

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM	Job No 5068
By RW	Date 07.19	Chkd RW	Element SURFACE WATER DRAINAGE DESIGN: DOMESTIC GEOCELLULAR SOAKAWAYS	Sheet No DSA/1
DATA		CALCULATIONS		RESULTS
1.	<u>PURPOSE</u> The purpose of these calculations is to determine the size of the soakaway required to disperse the run-off from the proposed dwellings, parking areas and drive / access road etc.			
2.	<u>SITE LAYOUT</u> The layout of the development site is shown on drawing N°5068/ 02 (as revised) This drawing shows the location of the proposed soakaway and the impermeable area draining to the facility.			
3.	<u>POROSITY TESTS</u> Porosity tests were carried out in accordance with BRE Digest 365 and CIRIA C753 in December 2016. The results of these tests is attached to these calculations and summarised in Section 6			
4.	<u>METHODOLOGY</u> Current best practice/design advice recommends that infiltration drainage systems should be designed to store the run-off from a 10% annual probability storm (1 in 10 year return period) and to half empty (by percolation) in a twenty-four hour period (CIRIA Report 156: Infiltration drainage - Manual of good practice). This latter requirement allows the system to cater for a succession of severe storm events However in order to achieve consistency between conventional drainage techniques (as set out in Sewers for Adoption), recent recommendations (CIRIA Report N° C609: Sustainable drainage systems - Hydraulic, structural and water quality advice) suggest that SUDS should be analysed for a 3.3% annual probability storm event (1 in 30 year return period) to ensure that internal flooding of properties and/or serious external flooding (SEF) does not occur. In addition, the Environment Agency, in pursuance of the requirements of TAN 15 (in Wales) and PPG25 (in England), recommends that greenfield run-off rates and volumes should be maintained after development for storm events up to a 1% annual probability (1 in 100 year return period). The additional water resulting from these severe storm events does not necessarily have to be stored within the SUDS, provided it can be contained by localised flooding of car parks and landscaped areas for short periods of time without adversely effecting residential or commercial property.			

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4.	<u>METHODOLOGY</u> (continued) These calculations therefore adopt the following methodology: 1. Rainfall intensities for different storm conditions are to be determined using the Wallingford Procedure 2. The infiltration device is to be sized to store the run-off from a 10% annual probability storm below the level of the incoming pipe(s) 3. The infiltration device is to be analysed to ensure that the run-off from a 3.3% annual probability storm is contained without the system flooding (ie that there is sufficient storage provided within the facility) 4. The system is to be further tested against 1% annual probability storm events to assess the volume of flooding and to confirm that it will not adversely effect residential or commercial property			
5.	<u>METHOD OF ANALYSIS</u> These calculations adopt the method of analysis for 3-D Infiltration Systems set out in CIRIA Report N° 156: Infiltration systems - Manual of good practice. For a vertically sided structure (ie a soakaway or infiltration trench) the maximum depth of water (h_{max}) can be calculated by solving the following equation $h_{max} = a (e^{(-bD)} - 1)$ where $a = (A_b / P) - (A_d / Pq)$ and $b = (Pq) / (nA_b)$ The time to half empty ($t_{1/2}$) can be determined from the following equation: $t_{1/2} = \frac{nA_b}{qP} \text{Log}_e \left\{ \frac{h_{max} + A_b / P}{h_{max} + A_b / P} \right\}$ The required inputs are: A_b area of base of infiltration device (m ²) P perimeter of infiltration device (m) A_D area to be drained (m ²) f infiltration rate from percolation tests (m/h) i, D intensity and duration of rainfall events with the required return period at the site location (m/h, h) n porosity of fill material (void volume/total volume) The results of these calculations are set out below			

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6. PERCOLATION TEST RESULTS Porosity tests were carried out in accordance with BRE Digest 365 and CIRIA C753 in December 2016 by Groundsolve Ltd to determine the infiltration rates across the site and proposed soakaway locations. The table below is a summary of the lowest infiltration rates derived from each of the trial pits. <table border="1"> <thead> <tr> <th>Trial Pit</th> <th>Soil Infiltration Rate f (m/s)</th> </tr> </thead> <tbody> <tr> <td>TP01 test 2</td> <td>7.488E-04</td> </tr> <tr> <td>TP02 test 1</td> <td>2.220E-05</td> </tr> <tr> <td>TP03 test 1</td> <td>9.645E-04</td> </tr> <tr> <td>TP04 test 3</td> <td>1.383E-04</td> </tr> <tr> <td>TP05 test 3</td> <td>3.865E-04</td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="3">Applicable Infiltration Rate m/s</th> </tr> </thead> <tbody> <tr> <td>Car Park</td> <td>3.865E-04</td> <td>TP05 (TP03 1No test)</td> </tr> <tr> <td>Plots 1-3 & Parking</td> <td>3.865E-04</td> <td>TP05</td> </tr> <tr> <td>Plots 1 to 6 rear</td> <td>1.383E-04</td> <td>TP04</td> </tr> <tr> <td>Plot 4-7 & Parking</td> <td>2.220E-05</td> <td>TP02</td> </tr> <tr> <td>Plot 8 Front & 9</td> <td>7.488E-04</td> <td>TP01</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Description</th> <th>Impermeable Area (m²)</th> <th>FOS</th> </tr> </thead> <tbody> <tr> <td>Access Road & Car Park</td> <td>433.80</td> <td>3</td> </tr> <tr> <td>Plot 1 to 3 Front & Parking</td> <td>143.25</td> <td>3</td> </tr> <tr> <td>Plots 1, 3, 4 & 6 Rear</td> <td>32.10</td> <td>2</td> </tr> <tr> <td>Plot 2 & 5 Rear</td> <td>23.50</td> <td>2</td> </tr> <tr> <td>Plot 4-7 & Parking</td> <td>158.00</td> <td>3</td> </tr> <tr> <td>Plot 8 Rear</td> <td>19.30</td> <td>2</td> </tr> <tr> <td>Plot 8 Front & 9</td> <td>68.50</td> <td>2</td> </tr> <tr> <td>(Plot 7 & 8 Option)</td> <td>42.40</td> <td>2</td> </tr> </tbody> </table>						Trial Pit	Soil Infiltration Rate f (m/s)	TP01 test 2	7.488E-04	TP02 test 1	2.220E-05	TP03 test 1	9.645E-04	TP04 test 3	1.383E-04	TP05 test 3	3.865E-04			Applicable Infiltration Rate m/s			Car Park	3.865E-04	TP05 (TP03 1No test)	Plots 1-3 & Parking	3.865E-04	TP05	Plots 1 to 6 rear	1.383E-04	TP04	Plot 4-7 & Parking	2.220E-05	TP02	Plot 8 Front & 9	7.488E-04	TP01	Description	Impermeable Area (m ²)	FOS	Access Road & Car Park	433.80	3	Plot 1 to 3 Front & Parking	143.25	3	Plots 1, 3, 4 & 6 Rear	32.10	2	Plot 2 & 5 Rear	23.50	2	Plot 4-7 & Parking	158.00	3	Plot 8 Rear	19.30	2	Plot 8 Front & 9	68.50	2	(Plot 7 & 8 Option)	42.40	2
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DATA		CALCULATIONS			RESULTS
8.	<u>DESIGN DATA - WATER STORAGE CELL SOAKAWAY</u>				
From porosity tests	Measured infiltration rate		f	1.39E+00 m/hr	
CIRIA C753 Pg. 553	Factor of safety	(Minor inconvenience, gardens, parking)	Fs	3.0	
CIRIA 156 Pg. 54	Porosity	(water storage cell)	n	0.95	
CIRIA C697 Pg. 4-31		(clean stone)	n	0.40	
From Plan (Plot 1)	Area to be drained		A _D	433.80 m²	
	Assume a soakaway of modular water storage cells wrapped in geotextile material, backfilled with 200mm of clean stone				
	Length	5.000 m	Effective Length	5.400 m	
	Width	3.000 m	Effective Width	3.400 m	
	Stone Surround	0.200 m			
CIRIA 156 Pg 54 & 93, C697 Pg 4-31	Effective porosity (geocells & excavation filled with clean stone)		n'	0.849	
9.	<u>FILTER DRAIN DESIGN</u>				
By Calculation, q = f/Fs	Effective infiltration coefficient (measured infiltration rate/factor of safety)		q	0.4638 m/hr	
From Plan	Area to be drained		A _D	433.80 m ²	
By Calculation, A _b = L * W	Base Area of soakaway		A _b	18.36 m ²	
By Calculation, P = 2L + 2W	Perimeter of Soakaway		P	17.60 m	
CIRIA 156 Pg. 57	Factor a = (A _b /P) - (iAD/Pq)		a	varies	
CIRIA 156 Pg. 57	Factor b = (Pq/nA _b)		b	0.523	

