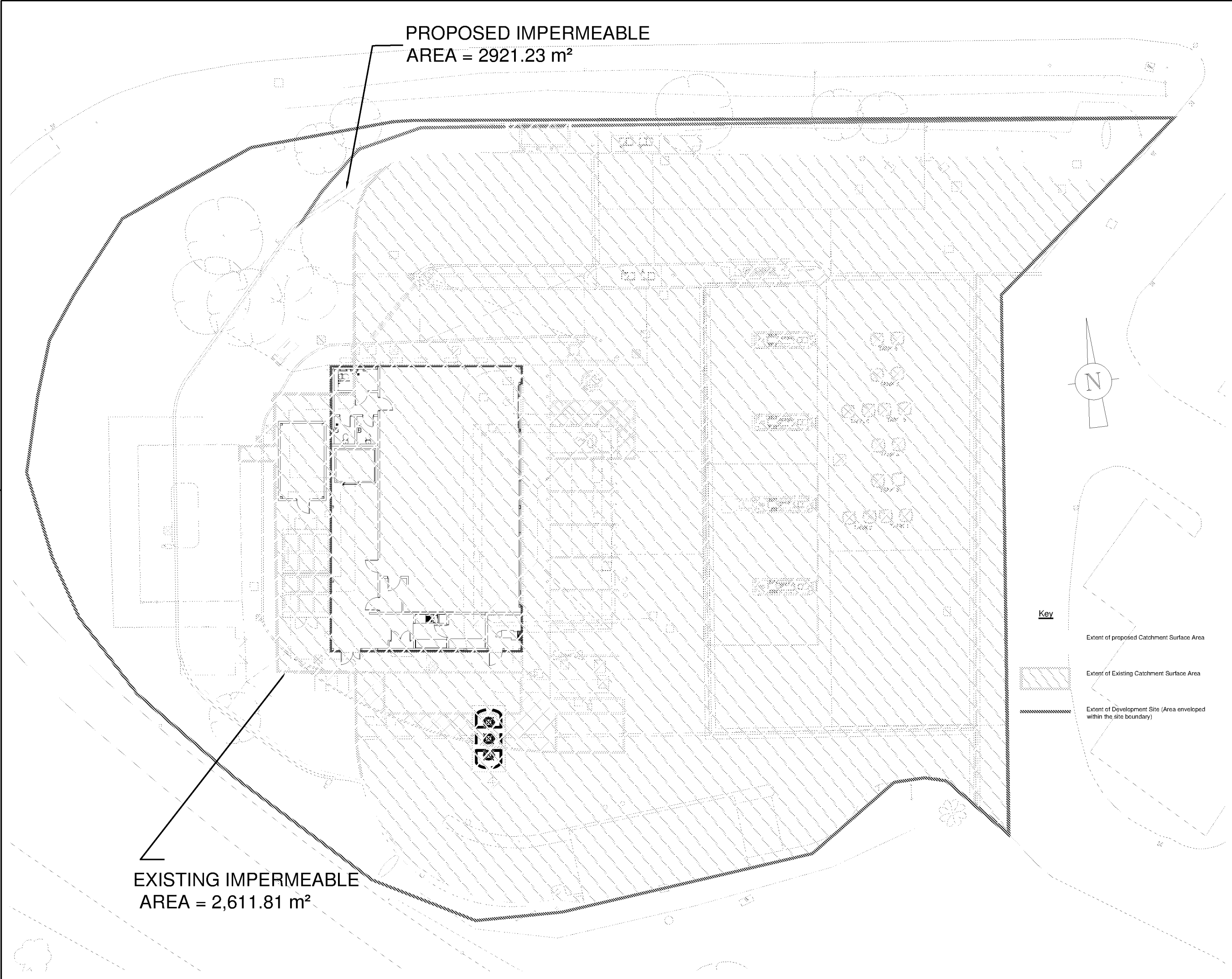
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Tel: 01933 440024 Fax: 01933 440041 Web: www.bcal.co.uk

Client
BAYLISS DESIGN LTD

Project
**SHELL EASTFIELD
RUSTINGTON
Littlehampton, West Sussex**

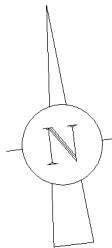
Drg. Title
DRAINAGE STRATEGY

Scales @ A1 1:125	Drawing No. 6239-20	Rev A
Status: INFORMATION		



PROPOSED IMPERMEABLE
AREA = 2921.23 m²

EXISTING IMPERMEABLE
AREA = 2,611.81 m²



- Key**
- Extent of proposed Catchment Surface Area
 - Extent of Existing Catchment Surface Area
 - Extent of Development Site (Area enveloped within the site boundary)

