Wesson Environmental

Solutions to Your Contaminated Land Issues

SUSTAINABLE DRAINAGE STRATEGY

90, SELBROOKE CRESCENT
BRISTOL

Prepared for Homes 4 All Ltd

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Project No. 001SAABP4

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The material and data in this report were prepared under the supervision and direction of the undersigned.

Wesson Environmental

Prepared by: Dr. Richard Wesson

[redacted]

Environmental Consultant

Date: 25 March 2021

1 Introduction

The site is located on land adjacent 90 Selbrooke Crescent, Bristol and comprises land adjacent to a residential property. The site is flat and is set in a residential area with domestic properties on all sides except to the south east where a road is present.

A soakaway test as detailed below to establish the feasibility of using this method for managing surface water. Following this, Wesson Environmental Ltd were engaged to devise a SuDS strategy. .

2 Infiltration testing

Infiltration testing was carried out on the site by Wavin on 14th May 2020 to determine the suitability of using infiltration for managing surface water. The results are included in Appendix B. The data indicates that site soils are not suitable for managing surface water by utilising infiltration.

3 Surface water management strategy

3.1 Updated Proposals.

Due to the anticipated low permeability of the soil at formation level, it was realised that a Type A pervious pavement using total infiltration was unlikely to be practical. A Type B partial infiltration system was considered, but rejected because again low infiltration rates would have made this impractical, and because it was unlikely that Wessex Water would accept proposals for the drainage pipe outputting to their infrastructure due to the potential for groundwater entering the system. In addition, the proximity of the system to the building footprint meant that infiltration had the potential to impact soil strength parameters. Consequently, it was decided that a Type C – no infiltration system was the most viable option.

Using this kind of pervious paving system would mean that no infiltration will occur and the mechanism in operation will be attenuation. It was realised that this being the case, that the use of attenuation tanks in addition to the storage offered by the pervious pavement system would be redundant only serve to complicate the system with attendant increases in the need for ongoing maintenance.

Therefore, it was proposed that a system was used that the storage beneath the pavement be used to manage drainage from the roof.

3.2 Specification

The pervious paving and subbase would need to deal with drainage from the following areas:

Roof = 84.55m^2
Drive = 100.10m^2
Total = 184.65m^2

Micro drainage was used in calculations (Appendix B) and utilised 100 year storms plus 40% climate change allowance. A void ratio in the subbase of 0.3 was used. The calculations indicate that 0.45m depth of subbase is sufficient to deal with surface water flows for the above areas. This will comprise an upper sub-base of 100mm depth and a lower subbase of 350mm depth.

The remainder of the system including connection to Wessex Water assets is shown in figure 1. This will include a flow control chamber orifice control fitted with Polypipe Permafilter unit or similar. The orifice diameter is 20mm and allows a maximum discharge rate of 0.8l/s.

4 Maintenance

The infiltration rate of a permeable block pavement will decrease but stabilise with age due to build-up of detritus in the jointing material. Evidence suggests that infiltration rate remain significantly higher than rainfall intensity despite this ,even when maintenance is not carried out[2]. Manufacturers in some cases recommend sweeping twice year as a precaution against clogging although this is not greater than would be undertaken on traditional pavements for aesthetic purposes. More critical is to prevent fine material including soil from contaminating the surface in the first instant and this may be achieved with landscape edging as shown in figure 2.

The outlet system should be regularly inspected to ensure that blockage is not present. Due to the location of the flow control device, litter and other debris are not anticipated to be an issue. Should ponding be observed on the surface then this will further indicate that the flow control may not be operating correctly and in this situation, inspection should take place of the latter.

5 Conclusions

The system described is sufficient to deal with a storm event with a 100 year return period. This comprises pervious pavement Type C with roof drainage going to the subbase area which will provide attenuation storage. Flow control on the output will comprise a flow chamber orifice control limiting output to 0.8 l/s.

References

1. CIRIA. The SuDS Manual (2015)
2. INTERPAVE. Guide to the design, Construction and Maintenance of Concrete Block Permeable Pavements. (2010).