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9.			<u>FILTER DRAIN DESIGN (continued)</u>								
			Duration		10 Year Return			30 Year Return			100 Year Return
		i	Factor a	Max Depth m	i	Factor a	Max Depth m	i	Factor a	Max Depth m	
min	hr	m/hr			m/hr			m/hr			
5	0.083	0.090	-3.7	0.159	0.108	-4.7	0.200	0.136	-6.2	0.265	
10	0.167	0.065	-2.4	0.201	0.079	-3.2	0.265	0.101	-4.3	0.361	
15	0.250	0.053	-1.8	0.218	0.065	-2.4	0.297	0.083	-3.4	0.416	
20	0.333	0.044	-1.3	0.207	0.054	-1.8	0.289	0.069	-2.6	0.422	
25	0.417	0.038	-1.0	0.193	0.047	-1.4	0.284	0.061	-2.2	0.429	
30	0.500	0.035	-0.8	0.184	0.042	-1.2	0.280	0.055	-1.9	0.434	
45	0.750	0.026	-0.4	0.117	0.033	-0.7	0.224	0.043	-1.2	0.397	
60	1.000	0.022	-0.1	0.058	0.028	-0.4	0.175	0.036	-0.9	0.358	
90	1.500	0.017	0.2	-0.086	0.021	-0.1	0.030	0.027	-0.4	0.220	
120	2.000	0.014	0.3	-0.201	0.017	0.1	-0.086	0.022	-0.2	0.098	
240	4.000	0.009	0.6	-0.517	0.011	0.5	-0.423	0.014	0.3	-0.271	
360	6.000	0.006	0.7	-0.673	0.008	0.6	-0.596	0.010	0.5	-0.476	
600	10.000	0.004	0.8	-0.802	0.006	0.8	-0.747	0.007	0.7	-0.662	
1440	24.000	0.002	0.9	-0.918	0.003	0.9	-0.890	0.004	0.8	-0.849	
For 1 in 10 year return period storm											
From Table	Maximum depth of water					h_{max}		0.218 m			
By calculation	Time for half emptying					$t_{1/2}$		0.2218 hr			<24 hrs OK
For 1 in 30 year return period storm											
Depth of storage (with allowance for porosity of water storage cells and stone surround)								0.079 m			
Total Depth required for 1 in 30 yr event								0.297 m			
Depth of water storage cells to be provided								0.4 m			
Residual volume available								1.609 m³			

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: CAR PARK		Sheet No DSA/7
DATA		CALCULATIONS			RESULTS
9. FILTER DRAIN DESIGN (continued) For 1 in 100 year return period storm (total catchment) Potential flood volume (in excess of storage provided for 1 in 30 year storm conditions)2.137 m³ +30%cc4.167 m³ Potential flood volume (in excess of total storage provided for in soakaway geocells & stone surround)0.528 m³ +30%cc2.558 m³ Soakaway accommodates the volume of retention required for the 3.3% annual probability storm event within the geocellular units and the stone surround. Additional storage for more extreme events will also be achieved within the geocellular units, 200mm stone surround, pipework, catchpits, chambers, bedding and backfill. It is likely that the volume of stone surround is greater than that used in the calculations thus increasing the storage provided for extreme events and climate change. Additional Storage Provided 0.10 upstream pipework2 m say1 No0.016 m³ 0.45 dia catchpit say 1.00 m2 No0.318 m³ 0.45 dia chambers say 0.00 m0 No0 m³ 0.334 m³ Residual 1 in 100yr storage required0.19 m³ 1 in 100yr + 30 % CC2.22 m³ Storage provided on the surface of the car park up to top of kerb level as shown on drawing 5068/04 as revised See Summary Page for 1 in 100 year + 30% Storage Volumes					

