

Date 18/02/26
Our Ref: MC0779 MJHD Fircroft Crescent SA

**Land at Fircroft Crescent, Rustington, West Sussex
Soakaway Design**

Meridian Civil Engineering Consultancy (MCEC) have been commissioned by MJHD to design a soakaway for the site at Fircroft Crescent, Rustington, West Sussex.

This soakaway design is based on the infiltration rate derived from testing carried on 26/02/2025. Infiltration testing results with interpretation can be found in Appendix III. The lowest tested infiltration rate of 3.1E-6m/s has been used for design purposes.

It is proposed that there be a soakaway located in the rear garden of each plot. It is understood each plot has the same size roof area of 144m².

A single soakaway 2.5mx8m in plan area and 0.8m in depth is proposed in the rear of each plot. This is designed to be able to accommodate all events up to and including the 1 in 100 year +45%CC event.

Furthermore, it should be noted that the proposed soakaway is designed so that rainfall events up to the 3.3% AEP event shall half empty their runoff volume within a maximum of 24 hours as defined by National standards for sustainable drainage systems (SuDS). Calculations to show this are included in Appendix IV.

MCEC have explored the option of providing a soakaway with a depth of 1.2m or 1.6m with a smaller plan area than the 2.5x8m initially proposed. MCEC have provided calculations to show that these options fail to half empty their runoff volume within a maximum of 24 hours. Calculations to show this are included in Appendix V.

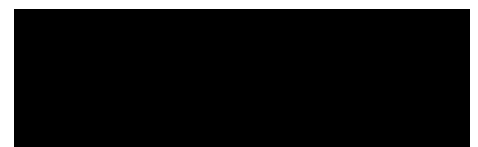
As the roof area is the same for each plot and the soakaways are to be the same dimensions only one soakaway has been included in the calculations. Calculations are attached in Appendix I.

Proposed drawings showing the locations of the proposed soakaways have been included in Appendix II.

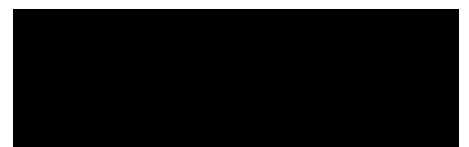
It is proposed that external hardstanding areas be constructed of permeable pavement. MCEC have provided calculations to show the performance of a typical permeable pavement. Calculations to show this are included in Appendix VI.

A winter groundwater monitoring report is included in Appendix VII and shows groundwater to be a minimum of 4.19m deep over the winter period. The 0.8m deep soakaway can therefore be sited 1m above the recorded groundwater level.

We trust this outlines the design and proposal and should you have any questions, or require further information please contact us.



Appendix I Soakaway Calculations



Nodes

	Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
✓	Roof Area	0.014	4.00	5.993	1200	2.313
✓	2	0.000		5.978		2.478

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
? 1.000	Roof Area	2	12.617	0.600	3.680	3.500	0.180	70.1	100	4.23	50.0

Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	Roof Area	2	0.920	7.2	2.4	2.213	2.378	0.014	0.0	39	0.825

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	12.617	70.1	100	SW_Standard	5.993	3.680	2.213	5.978	3.500	2.378

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Node Type
1.000	Roof Area	1200	Manhole	Adoptable	2	Junction

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Roof Area	5.993	2.313	1200				
					0	1.000	3.680
2	5.978	2.478		1	1.000	3.500	100
							

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.950	Drain Down Time (mins)	10080	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m ³ /ha)	0.0	Check Discharge Volume	x
Summer CV	0.950	Skip Steady State	x	Starting Level (m)			

Storm Durations

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	0	0	0
30	0	0	0	100	45	0	0

Node 2 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.01116	Porosity	0.95	Pit Width (m)	2.500	Inf Depth (m)	
Side Inf Coefficient (m/hr)	0.01116	Invert Level (m)	3.500	Pit Length (m)	8.000	Number Required	1
Safety Factor	1.5	Time to half empty (mins)	2158	Depth (m)	0.800		

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Roof Area	10	3.718	0.038	1.8	0.0428	0.0000	OK
360 minute winter	2	344	3.617	0.117	0.3	2.2280	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	Roof Area	1.000	2	1.8	1.138	0.253	0.0233
360 minute winter	2	Infiltration		0.0			

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	Roof Area	945	3.850	0.170	0.6	0.1926	0.0000	SURCHARGED
960 minute summer	2	945	3.850	0.350	0.6	6.6546	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
960 minute summer	Roof Area	1.000	2	0.6	0.543	0.083	0.0987
960 minute summer	2	Infiltration		0.1			

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	Roof Area	1320	3.953	0.273	0.5	0.3088	0.0000	SURCHARGED
1440 minute summer	2	1320	3.953	0.453	0.5	8.6067	0.0000	OK

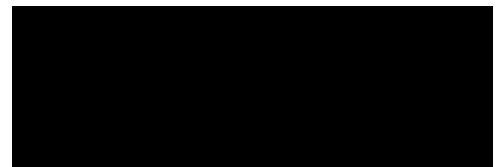
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
1440 minute summer	Roof Area	1.000	2	0.5	0.455	0.065	0.0987
1440 minute summer	2	Infiltration		0.1			

