

LEGEND

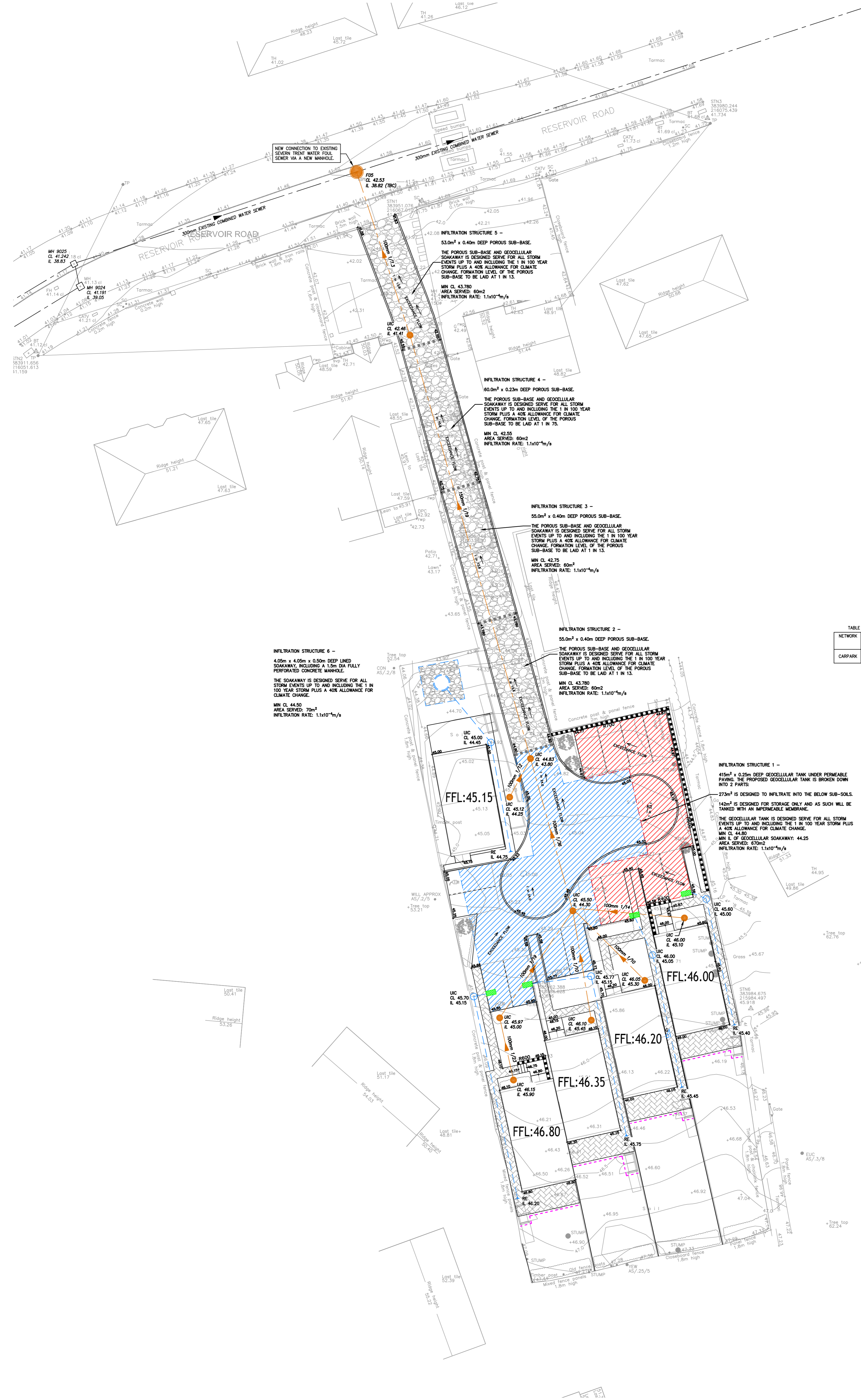
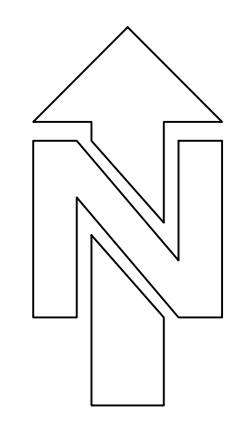
- FFL:45.65** Proposed finished floor level
- 48.31 Proposed level
- 1:25 Proposed gradient
- REOO Denotes approximate extent of retaining wall with max. retaining height shown.
- G Trapped yard gully
- RE Surface water rodding eye
- Gravel filter strip
- 100mm 1/100 Foul water drain
- 100mm 1/100 Surface water drain
- Existing foul water pipe
- S1 Surface water inspection chamber
- F1 Foul water inspection chamber
- Foul water manhole
- Concrete baffle separating permeable sub-base.
- Denotes extent of permeable block paving driveway with a porous sub-base.
- Denotes extent of permeable paved patio
- Denotes extent of proposed geocellular soakaway beneath proposed permeable paving
- Denotes extent of proposed geocellular tank lined with an impermeable membrane beneath proposed permeable paving.
- Geocellular distributor box.
- EXCEEDANCE FLOW Flood exceedance route