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 1-3 FRONT & PARKING		Sheet No DSA/8
DATA		CALCULATIONS			RESULTS
8.	<u>DESIGN DATA - WATER STORAGE CELL SOAKAWAY</u>				
From porosity tests	Measured infiltration rate		f	1.39E+00 m/hr	
CIRIA C753 Pg. 553	Factor of safety	(Minor inconvenience, gardens, parking)	Fs	3.0	
CIRIA 156 Pg. 54	Porosity	(water storage cell)	n	0.95	
CIRIA C697 Pg. 4-31		(clean stone)	n	0.40	
From Plan (Plot 1)	Area to be drained		A _D	143.25 m²	
	Assume a soakaway of modular water storage cells wrapped in geotextile material, backfilled with 200mm of clean stone				
	Length	6.000 m	Effective Length	6.400 m	
	Width	0.500 m	Effective Width	0.900 m	
	Stone Surround	0.200 m			
CIRIA 156 Pg 54 & 93, C697 Pg 4-31	Effective porosity (geocells & excavation filled with clean stone)		n'	0.686	
9.	<u>FILTER DRAIN DESIGN</u>				
By Calculation, q = f/Fs	Effective infiltration coefficient (measured infiltration rate/factor of safety)		q	0.4638 m/hr	
From Plan	Area to be drained		A _D	143.25 m ²	
By Calculation, A _b = L * W	Base Area of soakaway		A _b	5.76 m ²	
By Calculation, P = 2L + 2W	Perimeter of Soakaway		P	14.60 m	
CIRIA 156 Pg. 57	Factor a = (A _b /P) - (iAD/Pq)		a	varies	
CIRIA 156 Pg. 57	Factor b = (Pq/nA _b)		b	1.713	

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM							Job No 5068	
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 1-3 FRONT & PARKING							Sheet No DSA/9	
DATA			CALCULATIONS							RESULTS	
9.	<u>FILTER DRAIN DESIGN (continued)</u>										
	Duration		10 Year Return			30 Year Return			100 Year Return		
			i	Factor a	Max Depth	i	Factor a	Max Depth	i	Factor a	Max Depth
	min	hr	m/hr		m	m/hr		m	m/hr		m
	5	0.083	0.090	-1.5	0.200	0.108	-1.9	0.251	0.136	-2.5	0.331
	10	0.167	0.065	-1.0	0.243	0.079	-1.3	0.319	0.101	-1.7	0.432
	15	0.250	0.053	-0.7	0.253	0.065	-1.0	0.343	0.083	-1.4	0.477
	20	0.333	0.044	-0.5	0.232	0.054	-0.7	0.321	0.069	-1.1	0.466
	25	0.417	0.038	-0.4	0.211	0.047	-0.6	0.305	0.061	-0.9	0.456
	30	0.500	0.035	-0.3	0.195	0.042	-0.5	0.290	0.055	-0.8	0.443
	45	0.750	0.026	-0.2	0.119	0.033	-0.3	0.214	0.043	-0.5	0.367
	60	1.000	0.022	-0.1	0.064	0.028	-0.2	0.157	0.036	-0.4	0.304
	90	1.500	0.017	0.0	-0.039	0.021	0.0	0.039	0.027	-0.2	0.168
	120	2.000	0.014	0.1	-0.099	0.017	0.0	-0.031	0.022	-0.1	0.078
	240	4.000	0.009	0.2	-0.214	0.011	0.2	-0.171	0.014	0.1	-0.102
	360	6.000	0.006	0.3	-0.259	0.008	0.2	-0.227	0.010	0.2	-0.177
	600	10.000	0.004	0.3	-0.300	0.006	0.3	-0.278	0.007	0.2	-0.244
	1440	24.000	0.002	0.3	-0.345	0.003	0.3	-0.334	0.004	0.3	-0.317
	For 1 in 10 year return period storm										
	From Table	Maximum depth of water					h_{max}		0.253 m		
	By calculation	Time for half emptying					$t_{1/2}$		0.0059 hr		<24 hrs OK
For 1 in 30 year return period storm											
Depth of storage (with allowance for porosity of water storage cells and stone surround)								0.090 m			
Total Depth required for 1 in 30 yr event								0.343 m			
Depth of water storage cells to be provided								0.4 m			
Residual volume available								0.227 m ³			

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 1-3 FRONT & PARKING		Sheet No DSA/10
DATA		CALCULATIONS			RESULTS
9. FILTER DRAIN DESIGN (continued) For 1 in 100 year return period storm (total catchment) Potential flood volume (in excess of storage provided for 1 in 30 year storm conditions)0.532 m³ +30%cc1.097 m³ Potential flood volume (in excess of total storage provided for in soakaway geocells & stone surround)0.305 m³ +30%cc0.871 m³ Soakaway accommodates the volume of retention required for the 3.3% annual probability storm event within the geocellular units and the stone surround. Additional storage for more extreme events will also be achieved within the geocellular units, 200mm stone surround, pipework, catchpits, chambers, bedding and backfill. It is likely that the volume of stone surround is greater than that used in the calculations thus increasing the storage provided for extreme events and climate change. Additional Storage Provided 0.10 upstream pipework2 m say1 No0.016 m³ 0.45 dia catchpit say 1.00 m2 No0.318 m³ 0.45 dia chambers say 0.00 m0 No0 m³ 0.334 m³ Residual 1 in 100yr storage required-0.03 m³ 1 in 100yr + 30 % CC0.54 m³ Storage provided on the surface of the car park up to top of kerb level and parking area between plots 4 and 7 as shown on drawing 5068/04 as revised See Summary Page for 1 in 100 year + 30% Storage Volumes					

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 1, 3, 4 & 6 Rear		Sheet No DSA/11
DATA		CALCULATIONS			RESULTS
8. <u>DESIGN DATA - WATER STORAGE CELL SOAKAWAY</u>					
From porosity tests	Measured infiltration rate		f	4.98E-01 m/hr	
CIRIA C753 Pg. 553	Factor of safety	(Minor inconvenience, gardens, parking)	F _s	2.0	
CIRIA 156 Pg. 54	Porosity	(water storage cell)	n	0.95	
CIRIA C697 Pg. 4-31		(clean stone)	n	0.40	
From Plan (Plot 1)	Area to be drained		A _D	32.10 m²	
Assume a soakaway of modular water storage cells wrapped in geotextile material, backfilled with 200mm of clean stone					
	Length	2.000 m	Effective Length	2.400 m	
	Width	0.500 m	Effective Width	0.900 m	
	Stone Surround	0.200 m			
CIRIA 156 Pg 54 & 93, C697 Pg 4-31	Effective porosity (geocells & excavation filled with clean stone)		n'	0.655	
9. <u>FILTER DRAIN DESIGN</u>					
By Calculation, q = f/F _s	Effective infiltration coefficient (measured infiltration rate/factor of safety)		q	0.2489 m/hr	
From Plan	Area to be drained		A _D	32.10 m ²	
By Calculation, A _b = L * W	Base Area of soakaway		A _b	2.16 m ²	
By Calculation, P = 2L + 2W	Perimeter of Soakaway		P	6.60 m	
CIRIA 156 Pg. 57	Factor a = (A _b /P) - (iA _D /Pq)		a	varies	
CIRIA 156 Pg. 57	Factor b = (Pq/nA _b)		b	1.162	