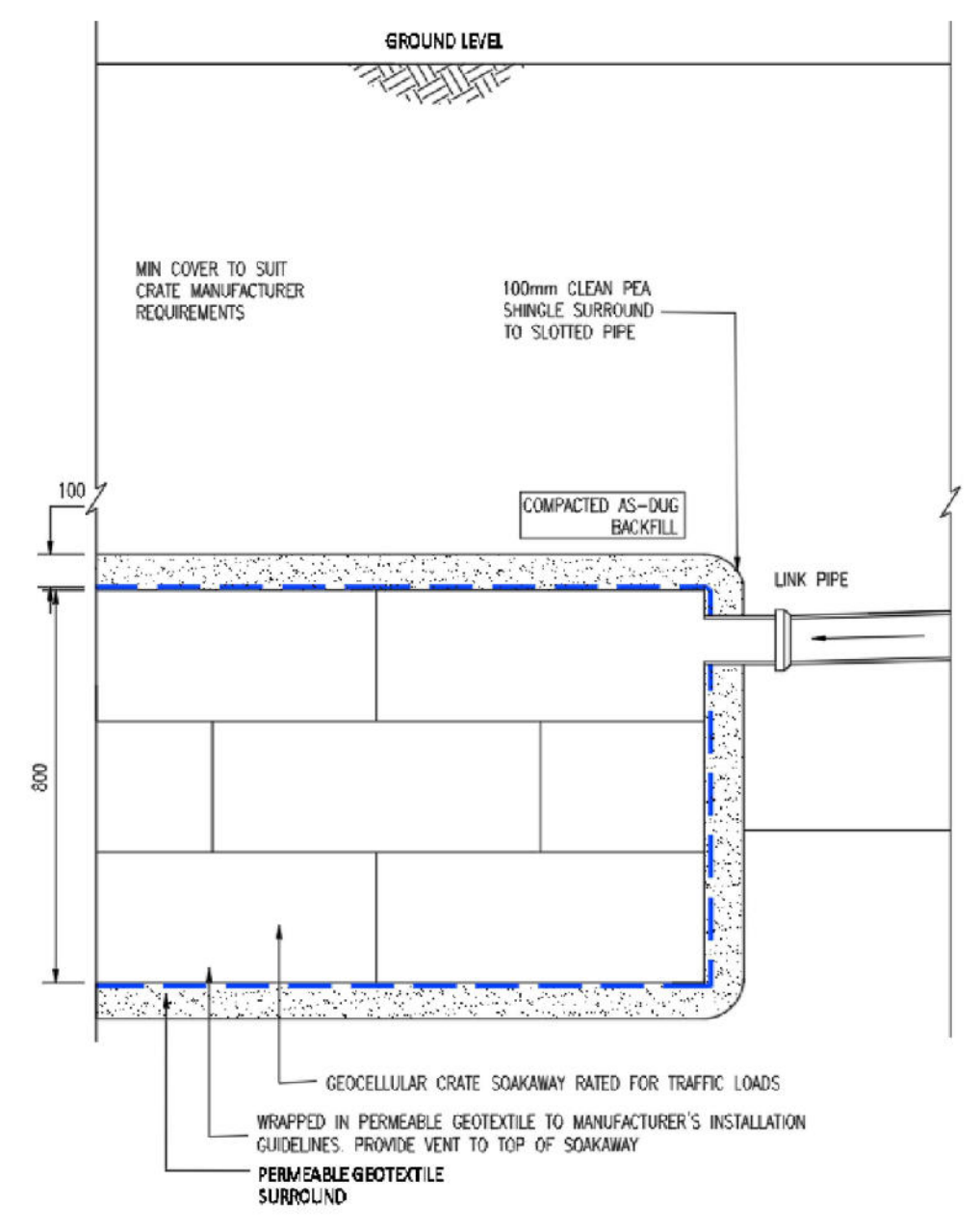
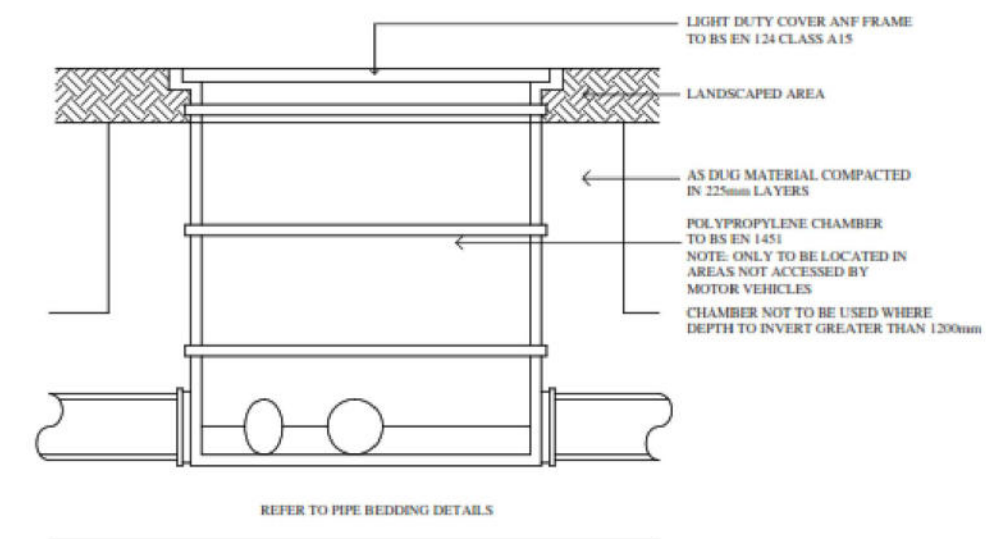
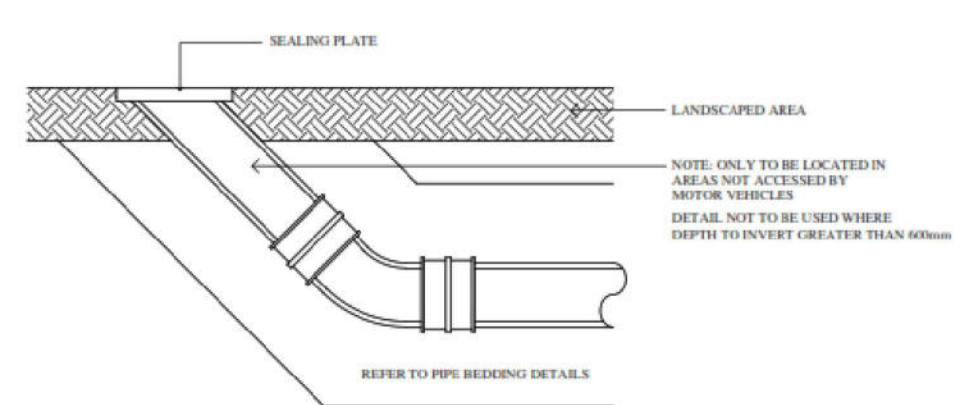
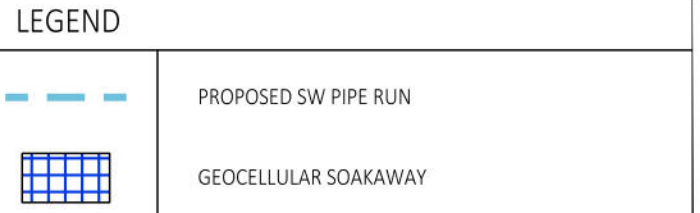
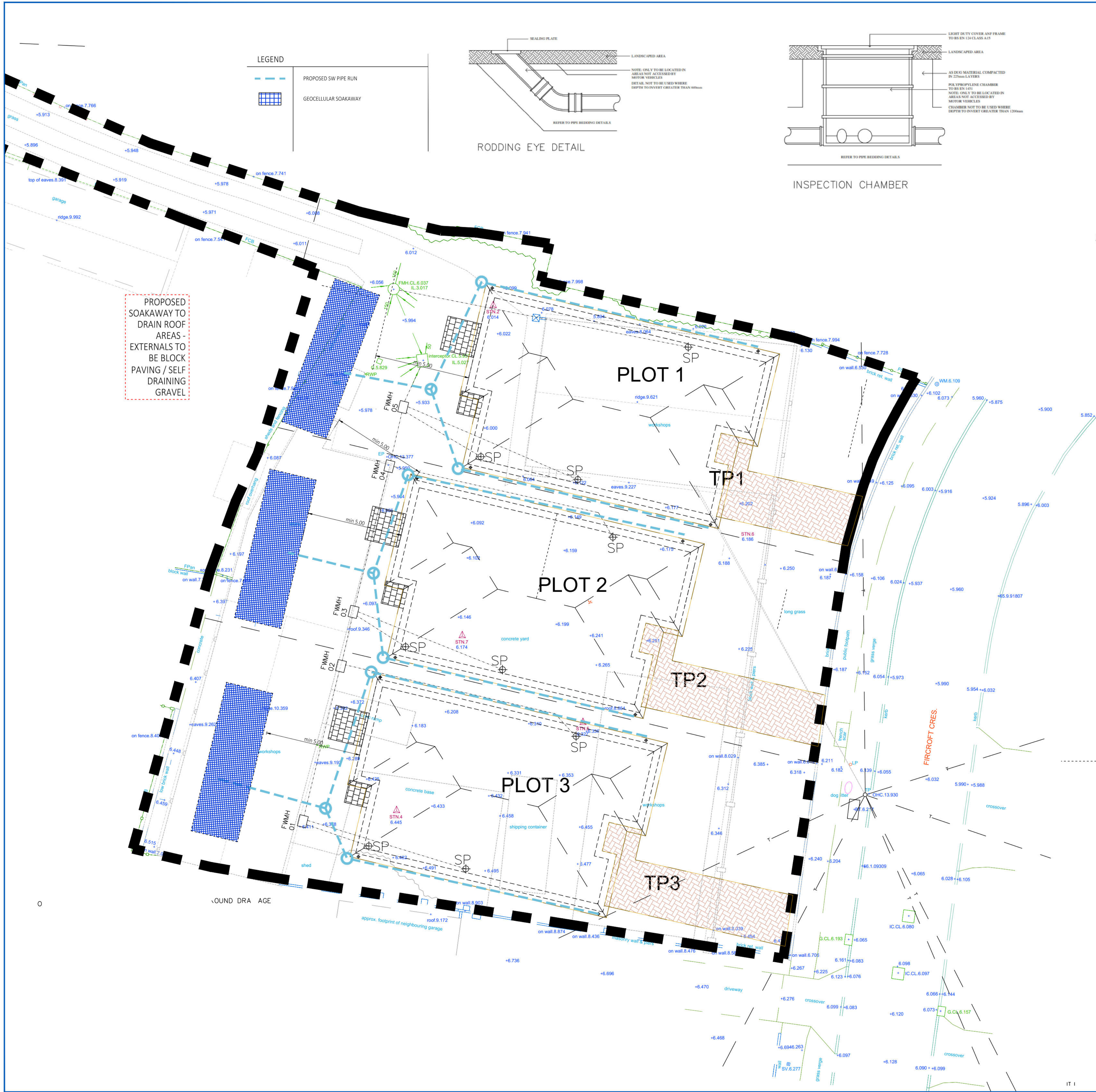
Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	Roof Area	2040	4.185	0.505	0.4	0.5708	0.0000	SURCHARGED
2160 minute winter	2	2040	4.185	0.685	0.4	13.0089	0.0000	OK

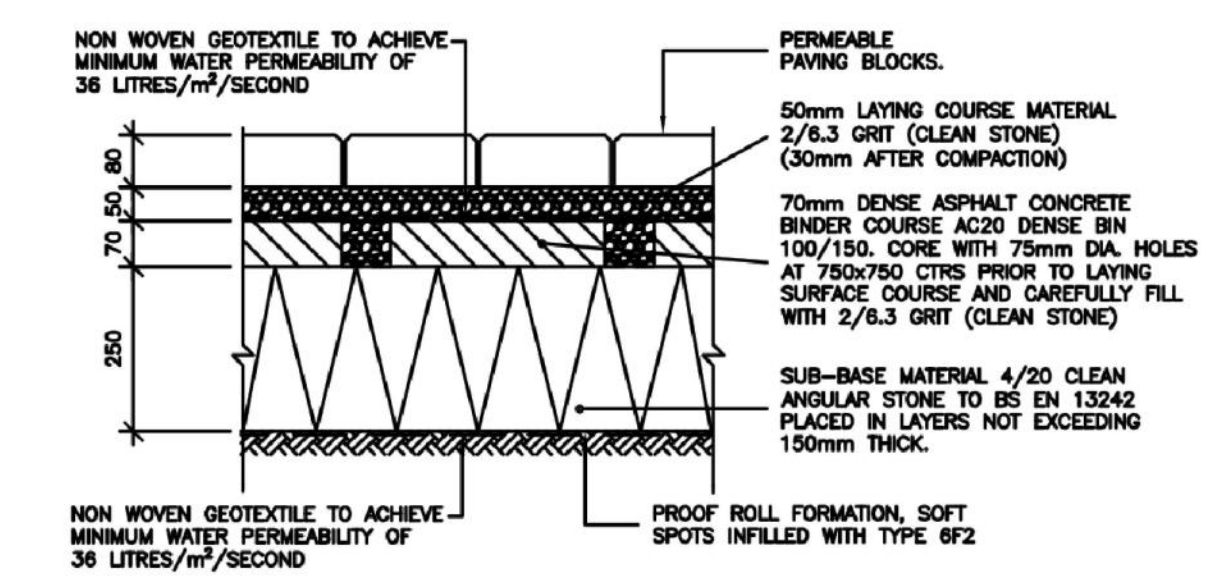
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
2160 minute winter	Roof Area	1.000	2	0.4	0.324	0.053	0.0987
2160 minute winter	2	Infiltration		0.1			