DRAINAGE STRATEGY NOTES

1. Based on site investigation report 488/RS by Wilson Associates it is understood that infiltration is possible at shallow depths. A such it is considered suitable to use soakaways at shallow depths.
2. The surface water runoff from the proposed access road will be collected by the proposed permeable surfacing which will drain into the proposed porous sub-base beneath where it will infiltrate in the ground. The proposed porous sub-base has been designed to serve all storm events up to and including the 1 in 100 year storm event plus a 40% allowance for climate change.
3. The surface water runoff from the 4 plots to the south and the proposed turning head and parking areas will drain to a geocellular tank at shallow depths below the proposed turning head. Part of the proposed geocellular tank is to be lined with an impermeable membrane whilst the rest is to be unlined to allow infiltration. The geocellular tank has been designed to serve all storm events up to and including a 1 in 100 year event plus a 40% allowance for climate change.
4. The surface water runoff for the plot to the north of the proposed turning head will be collected via a traditional below ground drainage network and conveyed to a proposed lined soakaway within the rear garden of the plot. The soakaway is designed to serve all storm events up to and including the 1 in 100 year storm event plus a 40% allowance for climate change.
5. Water quality improvements are provided by the proposed porous sub-base. Table A shows the required and achieved pollution mitigation indices.
6. The foul water drainage generated from the proposed development will be conveyed to the north of the site via a traditional network of below ground drainage, and connected to a new manhole to be installed on the line of the existing Severn Trent Water sewer on Reservoir Road.

TABLE A: POLLUTION MITIGATION INDICES

NETWORK	USE	POLLUTION HAZARD INDEX			SUBS COMPONENT	POLLUTION MITIGATION INDEX		
		TSS	METALS	TPH		TSS	METALS	TPH
CARPARK	ROAD/PARKING	0.5	0.4	0.4	PERMEABLE SURFACING	0.7	0.6	0.7



INFILTRATION STRUCTURE 6 -
 4.05m x 4.05m x 0.50m DEEP LINED SOAKAWAY INCLUDING A 1.2m DIA FULLY PERFORATED CONCRETE MANHOLE.
 THE SOAKAWAY IS DESIGNED SERVE FOR ALL STORM EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR STORM PLUS A 40% ALLOWANCE FOR CLIMATE CHANGE.
 MIN CL 44.50
 AREA SERVED: 70m²
 INFILTRATION RATE: 1.1x10⁻⁶m/s

INFILTRATION STRUCTURE 5 -
 53.0m² x 0.40m DEEP POROUS SUB-BASE.
 THE POROUS SUB-BASE AND GEOCELLULAR SOAKAWAY IS DESIGNED SERVE FOR ALL STORM EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR STORM PLUS A 40% ALLOWANCE FOR CLIMATE CHANGE. FORMATION LEVEL OF THE POROUS SUB-BASE TO BE LAID AT 1 IN 13.
 MIN CL 43.780
 AREA SERVED: 80m²
 INFILTRATION RATE: 1.1x10⁻⁶m/s

INFILTRATION STRUCTURE 4 -
 60.0m² x 0.23m DEEP POROUS SUB-BASE.
 THE POROUS SUB-BASE AND GEOCELLULAR SOAKAWAY IS DESIGNED SERVE FOR ALL STORM EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR STORM PLUS A 40% ALLOWANCE FOR CLIMATE CHANGE. FORMATION LEVEL OF THE POROUS SUB-BASE TO BE LAID AT 1 IN 75.
 MIN CL 42.55
 AREA SERVED: 80m²
 INFILTRATION RATE: 1.1x10⁻⁶m/s

INFILTRATION STRUCTURE 3 -
 55.0m² x 0.40m DEEP POROUS SUB-BASE.
 THE POROUS SUB-BASE AND GEOCELLULAR SOAKAWAY IS DESIGNED SERVE FOR ALL STORM EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR STORM PLUS A 40% ALLOWANCE FOR CLIMATE CHANGE. FORMATION LEVEL OF THE POROUS SUB-BASE TO BE LAID AT 1 IN 13.
 MIN CL 42.75
 AREA SERVED: 60m²
 INFILTRATION RATE: 1.1x10⁻⁶m/s

INFILTRATION STRUCTURE 2 -
 55.0m² x 0.40m DEEP POROUS SUB-BASE.
 THE POROUS SUB-BASE AND GEOCELLULAR SOAKAWAY IS DESIGNED SERVE FOR ALL STORM EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR STORM PLUS A 40% ALLOWANCE FOR CLIMATE CHANGE. FORMATION LEVEL OF THE POROUS SUB-BASE TO BE LAID AT 1 IN 13.
 MIN CL 43.750
 AREA SERVED: 60m²
 INFILTRATION RATE: 1.1x10⁻⁶m/s

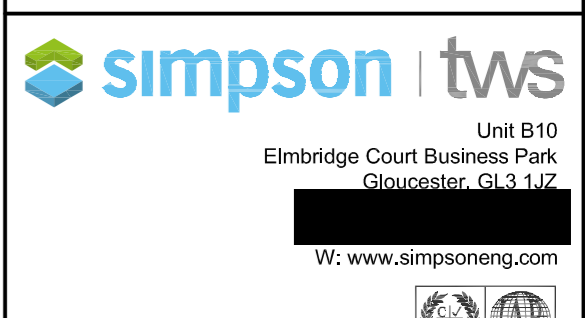
INFILTRATION STRUCTURE 1 -
 415m² x 0.25m DEEP GEOCELLULAR TANK UNDER PERMEABLE PAVING. THE PROPOSED GEOCELLULAR TANK IS BROKEN DOWN INTO 2 PARTS:
 273m² IS DESIGNED TO INFILTRATE INTO THE BELOW SUB-SOILS.
 142m² IS DESIGNED FOR STORAGE ONLY AND AS SUCH WILL BE TANKED WITH AN IMPERMEABLE MEMBRANE.
 THE GEOCELLULAR TANK IS DESIGNED SERVE FOR ALL STORM EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR STORM PLUS A 40% ALLOWANCE FOR CLIMATE CHANGE.
 MIN CL 44.80
 MIN IL OF GEOCELLULAR SOAKAWAY: 44.25
 AREA SERVED: 670m²
 INFILTRATION RATE: 1.1x10⁻⁶m/s