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM							Job No 5068		
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 1, 3, 4 & 6 Rear							Sheet No DSA/12		
DATA		CALCULATIONS								RESULTS		
9.		<u>FILTER DRAIN DESIGN (continued)</u>										
		Duration		10 Year Return			30 Year Return			100 Year Return		
				i	Factor a	Max Depth m	i	Factor a	Max Depth m	i	Factor a	Max Depth m
		min	hr	m/hr			m/hr			m/hr		
		5	0.083	0.090	-1.4	0.132	0.108	-1.8	0.164	0.136	-2.3	0.216
		10	0.167	0.065	-0.9	0.166	0.079	-1.2	0.215	0.101	-1.6	0.289
		15	0.250	0.053	-0.7	0.179	0.065	-0.9	0.238	0.083	-1.3	0.328
		20	0.333	0.044	-0.5	0.170	0.054	-0.7	0.231	0.069	-1.0	0.329
		25	0.417	0.038	-0.4	0.161	0.047	-0.6	0.226	0.061	-0.9	0.331
		30	0.500	0.035	-0.4	0.154	0.042	-0.5	0.222	0.055	-0.7	0.330
		45	0.750	0.026	-0.2	0.110	0.033	-0.3	0.180	0.043	-0.5	0.294
		60	1.000	0.022	-0.1	0.075	0.028	-0.2	0.147	0.036	-0.4	0.261
		90	1.500	0.017	0.0	-0.002	0.021	-0.1	0.063	0.027	-0.2	0.169
		120	2.000	0.014	0.1	-0.052	0.017	0.0	0.007	0.022	-0.1	0.101
		240	4.000	0.009	0.2	-0.159	0.011	0.1	-0.120	0.014	0.1	-0.057
		360	6.000	0.006	0.2	-0.202	0.008	0.2	-0.172	0.010	0.1	-0.126
		600	10.000	0.004	0.2	-0.240	0.006	0.2	-0.220	0.007	0.2	-0.188
		1440	24.000	0.002	0.3	-0.281	0.003	0.3	-0.271	0.004	0.3	-0.256
		For 1 in 10 year return period storm										
		From Table	Maximum depth of water					h_{max}		0.179 m		
By calculation	Time for half emptying					$t_{1/2}$		-0.031 hr		<24 hrs OK		
For 1 in 30 year return period storm												
Depth of storage (with allowance for porosity of water storage cells and stone surround)								0.060 m				
Total Depth required for 1 in 30 yr event								0.238 m				
Depth of water storage cells to be provided								0.4 m				
Residual volume available								0.228 m³				

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 1, 3, 4 & 6 Rear		Sheet No DSA/13
DATA		CALCULATIONS			RESULTS
9.		<u>FILTER DRAIN DESIGN (continued)</u>			
		For 1 in 100 year return period storm (total catchment)			
		Potential flood volume (in excess of storage provided for 1 in 30 year storm conditions)			0.131 m ³
		+30%cc			0.271 m ³
		Potential flood volume (in excess of total storage provided for in soakaway geocells & stone surround)			-0.098 m ³
		+30%cc			0.043 m ³
		Soakaway accommodates the volume of retention required for the 3.3% annual probability storm event within the geocellular units and the stone surround. Additional storage for more extreme events will also be achieved within the geocellular units, 200mm stone surround, pipework, catchpits, chambers, bedding and backfill.			
		It is likely that the volume of stone surround is greater than that used in the calculations thus increasing the storage provided for extreme events and climate change.			
		Additional Storage Provided			
		0.10 upstream pipework	6 m say	1 No	0.047 m ³
		0.45 dia catchpit	say 0.60 m	1 No	0.095 m ³
		0.45 dia chambers	say 0.55 m	1 No	0.087 m ³
					0.23 m ³
		Residual 1 in 100yr storage required			-0.33 m ³
		1 in 100yr + 30 % CC			-0.187 m ³
		Soakaway, upstream pipework, catchpit and chamber accommodates a greater volume required for 1 in 100 year events +30% allowance for climate change. Ponding of surface water may also occur on flat areas at the rear of the dwellings.			OK
		Gardens to be as flat as practically possible in area of soakaway with gravel boards to boundaries / upstand to retaining walls to allow ponding of water within garden area.			

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 2 & 5 Rear		Sheet No DSA/14
DATA		CALCULATIONS			RESULTS
8. <u>DESIGN DATA - WATER STORAGE CELL SOAKAWAY</u>					
From porosity tests	Measured infiltration rate		f	4.98E-01 m/hr	
CIRIA C753 Pg. 553	Factor of safety	(Minor inconvenience, gardens, parking)	Fs	2.0	
CIRIA 156 Pg. 54	Porosity	(water storage cell)	n	0.95	
CIRIA C697 Pg. 4-31		(clean stone)	n	0.40	
From Plan (Plot 1)	Area to be drained		A _D	23.50 m²	
Assume a soakaway of modular water storage cells wrapped in geotextile material, backfilled with 200mm of clean stone					
Length		1.000 m	Effective Length	1.400 m	
Width		0.500 m	Effective Width	0.900 m	
Stone Surround		0.200 m			
CIRIA 156 Pg 54 & 93, C697 Pg 4-31	Effective porosity (geocells & excavation filled with clean stone)		n'	0.618	
9. <u>FILTER DRAIN DESIGN</u>					
By Calculation, q = f/Fs	Effective infiltration coefficient (measured infiltration rate/factor of safety)		q	0.2489 m/hr	
From Plan	Area to be drained		A _D	23.50 m ²	
By Calculation, A _b = L * W	Base Area of soakaway		A _b	1.26 m ²	
By Calculation, P = 2L + 2W	Perimeter of Soakaway		P	4.60 m	
CIRIA 156 Pg. 57	Factor a = (A _b /P) - (iAD/Pq)		a	varies	
CIRIA 156 Pg. 57	Factor b = (Pq/nA _b)		b	1.470	