Appendix II Proposed Soakaway Design

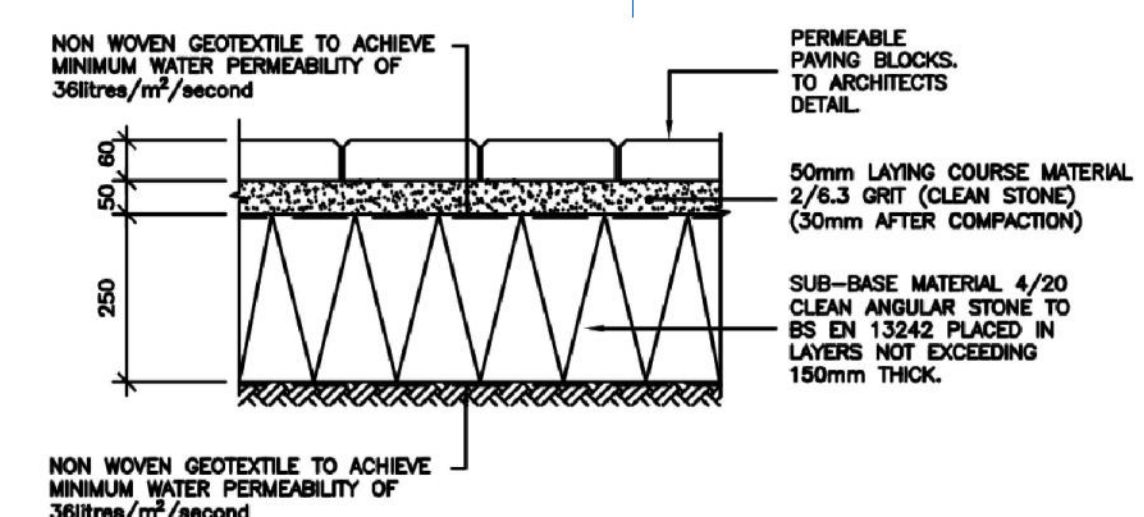




SOAKAWAY DETAIL



ACCESS ROAD PERMEABLE BLOCK PAVING CONSTRUCTION DETAIL



PERMEABLE PAVING CAR PARKING AREAS CONSTRUCTION DETAIL

1. GENERAL
- a. THIS DRAWING IS NOT TO BE SCALED, WORK TO FIGURED DIMENSIONS ONLY, CONFIRMED ON SITE.
- b. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL DRAWINGS, DETAILED SPECIFICATIONS WHERE APPLICABLE AND ALL ASSOCIATED DRAWINGS IN THIS SERIES.
- c. ANY DISCREPANCY ON THIS DRAWING IS TO BE REPORTED IMMEDIATELY TO THE PARTNERSHIP FOR CLARIFICATION.
- d. THE CONTRACTOR IS RESPONSIBLE FOR ALL TEMPORARY WORKS AND FOR THE STABILITY OF THE WORKS IN PROGRESS.
- e. CDM REGULATIONS 2015. ALL CURRENT DRAWINGS AND SPECIFICATIONS MUST BE READ IN CONJUNCTION WITH THE DESIGNER'S HAZARD RISK AND ENVIRONMENT ASSESSMENT RECORD. DESIGN HAS BEEN PRODUCED BASED ON INFORMATION PROVIDED BY THE CLIENT/PRINCIPLE DESIGNER AVAILABLE AT TIME OF ISSUE. CONTRACTOR TO REVIEW DRAWING AND SPECIFICATION IN CONTEXT WITH THE WIDER SITE AND SPECIFIC SITE INVESTIGATION, CONTAMINATION ASSESSMENT, ASBESTOS SURVEY, ENVIRONMENTAL SURVEY, UXO SURVEY AND ANY OTHER RELEVANT INFORMATION AND MANAGE RISKS RELATING TO THE WORKS OUTLINED IN THE DRAWINGS AND SPECIFICATION. PRINCIPLE CONTRACTOR TO MAKE DESIGNER AND CLIENT AWARE OF SITE SPECIFIC RISKS THAT MAY AFFECT THE DRAWING AND SPECIFICATION.
- f. CDM REGULATIONS 2015. FOR GENERIC MAINTENANCE AND MANAGEMENT RISKS REFER TO CHAPTER 36 OF CIRA 752 SUDS MANUAL FOR PROPRIETARY SYSTEMS SEE MANUFACTURER'S MANAGEMENT AND MAINTENANCE DETAILS AND RISK ASSESSMENT WITH REGARDS TO MAINTENANCE OF PROPRIETARY SYSTEMS.

BELOW GROUND DRAINAGE

NEW DRAIN RUNS TO BE 100mm VITRIFIED CLAYWARE OR PVCu PIPES WITH FLEXIBLE JOINTS LAID IN ACCORDANCE WITH MANUFACTURER'S REQUIREMENTS AND APPROVED DOCUMENT H RUNS TO BE LAID IN A GRANULAR BED AND SURROUND OR ENCASED IN CONCRETE BENEATH STRUCTURE. RUNS PASSING THROUGH STRUCTURAL WALLS TO BE BRIDGED WITH CONCRETE LINTOLS AND HAVE JOINTS WITHIN 150mm OF WALL ON EITHER SIDE. DRAINS LAID TO FALL NOT LESS THAN 1:80.

NEW MANHOLES TO COMPRISE ONE OF THE FOLLOWING:
1/ CONCRETE BASE WITH ENGINEERING BRICKWORK SIDES
2/ CONCRETE BASE WITH PRECAST CONCRETE RINGS
3/ PROPRIETARY PREFORMED PLASTIC UNITS.
CHANNELS FOR TYPES 1/ AND 2/ TO BE CLAYWARE HALF ROUND CHANNELS BEDDED AND BENCHED IN CEMENT MORTAR.

MANHOLE COVERS TO BE METAL SINGLE SEAL COVERS COVER GRADE TO BE LIGHTWEIGHT (PEDESTRIAN AREAS) OR MEDIUM (VEHICULAR AREAS)

SLAB, COVER AND INVERT LEVELS ARE PROPOSED

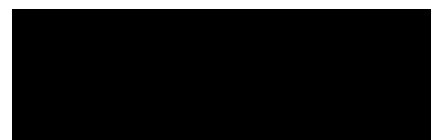
DOWNPIPES TO BE PROVIDED WITH RODDING ACCESS AT BASE AND BE CONNECTED TO EXISTING SURFACE WATER DRAIN IN NEW BARN LANE.

ALL PATHS / PATIOS ARE TO BE BUILT FROM IMPERMEABLE MATERIALS

COMPLETED INSTALLATION TO BE TESTED TO THE SATISFACTION OF THE LOCAL AUTHORITY

REV:	DESCRIPTION:	BY:	DATE:
STATUS: PRELIMINARY			
MERIDIAN CIVIL ENGINEERING CONSULTANCY			
CLIENT: MJHD Developments			
SITE: Land at Fircroft Crescent Rustington, West Sussex			
TITLE: Proposed Soakaway Design			
SCALE AT A1: 1:100	DATE: 06/02/2026	DRAWN: GH	CHECKED: MN
PROJECT NO: MC0779	DRAWING NO: CIV01	REVISION: -	

Appendix III Infiltration Testing and Interpretation



Site: Fircroft crescent (craft works) Rustington, West Sussex

Soakaway Test Pit No.		Date:	26-2-2025
Test No.	①	Sheet No.	Nº ~ 1
Pit Dimensions (m) L x W x D	2.100 L x 0.750 W x 2.100 D		
Weather:			

[illegible]

Site: Fircroft Crescent (Croft Works) Rustington, West Sussex

Soakaway Test Pit No.		Date:	28-2-2025
Test No.	(2)	Sheet No.	Nº - 2
Pit Dimensions (m) L x W x D	2.100 L X . 750 W X 2.100 D		
Weather:			

[illegible]

Site: Fircroft Crescent (Croft Works) Rustington, West Sussex

Soakaway Test Pit No.		Date:	3-3-2025
Test No.	③	Sheet No.	Nº ~ 3
Pit Dimensions (m) L x W x D	2.100 L x 0.750 W x 2.100 D		
Weather:			

[illegible]

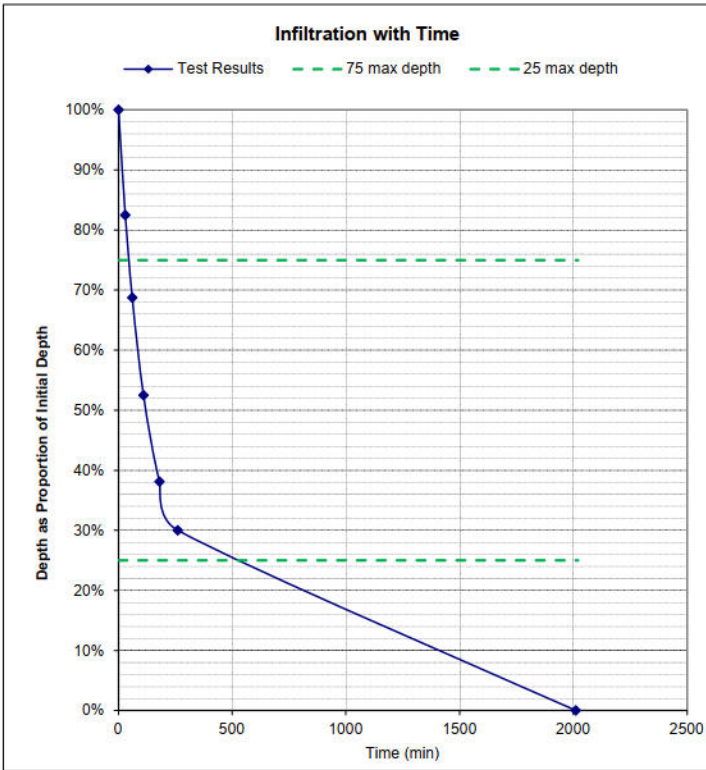
Legend

input
calculation
output
explanatory

If 25% was reached, the test is as per BRE365 procedure. Otherwise, the last entry in the table to the right is a linear extrapolation based on the last 2 readings.