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NOTES

Refer also to Drawings

No	Description	Date	By	Chk
Revisions to this Drawing				
Saved: O:\projects\62016239\Drawings\BCAL DW\6239-19, 20A, 21, 22 DRAINAGE STRATEGY.LDwg				
Drn By:	AD	Date:	29.03.19	Chkd: MB

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Drg. Title

IMPERMEABLE AREAS

Scales @ A1

1:125

Drawing No.

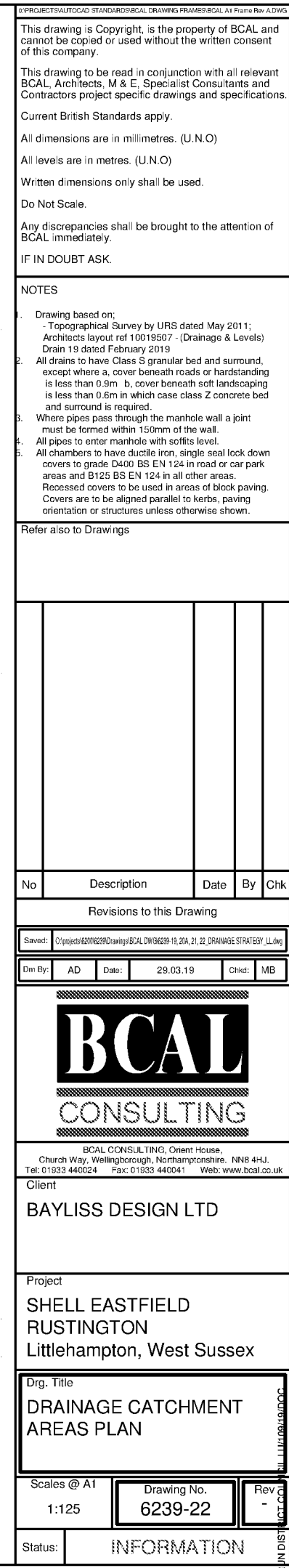
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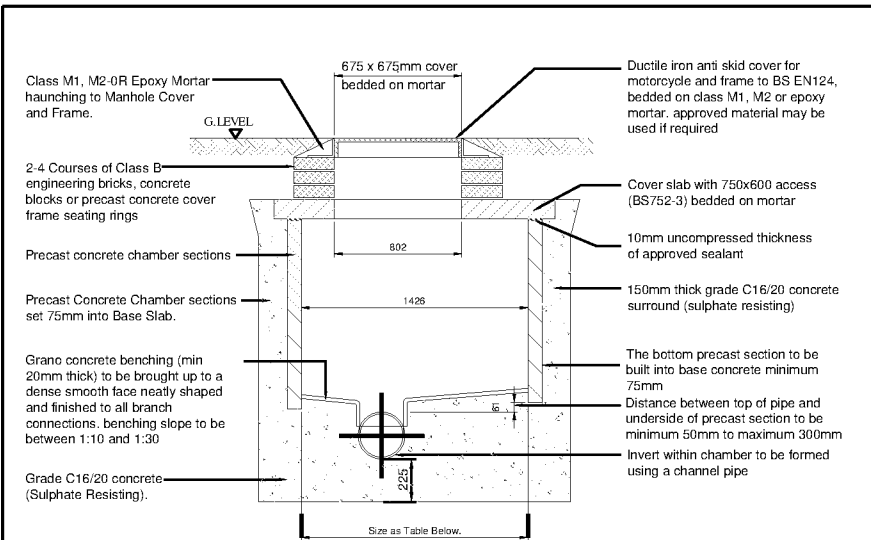
Rev

1

Status: INFORMATION

ARJN DIST



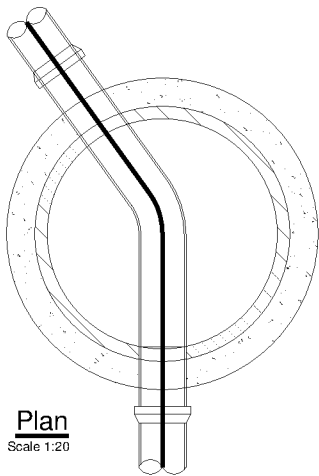


Shaft Diameters.