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM							Job No 5068	
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 2 & 5 Rear							Sheet No DSA/15	
DATA		CALCULATIONS								RESULTS	
9.	<u>FILTER DRAIN DESIGN (continued)</u>										
	Duration		10 Year Return			30 Year Return			100 Year Return		
			i	Factor a	Max Depth m	i	Factor a	Max Depth m	i	Factor a	Max Depth m
	min	hr	m/hr		m	m/hr		m	m/hr		m
	5	0.083	0.090	-1.6	0.181	0.108	-1.9	0.224	0.136	-2.5	0.291
	10	0.167	0.065	-1.1	0.230	0.079	-1.4	0.295	0.101	-1.8	0.390
	15	0.250	0.053	-0.8	0.250	0.065	-1.1	0.327	0.083	-1.4	0.442
	20	0.333	0.044	-0.6	0.243	0.054	-0.8	0.320	0.069	-1.1	0.444
	25	0.417	0.038	-0.5	0.234	0.047	-0.7	0.315	0.061	-1.0	0.447
	30	0.500	0.035	-0.4	0.228	0.042	-0.6	0.311	0.055	-0.9	0.446
	45	0.750	0.026	-0.3	0.179	0.033	-0.4	0.264	0.043	-0.6	0.402
	60	1.000	0.022	-0.2	0.142	0.028	-0.3	0.227	0.036	-0.5	0.361
	90	1.500	0.017	-0.1	0.060	0.021	-0.2	0.134	0.027	-0.3	0.254
	120	2.000	0.014	0.0	0.009	0.017	-0.1	0.074	0.022	-0.2	0.178
	240	4.000	0.009	0.1	-0.098	0.011	0.1	-0.057	0.014	0.0	0.010
	360	6.000	0.006	0.1	-0.143	0.008	0.1	-0.111	0.010	0.1	-0.063
	600	10.000	0.004	0.2	-0.182	0.006	0.2	-0.161	0.007	0.1	-0.128
	1440	24.000	0.002	0.2	-0.226	0.003	0.2	-0.215	0.004	0.2	-0.199
	For 1 in 10 year return period storm										
	From Table	Maximum depth of water					h_{max}		0.250 m		
By calculation	Time for half emptying					$t_{1/2}$		-0.045 hr			<24 hrs OK
For 1 in 30 year return period storm											
Depth of storage (with allowance for porosity of water storage cells and stone surround)								0.077 m			
Total Depth required for 1 in 30 yr event								0.327 m			
Depth of water storage cells to be provided								0.4 m			
Residual volume available								0.057 m ³			

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 2 & 5 Rear		Sheet No DSA/16
DATA		CALCULATIONS			RESULTS
9.		<u>FILTER DRAIN DESIGN (continued)</u>			
		For 1 in 100 year return period storm (total catchment)			
		Potential flood volume (in excess of storage provided for 1 in 30 year storm conditions)			0.093 m ³
					+30%cc 0.198 m ³
		Potential flood volume (in excess of total storage provided for in soakaway geocells & stone surround)			0.036 m ³
					+30%cc 0.141 m ³
		Soakaway accommodates the volume of retention required for the 3.3% annual probability storm event within the geocellular units and the stone surround. Additional storage for more extreme events will also be achieved within the geocellular units, 200mm stone surround, pipework, catchpits, chambers, bedding and backfill.			
		It is likely that the volume of stone surround is greater than that used in the calculations thus increasing the storage provided for extreme events and climate change.			
		Additional Storage Provided			
		0.10 upstream pipework 6 m say 1 No			0.047 m ³
		0.45 dia catchpit say 0.60 m 1 No			0.095 m ³
		0.45 dia chambers say 0.00 m 0 No			0 m ³
					0.143 m ³
		Residual 1 in 100yr storage required			-0.11 m ³
		1 in 100yr + 30 % CC			-0.002 m ³
		Soakaway, upstream pipework, catchpit and chamber accommodates a greater volume required for 1 in 100 year events +30% allowance for climate change. Ponding of surface water may also occur on flat areas at the rear of the dwellings.			OK
		Gardens to be as flat as practically possible in area of soakaway with gravel boards to boundaries / upstand to retaining walls to allow ponding of water within garden area.			

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068	
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 4-7 & PARKING		Sheet No DSA/17	
DATA		CALCULATIONS			RESULTS	
8.	<u>DESIGN DATA - WATER STORAGE CELL SOAKAWAY</u>					
	From porosity tests	Measured infiltration rate		f	7.99E-02 m/hr	
	CIRIA C753 Pg. 553	Factor of safety	(Minor inconvenience, gardens, parking)	Fs	3.0	
	CIRIA 156 Pg. 54	Porosity	(water storage cell)	n	0.95	
	CIRIA C697 Pg. 4-31		(clean stone)	n	0.40	
	From Plan	Area to be drained		A _D	158.00 m²	
	Assume a soakaway of modular water storage cells wrapped in geotextile material, backfilled with 200mm of clean stone					
		Length	5.000 m	Effective Length	5.400 m	
		Width	1.500 m	Effective Width	1.900 m	
		Stone Surround	0.200 m			
	CIRIA 156 Pg 54 & 93, C697 Pg 4-31	Effective porosity (geocells & excavation filled with clean stone)		n'	0.802	
	9.	<u>FILTER DRAIN DESIGN</u>				
		By Calculation, q = f/Fs	Effective infiltration coefficient (measured infiltration rate/factor of safety)		q	0.02664 m/hr
From Plan		Area to be drained		A _D	158.00 m ²	
By Calculation, A _b = L * W		Base Area of soakaway		A _b	10.26 m ²	
By Calculation, P = 2L + 2W		Perimeter of Soakaway		P	14.60 m	
CIRIA 156 Pg. 57		Factor a = (A _b /P) - (iAD/Pq)		a	varies	
CIRIA 156 Pg. 57		Factor b = (Pq/nA _b)		b	0.0473	