effective area of infiltration	volume between 75% and 25% effective depth	time for water to fall from 75% to 25% effective depth (sec)
ap50	Vp75-25	tp75-25
6.135 sq m	1.260 cub m	30318 s

time Proportion
(min) infiltrated



0	100%
30	83%
60	69%
110	53%
180	38%
260	30%
2010	0%
#N/A	#N/A
#N/A	#N/A
#N/A	#N/A
#N/A	#N/A
#N/A	#N/A
#N/A	#N/A
#N/A	#N/A
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#N/A	#N/A
#N/A	#N/A
#N/A	#N/A
#N/A	#N/A

75% line (of max water depth)

min	proportion
0	0.750
2020	0.750

25% line (of max water depth)

min	proportion
0	0.250
2020	0.250

Legend

input
calculation
output
<i>explanatory</i>

Time (min)	Depth from Top of Pit to Water Level (m)	Water Level from bottom (m)	Volume
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[illegible]

base (m2)	1.575	
sides (m2)	3.360	Up to 50% of effective depth
ends (m2)	1.200	Up to 50% of effective depth
a_{p50} (m2)	6.135	Up to 50% of effective depth

V_{p75} (m3)	1.890	The volume at 75% effective depth
V_{p25} (m3)	0.630	The volume at 25% effective depth
V_{p75-25} (m3)	1.260	Difference in volume

Interpolation between		t_{p75}	V_{p75}	END	END
	lower	30	2.111	The reading just before V_{p75}	
	upper	60	1.811	The reading just after V_{p75}	
Interpolation between		t_{p25}	V_{p25}		
	lower	600	0.945	The reading just before V_{p25}	
	upper	2040	0.000	The reading just after V_{p25}	

$t_{p75}(\text{mins})$	52.1	<i>The time reading corresponding to Vp75</i>
$t_{p25}(\text{mins})$	1080.0	<i>The time reading corresponding to Vp25</i>
$t_{p75-25}(\text{mins})$	1027.9	<i>The time between Vp75 and Vp25</i>

Soil Infiltration Rate	
m/s	m/h
3.33E-06	0.011988

effective area of infiltration	volume between 75% and 25% effective depth	time for water to fall from 75% to 25% effective depth (sec)
100	100	0
90	90	10
80	80	20
70	70	30
60	60	40
50	50	50
40	40	60
30	30	70
20	20	80
10	10	90
0	0	100

ap50	Vp75-25	tp75-25
6.135 sq m	1.260 cub m	61674 s

[illegible]

min	proportion
0	0.750
2050	0.750

min	proportion
0	0.250
2050	0.250

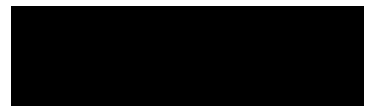
effective area of infiltration	volume between 75% and 25% effective depth	time for water to fall from 75% to 25% effective depth (sec)
ap50	Vp75-25	tp75-25
6.135 sq m	1.260 cub m	66254 s

[illegible]

min	proportion
0	0.750
2050	0.750

min	proportion
0	0.250
2050	0.250

Appendix IV Half Drain Time Calculations - Pass



30 Year Storm 1440min Winter (Critical duration) - Half Drain time calculations

Time (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Peak volume (m3)	Half of peak volume (m3)	Half-drain time (min)
15	3.500	0.000	0.0	0.0000	6.65	3.33	1125.0
30	3.502	0.002	0.1	0.0311			
45	3.506	0.006	0.1	0.1179			
60	3.511	0.011	0.1	0.2005			
75	3.515	0.015	0.1	0.2788			
90	3.519	0.019	0.1	0.3539			
105	3.522	0.022	0.1	0.4258			
120	3.526	0.026	0.1	0.4948			
135	3.530	0.030	0.1	0.5610			
150	3.533	0.033	0.1	0.6245			
165	3.536	0.036	0.1	0.6854			
180	3.539	0.039	0.1	0.7438			
195	3.542	0.042	0.1	0.7999			
210	3.545	0.045	0.1	0.8538			
225	3.548	0.048	0.1	0.9055			
240	3.550	0.050	0.1	0.9552			
255	3.553	0.053	0.1	1.0040			
270	3.555	0.055	0.1	1.0527			
285	3.558	0.058	0.1	1.1012			
300	3.561	0.061	0.1	1.1497			
315	3.563	0.063	0.1	1.1981			
330	3.566	0.066	0.1	1.2465			
345	3.568	0.068	0.1	1.2947			
360	3.573	0.073	0.2	1.3811			
375	3.580	0.080	0.2	1.5162			
390	3.587	0.087	0.2	1.6514			
405	3.596	0.096	0.3	1.8264			
420	3.608	0.108	0.3	2.0506			
435	3.622	0.122	0.4	2.3155			
450	3.638	0.138	0.4	2.6277			
465	3.657	0.157	0.5	2.9802			
480	3.680	0.180	0.6	3.4208			
495	3.705	0.205	0.6	3.8971			
510	3.727	0.227	0.5	4.3046			
525	3.744	0.244	0.4	4.6309			
540	3.759	0.259	0.4	4.9168			
555	3.772	0.272	0.3	5.1648			
570	3.783	0.283	0.3	5.3731			
585	3.792	0.292	0.2	5.5402			
600	3.798	0.298	0.2	5.6638			
615	3.805	0.305	0.2	5.7872			
630	3.809	0.309	0.1	5.8685			
645	3.811	0.311	0.1	5.9066			
660	3.813	0.313	0.1	5.9447			
675	3.815	0.315	0.1	5.9827			
690	3.817	0.317	0.1	6.0207			

The Half-drain time is calculated as the time it takes (after the end of the storm event) for half of the peak volume into the soakaway/structure to empty. The time from the start of the event to half emptying is 2085 min. The storm duration is 960 min. Therefore, the Half-drain time is 1125 min, which is within 24 hours.

Check **PASS**

705	3.819	0.319	0.1	6.0585
720	3.821	0.321	0.1	6.0963
735	3.823	0.323	0.1	6.1340
750	3.825	0.325	0.1	6.1717
765	3.827	0.327	0.1	6.2092
780	3.829	0.329	0.1	6.2467
795	3.831	0.331	0.1	6.2842
810	3.833	0.333	0.1	6.3215
825	3.835	0.335	0.1	6.3588
840	3.837	0.337	0.1	6.3960
855	3.839	0.339	0.1	6.4332
870	3.841	0.341	0.1	6.4702
885	3.842	0.342	0.1	6.5073
900	3.844	0.344	0.1	6.5442
915	3.846	0.346	0.1	6.5810
930	3.848	0.348	0.1	6.6178
945	3.850	0.350	0.1	6.6546
960	3.850	0.350	0.0	6.6493
975	3.847	0.347	0.0	6.6011
990	3.845	0.345	0.0	6.5530
1005	3.842	0.342	0.0	6.5049
1020	3.840	0.340	0.0	6.4570
1035	3.837	0.337	0.0	6.4092
1050	3.835	0.335	0.0	6.3614
1065	3.832	0.332	0.0	6.3138
1080	3.830	0.330	0.0	6.2662
1095	3.827	0.327	0.0	6.2188
1110	3.825	0.325	0.0	6.1714
1125	3.822	0.322	0.0	6.1241
1140	3.820	0.320	0.0	6.0769
1155	3.817	0.317	0.0	6.0298
1170	3.815	0.315	0.0	5.9828
1185	3.812	0.312	0.0	5.9358
1200	3.810	0.310	0.0	5.8890
1215	3.807	0.307	0.0	5.8422
1230	3.805	0.305	0.0	5.7956
1245	3.803	0.303	0.0	5.7490
1260	3.800	0.300	0.0	5.7025
1275	3.798	0.298	0.0	5.6561
1290	3.795	0.295	0.0	5.6098
1305	3.793	0.293	0.0	5.5636
1320	3.790	0.290	0.0	5.5175
1335	3.788	0.288	0.0	5.4714
1350	3.786	0.286	0.0	5.4255
1365	3.783	0.283	0.0	5.3796
1380	3.781	0.281	0.0	5.3338
1395	3.778	0.278	0.0	5.2882
1410	3.776	0.276	0.0	5.2429
1425	3.774	0.274	0.0	5.1976
1440	3.771	0.271	0.0	5.1526

