



Manchester University

NHS Foundation Trust



Sel Environmental Ltd

Real Innovation

SEL Environmental Ltd
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PROJECT	NORTH MANCHESTER GENERAL HOSPITAL
PROJECT NUMBER	20200 mscp
DOCUMENT NUMBER	20200-SEL-XX-XX-SP-X-0008
TITLE	Inflow, outflow and attenuation calculations
REVISION	P02
STATUS	S3
	FOR PLANNING

Revision	Description	Date	Issued By
P01	First Issue	21/05/2022	MG
P02	Catchment analysis added	08/08/2022	MG



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STORMWATER CATCHMENT ANALYSIS

Date: 08/08/2022 v3
Client: Morgan Sindall
Project: NMGH MSCP

Registered Office: Canal House, Bonsall Street, Blackburn, Lancashire, BB2 4DD
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Rainwater Catchment Area

Drawing ref: 20200-CUR-MSCP-EX-DR-D-7512

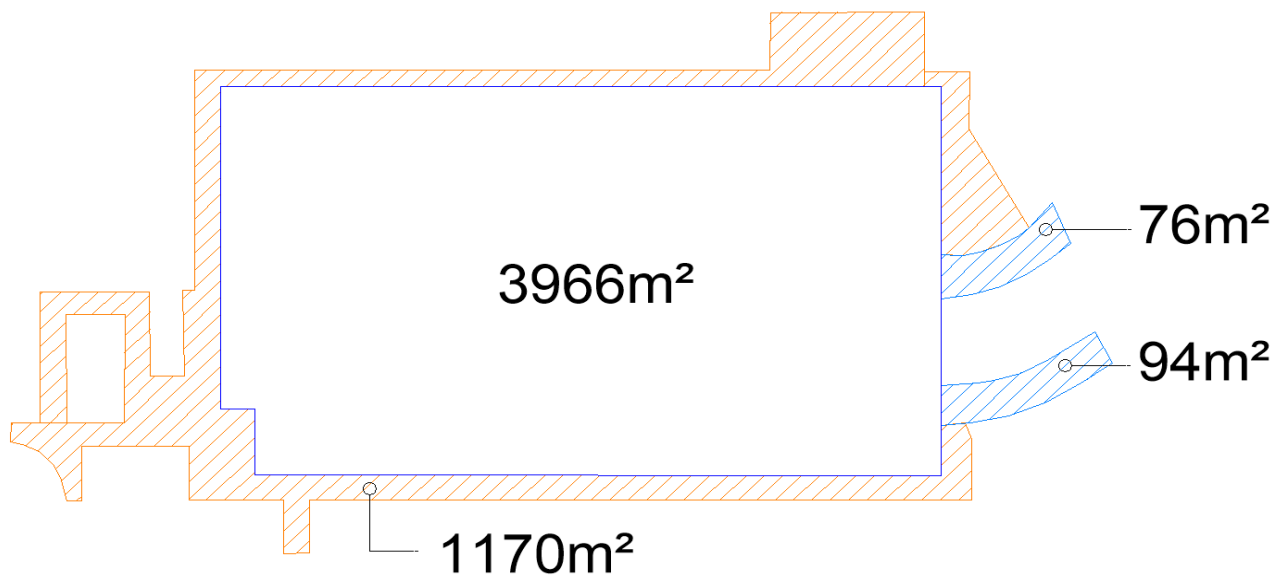
Zone	Area m ²
Building (MSCP)	3966
External area to perimeter	1170
Exit ramp	76
Entry ramp	94

Total	5306	m ²
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Site Layout - Catchments





Date: 08/08/2022 v3
Client: Morgan Sindall
Project: NMGH MSCP

Attenuation Requirement - MSCP + External Area

CRM Stormflow

Stormwater Management Software

Page 1

Client: Morgan Sindall
Project: NMGH - MSCP
Location: Manchester
Catchment: Building + External Areas

Catchment Details:

Buildings	3966 m ²	x 90 %
Dense surfacing	1170 m ²	x 90 %
Effective Area	4622.4 m ²	

Storage Details:

Length	2750 m
Width	1 m
Depth	0.275 m
Porosity	45 %
Area Increase	0 %

Rainfall Details - FSR Method:

Return Period	100 years
Climate Change Factor	40 %
r value	0.42
M5-60	19 mm
Summer Storm Profile	