Diameter of largest pipe in MH (mm)	Internal diameter of MH (mm)
UP TO 375MM	1200MM

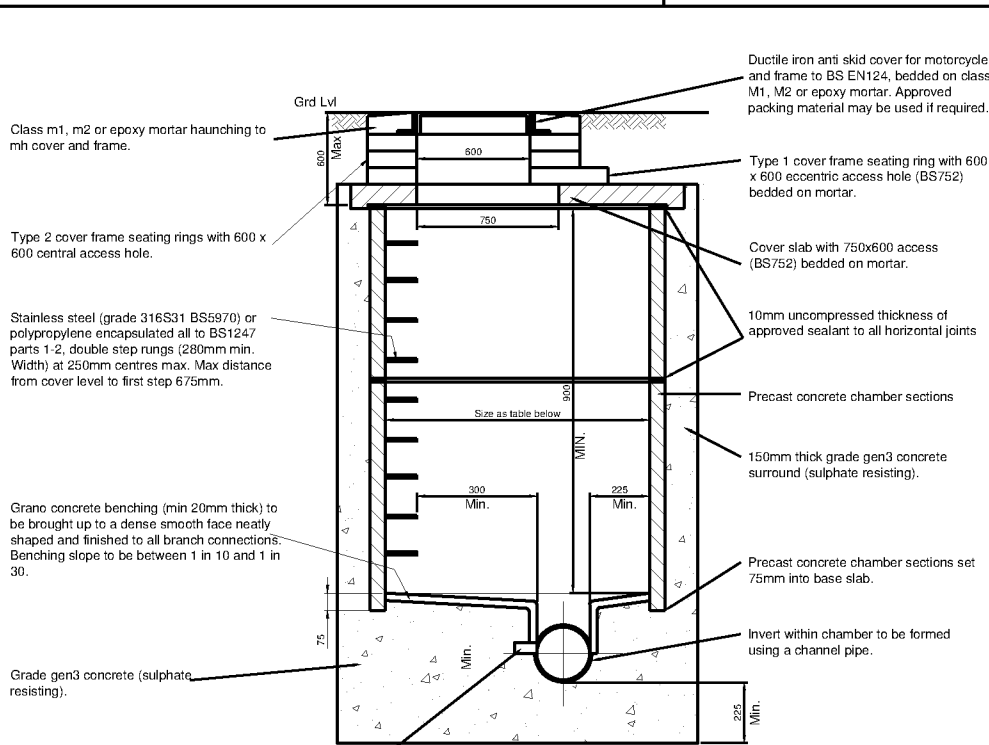
NB:
If Pipe Diameter exceeds 375mm use Manhole Type B.

All pipes entering or leaving manholes shall have a flexible joint within 600mm of the inside face of the manhole. The next pipe shall be a short "Rocker Pipe" 600mm Long.



Typical Manhole Detail Type E

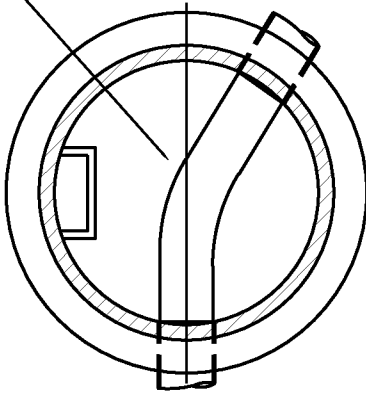
(depth to soffit 1.0m to 1.5m)



Toe holes to be provided in channel of sewers above 450mm dia.