A	SOAKAWAY / PERMEABLE PAVING DESIGN UPDATED TO SUIT ALFA COMMENTS.	AGC	06.06.22
MK			

DRAWING STATUS
PRELIMINARY


DRAWING TITLE
DRAINAGE STRATEGY

PROJECT
**99-101 RESERVOIR ROAD
 GLOUCESTER
 GL4 6SZ**



London, Henley-on Thames and Gloucester

Drawn	Chkd	Scale	Date
EL	ADC	1:200 @ A1	OCT 2021
Purpose of Issue			
PRELIMINARY			
Project Number	Drawing Number	Revision	
P21-599	SK100	A	

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Unit B10, Elmbridge Court Gloucester GL3 1JZ	P21-599 Reservoir Road Infiltration Structure 2	
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Innovyze Source Control 2020.1.3

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 12 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	43.561	0.361	1.0	1.0	Flood Risk
30 min Summer	43.595	0.395	1.1	1.2	Flood Risk
60 min Summer	43.598	0.398	1.1	1.2	Flood Risk
120 min Summer	43.567	0.367	1.1	1.1	Flood Risk
180 min Summer	43.533	0.333	1.0	0.9	Flood Risk
240 min Summer	43.503	0.303	0.9	0.7	Flood Risk
360 min Summer	43.455	0.255	0.7	0.5	O K
480 min Summer	43.421	0.221	0.6	0.4	O K
600 min Summer	43.395	0.195	0.6	0.3	O K
720 min Summer	43.375	0.175	0.5	0.2	O K
960 min Summer	43.346	0.146	0.4	0.2	O K
1440 min Summer	43.309	0.109	0.3	0.1	O K
2160 min Summer	43.280	0.080	0.2	0.1	O K
2880 min Summer	43.264	0.064	0.2	0.0	O K
4320 min Summer	43.248	0.048	0.1	0.0	O K
5760 min Summer	43.243	0.043	0.1	0.0	O K
7200 min Summer	43.240	0.040	0.1	0.0	O K
8640 min Summer	43.237	0.037	0.1	0.0	O K
10080 min Summer	43.234	0.034	0.1	0.0	O K
15 min Winter	43.560	0.360	1.0	1.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	117.448	0.0	14
30 min Summer	79.010	0.0	22
60 min Summer	50.812	0.0	40
120 min Summer	31.621	0.0	72
180 min Summer	23.637	0.0	102
240 min Summer	19.105	0.0	134
360 min Summer	14.037	0.0	192
480 min Summer	11.286	0.0	252
600 min Summer	9.522	0.0	312
720 min Summer	8.282	0.0	370
960 min Summer	6.640	0.0	492
1440 min Summer	4.854	0.0	734
2160 min Summer	3.541	0.0	1100
2880 min Summer	2.828	0.0	1464
4320 min Summer	2.055	0.0	2128
5760 min Summer	1.637	0.0	2888
7200 min Summer	1.371	0.0	3576
8640 min Summer	1.186	0.0	4360
10080 min Summer	1.049	0.0	5040
15 min Winter	117.448	0.0	14

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
30 min Winter	43.588	0.388	1.1	1.2	Flood Risk
60 min Winter	43.580	0.380	1.1	1.1	Flood Risk
120 min Winter	43.530	0.330	0.9	0.8	Flood Risk
180 min Winter	43.484	0.284	0.8	0.6	Flood Risk
240 min Winter	43.447	0.247	0.7	0.5	O K
360 min Winter	43.394	0.194	0.6	0.3	O K
480 min Winter	43.361	0.161	0.5	0.2	O K
600 min Winter	43.337	0.137	0.4	0.1	O K
720 min Winter	43.320	0.120	0.3	0.1	O K
960 min Winter	43.297	0.097	0.3	0.1	O K
1440 min Winter	43.271	0.071	0.2	0.0	O K
2160 min Winter	43.252	0.052	0.1	0.0	O K
2880 min Winter	43.246	0.046	0.1	0.0	O K
4320 min Winter	43.239	0.039	0.1	0.0	O K
5760 min Winter	43.235	0.035	0.1	0.0	O K
7200 min Winter	43.232	0.032	0.1	0.0	O K
8640 min Winter	43.229	0.029	0.0	0.0	O K
10080 min Winter	43.228	0.028	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
30 min Winter	79.010	0.0	24
60 min Winter	50.812	0.0	42
120 min Winter	31.621	0.0	74
180 min Winter	23.637	0.0	106
240 min Winter	19.105	0.0	136
360 min Winter	14.037	0.0	194
480 min Winter	11.286	0.0	254
600 min Winter	9.522	0.0	312
720 min Winter	8.282	0.0	370
960 min Winter	6.640	0.0	492
1440 min Winter	4.854	0.0	732
2160 min Winter	3.541	0.0	1076
2880 min Winter	2.828	0.0	1464
4320 min Winter	2.055	0.0	2160
5760 min Winter	1.637	0.0	2856
7200 min Winter	1.371	0.0	3544
8640 min Winter	1.186	0.0	4344
10080 min Winter	1.049	0.0	5104

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.006

Time (mins)	Area
From: To:	(ha)
0	4 0.006

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Model Details

Storage is Online Cover Level (m) 43.780

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.39600	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	13.0
Max Percolation (l/s)	14.4	Slope (1:X)	13.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	43.200	Membrane Depth (m)	0