1455	3.769	0.269	0.0	5.1078
1470	3.766	0.266	0.0	5.0633
1485	3.764	0.264	0.0	5.0190
1500	3.762	0.262	0.0	4.9749
1515	3.760	0.260	0.0	4.9310
1530	3.757	0.257	0.0	4.8873
1545	3.755	0.255	0.0	4.8437
1560	3.753	0.253	0.0	4.8003
1575	3.750	0.250	0.0	4.7570
1590	3.748	0.248	0.0	4.7139
1605	3.746	0.246	0.0	4.6708
1620	3.744	0.244	0.0	4.6279
1635	3.741	0.241	0.0	4.5852
1650	3.739	0.239	0.0	4.5425
1665	3.737	0.237	0.0	4.4999
1680	3.735	0.235	0.0	4.4575
1695	3.732	0.232	0.0	4.4151
1710	3.730	0.230	0.0	4.3729
1725	3.728	0.228	0.0	4.3308
1740	3.726	0.226	0.0	4.2887
1755	3.724	0.224	0.0	4.2467
1770	3.721	0.221	0.0	4.2049
1785	3.719	0.219	0.0	4.1631
1800	3.717	0.217	0.0	4.1214
1815	3.715	0.215	0.0	4.0798
1830	3.713	0.213	0.0	4.0383
1845	3.710	0.210	0.0	3.9968
1860	3.708	0.208	0.0	3.9555
1875	3.706	0.206	0.0	3.9142
1890	3.704	0.204	0.0	3.8730
1905	3.702	0.202	0.0	3.8318
1920	3.700	0.200	0.0	3.7907
1935	3.697	0.197	0.0	3.7497
1950	3.695	0.195	0.0	3.7087
1965	3.693	0.193	0.0	3.6678
1980	3.691	0.191	0.0	3.6269
1995	3.689	0.189	0.0	3.5861
2010	3.687	0.187	0.0	3.5454
2025	3.684	0.184	0.0	3.5046
2040	3.682	0.182	0.0	3.4639
2055	3.680	0.180	0.0	3.4220
2070	3.678	0.178	0.0	3.3787
2085	3.676	0.176	0.0	3.3352
2100	3.673	0.173	0.0	3.2917
2115	3.671	0.171	0.0	3.2482
2130	3.669	0.169	0.0	3.2048
2145	3.666	0.166	0.0	3.1614
2160	3.664	0.164	0.0	3.1181
2175	3.662	0.162	0.0	3.0749
2190	3.660	0.160	0.0	3.0318

Appendix V Half Drain Time Calculations - Fail



30 Year Storm 945min Winter (Critical duration) - Half Drain time calculations

Time (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Peak volume (m3)	Half of peak volume (m3)	Half-drain time from start of the storm event (min)	Half-drain time (min)
15	4.497	0.000	0.0	0.0000	7.38	3.69	2820	1875
30	4.499	0.002	0.1	0.0324				
45	4.505	0.008	0.1	0.1201				
60	4.510	0.013	0.1	0.2035				
75	4.516	0.019	0.1	0.2841				
90	4.521	0.024	0.1	0.3621				
105	4.526	0.029	0.1	0.4377				
120	4.531	0.034	0.1	0.5109				
135	4.535	0.038	0.1	0.5819				
150	4.540	0.043	0.1	0.6508				
165	4.544	0.047	0.1	0.7176	Check	FAIL		
180	4.548	0.051	0.1	0.7825				
195	4.553	0.056	0.1	0.8469				
210	4.557	0.060	0.1	0.9111				
225	4.561	0.064	0.1	0.9753				
240	4.565	0.068	0.1	1.0393				
255	4.570	0.073	0.1	1.1033				
270	4.574	0.077	0.1	1.1671				
285	4.578	0.081	0.1	1.2309				
300	4.582	0.085	0.1	1.2947				
315	4.586	0.089	0.1	1.3584				
330	4.591	0.094	0.1	1.4222				
345	4.595	0.098	0.1	1.4860				
360	4.602	0.105	0.2	1.5893				
375	4.612	0.115	0.2	1.7415				
390	4.622	0.125	0.2	1.8936				
405	4.634	0.137	0.3	2.0858				
420	4.650	0.153	0.3	2.3256				
435	4.668	0.171	0.4	2.6060				
450	4.690	0.193	0.4	2.9333				
465	4.714	0.217	0.5	3.2940				
480	4.741	0.244	0.5	3.7097				
495	4.771	0.274	0.6	4.1684				
510	4.799	0.302	0.5	4.5969				
525	4.822	0.325	0.4	4.9459				
540	4.843	0.346	0.4	5.2517				
555	4.860	0.363	0.3	5.5157				
570	4.874	0.377	0.3	5.7368				
585	4.886	0.389	0.2	5.9163				
600	4.895	0.398	0.2	6.0530				
615	4.904	0.407	0.2	6.1895				
630	4.910	0.413	0.1	6.2845				
645	4.914	0.417	0.1	6.3369				
660	4.917	0.420	0.1	6.3892				
675	4.921	0.424	0.1	6.4415				
690	4.924	0.427	0.1	6.4936				

The Half-drain time is calculated as the time it takes (after the end of the storm event) for half of the peak volume into the soakaway/structure to empty. The time from the start of the event to half emptying is 2820 min. The storm duration is 945 min. Therefore, the Half-drain time is 1875 min, which is more than 24 hours.

705	4.928	0.431	0.1	6.5457	
720	4.931	0.434	0.1	6.5976	
735	4.934	0.437	0.1	6.6495	
750	4.938	0.441	0.1	6.7013	
765	4.941	0.444	0.1	6.7530	
780	4.945	0.448	0.1	6.8046	
795	4.948	0.451	0.1	6.8561	
810	4.951	0.454	0.1	6.9075	
825	4.955	0.458	0.1	6.9589	
840	4.958	0.461	0.1	7.0101	
855	4.962	0.465	0.1	7.0613	
870	4.965	0.468	0.1	7.1123	
885	4.968	0.471	0.1	7.1633	
900	4.972	0.475	0.1	7.2142	
915	4.975	0.478	0.1	7.2650	
930	4.978	0.481	0.1	7.3158	
945	4.982	0.485	0.1	7.3664	
960	4.982	0.485	0.0	7.3756	Peak Volume is reached
975	4.980	0.483	0.0	7.3424	
990	4.978	0.481	0.0	7.3093	
1005	4.976	0.479	0.0	7.2762	
1020	4.974	0.477	0.0	7.2433	
1035	4.971	0.474	0.0	7.2103	
1050	4.969	0.472	0.0	7.1774	
1065	4.967	0.470	0.0	7.1446	
1080	4.965	0.468	0.0	7.1119	
1095	4.963	0.466	0.0	7.0791	
1110	4.961	0.464	0.0	7.0465	
1125	4.958	0.461	0.0	7.0139	
1140	4.956	0.459	0.0	6.9814	
1155	4.954	0.457	0.0	6.9489	
1170	4.952	0.455	0.0	6.9164	
1185	4.950	0.453	0.0	6.8841	
1200	4.948	0.451	0.0	6.8518	
1215	4.946	0.449	0.0	6.8195	
1230	4.944	0.447	0.0	6.7873	
1245	4.941	0.444	0.0	6.7551	
1260	4.939	0.442	0.0	6.7230	
1275	4.937	0.440	0.0	6.6910	
1290	4.935	0.438	0.0	6.6590	
1305	4.933	0.436	0.0	6.6271	
1320	4.931	0.434	0.0	6.5952	
1335	4.929	0.432	0.0	6.5634	
1350	4.927	0.430	0.0	6.5316	
1365	4.925	0.428	0.0	6.4999	
1380	4.923	0.426	0.0	6.4683	
1395	4.920	0.423	0.0	6.4367	
1410	4.918	0.421	0.0	6.4051	
1425	4.916	0.419	0.0	6.3736	
1440	4.914	0.417	0.0	6.3422	

1455	4.912	0.415	0.0	6.3108
1470	4.910	0.413	0.0	6.2795
1485	4.908	0.411	0.0	6.2482
1500	4.906	0.409	0.0	6.2170
1515	4.904	0.407	0.0	6.1858
1530	4.902	0.405	0.0	6.1547
1545	4.900	0.403	0.0	6.1237
1560	4.898	0.401	0.0	6.0926
1575	4.896	0.399	0.0	6.0617
1590	4.894	0.397	0.0	6.0308
1605	4.892	0.395	0.0	6.0000
1620	4.890	0.393	0.0	5.9692
1635	4.888	0.391	0.0	5.9384
1650	4.886	0.389	0.0	5.9077
1665	4.884	0.387	0.0	5.8771
1680	4.882	0.385	0.0	5.8465
1695	4.880	0.383	0.0	5.8160
1710	4.878	0.381	0.0	5.7855
1725	4.876	0.379	0.0	5.7551
1740	4.874	0.377	0.0	5.7247
1755	4.872	0.375	0.0	5.6944
1770	4.870	0.373	0.0	5.6641
1785	4.868	0.371	0.0	5.6339
1800	4.866	0.369	0.0	5.6038
1815	4.864	0.367	0.0	5.5737
1830	4.862	0.365	0.0	5.5436
1845	4.860	0.363	0.0	5.5136
1860	4.858	0.361	0.0	5.4836
1875	4.856	0.359	0.0	5.4537
1890	4.854	0.357	0.0	5.4239
1905	4.852	0.355	0.0	5.3941
1920	4.850	0.353	0.0	5.3643
1935	4.848	0.351	0.0	5.3346
1950	4.846	0.349	0.0	5.3050
1965	4.844	0.347	0.0	5.2754
1980	4.842	0.345	0.0	5.2459
1995	4.840	0.343	0.0	5.2164
2010	4.838	0.341	0.0	5.1869
2025	4.836	0.339	0.0	5.1575
2040	4.834	0.337	0.0	5.1282
2055	4.832	0.335	0.0	5.0989
2070	4.831	0.334	0.0	5.0697
2085	4.829	0.332	0.0	5.0405
2100	4.827	0.330	0.0	5.0113
2115	4.825	0.328	0.0	4.9822
2130	4.823	0.326	0.0	4.9532
2145	4.821	0.324	0.0	4.9242
2160	4.819	0.322	0.0	4.8953
2175	4.817	0.320	0.0	4.8664
2190	4.815	0.318	0.0	4.8375

