BAYNHAM MEIKLE
Consulting Civil and Structural Engineers

20th February 2024

13508 – Havant Phase 2: - Engineers Response to planning condition 28

Application Summary: -

Reference: APP/22/00172

Proposal: Surface Water Drainage Scheme

Condition 28 requires the following:

Prior to the commencement of each phase of development a detailed surface water drainage scheme for that phase, based on the principles within the Flood Risk Assessment & Outline Drainage Strategy Report ref: 13023 / R102 Rev 5.0, shall be submitted and approved in writing by the Local Planning Authority. The submitted details shall include:

A. A technical summary highlighting any changes to the design from that within the approved Flood Risk Assessment.

B. Detailed drainage layout drawings at an identified scale indicating catchment areas, referenced drainage features, manhole cover and invert levels and pipe diameters, lengths and gradients.

C. Detailed hydraulic calculations for all rainfall events, including the listed below. The hydraulic calculations should take into account the connectivity of the entire drainage features including the discharge location. The results should include design and simulation criteria, network design and result tables, manholes schedule tables and summary of critical result by maximum level during the 1 in 1, 1 in 30 and 1 in 100 (plus an allowance for climate change) rainfall events. The drainage features should have the same reference that the submitted drainage layout.

D. Confirmation on how impacts of high groundwater will be managed in the design of the proposed drainage system to ensure that storage capacity is not lost, and structural integrity is maintained.

E. Confirmation that sufficient water quality measures have been included to satisfy the methodology in the Ciria SuDS Manual C753.

BAYNHAM MEIKLE
Consulting Civil and Structural Engineers

F. Evidence to show that the proposed SuDS scheme will ensure there will be no deterioration in water quality (or changes in water quantity) in discharges from the site.

G. Exceedance plans demonstrating the flow paths and areas of ponding in the event of blockages or storms exceeding design criteria.

The development in each phase shall thereafter be carried out in accordance with the approved drainage details for that phase.

Phase 2 Considerations

The indicative drainage design within the approved flood risk assessment shows both zones 3A and 3B discharging into a new manhole constructed in line with the existing 375mm dia sewer at a combined discharge rate of 132 l/s. Zone 3B (now Phase 2) is now proposed to discharge independently into the existing storm manhole on site at a discharge rate of 19.1 l/s. The proposed volume of attenuation within the approved flood risk assessment will remain the same.

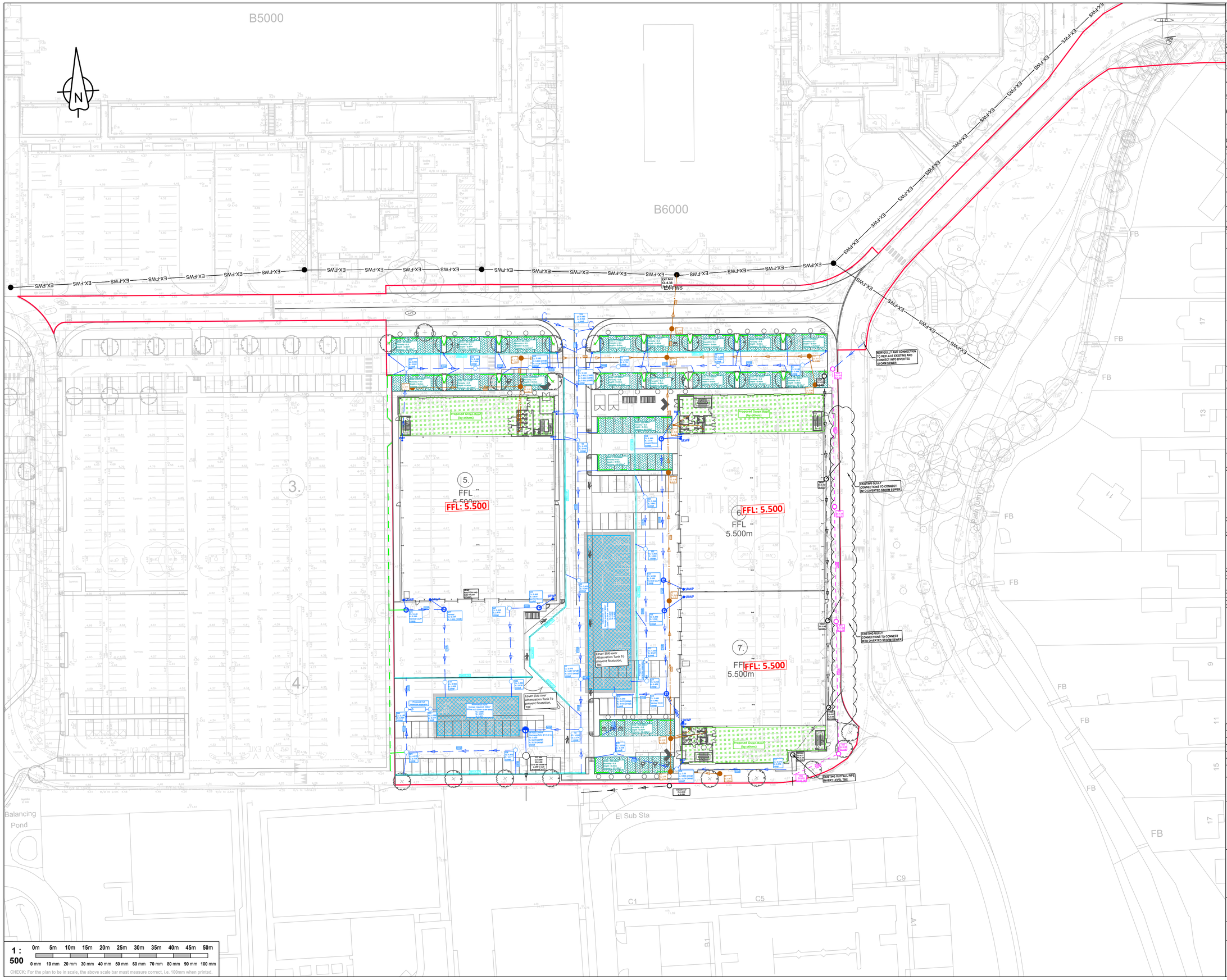
The proposed drainage scheme for Phase 2 includes green roofs to each unit, permeable paving within the car parking areas, and a full retention separator within the service yards which will pick up run off before entering the underground cellular attenuation tanks.