APPENDIX A

FIGURES

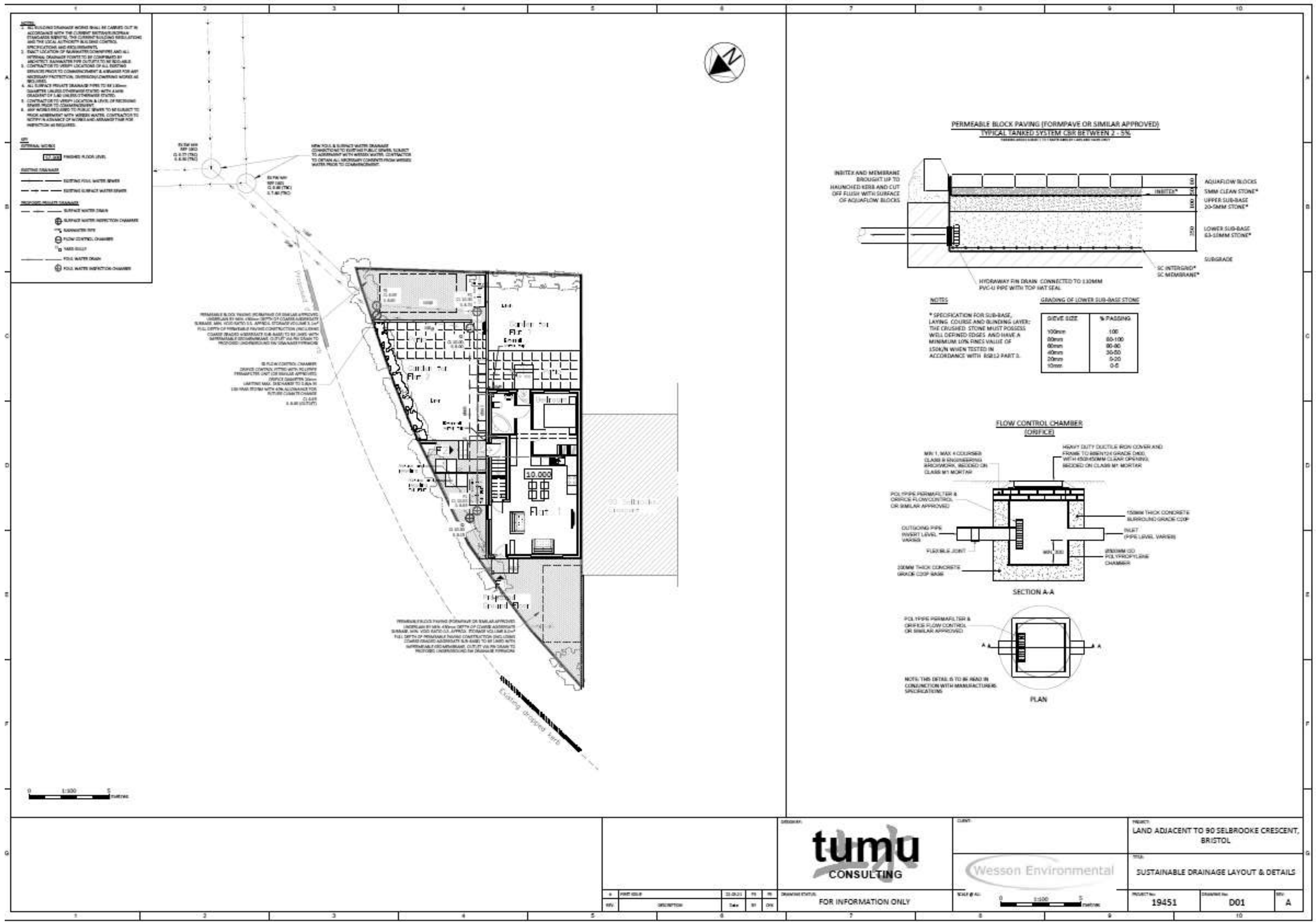

Figure 1. SuDS system detail

APPENDIX B
Infiltration Testing

WAVIN Stormwater Management

AquaCell Soakaway designed in accordance with BRE 365

Project & Site Details

Project Number	S18726	**Produced by**	Harry Wrobel
Client	Quake Repairs	**Checked by**	
Site Name	90 Selbrooke Crescent,		
Location	Fishponds, BS162PS.	**Date**	14/05/2020

Drainage Details

Area	56 m²	**Climate Change**	0 %
Catchment Type	Roof	**Effective Area**	50 m²
Area Reduction Factor	0.9	**Additional Inflow**	0.00 l/s

Discharge Parameters

Infiltration Rate	5.70E-06	**Soil Type**	
Factor of Safety	2	**Source**	
Effective Infiltration Rate	2.85E-06		
Additional Outflow*	0.00 l/s	**Depth to Groundwater (m)**	

*flat rate from pump only

Rainfall Data

R value	0.39	**Storm Return Period**	1 in 30 years
M5-60	20	**Country**	England and Wales