2205	4.813	0.316	0.0	4.8088
2220	4.811	0.314	0.0	4.7800
2235	4.810	0.313	0.0	4.7513
2250	4.808	0.311	0.0	4.7227
2265	4.806	0.309	0.0	4.6941
2280	4.804	0.307	0.0	4.6656
2295	4.802	0.305	0.0	4.6371
2310	4.800	0.303	0.0	4.6086
2325	4.798	0.301	0.0	4.5802
2340	4.796	0.299	0.0	4.5519
2355	4.795	0.298	0.0	4.5236
2370	4.793	0.296	0.0	4.4954
2385	4.791	0.294	0.0	4.4672
2400	4.789	0.292	0.0	4.4392
2415	4.787	0.290	0.0	4.4113
2430	4.785	0.288	0.0	4.3835
2445	4.784	0.287	0.0	4.3558
2460	4.782	0.285	0.0	4.3282
2475	4.780	0.283	0.0	4.3007
2490	4.778	0.281	0.0	4.2734
2505	4.776	0.279	0.0	4.2462
2520	4.775	0.278	0.0	4.2191
2535	4.773	0.276	0.0	4.1920
2550	4.771	0.274	0.0	4.1651
2565	4.769	0.272	0.0	4.1383
2580	4.767	0.270	0.0	4.1115
2595	4.766	0.269	0.0	4.0848
2610	4.764	0.267	0.0	4.0582
2625	4.762	0.265	0.0	4.0316
2640	4.760	0.263	0.0	4.0051
2655	4.759	0.262	0.0	3.9787
2670	4.757	0.260	0.0	3.9524
2685	4.755	0.258	0.0	3.9261
2700	4.754	0.257	0.0	3.8998
2715	4.752	0.255	0.0	3.8737
2730	4.750	0.253	0.0	3.8476
2745	4.748	0.251	0.0	3.8215
2760	4.747	0.250	0.0	3.7955
2775	4.745	0.248	0.0	3.7696
2790	4.743	0.246	0.0	3.7437
2805	4.742	0.245	0.0	3.7179
2820	4.740	0.243	0.0	3.6921
2835	4.738	0.241	0.0	3.6664
2850	4.737	0.240	0.0	3.6407
2865	4.735	0.238	0.0	3.6151
2880	4.733	0.236	0.0	3.5895
2895	4.731	0.234	0.0	3.5640
2910	4.730	0.233	0.0	3.5385
2925	4.728	0.231	0.0	3.5130
2940	4.726	0.229	0.0	3.4876

Volume in the storage drops below half its peak volume.

30 Year Storm 960min Winter (Critical duration) - Half Drain time calculations

Time (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Peak volume (m3)	Half of peak volume (m3)	Half-drain time from start of the storm event (min)	Half-drain time (min)
15	3.000	0.000	0.0	0.0000	7.43	3.71	3330	2370
30	3.003	0.003	0.1	0.0318				
45	3.011	0.011	0.1	0.1186				
60	3.019	0.019	0.1	0.2008				
75	3.026	0.026	0.1	0.2801				
90	3.033	0.033	0.1	0.3568				
105	3.040	0.040	0.1	0.4310				
120	3.047	0.047	0.1	0.5028				
135	3.054	0.054	0.1	0.5727				
150	3.060	0.060	0.1	0.6422				
165	3.067	0.067	0.1	0.7116				
180	3.073	0.073	0.1	0.7810				
195	3.080	0.080	0.1	0.8503				
210	3.086	0.086	0.1	0.9197				
225	3.093	0.093	0.1	0.9891				
240	3.099	0.099	0.1	1.0588				
255	3.106	0.106	0.1	1.1290				
270	3.112	0.112	0.1	1.1991				
285	3.119	0.119	0.1	1.2691				
300	3.125	0.125	0.1	1.3389				
315	3.132	0.132	0.1	1.4087				
330	3.138	0.138	0.1	1.4783				
345	3.145	0.145	0.1	1.5478				
360	3.155	0.155	0.2	1.6560				
375	3.169	0.169	0.2	1.8018				
390	3.181	0.181	0.2	1.9389				
405	3.198	0.198	0.3	2.1136				
420	3.218	0.218	0.3	2.3281				
435	3.242	0.242	0.4	2.5850				
450	3.270	0.270	0.4	2.8908				
465	3.303	0.303	0.5	3.2368				
480	3.343	0.343	0.5	3.6635				
495	3.386	0.386	0.5	4.1309				
510	3.426	0.426	0.5	4.5576				
525	3.459	0.459	0.4	4.9022				
540	3.487	0.487	0.4	5.2050				
555	3.512	0.512	0.3	5.4672				
570	3.532	0.532	0.3	5.6877				
585	3.549	0.549	0.2	5.8678				
600	3.562	0.562	0.2	6.0063				
615	3.575	0.575	0.2	6.1446				
630	3.584	0.584	0.1	6.2426				
645	3.589	0.589	0.1	6.2992				
660	3.595	0.595	0.1	6.3558				
675	3.600	0.600	0.1	6.4122				
690	3.605	0.605	0.1	6.4686				

The Half-drain time is calculated as the time it takes (after the end of the storm event) for half of the peak volume into the soakaway/structure to empty. The time from the start of the event to half emptying is 3330 min. The storm duration is 960 min. Therefore, the Half-drain time is 2370 min, which is more than 24 hours.

Check **FAIL**

705	3.610	0.610	0.1	6.5248	
720	3.616	0.616	0.1	6.5810	
735	3.621	0.621	0.1	6.6371	
750	3.626	0.626	0.1	6.6930	
765	3.631	0.631	0.1	6.7489	
780	3.637	0.637	0.1	6.8047	
795	3.642	0.642	0.1	6.8604	
810	3.647	0.647	0.1	6.9161	
825	3.652	0.652	0.1	6.9716	
840	3.657	0.657	0.1	7.0270	
855	3.663	0.663	0.1	7.0824	
870	3.668	0.668	0.1	7.1377	
885	3.673	0.673	0.1	7.1928	
900	3.678	0.678	0.1	7.2479	
915	3.683	0.683	0.1	7.3029	
930	3.688	0.688	0.1	7.3578	
945	3.694	0.694	0.1	7.4126	
960	3.695	0.695	0.0	7.4272	Peak Volume is reached
975	3.692	0.692	0.0	7.4006	
990	3.690	0.690	0.0	7.3740	
1005	3.687	0.687	0.0	7.3474	
1020	3.685	0.685	0.0	7.3210	
1035	3.682	0.682	0.0	7.2945	
1050	3.680	0.680	0.0	7.2681	
1065	3.678	0.678	0.0	7.2418	
1080	3.675	0.675	0.0	7.2154	
1095	3.673	0.673	0.0	7.1892	
1110	3.670	0.670	0.0	7.1629	
1125	3.668	0.668	0.0	7.1367	
1140	3.665	0.665	0.0	7.1106	
1155	3.663	0.663	0.0	7.0845	
1170	3.660	0.660	0.0	7.0584	
1185	3.658	0.658	0.0	7.0324	
1200	3.656	0.656	0.0	7.0064	
1215	3.653	0.653	0.0	6.9805	
1230	3.651	0.651	0.0	6.9546	
1245	3.648	0.648	0.0	6.9288	
1260	3.646	0.646	0.0	6.9030	
1275	3.643	0.643	0.0	6.8772	
1290	3.641	0.641	0.0	6.8515	
1305	3.639	0.639	0.0	6.8258	
1320	3.636	0.636	0.0	6.8001	
1335	3.634	0.634	0.0	6.7745	
1350	3.631	0.631	0.0	6.7490	
1365	3.629	0.629	0.0	6.7235	
1380	3.627	0.627	0.0	6.6980	
1395	3.624	0.624	0.0	6.6725	
1410	3.622	0.622	0.0	6.6471	
1425	3.620	0.620	0.0	6.6218	
1440	3.617	0.617	0.0	6.5965	

1455	3.615	0.615	0.0	6.5712
1470	3.612	0.612	0.0	6.5460
1485	3.610	0.610	0.0	6.5208
1500	3.608	0.608	0.0	6.4956
1515	3.605	0.605	0.0	6.4705
1530	3.603	0.603	0.0	6.4455
1545	3.601	0.601	0.0	6.4204
1560	3.598	0.598	0.0	6.3955
1575	3.596	0.596	0.0	6.3705
1590	3.594	0.594	0.0	6.3456
1605	3.591	0.591	0.0	6.3207
1620	3.589	0.589	0.0	6.2959
1635	3.587	0.587	0.0	6.2711
1650	3.584	0.584	0.0	6.2464
1665	3.582	0.582	0.0	6.2217
1680	3.580	0.580	0.0	6.1970
1695	3.578	0.578	0.0	6.1724
1710	3.575	0.575	0.0	6.1478
1725	3.573	0.573	0.0	6.1233
1740	3.571	0.571	0.0	6.0988
1755	3.568	0.568	0.0	6.0743
1770	3.566	0.566	0.0	6.0499
1785	3.564	0.564	0.0	6.0255
1800	3.561	0.561	0.0	6.0011
1815	3.559	0.559	0.0	5.9768
1830	3.557	0.557	0.0	5.9526
1845	3.555	0.555	0.0	5.9283
1860	3.552	0.552	0.0	5.9042
1875	3.550	0.550	0.0	5.8800
1890	3.548	0.548	0.0	5.8559
1905	3.546	0.546	0.0	5.8318
1920	3.543	0.543	0.0	5.8078
1935	3.541	0.541	0.0	5.7838
1950	3.539	0.539	0.0	5.7598
1965	3.537	0.537	0.0	5.7359
1980	3.534	0.534	0.0	5.7120
1995	3.532	0.532	0.0	5.6882
2010	3.530	0.530	0.0	5.6644
2025	3.528	0.528	0.0	5.6406
2040	3.526	0.526	0.0	5.6169
2055	3.523	0.523	0.0	5.5932
2070	3.521	0.521	0.0	5.5696
2085	3.519	0.519	0.0	5.5460
2100	3.517	0.517	0.0	5.5224
2115	3.514	0.514	0.0	5.4989
2130	3.512	0.512	0.0	5.4754
2145	3.510	0.510	0.0	5.4519
2160	3.508	0.508	0.0	5.4285
2175	3.506	0.506	0.0	5.4051
2190	3.504	0.504	0.0	5.3818