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 12 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	42.531	0.361	1.0	1.0	Flood Risk
30 min Summer	42.565	0.395	1.1	1.2	Flood Risk
60 min Summer	42.568	0.398	1.1	1.2	Flood Risk
120 min Summer	42.537	0.367	1.1	1.1	Flood Risk
180 min Summer	42.503	0.333	1.0	0.9	Flood Risk
240 min Summer	42.473	0.303	0.9	0.7	Flood Risk
360 min Summer	42.425	0.255	0.7	0.5	O K
480 min Summer	42.391	0.221	0.6	0.4	O K
600 min Summer	42.365	0.195	0.6	0.3	O K
720 min Summer	42.345	0.175	0.5	0.2	O K
960 min Summer	42.316	0.146	0.4	0.2	O K
1440 min Summer	42.279	0.109	0.3	0.1	O K
2160 min Summer	42.250	0.080	0.2	0.1	O K
2880 min Summer	42.234	0.064	0.2	0.0	O K
4320 min Summer	42.218	0.048	0.1	0.0	O K
5760 min Summer	42.213	0.043	0.1	0.0	O K
7200 min Summer	42.210	0.040	0.1	0.0	O K
8640 min Summer	42.207	0.037	0.1	0.0	O K
10080 min Summer	42.204	0.034	0.1	0.0	O K
15 min Winter	42.530	0.360	1.0	1.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	117.448	0.0	14
30 min Summer	79.010	0.0	22
60 min Summer	50.812	0.0	40
120 min Summer	31.621	0.0	72
180 min Summer	23.637	0.0	102
240 min Summer	19.105	0.0	134
360 min Summer	14.037	0.0	192
480 min Summer	11.286	0.0	252
600 min Summer	9.522	0.0	312
720 min Summer	8.282	0.0	370
960 min Summer	6.640	0.0	492
1440 min Summer	4.854	0.0	734
2160 min Summer	3.541	0.0	1100
2880 min Summer	2.828	0.0	1464
4320 min Summer	2.055	0.0	2128
5760 min Summer	1.637	0.0	2888
7200 min Summer	1.371	0.0	3576
8640 min Summer	1.186	0.0	4360
10080 min Summer	1.049	0.0	5040
15 min Winter	117.448	0.0	14

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
30 min Winter	42.558	0.388	1.1	1.2	Flood Risk
60 min Winter	42.550	0.380	1.1	1.1	Flood Risk
120 min Winter	42.500	0.330	0.9	0.8	Flood Risk
180 min Winter	42.454	0.284	0.8	0.6	Flood Risk
240 min Winter	42.417	0.247	0.7	0.5	O K
360 min Winter	42.364	0.194	0.6	0.3	O K
480 min Winter	42.331	0.161	0.5	0.2	O K
600 min Winter	42.307	0.137	0.4	0.1	O K
720 min Winter	42.290	0.120	0.3	0.1	O K
960 min Winter	42.267	0.097	0.3	0.1	O K
1440 min Winter	42.241	0.071	0.2	0.0	O K
2160 min Winter	42.222	0.052	0.1	0.0	O K
2880 min Winter	42.216	0.046	0.1	0.0	O K
4320 min Winter	42.209	0.039	0.1	0.0	O K
5760 min Winter	42.205	0.035	0.1	0.0	O K
7200 min Winter	42.202	0.032	0.1	0.0	O K
8640 min Winter	42.199	0.029	0.0	0.0	O K
10080 min Winter	42.198	0.028	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
30 min Winter	79.010	0.0	24
60 min Winter	50.812	0.0	42
120 min Winter	31.621	0.0	74
180 min Winter	23.637	0.0	106
240 min Winter	19.105	0.0	136
360 min Winter	14.037	0.0	194
480 min Winter	11.286	0.0	254
600 min Winter	9.522	0.0	312
720 min Winter	8.282	0.0	370
960 min Winter	6.640	0.0	492
1440 min Winter	4.854	0.0	732
2160 min Winter	3.541	0.0	1076
2880 min Winter	2.828	0.0	1464
4320 min Winter	2.055	0.0	2160
5760 min Winter	1.637	0.0	2856
7200 min Winter	1.371	0.0	3544
8640 min Winter	1.186	0.0	4344
10080 min Winter	1.049	0.0	5104

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.006

Time (mins)	Area
From: To:	(ha)
0	4 0.006

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Model Details

Storage is Online Cover Level (m) 42.750

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.39600	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	13.0
Max Percolation (l/s)	14.4	Slope (1:X)	13.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	42.170	Membrane Depth (m)	0

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 5 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	42.225	0.125	2.1	0.7	O K
30 min Summer	42.230	0.130	2.1	0.8	O K
60 min Summer	42.219	0.119	2.0	0.6	O K
120 min Summer	42.197	0.097	1.6	0.4	O K
180 min Summer	42.180	0.080	1.3	0.3	O K
240 min Summer	42.169	0.069	1.1	0.2	O K
360 min Summer	42.154	0.054	0.9	0.1	O K
480 min Summer	42.147	0.047	0.7	0.1	O K
600 min Summer	42.143	0.043	0.6	0.1	O K
720 min Summer	42.140	0.040	0.5	0.1	O K
960 min Summer	42.136	0.036	0.4	0.1	O K
1440 min Summer	42.131	0.031	0.3	0.0	O K
2160 min Summer	42.127	0.027	0.2	0.0	O K
2880 min Summer	42.124	0.024	0.2	0.0	O K
4320 min Summer	42.120	0.020	0.1	0.0	O K
5760 min Summer	42.118	0.018	0.1	0.0	O K
7200 min Summer	42.117	0.017	0.1	0.0	O K
8640 min Summer	42.115	0.015	0.1	0.0	O K
10080 min Summer	42.115	0.015	0.1	0.0	O K
15 min Winter	42.221	0.121	2.0	0.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	117.448	0.0	12
30 min Summer	79.010	0.0	20
60 min Summer	50.812	0.0	36
120 min Summer	31.621	0.0	66
180 min Summer	23.637	0.0	96
240 min Summer	19.105	0.0	126
360 min Summer	14.037	0.0	186
480 min Summer	11.286	0.0	244
600 min Summer	9.522	0.0	306
720 min Summer	8.282	0.0	366
960 min Summer	6.640	0.0	482
1440 min Summer	4.854	0.0	722
2160 min Summer	3.541	0.0	1096
2880 min Summer	2.828	0.0	1436
4320 min Summer	2.055	0.0	2192
5760 min Summer	1.637	0.0	2888
7200 min Summer	1.371	0.0	3672
8640 min Summer	1.186	0.0	4368
10080 min Summer	1.049	0.0	5080
15 min Winter	117.448	0.0	13