Duration	Intensity		Required storage(m ³)
	mm	mm/h	
5 min	18.6	223.0	84.692
10 min	27.6	165.5	125.052
15 min	33.2	132.8	149.833
30 min	43.3	86.6	192.603
45 min	49.4	65.8	216.879
60 min	53.8	53.8	233.333
2 hours	64.7	32.3	267.927
6 hours	82.1	13.7	286.198
24 hours	107.8	4.5	224.431

Outflow Details:

Infiltration rate	0 m/hr
Attenuation Control	Orifice Plate
Control Diameter	53 mm
Discharge rate	4.8 l/s
Orifice Depth	0.425 m

Result:

Outcome	Pass
Critical Storm Duration	4.68 hrs
Hmax	0.233 m
Required Volume	288.756 m ³
Time to half empty	8.4 hrs



Date: 08/08/2022 v3
Client: Morgan Sindall
Project: NMGH MSCP

Attenuation Requirement - Exit Ramp

CRM Stormflow

Stormwater Management Software

Page 1

Client: Morgan Sindall
Project: NMGH - MSCP
Location: Manchester
Catchment: Exit Ramp

Catchment Details:

Buildings	0 m ²	x 90 %
Dense surfacing	76 m ²	x 90 %
Effective Area	68.4 m ²	

Storage Details:

Length	76 m
Width	1 m
Depth	0.21 m
Porosity	30 %
Area Increase	0 %

Rainfall Details - FSR Method:

Return Period	100 years
Climate Change Factor	40 %
r value	0.42
M5-60	19 mm
Summer Storm Profile	

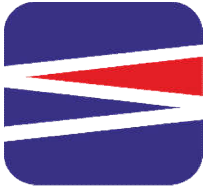
Duration	Intensity		Required storage(m ³)
	mm	mm/h	
5 min	18.6	223.0	1.246
10 min	27.6	165.5	1.836
15 min	33.2	132.8	2.195
30 min	43.3	86.6	2.805
45 min	49.4	65.8	3.141
60 min	53.8	53.8	3.361
2 hours	64.7	32.3	3.781
6 hours	82.1	13.7	3.714
24 hours	107.8	4.5	2.651

Outflow Details:

Infiltration rate	0 m/hr
Attenuation Control	Orifice Plate
Control Diameter	8 mm
Discharge rate	0.1 l/s
Orifice Depth	0.34 m

Result:

Outcome	Pass
Critical Storm Duration	3.4 hrs
Hmax	0.171 m
Required Volume	3.91 m ³
Time to half empty	5.4 hrs



Date: 08/08/2022 v3
Client: Morgan Sindall
Project: NMGH MSCP

Attenuation Requirement - Entry Ramp

CRM Stormflow

Stormwater Management Software

Page 1

Client: Morgan Sindall
Project: NMGH - MSCP
Location: Manchester
Catchment: Entry Ramp

Catchment Details:

Buildings	0 m ²	x 90 %
Dense surfacing	94 m ²	x 90 %
Effective Area	84.6 m ²	

Storage Details:

Length	94 m
Width	1 m
Depth	0.21 m
Porosity	30 %
Area Increase	0 %

Rainfall Details - FSR Method:

Return Period	100 years
Climate Change Factor	40 %
r value	0.42
M5-60	19 mm
Summer Storm Profile	

Duration	Intensity		Required storage(m ³)
	mm	mm/h	
5 min	18.6	223.0	1.558
10 min	27.6	165.5	2.305
15 min	33.2	132.8	2.766
30 min	43.3	86.6	3.574
45 min	49.4	65.8	4.044
60 min	53.8	53.8	4.370
2 hours	64.7	32.3	5.106
6 hours	82.1	13.7	5.841
24 hours	107.8	4.5	5.139

Outflow Details:

Infiltration rate	0 m/hr
Attenuation Control	Orifice Plate
Control Diameter	6 mm
Discharge rate	0.1 l/s
Orifice Depth	0.34 m

Result:

Outcome	Pass
Critical Storm Duration	7.95 hrs
Hmax	0.209 m
Required Volume	5.885 m ³
Time to half empty	8.2 hrs



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Site Layout - Sub-base Attenuation Zones