Time	Z1 Value	y mm	Z2 Value	p mm	Inflow	Outflow	Storage	Minimum Length	Time To Half -Empty
5min	0.37	7.40	1.44	10.66	0.54	0.01	0.528	0.117	5.36
10min	0.52	10.40	1.47	15.29	0.77	0.02	0.752	0.167	7.63
15min	0.63	12.60	1.47	18.52	0.93	0.03	0.906	0.202	9.20
30min	0.80	16.00	1.51	24.16	1.22	0.06	1.162	0.262	11.85
1hr	1.00	20.00	1.52	30.40	1.53	0.11	1.421	0.325	14.65
2hr	1.20	24.00	1.52	36.48	1.84	0.22	1.617	0.381	17.10
4hr	1.45	29.00	1.51	43.79	2.21	0.44	1.764	0.439	19.62
6hr	1.60	32.00	1.49	47.68	2.40	0.66	1.738	0.460	20.51
10hr	1.82	36.40	1.49	54.24	2.73	1.11	1.626	0.487	21.68
24hr	2.20	44.00	1.45	63.80	3.22	2.66	0.557	0.437	19.51
48hr	2.70	54.00	1.41	76.14	3.84	5.32	-1.479	0.310	13.99

Soakaway Parameters

Length	0.5 m	**Width**	12.0 m
Depth	0.4 m	**Void**	95 %

Results

Critical storm duration (hrs)	10hr	
Minimum Required Length (m)	0.487	
Half Time Empty (hrs)	21.68	PASS

AquaCell Modular Units

No. Units Long	0.5	**No. Units Wide**	24
No. Units Deep	1		
Total Number of Units	**12**	**Unit Type**	

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APPENDIX C
Microdrainage Output

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes UKPartH Manhole Sizes UKPartH

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	12.000	0.150	80.0	0.011	5.00	0.0	0.600	o	100	Pipe/Conduit	🔒
S1.001	5.900	0.100	59.0	0.002	0.00	0.0	0.600	o	100	Pipe/Conduit	🔓
S1.002	13.900	0.200	69.5	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	🔓

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.23	9.150	0.011	0.0	0.0	0.0	0.86	6.8	1.5
S1.001	50.00	5.33	9.000	0.013	0.0	0.0	0.0	1.00	7.9	1.8
S1.002	50.00	5.58	8.900	0.013	0.0	0.0	0.0	0.92	7.3	1.8

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	10.300	1.150	Open Manhole	450	S1.000	9.150	100				
S2	10.000	1.000	Open Manhole	450	S1.001	9.000	100	S1.000	9.000	100	
S3	9.950	1.050	Open Manhole	450	S1.002	8.900	100	S1.001	8.900	100	
S1902	9.770	1.070	Open Manhole	1200		OUTFALL		S1.002	8.700	100	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	100	S1	10.300	9.150	1.050	Open Manhole	450
S1.001	o	100	S2	10.000	9.000	0.900	Open Manhole	450
S1.002	o	100	S3	9.950	8.900	0.950	Open Manhole	450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	12.000	80.0	S2	10.000	9.000	0.900	Open Manhole	450
S1.001	5.900	59.0	S3	9.950	8.900	0.950	Open Manhole	450
S1.002	13.900	69.5	S1902	9.770	8.700	0.970	Open Manhole	1200

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.002	S1902	9.770	8.700	8.500	1200	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.350		

Online Controls for Storm

Orifice Manhole: S3, DS/PN: S1.002, Volume (m^3): 0.2

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 8.900

Storage Structures for Storm

Porous Car Park Manhole: S1, DS/PN: S1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.5
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	12.5	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.720	Cap Volume Depth (m)	0.450

Porous Car Park Manhole: S3, DS/PN: S1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	2.9
Membrane Percolation (mm/hr)	1000	Length (m)	7.9
Max Percolation (l/s)	6.4	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.370	Cap Volume Depth (m)	0.450

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	30 Winter	1	+0%	1/15 Summer				9.383	0.133	0.000
S1.001	S2	30 Winter	1	+0%	1/15 Summer				9.377	0.277	0.000
S1.002	S3	30 Winter	1	+0%	1/15 Summer				9.373	0.373	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.18		1.1	SURCHARGED	
S1.001	S2	0.13		0.9	SURCHARGED	
S1.002	S3	0.08		0.6	SURCHARGED	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	20.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.350	Cv (Winter)	0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	60 Winter	30	+0%	1/15 Summer				9.555	0.305	0.000
S1.001	S2	60 Winter	30	+0%	1/15 Summer				9.549	0.449	0.000
S1.002	S3	60 Winter	30	+0%	1/15 Summer				9.544	0.544	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.29		1.9	SURCHARGED	
S1.001	S2	0.31		2.2	SURCHARGED	
S1.002	S3	0.10		0.7	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	60 Winter	100	+40%	1/15 Summer				9.768	0.518	0.000
S1.001	S2	60 Winter	100	+40%	1/15 Summer				9.762	0.662	0.000
S1.002	S3	60 Winter	100	+40%	1/15 Summer				9.757	0.757	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.53		3.4	SURCHARGED	
S1.001	S2	0.56		3.9	FLOOD RISK	
S1.002	S3	0.11		0.8	FLOOD RISK	