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM							Job No 5068			
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 4-7 & PARKING							Sheet No DSA/18			
DATA			CALCULATIONS							RESULTS			
9.			<u>FILTER DRAIN DESIGN (continued)</u>										
			Duration		10 Year Return			30 Year Return			100 Year Return		
					i	Factor a	Max Depth m	i	Factor a	Max Depth m	i	Factor a	Max Depth m
			min	hr	m/hr			m/hr			m/hr		
			5	0.083	0.090	-35.8	0.141	0.108	-43.1	0.169	0.136	-54.7	0.215
			10	0.167	0.065	-25.7	0.201	0.079	-31.5	0.248	0.101	-40.3	0.316
			15	0.250	0.053	-20.8	0.245	0.065	-25.8	0.303	0.083	-33.2	0.390
			20	0.333	0.044	-17.1	0.268	0.054	-21.1	0.329	0.069	-27.4	0.429
			25	0.417	0.038	-14.8	0.289	0.047	-18.3	0.358	0.061	-24.0	0.468
			30	0.500	0.035	-13.4	0.313	0.042	-16.6	0.387	0.055	-21.7	0.506
			45	0.750	0.026	-10.0	0.350	0.033	-12.5	0.437	0.043	-16.6	0.579
			60	1.000	0.022	-8.4	0.386	0.028	-10.6	0.487	0.036	-14.0	0.646
			90	1.500	0.017	-6.1	0.415	0.021	-7.7	0.527	0.027	-10.4	0.709
			120	2.000	0.014	-4.9	0.442	0.017	-6.3	0.565	0.022	-8.4	0.760
			240	4.000	0.009	-2.8	0.477	0.011	-3.6	0.618	0.014	-4.9	0.846
			360	6.000	0.006	-1.9	0.468	0.008	-2.5	0.620	0.010	-3.5	0.857
			600	10.000	0.004	-1.1	0.418	0.006	-1.5	0.578	0.007	-2.2	0.822
			1440	24.000	0.002	-0.3	0.171	0.003	-0.5	0.315	0.004	-0.8	0.531
			For 1 in 10 year return period storm										
			From Table	Maximum depth of water					h_{max}	0.477 m			
			By calculation	Time for half emptying					$t_{1/2}$	4.27 hr			
For 1 in 30 year return period storm													
Depth of storage (with allowance for porosity of water storage cells and stone surround)								0.143 m					
Total Depth required for 1 in 30 yr event								0.620 m					
Depth of water storage cells to be provided								0.8 m					
Residual volume available								1.480 m³					

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068																
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOTS 4-7 & PARKING		Sheet No DSA/19																
DATA		CALCULATIONS			RESULTS																
9. <u>FILTER DRAIN DESIGN (continued)</u> For 1 in 100 year return period storm (total catchment) Potential flood volume (in excess of storage provided for 1 in 30 year storm conditions) 1.946 m³ +30%cc 4.061 m³ Potential flood volume (in excess of total storage provided for in soakaway geocells & stone surround) 0.466 m³ +30%cc 2.581 m³ Soakaway accommodates the volume of retention required for the 3.3% annual probability storm event within the geocellular units and the stone surround. Additional storage for more extreme events will also be achieved within the geocellular units, 200mm stone surround, pipework, catchpits, chambers, bedding and backfill. It is likely that the volume of stone surround is greater than that used in the calculations thus increasing the storage provided for extreme events and climate change. Additional Storage Provided<table><tr><td>0.15 upstream pipework</td><td>20 m say</td><td>1 No</td><td>0.353 m³</td></tr><tr><td>0.45 dia catchpit</td><td>say 0.95 m</td><td>2 No</td><td>0.302 m³</td></tr><tr><td>0.45 dia chambers</td><td>say 1.00 m</td><td>0 No</td><td>0 m³</td></tr><tr><td colspan="3"></td><td> 0.656 m³ </td></tr></table> Residual 1 in 100yr storage required -0.19 m³ 1 in 100yr + 30 % CC 1.93 m³ Storage provided on the surface of the car park up to top of kerb level and parking area between plots 4 and 7 as shown on drawing 5068/04 as revised See Summary Page for 1 in 100 year + 30% Storage Volumes						0.15 upstream pipework	20 m say	1 No	0.353 m ³	0.45 dia catchpit	say 0.95 m	2 No	0.302 m ³	0.45 dia chambers	say 1.00 m	0 No	0 m ³				0.656 m³
0.15 upstream pipework	20 m say	1 No	0.353 m ³																		
0.45 dia catchpit	say 0.95 m	2 No	0.302 m ³																		
0.45 dia chambers	say 1.00 m	0 No	0 m ³																		
			0.656 m³																		

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOT 8 REAR		Sheet No DSA/20
DATA		CALCULATIONS			RESULTS
8. <u>DESIGN DATA - WATER STORAGE CELL SOAKAWAY</u>					
From porosity tests	Measured infiltration rate		f	2.70E+00 m/hr	
CIRIA C753 Pg. 553	Factor of safety	(Minor inconvenience, gardens, parking)	Fs	2.0	
CIRIA 156 Pg. 54	Porosity	(water storage cell)	n	0.40	
CIRIA C697 Pg. 4-31		(clean stone)	n	0.40	
From Plan (Plot 1)	Area to be drained		A _D	19.30 m²	
Assume a soakaway of modular water storage cells wrapped in geotextile material, backfilled with 200mm of clean stone					
	Length	1.000 m	Effective Length	1.000 m	
	Width	0.500 m	Effective Width	0.500 m	
	Stone Surround	0.000 m			
CIRIA 156 Pg 54 & 93, C697 Pg 4-31	Effective porosity (geocells & excavation filled with clean stone)		n'	0.400	
9. <u>FILTER DRAIN DESIGN</u>					
By Calculation, q = f/Fs	Effective infiltration coefficient (measured infiltration rate/factor of safety)		q	1.3478 m/hr	
From Plan	Area to be drained		A _D	19.30 m ²	
By Calculation, A _b = L * W	Base Area of soakaway		A _b	0.50 m ²	
By Calculation, P = 2L + 2W	Perimeter of Soakaway		P	3.00 m	
CIRIA 156 Pg. 57	Factor a = (Ab/P) - (iAD/Pq)		a	varies	
CIRIA 156 Pg. 57	Factor b = (Pq/nAb)		b	20.217	