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Slope Attenuation Analysis

Ref	Slope Length m	Slope Width m	Surfacing Thickness m	Voided Sub-base Thickness m	Gradient	Attenuation (if flat) m ³	Attenuation (on slope) m ³	Efficiency	equivalent water depth mm
Exit ramp - permeable paving 1	16.0	4.8	0.240	0.210	0.009	4.788	4.788	100.00%	63
Entry ramp - permeable paving 2	19.0	4.9	0.240	0.210	0.013	5.922	5.922	100.00%	63



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Attenuation Allocation

Drawing ref: 20200-CUR-MSCP-EX-DR-D-7512

Attenuation requirement m³ 298.551

Zone	Area m ²	Attenuation Required m ³	Attenuation Provided m ³
Building	3966	222.976	
External area	1170	65.780	
Attenuation for above is provided below the groundfloor parking area of theMSCP		288.756	338.582
Exit ramp	76	3.91	4.788
Entry ramp	94	5.885	5.922
Total Attenuation Required m ³		298.551	
Total Attenuation Provided m ³			349.292

All attenuation is provided below ground. Attenuation provided 349.3m³ exceeds
attenuation required 298.6m³, therefore no flooding during 1in100yr + 40% CC event.

Storage Below GF Parking in MSCP

Formavoid Storage Calculator

Date: 08/08/2022 v3
Client: Morgan Sindall
Project: NMGH MSCP
Drawing ref: SelSketch-Formavoid



STORAGE VOLUME IN DEPTH OF AGGREGATE + 1 LAYER OF FORMAVOID

	Length	Width	Depth mm	% Void	Gross Volume m ³	Storage m ³
Type 3 above Formavoid tray	2746	1	175	30	480.550	144.165
Formavoid Stone fill (equivalent ave. depth)	2746	1	36	30		29.657
Formavoid free space below arch	2746	1	100	60	274.600	164.760
Totals			275		755.150	338.582
					Storage void	44.84%

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Diffuser RWP Inlet

Date: 01/03/2022
Client: Morgan Sindall
Project: NMGH MSCP

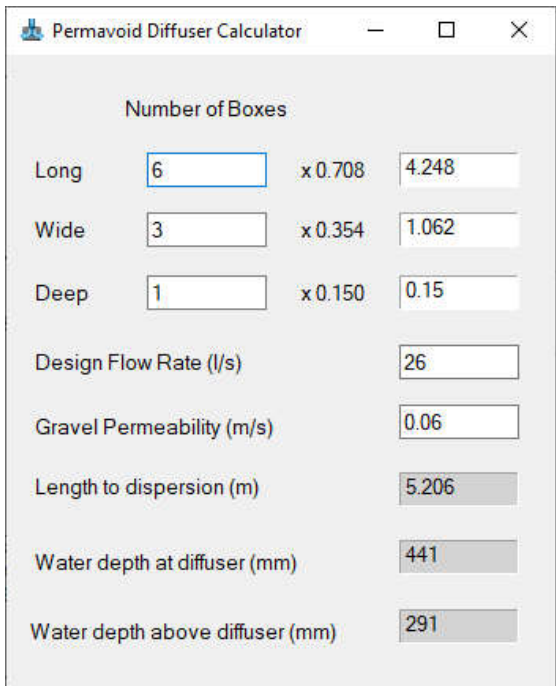
Proposed Construction Buildup

40 AC10
60 AC20
100 AC32
150 Type3
100 Fvoid
= 450mm depth

Therefore 300 cover over permavoid diffuser

Based on previous discussions 260 l/s from roof, below was for 10 rwp outlets (previous submission)

Therefore 4.248m x 1.062m will accept inflows up to 26 l/s



The screenshot shows a software window titled "Permavoid Diffuser Calculator". It contains several input fields and calculated results:

Number of Boxes			
Long	6	x 0.708	4.248
Wide	3	x 0.354	1.062
Deep	1	x 0.150	0.15
Design Flow Rate (l/s)		26	
Gravel Permeability (m/s)		0.06	
Length to dispersion (m)		5.206	
Water depth at diffuser (mm)		441	
Water depth above diffuser (mm)		291	



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Discharge Rates

Zone	Area m ²	Discharge Flow Rate l/s
Building + External Area	3966	4.8
Exit ramp - permeable paving 1	76	0.1
Entry ramp - permeable paving 2	94	0.1
Total Combined Discharge Rate		5

* Each of the above areas will have individual orifice flow control chambers at their discharge points, restricted to the above discharge rates. These will then connect to a final orifice flow control chamber that will be restricted to 5 l/s.



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