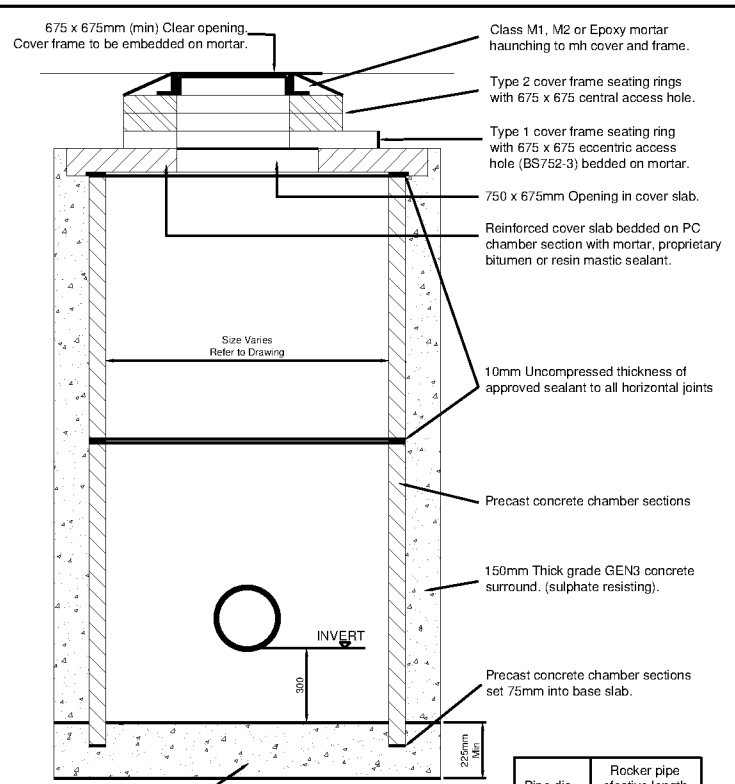
Shaft diameters	
Dia of largest pipe in MH (mm)	Internal dia of MH (mm)
Less than 375	1200
375 TO 450	1500 (1350 not available)
500 TO 700	1500

Chambers with outgoing pipes greater than 600mm dia. Shall be fitted with removable stainless steel (grade 316) safety chains or polypropylene rope.

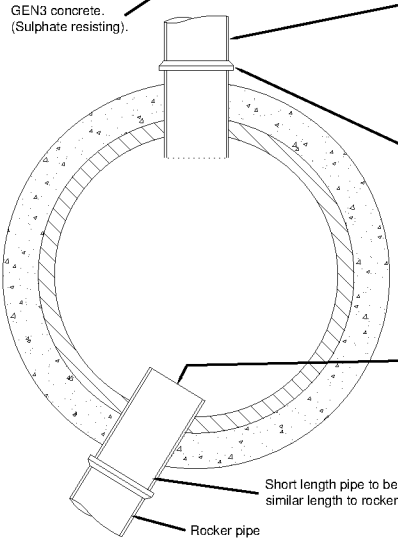


Typical Manhole Detail Type B

(depth to soffit 1.5m to 3.0m)

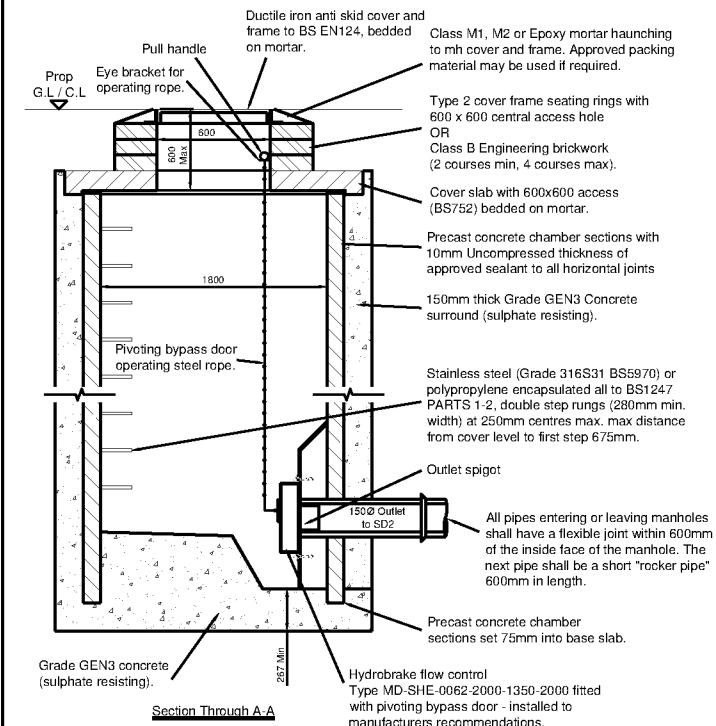


Pipe dia.	Rocker pipe effective length
150-600	0.6
675-750	1.0
>825	1.25

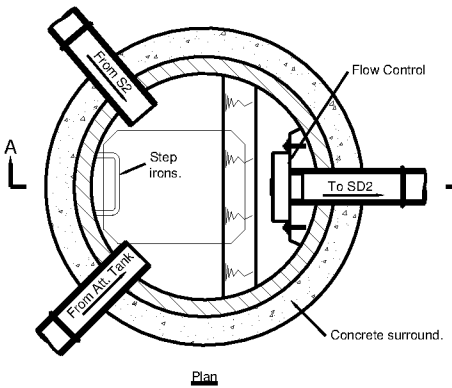


Typical Manhole Detail Type BR11 (Catchpit)