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
30 min Winter	42.222	0.122	2.0	0.7	O K
60 min Winter	42.203	0.103	1.7	0.5	O K
120 min Winter	42.175	0.075	1.2	0.3	O K
180 min Winter	42.159	0.059	1.0	0.2	O K
240 min Winter	42.149	0.049	0.8	0.1	O K
360 min Winter	42.142	0.042	0.6	0.1	O K
480 min Winter	42.138	0.038	0.5	0.1	O K
600 min Winter	42.135	0.035	0.4	0.1	O K
720 min Winter	42.133	0.033	0.4	0.0	O K
960 min Winter	42.129	0.029	0.3	0.0	O K
1440 min Winter	42.125	0.025	0.2	0.0	O K
2160 min Winter	42.121	0.021	0.1	0.0	O K
2880 min Winter	42.119	0.019	0.1	0.0	O K
4320 min Winter	42.116	0.016	0.1	0.0	O K
5760 min Winter	42.114	0.014	0.1	0.0	O K
7200 min Winter	42.113	0.013	0.1	0.0	O K
8640 min Winter	42.112	0.012	0.0	0.0	O K
10080 min Winter	42.112	0.012	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
30 min Winter	79.010	0.0	21
60 min Winter	50.812	0.0	36
120 min Winter	31.621	0.0	66
180 min Winter	23.637	0.0	96
240 min Winter	19.105	0.0	124
360 min Winter	14.037	0.0	184
480 min Winter	11.286	0.0	246
600 min Winter	9.522	0.0	306
720 min Winter	8.282	0.0	366
960 min Winter	6.640	0.0	482
1440 min Winter	4.854	0.0	734
2160 min Winter	3.541	0.0	1104
2880 min Winter	2.828	0.0	1448
4320 min Winter	2.055	0.0	2096
5760 min Winter	1.637	0.0	2816
7200 min Winter	1.371	0.0	3536
8640 min Winter	1.186	0.0	4360
10080 min Winter	1.049	0.0	5024

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Innovyze	Source Control 2020.1.3
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.006

Time (mins)	Area
From: To:	(ha)
0	4 0.006

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Innovyze Source Control 2020.1.3

Model Details

Storage is Online Cover Level (m) 42.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.39600	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	15.0
Max Percolation (l/s)	16.7	Slope (1:X)	75.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	42.100	Membrane Depth (m)	0

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 12 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	41.361	0.361	1.0	1.0	Flood Risk
30 min Summer	41.395	0.395	1.1	1.2	Flood Risk
60 min Summer	41.398	0.398	1.1	1.2	Flood Risk
120 min Summer	41.367	0.367	1.1	1.1	Flood Risk
180 min Summer	41.333	0.333	1.0	0.9	Flood Risk
240 min Summer	41.303	0.303	0.9	0.7	Flood Risk
360 min Summer	41.255	0.255	0.7	0.5	O K
480 min Summer	41.221	0.221	0.6	0.4	O K
600 min Summer	41.195	0.195	0.6	0.3	O K
720 min Summer	41.175	0.175	0.5	0.2	O K
960 min Summer	41.146	0.146	0.4	0.2	O K
1440 min Summer	41.109	0.109	0.3	0.1	O K
2160 min Summer	41.080	0.080	0.2	0.1	O K
2880 min Summer	41.064	0.064	0.2	0.0	O K
4320 min Summer	41.048	0.048	0.1	0.0	O K
5760 min Summer	41.043	0.043	0.1	0.0	O K
7200 min Summer	41.040	0.040	0.1	0.0	O K
8640 min Summer	41.037	0.037	0.1	0.0	O K
10080 min Summer	41.034	0.034	0.1	0.0	O K
15 min Winter	41.360	0.360	1.0	1.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	117.448	0.0	14
30 min Summer	79.010	0.0	22
60 min Summer	50.812	0.0	40
120 min Summer	31.621	0.0	72
180 min Summer	23.637	0.0	102
240 min Summer	19.105	0.0	134
360 min Summer	14.037	0.0	192
480 min Summer	11.286	0.0	252
600 min Summer	9.522	0.0	312
720 min Summer	8.282	0.0	370
960 min Summer	6.640	0.0	492
1440 min Summer	4.854	0.0	734
2160 min Summer	3.541	0.0	1100
2880 min Summer	2.828	0.0	1464
4320 min Summer	2.055	0.0	2128
5760 min Summer	1.637	0.0	2888
7200 min Summer	1.371	0.0	3576
8640 min Summer	1.186	0.0	4360
10080 min Summer	1.049	0.0	5040
15 min Winter	117.448	0.0	14