Suds maintenance plan has been prepared to demonstrate the required maintenance and frequency requirements for the proposed Suds to ensure water quality is maintained throughout the lifespan of the development.

Due to the high-water table, cover slabs have been proposed over the attenuation tanks.

A drainage strategy plan, drawing ref 13508_121, along with the SuDs Maintenance plan and hydraulic calculations can be found appended to this note.

© 2023 Baynham Meikle



1 : 500 — 0m 5m 10m 15m 20m 25m 30m 35m 40m 45m 50m — 0 mm 10 mm 20 mm 30 mm 40 mm 50 mm 60 mm 70 mm 80 mm 90 mm 100 mm

CHECK: For the plan to be in scale, the above scale bar must measure correct, i.e. 100mm when printed.

Notes

A1

1. Topographical Survey carried out by **Greenhatch**, Drawing No.:
   - **38869_T - Topographical Survey Plan** (Dated **Jan 2023**).
2. Proposed Site Layout taken from **PRC**, Drawing No.:
   - **11629_PL004 - Proposed Site Plan** (Dated **JAN 2024**).
3. Do not scale from this drawing. All dimensions must be checked & verified on-site. If in doubt ask.
4. The Contractor is to check & verify all dimensions & levels before any work is started on-site.
5. Existing site survey works have been carried out by others & no guarantee can be given by Baynham Meikle for their accuracy.
6. Any discrepancies noted on-site are to be reported to Baynham Meikle immediately.
7. This drawing is to be read in conjunction with all relevant Architects', Engineers' and other Specialists' drawings & specifications.
8. For existing ground conditions, refer to Site Investigation reports.
9. The drainage installation is to be compliant with Building Regs. (Part H).
10. All adoptable drainage works shall comply with "Water UK - Design and Construction Guide".
11. The following pipe strengths shall be adopted (unless noted otherwise):
    - Pipes up to and including 150mm Ø to be PVC-U to BS-EN 1329, or Clayware to BS-EN 295 Class 160.
    - Pipes 150mm Ø up to and including 225mm Ø to be Clayware to BS-EN 295 Class 160.
    - Pipes 300mm Ø to be Clay to BS-EN 295 Class 160 or Concrete to BS 5911 Class M.
    - Pipes over 300mm Ø to be Concrete to BS 5911 Class M.
9. All pipe runs to be laid with flexible joints.
10. All pipes entering and exiting manholes are to be connected to pipe soffits level unless noted otherwise.
11. Pipe Bedding and surround to be as follows:

Location:	Cover to Soffit:		Pipe Bedding:
	Clay / Conc	Flexible	
Roads.	>1.2m	>0.9m	Class S
	<1.2m	<0.9m	Class Z
Hard and Soft Landscaping.	>0.6m		Class S
	<0.6m		Class Z

12. The following Conc. mixes are to be used (in accordance with BS 8500):

Location:	Mix Reference:
Concrete Surround to Pipes	ST4
Concrete Base and Surround to Manholes	ST4

13. All precast-concrete products (i.e. pipes, manhole rings, etc.) shall be of suitable Concrete mix to cater for Class 2 Sulphates.
14. Pre-formed channels are to be used in manholes where applicable.
15. Granolithic Concrete benching to be steel trowelled to a dense smooth face neatly shaped and finished to all branch connections and laid in accordance with the Specification.
16. All connections to be turned in direction of flow using pipe bends.
17. Manhole covers and frames to be Ductile Iron Medium Duty grade B125 rectangular to BS-EN 124 positions outside vehicular-trafficked areas, and Heavy Duty grade D400 in vehicular-trafficked areas.
18. Manhole covers and frames to be Ductile Iron Medium Duty grade A15 covers in Soft Landscaping.
19. First flexible joint in pipes adjacent to a manhole shall be a maximum of 600mm from inside face of manhole, connecting to rocker pipe.
20. The length of Rocker Pipe is as follows:

Pipe Diameter:	Length of Rocker Pipe:
150mm - 600mm	600mm
675mm - 750mm	1000mm
825mm & Over	1250mm

21. Manholes with outgoing pipes greater than 600mm Ø shall be fitted with guard bars, safety chains or other safety devices.
22. The Principle Contractor shall be responsible for checking the existing line and invert levels of any connection points for both the Foul and Surface Water systems, prior to undertaking installation of any new drainage works. Any deviation to the levels and positions indicated on the drawing should be brought to the attention of the Engineer.
23. All invert levels specified are outgoing (except Backdrop connections).
24. All Foul connections to be 150mm Ø laid at a minimum gradient of 1/40 unless noted otherwise, Surface Water pipe sizes are as indicated.
25. Foul pipes to be externally vented (SVP) at head of run.
26. For location of internal SVP, SS, etc., refer to Architect's latest layouts.
27. Internal Foul drainage connections / positions and setting-out information to be confirmed by the M&E Consultant / Architect.

Rev	Date	Description	By	Chkd
P03	20/03/2024	Updated To Suit Latest Site Layout	R.B.	A.B.
T02	08/03/2024	Updated To Suit Latest Site Layout	R.B.	A.B.
T01	23/02/2024	Tender Issue	R.B.	A.B.
P02	05/12/2023	Planning Issue	R.B.	A.B.
P01	17/11/2023	For Information	R.B.	A.B.