2205	3.501	0.501	0.0	5.3585
2220	3.499	0.499	0.0	5.3352
2235	3.497	0.497	0.0	5.3120
2250	3.495	0.495	0.0	5.2888
2265	3.493	0.493	0.0	5.2657
2280	3.491	0.491	0.0	5.2425
2295	3.488	0.488	0.0	5.2195
2310	3.486	0.486	0.0	5.1964
2325	3.484	0.484	0.0	5.1734
2340	3.482	0.482	0.0	5.1505
2355	3.480	0.480	0.0	5.1275
2370	3.478	0.478	0.0	5.1046
2385	3.475	0.475	0.0	5.0818
2400	3.473	0.473	0.0	5.0590
2415	3.471	0.471	0.0	5.0362
2430	3.469	0.469	0.0	5.0134
2445	3.467	0.467	0.0	4.9907
2460	3.465	0.465	0.0	4.9681
2475	3.463	0.463	0.0	4.9454
2490	3.461	0.461	0.0	4.9228
2505	3.458	0.458	0.0	4.9003
2520	3.456	0.456	0.0	4.8778
2535	3.454	0.454	0.0	4.8553
2550	3.452	0.452	0.0	4.8328
2565	3.450	0.450	0.0	4.8104
2580	3.448	0.448	0.0	4.7880
2595	3.446	0.446	0.0	4.7657
2610	3.444	0.444	0.0	4.7434
2625	3.442	0.442	0.0	4.7211
2640	3.440	0.440	0.0	4.6989
2655	3.438	0.438	0.0	4.6767
2670	3.435	0.435	0.0	4.6545
2685	3.433	0.433	0.0	4.6324
2700	3.431	0.431	0.0	4.6103
2715	3.429	0.429	0.0	4.5882
2730	3.427	0.427	0.0	4.5662
2745	3.425	0.425	0.0	4.5442
2760	3.423	0.423	0.0	4.5223
2775	3.421	0.421	0.0	4.5004
2790	3.419	0.419	0.0	4.4785
2805	3.417	0.417	0.0	4.4567
2820	3.415	0.415	0.0	4.4349
2835	3.413	0.413	0.0	4.4131
2850	3.411	0.411	0.0	4.3914
2865	3.409	0.409	0.0	4.3697
2880	3.407	0.407	0.0	4.3480
2895	3.405	0.405	0.0	4.3264
2910	3.403	0.403	0.0	4.3048
2925	3.401	0.401	0.0	4.2832
2940	3.399	0.399	0.0	4.2617

2955	3.397	0.397	0.0	4.2402
2970	3.395	0.395	0.0	4.2188
2985	3.393	0.393	0.0	4.1973
3000	3.391	0.391	0.0	4.1759
3015	3.389	0.389	0.0	4.1546
3030	3.387	0.387	0.0	4.1333
3045	3.385	0.385	0.0	4.1120
3060	3.383	0.383	0.0	4.0908
3075	3.381	0.381	0.0	4.0695
3090	3.379	0.379	0.0	4.0484
3105	3.377	0.377	0.0	4.0272
3120	3.375	0.375	0.0	4.0061
3135	3.373	0.373	0.0	3.9850
3150	3.371	0.371	0.0	3.9640
3165	3.369	0.369	0.0	3.9430
3180	3.367	0.367	0.0	3.9220
3195	3.365	0.365	0.0	3.9011
3210	3.363	0.363	0.0	3.8802
3225	3.361	0.361	0.0	3.8593
3240	3.359	0.359	0.0	3.8385
3255	3.357	0.357	0.0	3.8177
3270	3.355	0.355	0.0	3.7969
3285	3.353	0.353	0.0	3.7762
3300	3.351	0.351	0.0	3.7555
3315	3.349	0.349	0.0	3.7348
3330	3.348	0.348	0.0	3.7142
3345	3.346	0.346	0.0	3.6935
3360	3.344	0.344	0.0	3.6730
3375	3.342	0.342	0.0	3.6524
3390	3.340	0.340	0.0	3.6319
3405	3.338	0.338	0.0	3.6115
3420	3.336	0.336	0.0	3.5910
3435	3.334	0.334	0.0	3.5706
3450	3.332	0.332	0.0	3.5503
3465	3.330	0.330	0.0	3.5299
3480	3.328	0.328	0.0	3.5096
3495	3.326	0.326	0.0	3.4894
3510	3.325	0.325	0.0	3.4691
3525	3.323	0.323	0.0	3.4489
3540	3.321	0.321	0.0	3.4287
3555	3.319	0.319	0.0	3.4086
3570	3.317	0.317	0.0	3.3885
3585	3.315	0.315	0.0	3.3684
3600	3.313	0.313	0.0	3.3484
3615	3.311	0.311	0.0	3.3284
3630	3.310	0.310	0.0	3.3084
3645	3.308	0.308	0.0	3.2884
3660	3.306	0.306	0.0	3.2685
3675	3.304	0.304	0.0	3.2487
3690	3.302	0.302	0.0	3.2288

Volume in the storage drops below half its peak volume.

Appendix VI Permeable Pavement Calculation



Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
HARDSTANDING	0.001	4.00	5.993	1200	59.355	99.447	0.483	5.510
PP	0.000		5.978		57.302	99.324	0.489	5.489

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	HARDSTANDING	PP	2.057	0.600	5.510	5.489	0.021	97.9	100	4.04	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.777	6.1	0.2	0.383	0.389	0.001	0.0	11	0.328

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.950	Drain Down Time (mins)	10080	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	Check Discharge Volume	x
Summer CV	0.950	Skip Steady State	x	Starting Level (m)			

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 | 2160 | 2880

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	0	0	0
30	0	0	0	100	45	0	0

Node PP Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.01116	Porosity	0.30	Width (m)	2.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.01116	Invert Level (m)	5.489	Length (m)	5.000	Inf Depth (m)	
Safety Factor	1.5	Time to half empty (mins)	164	Slope (1:X)	9999.0		

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	HARDSTANDING	11	5.520	0.010	0.1	0.0108	0.0000	OK
120 minute summer	PP	72	5.507	0.018	0.1	0.0520	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
15 minute summer	HARDSTANDING	1.000	PP	0.1	0.470	0.017	0.0006	
120 minute summer	PP	Infiltration		0.0				

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	HARDSTANDING	156	5.569	0.059	0.2	0.0669	0.0000	OK
240 minute winter	PP	156	5.569	0.080	0.2	0.2390	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
240 minute winter	HARDSTANDING	1.000	PP	0.2	0.436	0.028	0.0119	
240 minute winter	PP	Infiltration		0.0				

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

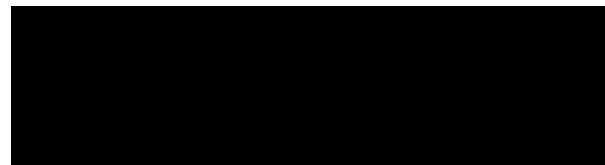
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	HARDSTANDING	232	5.594	0.084	0.2	0.0954	0.0000	OK
360 minute winter	PP	232	5.594	0.105	0.1	0.3145	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
360 minute winter	HARDSTANDING	1.000	PP	0.1	0.386	0.021	0.0153	
360 minute winter	PP	Infiltration		0.0				

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	HARDSTANDING	132	5.638	0.128	0.3	0.1453	0.0000	SURCHARGED
180 minute summer	PP	132	5.638	0.149	0.4	0.4469	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
180 minute summer	HARDSTANDING	1.000	PP	0.4	0.436	0.063	0.0161
180 minute summer	PP	Infiltration		0.0			

Appendix VII WINTER GROUNDWATER MONITORING



Winter Groundwater Monitoring Report

Croft Works, Mill Lane, Rustington, West Sussex, BN16 3JN

January 2026

Winter Groundwater Monitoring Report – Croft Works, Rustington

Proposed Residential Development: Croft Works (also known as Fircroft Crescent), Rustington, West Sussex

Development Proposal: Demolition of existing workshops and redevelopment of the brownfield site to provide 3 no. single-storey bungalows with associated permeable driveways, patios and soft landscaping.