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM							Job No 5068		
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOT 8 REAR							Sheet No DSA/21		
DATA		CALCULATIONS									RESULTS	
9.	<u>FILTER DRAIN DESIGN (continued)</u>											
	Duration		10 Year Return			30 Year Return			100 Year Return			
			i	Factor a	Max Depth m	i	Factor a	Max Depth m	i	Factor a	Max Depth m	
	min	hr	m/hr			m/hr			m/hr			
	5	0.083	0.090	-0.3	0.214	0.108	-0.3	0.283	0.136	-0.5	0.394	
	10	0.167	0.065	-0.1	0.138	0.079	-0.2	0.205	0.101	-0.3	0.304	
	15	0.250	0.053	-0.1	0.086	0.065	-0.1	0.143	0.083	-0.2	0.230	
	20	0.333	0.044	0.0	0.043	0.054	-0.1	0.089	0.069	-0.2	0.164	
	25	0.417	0.038	0.0	0.016	0.047	-0.1	0.057	0.061	-0.1	0.124	
	30	0.500	0.035	0.0	-0.001	0.042	0.0	0.036	0.055	-0.1	0.096	
	45	0.750	0.026	0.0	-0.040	0.033	0.0	-0.011	0.043	0.0	0.037	
	60	1.000	0.022	0.1	-0.060	0.028	0.0	-0.034	0.036	0.0	0.006	
	90	1.500	0.017	0.1	-0.087	0.021	0.1	-0.068	0.027	0.0	-0.037	
	120	2.000	0.014	0.1	-0.101	0.017	0.1	-0.085	0.022	0.1	-0.059	
	240	4.000	0.009	0.1	-0.126	0.011	0.1	-0.116	0.014	0.1	-0.101	
	360	6.000	0.006	0.1	-0.136	0.008	0.1	-0.129	0.010	0.1	-0.118	
	600	10.000	0.004	0.1	-0.145	0.006	0.1	-0.140	0.007	0.1	-0.133	
	1440	24.000	0.002	0.2	-0.155	0.003	0.2	-0.153	0.004	0.1	-0.149	
	For 1 in 10 year return period storm											
From Table	Maximum depth of water					h_{max}		0.214 m				
By calculation	Time for half emptying					$t_{1/2}$		-0.010 hr			<24 hrs OK	
For 1 in 30 year return period storm												
Depth of storage (with allowance for porosity of water storage cells and stone surround)								0.070 m				
Total Depth required for 1 in 30 yr event								0.283 m				
Depth of water storage cells to be provided								0.4 m				
Residual volume available								0.023 m³				

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOT 8 REAR		Sheet No DSA/22
DATA		CALCULATIONS			RESULTS
9.		<u>FILTER DRAIN DESIGN (continued)</u>			
		For 1 in 100 year return period storm (total catchment)			
		Potential flood volume (in excess of storage provided for 1 in 30 year storm conditions)			0.022 m ³
		+30%cc			0.046 m ³
		Potential flood volume (in excess of total storage provided for in soakaway geocells & stone surround)			-0.001 m ³
		+30%cc			0.022 m ³
		Soakaway accommodates the volume of retention required for the 3.3% annual probability storm event within the geocellular units and the stone surround. Additional storage for more extreme events will also be achieved within the geocellular units, 200mm stone surround, pipework, catchpits, chambers, bedding and backfill.			
		It is likely that the volume of stone surround is greater than that used in the calculations thus increasing the storage provided for extreme events and climate change.			
		Additional Storage Provided			
		0.10 upstream pipework	4 m say	1 No	0.031 m ³
		0.45 dia catchpit	say 1.00 m	1 No	0.159 m ³
		0.45 dia chambers	say 0.00 m	0 No	0 m ³
					0.19 m ³
		Residual 1 in 100yr storage required			-0.19 m ³
		1 in 100yr + 30 % CC			-0.168 m³
		Soakaway, upstream pipework, catchpit and chamber accommodate the volume required for 1 in 100 year events +30% allowance for climate change. Ponding of surface water may also occur on flat areas at the rear of the dwellings.			
		Gardens to be as flat as practically possible in area of soakaway with gravel boards to boundaries / upstand to retaining walls to allow ponding of water within garden area.			
					OK

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM	Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOT 8 FRONT & 9	Sheet No DSA/23
DATA	CALCULATIONS			RESULTS
8.	<u>DESIGN DATA - WATER STORAGE CELL SOAKAWAY</u>			
From porosity tests	Measured infiltration rate	f	2.70E+00 m/hr	
CIRIA C753 Pg. 553	Factor of safety (Minor inconvenience, gardens, parking)	F _s	2.0	
CIRIA 156 Pg. 54	Porosity (water storage cell)	n	0.95	
CIRIA C697 Pg. 4-31	(clean stone)	n	0.40	
From Plan (Plot 1)	Area to be drained	A _D	68.50 m²	
	Assume a soakaway of modular water storage cells wrapped in geotextile material, backfilled with 200mm of clean stone			
	Length 2.000 m	Effective Length	2.400 m	
	Width 0.500 m	Effective Width	0.900 m	
	Stone Surround 0.200 m			
CIRIA 156 Pg 54 & 93, C697 Pg 4-31	Effective porosity (geocells & excavation filled with clean stone)	n'	0.655	
9.	<u>FILTER DRAIN DESIGN</u>			
By Calculation, q = f/F _s	Effective infiltration coefficient (measured infiltration rate/factor of safety)	q	1.3478 m/hr	
From Plan	Area to be drained	A _D	68.50 m ²	
By Calculation, A _b = L * W	Base Area of soakaway	A _b	2.16 m ²	
By Calculation, P = 2L + 2W	Perimeter of Soakaway	P	6.60 m	
CIRIA 156 Pg. 57	Factor a = (A _b /P) - (iA _D /Pq)	a	varies	
CIRIA 156 Pg. 57	Factor b = (Pq/nA _b)	b	6.291	