Revision Schedule

Drawing Status

For Planning

Project Title

Langstone Technology Park
Phase 2
Havant

Drawing Title

Proposed Drainage Plan

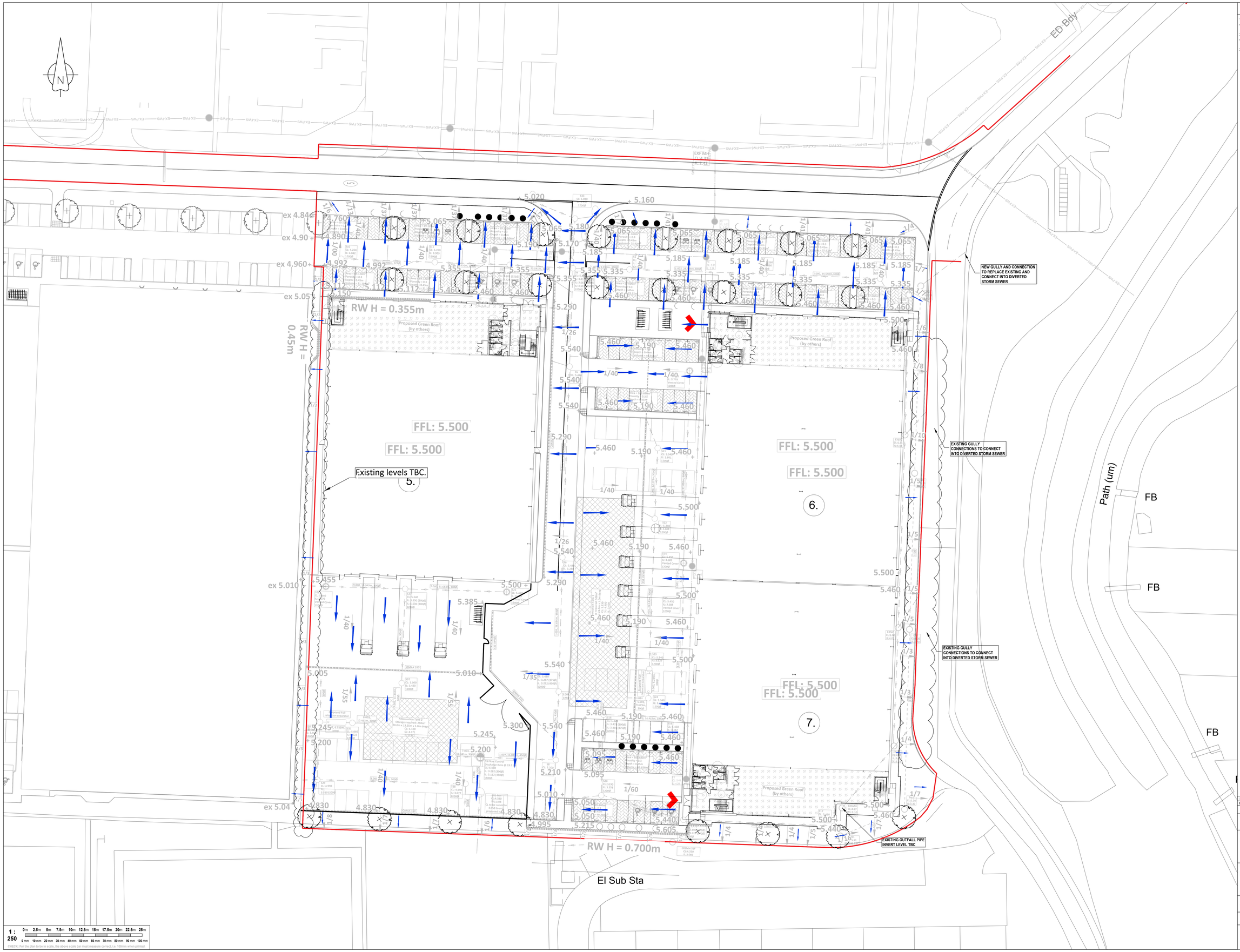
Drawing Number: **13508_121**

Revision: **P03**

BM Ref	Scale @ A1	Drawn by	Checked by	Project Eng
13508	1 : 500	R.B.	A.B.	G.L.

BAYNHAM MEIKLE
Consulting Civil & Structural Engineers
0121 434 4100
admin@baynhammeikle.co.uk
www.baynhammeikle.co.uk

© 2023 Baynham Meikle



Notes

A0

1. Topographical Survey carried out by **Greenhatch**, Drawing No.:
   - **38869_T - Topographical Survey Plan** (Dated **Jan 2023**).
2. Proposed Site Layout taken from **PRC**, Drawing No.:
   - **11629/003 - Proposed Site Plan** (Dated **October 2023**).
3. Do not scale from this drawing. All dimensions must be checked & verified on-site. If in doubt ask.

Rev	Date	Description	By	Chkd
P01	05/02/2024	For Information.	A.B.	A.B.

Revision Schedule

Drawing Status
For Planning

Project Title
Langstone Technology Park

Drawing Title
Proposed Exceedance Plan

Drawing Number
13508-128

Revision
P01

BM Ref	Scale @ A0	Drawn by	Checked by	Project Eng
13508	1 : 250	R.B.	A.B.	G.L.

BAYNHAM MEIKLE
Consulting Civil & Structural Engineers
0121 434 4100
admin@baynhammeikle.co.uk
www.baynhammeikle.co.uk

1 : 250 — 0m 2.5m 5m 7.5m 10m 12.5m 15m 17.5m 20m 22.5m 25m; 0 mm 10 mm 20 mm 30 mm 40 mm 50 mm 60 mm 70 mm 80 mm 90 mm 100 mm

CHECK: For the plan to be in scale, the above scale bar must measure correct, i.e. 100mm when printed.

Drainage Design Report

Flow

v10.7

Copyright © 1988-2023 Causeway Technologies Ltd

Network	Storm Network
Filename	13508 - Storm Calculations.pfd
Username	Alla Bolton (alla.bolton@bm-p.co.uk)
Last analysed	05/12/2023 16:35:23
Report produced on	05/12/2023 16:37:36

Causeway Sales

Tel:	+44(0) 1628 552000
Fax:	+44(0) 1628 552001
Email:	marketing@causeway.com
Web:	www.causeway.com

Technical support web portal:

http://support.causeway.com

Rainfall Methodology	FSR
Return Period (years)	2
Additional Flow (%)	0
FSR Region	England and Wales
M5-60 (mm)	20.000
Ratio-R	0.400
CV	0.900
Time of Entry (mins)	5.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	Yes
Enforce best practice design rules	Yes