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
30 min Winter	41.388	0.388	1.1	1.2	Flood Risk
60 min Winter	41.380	0.380	1.1	1.1	Flood Risk
120 min Winter	41.330	0.330	0.9	0.8	Flood Risk
180 min Winter	41.284	0.284	0.8	0.6	Flood Risk
240 min Winter	41.247	0.247	0.7	0.5	O K
360 min Winter	41.194	0.194	0.6	0.3	O K
480 min Winter	41.161	0.161	0.5	0.2	O K
600 min Winter	41.137	0.137	0.4	0.1	O K
720 min Winter	41.120	0.120	0.3	0.1	O K
960 min Winter	41.097	0.097	0.3	0.1	O K
1440 min Winter	41.071	0.071	0.2	0.0	O K
2160 min Winter	41.052	0.052	0.1	0.0	O K
2880 min Winter	41.046	0.046	0.1	0.0	O K
4320 min Winter	41.039	0.039	0.1	0.0	O K
5760 min Winter	41.035	0.035	0.1	0.0	O K
7200 min Winter	41.032	0.032	0.1	0.0	O K
8640 min Winter	41.029	0.029	0.0	0.0	O K
10080 min Winter	41.028	0.028	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
30 min Winter	79.010	0.0	24
60 min Winter	50.812	0.0	42
120 min Winter	31.621	0.0	74
180 min Winter	23.637	0.0	106
240 min Winter	19.105	0.0	136
360 min Winter	14.037	0.0	194
480 min Winter	11.286	0.0	254
600 min Winter	9.522	0.0	312
720 min Winter	8.282	0.0	370
960 min Winter	6.640	0.0	492
1440 min Winter	4.854	0.0	732
2160 min Winter	3.541	0.0	1076
2880 min Winter	2.828	0.0	1464
4320 min Winter	2.055	0.0	2160
5760 min Winter	1.637	0.0	2856
7200 min Winter	1.371	0.0	3544
8640 min Winter	1.186	0.0	4344
10080 min Winter	1.049	0.0	5104

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.006

Time (mins)	Area
From: To:	(ha)
0	4 0.006

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Model Details

Storage is Online Cover Level (m) 41.580

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.39600	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	13.0
Max Percolation (l/s)	14.4	Slope (1:X)	13.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	41.000	Membrane Depth (m)	0

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 84 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	44.309	0.309	0.3	1.9	Flood Risk
30 min Summer	44.392	0.392	0.3	2.4	Flood Risk
60 min Summer	44.451	0.451	0.4	2.8	Flood Risk
120 min Summer	44.488	0.488	0.4	3.0	Flood Risk
180 min Summer	44.494	0.494	0.4	3.0	Flood Risk
240 min Summer	44.487	0.487	0.4	3.0	Flood Risk
360 min Summer	44.461	0.461	0.4	2.8	Flood Risk
480 min Summer	44.435	0.435	0.4	2.7	Flood Risk
600 min Summer	44.410	0.410	0.4	2.5	Flood Risk
720 min Summer	44.388	0.388	0.3	2.4	Flood Risk
960 min Summer	44.350	0.350	0.3	2.2	Flood Risk
1440 min Summer	44.294	0.294	0.3	1.8	Flood Risk
2160 min Summer	44.239	0.239	0.2	1.5	Flood Risk
2880 min Summer	44.203	0.203	0.2	1.2	Flood Risk
4320 min Summer	44.158	0.158	0.1	1.0	O K
5760 min Summer	44.130	0.130	0.1	0.8	O K
7200 min Summer	44.111	0.111	0.1	0.7	O K
8640 min Summer	44.098	0.098	0.1	0.6	O K
10080 min Summer	44.087	0.087	0.1	0.5	O K
15 min Winter	44.310	0.310	0.3	1.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	117.448	0.0	18
30 min Summer	79.010	0.0	31
60 min Summer	50.812	0.0	52
120 min Summer	31.621	0.0	84
180 min Summer	23.637	0.0	118
240 min Summer	19.105	0.0	154
360 min Summer	14.037	0.0	220
480 min Summer	11.286	0.0	286
600 min Summer	9.522	0.0	350
720 min Summer	8.282	0.0	414
960 min Summer	6.640	0.0	540
1440 min Summer	4.854	0.0	782
2160 min Summer	3.541	0.0	1148
2880 min Summer	2.828	0.0	1504
4320 min Summer	2.055	0.0	2248
5760 min Summer	1.637	0.0	2944
7200 min Summer	1.371	0.0	3680
8640 min Summer	1.186	0.0	4408
10080 min Summer	1.049	0.0	5144
15 min Winter	117.448	0.0	17

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	44.394	0.394	0.4	2.4	Flood Risk
60 min Winter	44.454	0.454	0.4	2.8	Flood Risk
120 min Winter	44.484	0.484	0.4	3.0	Flood Risk
180 min Winter	44.480	0.480	0.4	3.0	Flood Risk
240 min Winter	44.465	0.465	0.4	2.9	Flood Risk
360 min Winter	44.427	0.427	0.4	2.6	Flood Risk
480 min Winter	44.392	0.392	0.3	2.4	Flood Risk
600 min Winter	44.362	0.362	0.3	2.2	Flood Risk
720 min Winter	44.335	0.335	0.3	2.1	Flood Risk
960 min Winter	44.292	0.292	0.3	1.8	Flood Risk
1440 min Winter	44.233	0.233	0.2	1.4	Flood Risk
2160 min Winter	44.180	0.180	0.2	1.1	O K
2880 min Winter	44.148	0.148	0.1	0.9	O K
4320 min Winter	44.110	0.110	0.1	0.7	O K
5760 min Winter	44.089	0.089	0.1	0.5	O K
7200 min Winter	44.075	0.075	0.1	0.5	O K
8640 min Winter	44.065	0.065	0.1	0.4	O K
10080 min Winter	44.058	0.058	0.1	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	79.010	0.0	31
60 min Winter	50.812	0.0	56
120 min Winter	31.621	0.0	90
180 min Winter	23.637	0.0	128
240 min Winter	19.105	0.0	164
360 min Winter	14.037	0.0	234
480 min Winter	11.286	0.0	302
600 min Winter	9.522	0.0	368
720 min Winter	8.282	0.0	432
960 min Winter	6.640	0.0	560
1440 min Winter	4.854	0.0	808
2160 min Winter	3.541	0.0	1172
2880 min Winter	2.828	0.0	1532
4320 min Winter	2.055	0.0	2252
5760 min Winter	1.637	0.0	2992
7200 min Winter	1.371	0.0	3680
8640 min Winter	1.186	0.0	4416
10080 min Winter	1.049	0.0	5144