Report Type: Winter Groundwater Monitoring & Infiltration Suitability Assessment

Prepared by: Geotechnical & Drainage Engineer

Date: March 2025

Executive Summary

This Winter Groundwater Monitoring Report has been prepared to support the proposed redevelopment of the former Croft Works site in Rustington for three single-storey residential bungalows. The site is a previously developed brownfield plot currently occupied by workshop buildings and impermeable hardstanding. The proposed development will remove these surfaces and introduce permeable paving, soakaways, and landscaped areas, representing a substantial improvement in surface water management over the existing situation.

Ground conditions have been established through trial pitting, borehole logging, BRE Digest 365 infiltration testing, and winter groundwater monitoring between October 2024 and March 2025. Deep test pit excavated to approximately 4.3 m below ground level (bgl) remained dry, and it is assumed that below the soil/silty clay substrate, the strata comprise structureless chalk, providing natural drainage capacity.

Shallow trial pits TP1–TP3, excavated to 600 mm bgl across the proposed driveway and patio areas, were also dry, demonstrating that shallow permeable paving is feasible.

BRE Digest 365 infiltration testing in March 2025 showed rapid drawdown and overnight dissipation of test water, confirming that infiltration-based drainage is feasible even under conservative winter conditions.

On the basis of these investigations, the Highest Likely Groundwater Level (HLGWL) is conservatively assessed at greater than 4.3 m bgl, providing sufficient vertical separation for soakaways, driveways, and patios in accordance with BRE Digest 365, BS5930:2019+A2:2010, and the requirements of West Sussex County Council (LLFA). The proposed drainage strategy also aligns with the National Planning Policy Framework (NPPF) and Arun District Council policy on sustainable surface water management.

1. Introduction

This report presents the findings of winter groundwater monitoring and associated ground investigation works undertaken at the Croft Works site in Rustington. The purpose of the report is to establish the seasonal groundwater regime and to assess the suitability of infiltration-based surface water drainage systems in support of the proposed residential redevelopment.

The investigation has been carried out in accordance with:

- BS5930:2019+A2:2010 – Code of Practice for Site Investigations,
- BRE Digest 365 – Soakaway Design Guidance.

Emphasis has been placed on determining the Highest Likely Groundwater Level during winter, which is critical for the safe and effective design of soakaways and permeable paving.

2. Site Description and Proposed Development

The site is located at Croft Works (also known as Fircroft Crescent) in Rustington, West Sussex. It comprises a previously developed brownfield plot historically used for light industrial workshop purposes. The site is generally level and is surrounded by established residential development. At present, the majority of the site is covered by buildings, concrete slabs and tarmac hardstanding, resulting in a high proportion of impermeable surfacing.

The proposed development comprises the demolition of the existing workshops and the redevelopment of the site to provide three single-storey bungalows. Associated external works include the formation of permeable driveways and patios together with the introduction of private garden areas and soft landscaping. The proposals will therefore significantly reduce the extent of impermeable surfacing and represent a substantial improvement in surface water management compared with the existing use.

3. Scope of Investigation

The scope of works undertaken to inform this report included trial pitting, borehole logging, BRE Digest 365 infiltration testing and winter groundwater monitoring. These investigations were designed to characterise the ground conditions across the site, identify the presence or absence of groundwater during the winter period and assess the feasibility of infiltration-based drainage solutions.

4. Ground Conditions

Ground conditions across the site have been established from borehole and trial pit data, including Borehole TP4 logged on 25 November 2025. The recorded ground profile is considered representative of the site as a whole and is consistent with the known geology of the area.

The uppermost stratum comprised a concrete slab associated with the existing workshops, extending to approximately 0.11 m below ground level. Beneath this, made ground and reworked

material was encountered, with topsoil locally present to depths of up to approximately 0.90 m below ground level. Below this level, the natural strata comprised orange-brown silty clay, which was recorded as dry at the time of investigation, with occasional pockets of sand and flint gravel.

This cohesive horizon extended to a depth of approximately 4.3m below ground level.

Below the depth of investigation, the strata are inferred to comprise structureless chalk. This interpretation is consistent with regional geological mapping and with ground investigations undertaken at nearby sites, including the Barn Close development.

Little groundwater was encountered within Borehole TP4 to the full depth of investigation, providing strong evidence of low groundwater levels during late autumn and early winter conditions.

5. BRE Digest 365 Infiltration Testing

BRE Digest 365 compliant infiltration testing was undertaken within a dedicated soakaway test pit excavated to a depth of approximately 2.1 m below ground level. The testing was carried out on 26th Feb – 4 March 2025, a period considered representative of conservative winter conditions.

Following filling of the test pit, water levels were monitored at regular intervals throughout the day to assess infiltration performance. The results demonstrated a steady and continuous drawdown of water, with complete dissipation observed by the following morning.

No groundwater was encountered to the base of the deepest test pit (4.3 m bgl), confirming low groundwater levels and suitability for infiltration systems.

The rapid dissipation of test water indicates that the underlying strata are capable of accepting infiltration and that no perched or persistent groundwater was present within the depth of the test pit. The results are considered advantageous, particularly given the timing of the testing during the winter period, and confirm that infiltration-based drainage solutions are feasible at the site subject to appropriate design.

6. Winter Groundwater Monitoring

Winter groundwater monitoring was undertaken to establish the Highest Likely Groundwater Level during the period when groundwater levels are typically at their seasonal maximum. Monitoring visits were carried out on six occasions between October 2024 and March 2025, following periods of rainfall and during peak winter conditions.

During each monitoring visit, trial pits and excavations were inspected for evidence of standing or seepage groundwater. Across all six visits, no natural groundwater was encountered to depths of approximately 4.2 m below ground level. The silty clay strata were observed to be damp to locally moist during mid-winter visits, but no free water was recorded.

Additional observations were made during BRE Digest 365 testing in early March 2025. The water levels recorded during testing were associated solely with introduced test water and showed rapid drawdown and complete dissipation. These observations confirm that the site is not subject to high groundwater levels and that the recorded water levels do not represent the natural groundwater regime.

Borehole	Date & Depth (M bgl)					
	24/10/24	22/11/24	20/12/24	17/1/25	14/2/25	21/3/25
TP1 – TP3	0.60 (dry)	0.60 (dry)	0.60 (dry)	0.60 (dry)	0.60 (dry)	0.60 (dry)
TP4	4.25	4.30	4.27	4.30	4.19	4.29

7. Assessment of Highest Likely Groundwater Level

On the basis of borehole data, six winter monitoring visits and BRE Digest 365 testing, the Highest Likely Groundwater Level at the site has been conservatively assessed to be deeper than 4.2m below existing ground level. This assessment reflects a precautionary approach and is supported by the absence of groundwater within the depth of investigation during the winter monitoring period.

The assessed groundwater levels provide adequate vertical separation between proposed infiltration features and groundwater in accordance with BRE Digest 365. In particular, a minimum clearance of 1.0 m between soakaway bases and groundwater can be readily achieved, and shallow permeable paving systems can be constructed without risk of interaction with groundwater.

8. Implications for Drainage Design

The findings of the investigation confirm that infiltration-based drainage is appropriate for the proposed development. Roof water can be discharged to soakaways designed in accordance with BRE Digest 365, located clear of building foundations. The assessed groundwater levels allow soakaway bases to be positioned with adequate separation to groundwater, ensuring long-term performance and resilience.

The winter groundwater monitoring also supports the use of permeable paving for small residential driveways and patios. No groundwater was encountered within 600 mm of ground level during the monitoring period, indicating that shallow permeable pavement constructions are suitable. The introduction of permeable surfaces and landscaped areas represents a significant improvement over the existing impermeable hardstanding and will reduce surface water runoff rates and volumes.

9. Statement of Policy Compliance (Arun District Council / WSCC)

This report has been prepared with specific regard to the requirements of Arun District Council as Local Planning Authority and West Sussex County Council in its role as Lead Local Flood

Authority. The scope and methodology of the investigations undertaken are consistent with WSCC LLFA standing advice for infiltration drainage and reflect approaches previously accepted within the district.

Winter groundwater monitoring has been undertaken over a full winter cycle, exceeding the level of evidence typically required for small-scale residential developments. The Highest Likely Groundwater Level has been conservatively assessed, and adequate vertical separation between infiltration features and groundwater can be achieved in accordance with BRE Digest 365. The proposed drainage strategy follows the drainage hierarchy set out in national policy and accords with local policy objectives for sustainable development and flood risk reduction.

10. Drainage Justification for Planning Submission

The existing Croft Works site is almost entirely covered by impermeable buildings and hardstanding associated with its former industrial use. Surface water runoff from the site is therefore currently unmanaged. The proposed redevelopment will remove these impermeable surfaces and introduce infiltration-based drainage features, including soakaways, permeable paving and landscaped areas.

Site-specific investigation, winter groundwater monitoring and BRE Digest 365 testing have demonstrated that infiltration drainage is feasible even under conservative winter conditions. No natural groundwater has been encountered within the depths relevant to infiltration features, and the assessed Highest Likely Groundwater Level allows for appropriate design clearances.

The proposed drainage strategy therefore represents a clear and demonstrable betterment over the existing situation and accords with the National Planning Policy Framework, Arun District Council policy and WSCC LLFA guidance. This report provides a robust technical justification to support the drainage strategy submitted in support of the planning application.

11. Conclusions

The investigations undertaken at the Croft Works site confirm that the ground conditions and groundwater regime are suitable for infiltration-based drainage. Borehole logging, winter groundwater monitoring and BRE Digest 365 testing have demonstrated low groundwater levels and advantageous infiltration characteristics. The proposed development will result in a net improvement in surface water management compared with the existing brownfield use and is considered technically appropriate and policy-compliant.