Copyright © 1988-2023 Causeway Technologies Ltd

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Width (mm)	Sump (m)	Easting (m)	Northing (m)	Depth (m)	Notes
S1	0.046	5.00		5.260	Manhole	Adoptable	1200			471375.897	105605.950	1.272	
S2	0.058	5.00		5.260	Manhole	Adoptable	1200			471351.377	105606.935	1.394	
S3	0.058	5.00		5.260	Manhole	Adoptable	1200			471322.404	105607.907	1.539	
S4	0.026	5.00		5.270	Manhole	Adoptable	1200			471310.336	105608.151	1.759	
S5	0.088	5.00		5.440	Manhole	Adoptable	1200			471309.618	105587.157	1.995	
S6	0.026	5.00		5.440	Manhole	Adoptable	1200			471308.077	105546.425	2.152	
S7	0.026	5.00		5.480	Manhole	Adoptable	1200			471307.300	105517.742	2.268	
S8	0.006	5.00		5.200	Manhole	Adoptable	1200			471306.678	105503.128	2.026	
S9				5.130	Manhole	Adoptable	1500			471290.609	105503.751	1.998	
S10	0.048	5.00		5.260	Manhole	Adoptable	1200			471260.872	105610.183	1.218	
S11	0.043	5.00		5.260	Manhole	Adoptable	1200			471280.848	105609.429	1.351	
S12	0.043	5.00		5.260	Manhole	Adoptable	1200			471296.815	105608.885	1.532	
S13	0.099	5.00		5.430	Manhole	Adoptable	1200			471335.253	105586.235	1.555	
S14	0.099	5.00		5.450	Manhole	Adoptable	1200			471333.977	105545.199	1.836	
S15	0.085	5.00		5.450	Manhole	Adoptable	1200			471333.859	105538.629	1.862	
S16				5.320	Manhole	Adoptable	1200			471316.865	105512.828	1.904	
S17	0.039	5.00		5.460	Manhole	Adoptable	1200			471366.073	105489.062	1.490	
S18				5.470	Manhole	Adoptable	1200			471333.922	105490.370	1.744	
S19	0.085	5.00		5.450	Manhole	Adoptable	1200			471333.310	105512.208	1.968	
S20	0.039	5.00		5.190	Manhole	Adoptable	1200			471316.378	105495.574	1.632	
S21	0.060	5.00		5.340	Manhole	Adoptable	1200			471328.416	105569.759	1.479	
S22	0.060	5.00		5.340	Manhole	Adoptable	1200			471327.804	105554.691	1.652	
S23	0.060	5.00		5.340	Manhole	Adoptable	1200			471326.628	105522.570	1.813	
S24				5.340	Manhole	Adoptable	1200			471326.432	105516.334	1.844	
S25	0.110	5.00		5.450	Manhole	Adoptable	1200			471296.170	105539.029	1.771	
S26	0.110	5.00		5.440	Manhole	Adoptable	1200			471257.561	105540.201	1.870	
S27				5.450	Manhole	Adoptable	1200			471274.496	105539.687	1.920	
S28	0.042	5.00		4.990	Manhole	Adoptable	1200			471287.405	105498.056	1.313	
S29	0.042	5.00		4.990	Manhole	Adoptable	1200			471255.733	105498.927	1.471	
S30	0.136	5.00		5.210	Manhole	Adoptable	1200			471256.308	105511.262	1.752	
S31				5.210	Manhole	Adoptable	1200			471263.238	105511.070	1.787	
S32				5.060	Manhole	Adoptable	1200			471273.756	105519.565	1.630	

Copyright © 1988-2023 Causeway Technologies Ltd

	S33	0.026	5.00		5.080	Manhole	Adoptable	1200			471310.762	105618.769	1.130	
	EXS				4.950	Manhole	Adoptable	1800			471290.395	105496.227	1.850	
	TANK				5.230	Manhole	Adoptable	1200			471316.776	105516.997	1.830	
	TANK 2				5.100	Manhole	Adoptable	1200			471273.346	105508.254	1.729	