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.007

Time (mins)		Area
From:	To:	(ha)
0	4	0.007

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Model Details

Storage is Online Cover Level (m) 44.500

Lined Soakaway Structure

Infiltration Coefficient Base (m/hr)	0.00000	Ring Diameter (m)	1.50
Infiltration Coefficient Side (m/hr)	0.39600	Pit Multiplier	2.7
Safety Factor	2.0	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	44.000	Cap Infiltration Depth (m)	0.000

From: [REDACTED]
Sent: Tuesday, June 7, 2022 1:19 PM
To: Joann Meneaud <Joann.Meneaud@gloucester.gov.uk>
Subject: FW: Land to the rear of 99-101 Reservoir Road 21/01201/FUL - Drainage

CAUTION: This email originates from outside the organisation. Do not click links or open attachments unless you trust the sender and know the contact is safe. Contact IT if in doubt

Dear Joann,

In response to the comments received from the Council's drainage engineer, please see the comments below from Simpson Associates and the attached updated drainage strategy (P21-599-SK100A) and Micro Drainage calculations for infiltration structures 1-6. I will be on leave from Thursday and back in the office on 1st July, however in the event that there are any follow up queries whilst I am away, I would be grateful if the drainage engineer could contact Andrew De Croos direct. His contact details are in his email below.

With regards to the Tree Consultation comments received, I can confirm that a soft landscape plan has been commissioned and will be submitted shortly.

Are there any other comments that you have received that I should be aware of?

Regards

[REDACTED]

[REDACTED]

Director
Eclipse Planning Services
12 Church Green, Ramsey, Cambridgeshire, PE26 1DW
[REDACTED]
[REDACTED]
W: eclipseplanningservices.com

PLEASE NOTE I WILL BE OUT OF THE OFFICE FROM 9th - 30th JUNE 2022 (INCLUSIVE)

This email message and any attached file is confidential. If you should not have received it, please notify the sender and delete it without forwarding, copying or disclosing its contents.

From: [REDACTED]
Sent: 06 June 2022 17:21
To: [REDACTED]
[REDACTED]
Subject: RE: Land to the rear of 99-101 Reservoir Road 21/01201/FUL

Hi [REDACTED]

Please find attached an updated drainage strategy and supporting calculations. I've also added comments below.

I would be happy to discuss directly with the drainage officer.

1. There is no accompanying plan to demonstrate what areas are being captured by the SUDS elements. This contributing area plan needs to be presented with areas marked up in m²
The areas for each SuDS component are stated on the drawing. The drawing is relatively uncomplicated and so should be reasonable clear where each plot drains to, particularly for someone familiar with drainage design.
 - Infiltration structure 1 drains the permeable paved surface and plots 1-4.
 - Infiltration structures 2-5 drain only themselves, ie the permeable paving.
 - Infiltration structure 6 drains plot 5.
2. The Cv values would be expected to be set to 1 as the area is quick response hardstanding (pavements can be at 0.9);
The calculations have been updated to use a Cv value of 1. Updated calcs attached.
3. Can you provide details of the PIMP value and FLOOD RISK threshold in relation to the modelling;
100% of the drained impermeable area has been included.
The 'flood risk' threshold within the calculations is 300mm.
4. The infiltration through the base of a soakaway is discounted as over the life of the development the base will become blocked with fines and not work - this needs to be addressed
For infiltration structure 6 (plot 5 soakaway), the base of the soakaway has been discounted, updated calcs attached.
For permeable paving, the very nature of the construction filters out the debris that could block traditional soakaways and therefore, it is appropriate to use the base and sides for infiltration.
5. Soakaways should be greater than 5m away from properties - the use of the pavement unfortunately does not achieve this and should be addressed.
Infiltration structure 6 (plot 5 soakaway) is located 5m from the building.
The porous sub base beneath the permeable paving has RWP's discharging into it. We have ensured that the point of concentration at the distributor box is located at least 5m away from the plots. From distributor boxes, the flows will be spread widely over the large area of permeable paving rather than concentrating flows to a single point which is what traditional soakaways do. With this being the case, the 5m offset criteria would not be appropriate.
6. It is not clear how the 2-stage system works
Infiltration structure 1
Permeable paving has been used widely. However, the boundary levels dictate the need for a retaining wall. The area immediately adjacent the retaining wall has been lined with an impermeable membrane to prevent infiltration in these locations whilst still providing a zone to attenuation surface water flows.
7. Using permeable pavement is acceptable for the area it receives - unfortunately if it is to drain other areas it needs to be addressed as a soakaway (and associated building regs) and design
See item 5.

8. Qbar for the site and therefore the maximum rate of discharge from the site connecting into a STW surface water drain would be in the region of 0.5 l/s

The site is proposed to drain via infiltration and therefore an offsite connection to the STW sewer is not required.