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM							Job No 5068	
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOT 8 FRONT & 9							Sheet No DSA/24	
DATA			CALCULATIONS							RESULTS	
9.			<u>FILTER DRAIN DESIGN (continued)</u>								
			Duration		10 Year Return			30 Year Return			100 Year Return
		i	Factor a	Max Depth m	i	Factor a	Max Depth m	i	Factor a	Max Depth m	
min	hr	m/hr			m/hr			m/hr			
5	0.083	0.090	-0.4	0.149	0.108	-0.5	0.205	0.136	-0.7	0.295	
10	0.167	0.065	-0.2	0.112	0.079	-0.3	0.185	0.101	-0.4	0.292	
15	0.250	0.053	-0.1	0.064	0.065	-0.2	0.138	0.083	-0.3	0.250	
20	0.333	0.044	0.0	0.010	0.054	-0.1	0.075	0.069	-0.2	0.181	
25	0.417	0.038	0.0	-0.031	0.047	0.0	0.031	0.061	-0.1	0.131	
30	0.500	0.035	0.1	-0.058	0.042	0.0	0.000	0.055	-0.1	0.093	
45	0.750	0.026	0.1	-0.123	0.033	0.1	-0.075	0.043	0.0	0.001	
60	1.000	0.022	0.2	-0.155	0.028	0.1	-0.114	0.036	0.0	-0.049	
90	1.500	0.017	0.2	-0.199	0.021	0.2	-0.168	0.027	0.1	-0.117	
120	2.000	0.014	0.2	-0.221	0.017	0.2	-0.195	0.022	0.2	-0.154	
240	4.000	0.009	0.3	-0.261	0.011	0.2	-0.246	0.014	0.2	-0.221	
360	6.000	0.006	0.3	-0.278	0.008	0.3	-0.266	0.010	0.2	-0.248	
600	10.000	0.004	0.3	-0.293	0.006	0.3	-0.285	0.007	0.3	-0.273	
1440	24.000	0.002	0.3	-0.309	0.003	0.3	-0.305	0.004	0.3	-0.299	
For 1 in 10 year return period storm											
From Table	Maximum depth of water					h_{max}		0.149 m			
By calculation	Time for half emptying					$t_{1/2}$		-0.0059 hr			<24 hrs OK
For 1 in 30 year return period storm											
Depth of storage (with allowance for porosity of water storage cells and stone surround)								0.056 m			
Total Depth required for 1 in 30 yr event								0.205 m			
Depth of water storage cells to be provided								0.4 m			
Residual volume available								0.275 m ³			

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: PLOT 8 FRONT & 9		Sheet No DSA/25
DATA	CALCULATIONS				RESULTS
9.	FILTER DRAIN DESIGN (continued)				OK
	For 1 in 100 year return period storm (total catchment)				
	Potential flood volume (in excess of storage provided for 1 in 30 year storm conditions) 0.126 m³				
	+30%cc 0.251 m³				
	Potential flood volume (in excess of total storage provided for in soakaway geocells & stone surround) -0.149 m³				
	+30%cc -0.024 m³				
	Soakaway accommodates the volume of retention required for the 3.3% annual probability storm event within the geocellular units and the stone surround. Additional storage for more extreme events will also be achieved within the geocellular units, 200mm stone surround, pipework, catchpits, chambers, bedding and backfill.				
	It is likely that the volume of stone surround is greater than that used in the calculations thus increasing the storage provided for extreme events and climate change.				
	Additional Storage Provided				
	0.10 upstream pipework 6 m say 1 No 0.047 m³				
	0.45 dia catchpit say 1.30 m 1 No 0.207 m³				
	0.45 dia chambers say 0.00 m 0 No 0 m³				
	0.254 m³				
	Residual 1 in 100yr storage required -0.40 m³				
	1 in 100yr + 30 % CC -0.278 m³				
	Soakaway, upstream pipework, catchpit and chamber accommodates a greater volume required for 1 in 100 year events +30% allowance for climate change. Ponding of surface water may also occur on flat areas at the rear of the dwellings.				
	Gardens to be as flat as practically possible in area of soakaway with gravel boards to boundaries / upstand to retaining walls to allow ponding of water within garden area.				

CALCULATION SHEET



Client MR PAUL WOOLLAM			Job Title PROPOSED RESIDENTIAL DEVELOPMENT BRIARY CLOSE, WREXHAM		Job No 5068																								
By RW	Date 07.19	Chkd RW	Element GEOCELLULAR SOAKAWAY: SUMMARY		Sheet No DSA26																								
DATA			CALCULATIONS		RESULTS																								
10. SUMMARY The calculations demonstrate that the domestic soakaways to individual dwellings provide sufficient storage within the geocellular units, stone surround, catchpit, pipework and upstram chamber(s) to accommodate the 1 in 100 year return period events plus a 30% allowance for climate change. The design of the soakaways also incorporates a suitable factor of safety in accordance with CIRIA C753 The SuDS Manual Table 25.2. Additional storage is also provided on the surface of flat garden areas etc. Additional storage is provided on the surface of the parking areas to accommodate excess surface water from soakaways located in the parking and access road. Additional storage is also provided in the rear garden of Plot 9. See drawing 5068/04 as revised Excess Surface Water From Soakaways for 1 in 100 + 30% cc <table border="1"> <thead> <tr> <th>Reference</th> <th>Excess SW Volume m³</th> </tr> </thead> <tbody> <tr> <td>Car Park</td> <td>2.22</td> </tr> <tr> <td>Plots 1-3 & Parking</td> <td>0.54</td> </tr> <tr> <td>Plot 4-7 & Parking</td> <td>1.93</td> </tr> <tr> <td>Total</td> <td>4.69</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th></th> <th>Storage Volume Provided m³</th> <th>FOS</th> </tr> </thead> <tbody> <tr> <td>Car Park</td> <td>4.68</td> <td></td> </tr> <tr> <td>Plots 1-3 & Parking</td> <td>2.63</td> <td></td> </tr> <tr> <td>Total</td> <td>7.31</td> <td>1.56</td> </tr> </tbody> </table> <table border="1"> <tbody> <tr> <td>Plot 9</td> <td>4.76</td> </tr> </tbody> </table>						Reference	Excess SW Volume m ³	Car Park	2.22	Plots 1-3 & Parking	0.54	Plot 4-7 & Parking	1.93	Total	4.69		Storage Volume Provided m ³	FOS	Car Park	4.68		Plots 1-3 & Parking	2.63		Total	7.31	1.56	Plot 9	4.76
Reference	Excess SW Volume m ³																												
Car Park	2.22																												
Plots 1-3 & Parking	0.54																												
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	Storage Volume Provided m ³	FOS																											
Car Park	4.68																												
Plots 1-3 & Parking	2.63																												
Total	7.31	1.56																											
Plot 9	4.76																												

OK

Additional