Copyright © 1988-2023 Causeway Technologies Ltd

Name	US Node	DS Node	Length (m)	ks (mm) / n	Velocity Equation	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)	Con Offset (m)	Min DS IL (m)	Lateral Area (ha)	Lateral Ins Point (%)	Lateral T of E (mins)
1.000	S1	S2	24.540	0.600	Colebrook-White	3.988	3.866	0.122	201.1	300	Circular	5.37	50.0					
1.001	S2	S3	28.989	0.600	Colebrook-White	3.866	3.721	0.145	199.9	300	Circular	5.81	50.0					
1.002	S3	S4	12.070	0.600	Colebrook-White	3.721	3.661	0.060	201.2	300	Circular	5.99	50.0					
1.003	S4	S5	21.006	0.600	Colebrook-White	3.511	3.445	0.066	318.3	450	Circular	6.30	50.0					
1.004	S5	S6	40.761	0.600	Colebrook-White	3.445	3.288	0.157	259.6	450	Circular	6.84	50.0					
1.005	S6	S7	28.694	0.600	Colebrook-White	3.288	3.212	0.076	377.5	450	Circular	7.30	50.0					
1.006	S7	S8	14.627	0.600	Colebrook-White	3.212	3.174	0.038	384.9	450	Circular	7.53	50.0					
1.007	S8	S9	16.081	0.600	Colebrook-White	3.174	3.132	0.042	382.9	450	Circular	7.79	50.0					
1.008	S9	EXS	7.527	0.600	Colebrook-White	3.132	3.100	0.032	235.2	300	Circular	7.92	50.0					
2.000	S10	S11	19.990	0.600	Colebrook-White	4.042	3.909	0.133	150.3	225	Circular	5.31	50.0					
2.001	S11	S12	15.976	0.600	Colebrook-White	3.909	3.803	0.106	150.7	225	Circular	5.56	50.0					
2.002	S12	S4	13.541	0.600	Colebrook-White	3.728	3.661	0.067	202.1	300	Circular	5.77	50.0					
3.000	S13	S14	41.056	0.600	Colebrook-White	3.875	3.689	0.186	220.7	300	Circular	5.65	50.0					
4.001	S14	S15	6.571	0.600	Colebrook-White	3.614	3.588	0.026	252.7	375	Circular	5.75	50.0					
4.002	S15	S19	26.427	0.600	Colebrook-White	3.588	3.482	0.106	249.3	375	Circular	6.13	50.0					
4.003	S19	S16	16.457	0.600	Colebrook-White	3.482	3.416	0.066	249.3	375	Circular	6.37	50.0					
4.004	S16	TANK	4.170	0.600	Colebrook-White	3.416	3.400	0.016	260.6	375	Circular	6.43	50.0					
4.005	TANK	S7	9.505	0.600	Colebrook-White	3.400	3.287	0.113	84.1	375	Circular	6.51	50.0					
4.000	S17	S18	32.178	0.600	Colebrook-White	3.970	3.801	0.169	190.4	225	Circular	5.57	50.0					
5.001	S18	S20	18.300	0.600	Colebrook-White	3.726	3.558	0.168	108.9	300	Circular	5.77	50.0					
5.002	S20	S16	17.261	0.600	Colebrook-White	3.558	3.472	0.086	200.7	300	Circular	6.03	50.0					
5.000	S21	S22	15.080	0.600	Colebrook-White	3.861	3.688	0.173	87.2	300	Circular	5.15	50.0					
6.001	S22	S23	32.143	0.600	Colebrook-White	3.688	3.527	0.161	199.6	300	Circular	5.63	50.0					
6.002	S23	S24	6.239	0.600	Colebrook-White	3.527	3.496	0.031	201.3	300	Circular	5.73	50.0					
6.003	S24	TANK	9.679	0.600	Colebrook-White	3.496	3.448	0.048	201.6	300	Circular	5.87	50.0					
7.000	S25	S27	21.684	0.600	Colebrook-White	3.679	3.530	0.149	145.5	300	Circular	5.28	50.0					
8.001	S27	S32	20.136	0.600	Colebrook-White	3.530	3.430	0.100	201.4	300	Circular	5.68	50.0					
8.002	S32	TANK 2	11.318	0.600	Colebrook-White	3.430	3.371	0.059	191.8	300	Circular	5.84	50.0					
7.004	TANK 2	S9	17.841	0.600	Colebrook-White	3.371	3.282	0.089	200.5	300	Circular	6.20	50.0					
8.000	S28	S29	31.684	0.600	Colebrook-White	3.677	3.519	0.158	200.5	300	Circular	5.48	50.0					
7.001	S29	S30	12.348	0.600	Colebrook-White	3.519	3.458	0.061	202.4	300	Circular	5.66	50.0					
7.002	S30	S31	6.933	0.600	Colebrook-White	3.458	3.423	0.035	198.1	300	Circular	5.77	50.0					
7.003	S31	TANK 2	10.493	0.600	Colebrook-White	3.423	3.371	0.052	201.8	300	Circular	5.93	50.0					
9.000	S26	S27	16.943	0.600	Colebrook-White	3.570	3.530	0.040	423.6	300	Circular	5.37	50.0					
10.000	S33	S4	10.627	0.600	Colebrook-White	3.950	3.811	0.139	76.4	150	Circular	5.15	50.0					

Copyright © 1988-2023 Causeway Technologies Ltd

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Sump (m)	Node Type	MH Type		Link	IL (m)	Dia (mm)	Link Type
S1	471375.897	105605.950	5.260	1.272	1200			Manhole	Adoptable					
										0	1.000	3.988	300	Circular
S2	471351.377	105606.935	5.260	1.394	1200			Manhole	Adoptable	1	1.000	3.866	300	Circular
										0	1.001	3.866	300	Circular
S3	471322.404	105607.907	5.260	1.539	1200			Manhole	Adoptable	1	1.001	3.721	300	Circular
										0	1.002	3.721	300	Circular
S4	471310.336	105608.151	5.270	1.759	1200			Manhole	Adoptable	1	10.000	3.811	150	Circular
										2	2.002	3.661	300	Circular
										3	1.002	3.661	300	Circular
										0	1.003	3.511	450	Circular
S5	471309.618	105587.157	5.440	1.995	1200			Manhole	Adoptable	1	1.003	3.445	450	Circular
										0	1.004	3.445	450	Circular
S6	471308.077	105546.425	5.440	2.152	1200			Manhole	Adoptable	1	1.004	3.288	450	Circular
										0	1.005	3.288	450	Circular
S7	471307.300	105517.742	5.480	2.268	1200			Manhole	Adoptable	1	4.005	3.287	375	Circular
										2	1.005	3.212	450	Circular
										0	1.006	3.212	450	Circular
S8	471306.678	105503.128	5.200	2.026	1200			Manhole	Adoptable	1	1.006	3.174	450	Circular
										0	1.007	3.174	450	Circular