Kind regards

[Redacted]

Partner

[Redacted]

[Redacted]

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 51 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
15 min Summer	44.514	0.264	3.9	13.4	Flood Risk
30 min Summer	44.557	0.307	4.5	17.8	Flood Risk
60 min Summer	44.585	0.335	5.0	20.8	Flood Risk
120 min Summer	44.598	0.348	5.2	22.2	Flood Risk
180 min Summer	44.594	0.344	5.1	21.8	Flood Risk
240 min Summer	44.585	0.335	5.0	20.8	Flood Risk
360 min Summer	44.562	0.312	4.6	18.3	Flood Risk
480 min Summer	44.541	0.291	4.3	16.2	Flood Risk
600 min Summer	44.523	0.273	4.0	14.4	Flood Risk
720 min Summer	44.507	0.257	3.8	12.8	Flood Risk
960 min Summer	44.482	0.232	3.4	10.4	O K
1440 min Summer	44.443	0.193	2.9	7.2	O K
2160 min Summer	44.405	0.155	2.3	4.6	O K
2880 min Summer	44.379	0.129	1.9	3.2	O K
4320 min Summer	44.348	0.098	1.4	1.8	O K
5760 min Summer	44.328	0.078	1.2	1.2	O K
7200 min Summer	44.316	0.066	1.0	0.8	O K
8640 min Summer	44.307	0.057	0.8	0.6	O K
10080 min Summer	44.300	0.050	0.7	0.5	O K
15 min Winter	44.514	0.264	3.9	13.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
15 min Summer	117.448	0.0	17
30 min Summer	79.010	0.0	30
60 min Summer	50.812	0.0	48
120 min Summer	31.621	0.0	82
180 min Summer	23.637	0.0	116
240 min Summer	19.105	0.0	148
360 min Summer	14.037	0.0	214
480 min Summer	11.286	0.0	278
600 min Summer	9.522	0.0	340
720 min Summer	8.282	0.0	402
960 min Summer	6.640	0.0	522
1440 min Summer	4.854	0.0	764
2160 min Summer	3.541	0.0	1124
2880 min Summer	2.828	0.0	1472
4320 min Summer	2.055	0.0	2204
5760 min Summer	1.637	0.0	2936
7200 min Summer	1.371	0.0	3664
8640 min Summer	1.186	0.0	4368
10080 min Summer	1.049	0.0	5088
15 min Winter	117.448	0.0	17

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m ³)	Status
30 min Winter	44.558	0.308	4.6	17.9	Flood Risk
60 min Winter	44.584	0.334	4.9	20.6	Flood Risk
120 min Winter	44.591	0.341	5.1	21.4	Flood Risk
180 min Winter	44.581	0.331	4.9	20.3	Flood Risk
240 min Winter	44.566	0.316	4.7	18.7	Flood Risk
360 min Winter	44.535	0.285	4.2	15.5	Flood Risk
480 min Winter	44.508	0.258	3.8	12.9	Flood Risk
600 min Winter	44.486	0.236	3.5	10.8	O K
720 min Winter	44.467	0.217	3.2	9.1	O K
960 min Winter	44.437	0.187	2.8	6.7	O K
1440 min Winter	44.395	0.145	2.1	4.1	O K
2160 min Winter	44.359	0.109	1.6	2.3	O K
2880 min Winter	44.337	0.087	1.3	1.5	O K
4320 min Winter	44.313	0.063	0.9	0.8	O K
5760 min Winter	44.300	0.050	0.7	0.5	O K
7200 min Winter	44.296	0.046	0.6	0.4	O K
8640 min Winter	44.292	0.042	0.5	0.3	O K
10080 min Winter	44.290	0.040	0.5	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Time-Peak (mins)
30 min Winter	79.010	0.0	30
60 min Winter	50.812	0.0	50
120 min Winter	31.621	0.0	86
180 min Winter	23.637	0.0	124
240 min Winter	19.105	0.0	158
360 min Winter	14.037	0.0	226
480 min Winter	11.286	0.0	290
600 min Winter	9.522	0.0	352
720 min Winter	8.282	0.0	412
960 min Winter	6.640	0.0	532
1440 min Winter	4.854	0.0	766
2160 min Winter	3.541	0.0	1124
2880 min Winter	2.828	0.0	1472
4320 min Winter	2.055	0.0	2204
5760 min Winter	1.637	0.0	2904
7200 min Winter	1.371	0.0	3624
8640 min Winter	1.186	0.0	4408
10080 min Winter	1.049	0.0	5040

Unit B10, Elmbridge Court Gloucester GL3 1JZ	P21-599 Reservoir Road Infiltration Structure 1	
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Innovyze	Source Control 2020.1.3
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.067

Time (mins)	Area
From: To:	(ha)
0	4 0.067

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Unit B10, Elmbridge Court Gloucester GL3 1JZ	P21-599 Reservoir Road Infiltration Structure 1	
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Model Details

Storage is Online Cover Level (m) 44.800

Complex Structure

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.39600	Width (m)	11.7
Membrane Percolation (mm/hr)	1000	Length (m)	23.0
Max Percolation (l/s)	74.8	Slope (1:X)	23.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	44.250	Cap Volume Depth (m)	0.250

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	23.0
Max Percolation (l/s)	38.3	Slope (1:X)	23.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	44.250	Cap Volume Depth (m)	0.250

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	18.5
Membrane Percolation (mm/hr)	1000	Length (m)	23.0
Max Percolation (l/s)	118.2	Slope (1:X)	23.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	44.500	Membrane Depth (m)	0