(Max depth to soffit 3.0m)

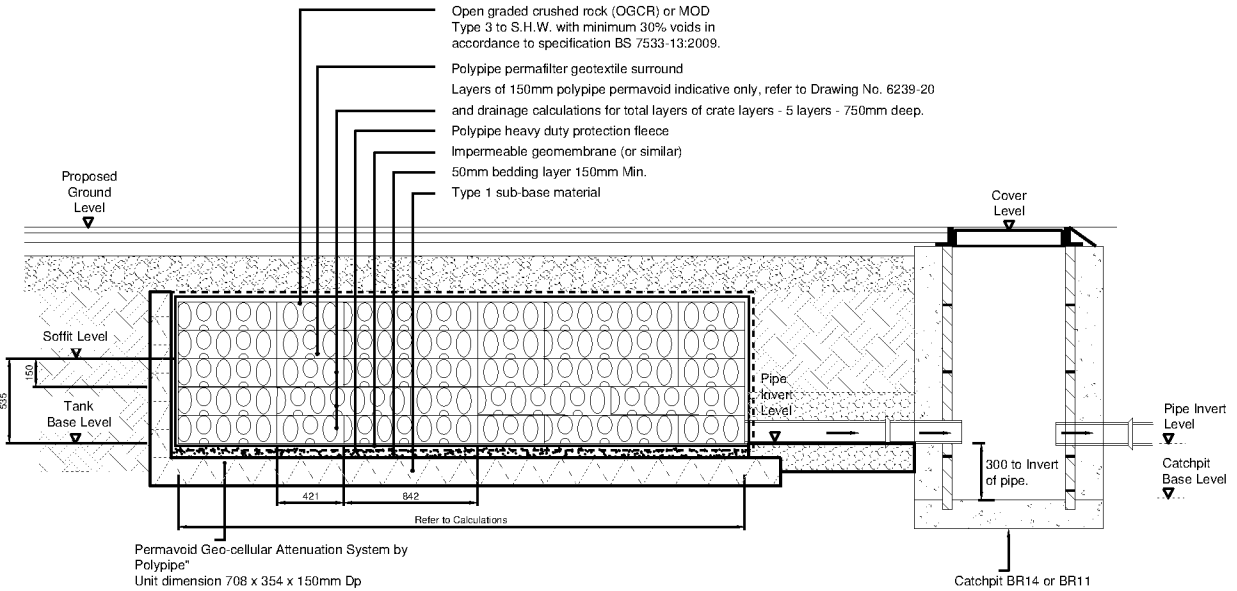


Flow Control Device Chamber MH S10



Flow Control Chamber Notes

- Refer to drawing 5908-80 for details of the overall drainage system.
- Flow control device to be installed generally in accordance with manufacturers recommendations.
- Mounting block to consist of GEN 3/ST4 concrete secured to the PCC chamber rings by appropriate proprietary ties. Class F2 formwork to all exposed faces, U2 finish to unformed surfaces.



Notes

- Minimum cover depth are accordance with crate suppliers recommendations.
- Refer to manufacturers recommendations for installation.

Typical Permavoid Geo-cellular Attenuation System

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NOTES

Refer also to Drawings

No	Description	Date	By	Chk
A	Drawing updated in line with Arun District Council's comments, dated 11/04/2019.	08.05.19	LL	BK

Revisions to this Drawing

Saved: O:\projects\6239\Drawings\BCAL DWG\6239-23 Construction Details, LL

Dim By:	AD	Date:	29/03/2019	Chkd:	BK
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PROPOSED STANDARD
CONSTRUCTION DETAILS

Scales @ A1

1:125

Drawing No.

6239_23

Rev

1

Status:

FOR APPROVAL