Copyright © 1988-2023 Causeway Technologies Ltd

S9	471290.609	105503.751	5.130	1.998	1500			Manhole	Adoptable	1	7.004	3.282	300	Circular
										2	1.007	3.132	450	Circular
										0	1.008	3.132	300	Circular
S10	471260.872	105610.183	5.260	1.218	1200			Manhole	Adoptable					
										0	2.000	4.042	225	Circular
S11	471280.848	105609.429	5.260	1.351	1200			Manhole	Adoptable	1	2.000	3.909	225	Circular
										0	2.001	3.909	225	Circular
S12	471296.815	105608.885	5.260	1.532	1200			Manhole	Adoptable	1	2.001	3.803	225	Circular
										0	2.002	3.728	300	Circular
S13	471335.253	105586.235	5.430	1.555	1200			Manhole	Adoptable					
										0	3.000	3.875	300	Circular
S14	471333.977	105545.199	5.450	1.836	1200			Manhole	Adoptable	1	3.000	3.689	300	Circular
										0	4.001	3.614	375	Circular
S15	471333.859	105538.629	5.450	1.862	1200			Manhole	Adoptable	1	4.001	3.588	375	Circular
										0	4.002	3.588	375	Circular
S16	471316.865	105512.828	5.320	1.904	1200			Manhole	Adoptable	1	5.002	3.472	300	Circular
										2	4.003	3.416	375	Circular
										0	4.004	3.416	375	Circular
S17	471366.073	105489.062	5.460	1.490	1200			Manhole	Adoptable					

Copyright © 1988-2023 Causeway Technologies Ltd

										0	4.000	3.970	225	Circular
S18	471333.922	105490.370	5.470	1.744	1200			Manhole	Adoptable	1	4.000	3.801	225	Circular
										0	5.001	3.726	300	Circular
S19	471333.310	105512.208	5.450	1.968	1200			Manhole	Adoptable	1	4.002	3.482	375	Circular
										0	4.003	3.482	375	Circular
S20	471316.378	105495.574	5.190	1.632	1200			Manhole	Adoptable	1	5.001	3.558	300	Circular
										0	5.002	3.558	300	Circular
S21	471328.416	105569.759	5.340	1.479	1200			Manhole	Adoptable					
										0	5.000	3.861	300	Circular
S22	471327.804	105554.691	5.340	1.652	1200			Manhole	Adoptable	1	5.000	3.688	300	Circular
										0	6.001	3.688	300	Circular
S23	471326.628	105522.570	5.340	1.813	1200			Manhole	Adoptable	1	6.001	3.527	300	Circular
										0	6.002	3.527	300	Circular
S24	471326.432	105516.334	5.340	1.844	1200			Manhole	Adoptable	1	6.002	3.496	300	Circular
										0	6.003	3.496	300	Circular
S25	471296.170	105539.029	5.450	1.771	1200			Manhole	Adoptable					
										0	7.000	3.679	300	Circular
S26	471257.561	105540.201	5.440	1.870	1200			Manhole	Adoptable					

Copyright © 1988-2023 Causeway Technologies Ltd

										0	9.000	3.570	300	Circular
S27	471274.496	105539.687	5.450	1.920	1200			Manhole	Adoptable	1	9.000	3.530	300	Circular
										2	7.000	3.530	300	Circular
										0	8.001	3.530	300	Circular
S28	471287.405	105498.056	4.990	1.313	1200			Manhole	Adoptable					
										0	8.000	3.677	300	Circular
S29	471255.733	105498.927	4.990	1.471	1200			Manhole	Adoptable	1	8.000	3.519	300	Circular
										0	7.001	3.519	300	Circular
S30	471256.308	105511.262	5.210	1.752	1200			Manhole	Adoptable	1	7.001	3.458	300	Circular
										0	7.002	3.458	300	Circular
S31	471263.238	105511.070	5.210	1.787	1200			Manhole	Adoptable	1	7.002	3.423	300	Circular
										0	7.003	3.423	300	Circular
S32	471273.756	105519.565	5.060	1.630	1200			Manhole	Adoptable	1	8.001	3.430	300	Circular
										0	8.002	3.430	300	Circular
S33	471310.762	105618.769	5.080	1.130	1200			Manhole	Adoptable					
										0	10.000	3.950	150	Circular
EXS	471290.395	105496.227	4.950	1.850	1800			Manhole	Adoptable	1	1.008	3.100	300	Circular
TANK	471316.776	105516.997	5.230	1.830	1200			Manhole	Adoptable	1	6.003	3.448	300	Circular

Copyright © 1988-2023 Causeway Technologies Ltd

										2	4.004	3.400	375	Circular
										0	4.005	3.400	375	Circular
TANK 2	471273.346	105508.254	5.100	1.729	1200			Manhole	Adoptable	1	8.002	3.371	300	Circular
										2	7.003	3.371	300	Circular
										0	7.004	3.371	300	Circular

Copyright © 1988-2023 Causeway Technologies Ltd

Rainfall Methodology	FEH-22		Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
Summer CV	0.750		2	0	0	0
Winter CV	0.840		30	0	0	0
Analysis Speed	Normal		30	25	0	0
Skip Steady State	No		100	0	0	0
Drain Down Time (mins)	240		100	40	0	0
Additional Storage (m³/ha)	0.0		100	45	0	0
Storm Durations (mins)	15					
	30					
	60					
	120					
	180					
	240					
	360					
	480					
	600					
	720					
	960					
	1440					
Check Discharge Rate(s)	No					
Check Discharge Volume	No					
100 year 360 minute (m³)						

Copyright © 1988-2023 Causeway Technologies Ltd

Hydro-Brake®												
Node	Flap Valve	Online / Offline	Replaces Downstream Link	Loop to Node	Invert Level (m)	Design Depth (m)	Design Flow (l/s)	Objective	Sump Available	Product Number	Min Outlet Diameter (m)	Min Node Diameter (mm)
S9	No	Online	Yes		3.132	1.500	19.1	(HE) Minimise upstream storage	Yes	CTL-SHE-0188-1910-1500-1910	0.225	1500

Copyright © 1988-2023 Causeway Technologies Ltd

Depth/Area/Inf Area

Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Depth (m)	Area (m²)	Inf. Area (m²)
TANK	0.00000	0.00000	2.0	0.95	3.400		0.000	530.0	0.0
							1.000	530.0	0.0
							1.001	0.0	0.0
TANK 2	0.00000	0.00000	2.0	0.95	3.371		0.000	264.0	0.0
							1.000	264.0	0.0
							1.001	0.0	0.0
S1	0.00000	0.00000	2.0	0.30	3.988	132	0.000	230.3	0.0
							0.450	230.3	0.0
							0.451	0.0	0.0
S2	0.00000	0.00000	2.0	0.30	3.866	204	0.000	115.2	0.0
							0.450	115.2	0.0
							0.451	0.0	0.0
S3	0.00000	0.00000	2.0	0.30	3.721		0.000	224.5	0.0
							0.450	224.5	0.0
							0.451	0.0	0.0
S10	0.00000	0.00000	2.0	0.30	4.042	104	0.000	138.2	0.0
							0.450	138.2	0.0
							0.451	0.0	0.0
S11	0.00000	0.00000	2.0	0.30	3.909	180	0.000	138.2	0.0
							0.450	138.2	0.0
							0.451	0.0	0.0
S12	0.00000	0.00000	2.0	0.30	3.728		0.000	132.5	0.0
							0.450	132.5	0.0
							0.451	0.0	0.0
S5	0.00000	0.00000	2.0	0.30	3.445		0.000	207.4	0.0
							0.450	207.4	0.0
							0.451	0.0	0.0

Copyright © 1988-2023 Causeway Technologies Ltd

S20	0.00000	0.00000	2.0	0.30	3.558		0.000	213.1	0.0
							0.450	213.1	0.0
							0.451	0.0	0.0

Copyright © 1988-2023 Causeway Technologies Ltd

Node Size	Yes
Node Losses	Yes
Link Size	Yes
Minimum Diameter (mm)	150
Link Length	Yes
Maximum Length (m)	100.000
Coordinates	Yes
Accuracy (m)	1.000
Crossings	Yes
Cover Depth	Yes
Minimum Cover Depth (m)	
Maximum Cover Depth (m)	3.000
Backdrops	Yes
Minimum Backdrop Height (m)	
Maximum Backdrop Height (m)	1.500
Full Bore Velocity	Yes
Minimum Full Bore Velocity (m/s)	
Maximum Full Bore Velocity (m/s)	3.000
Proportional Velocity	Yes
Return Period (years)	
Minimum Proportional Velocity (m/s)	0.750
Maximum Proportional Velocity (m/s)	3.000
Surcharged Depth	Yes
Return Period (years)	
Maximum Surcharged Depth (m)	0.100
Flooding	Yes
Return Period (years)	30
Time to Half Empty	No
Return Period (years)	
Discharge Rates	Yes
Discharge Volume	Yes
100 year 360 minute (m^3)	

Copyright © 1988-2023 Causeway Technologies Ltd

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	113.887	32.226
2 year 15 minute winter	79.921	32.226
2 year 30 minute summer	73.907	20.913
2 year 30 minute winter	51.864	20.913
2 year 60 minute summer	49.406	13.057
2 year 60 minute winter	32.824	13.057
2 year 120 minute summer	32.980	8.716
2 year 120 minute winter	21.911	8.716
2 year 180 minute summer	26.269	6.760
2 year 180 minute winter	17.076	6.760
2 year 240 minute summer	21.220	5.608
2 year 240 minute winter	14.098	5.608
2 year 360 minute summer	16.602	4.272
2 year 360 minute winter	10.792	4.272
2 year 480 minute summer	13.244	3.500
2 year 480 minute winter	8.799	3.500
2 year 600 minute summer	10.928	2.989
2 year 600 minute winter	7.466	2.989
2 year 720 minute summer	9.785	2.622
2 year 720 minute winter	6.576	2.622
2 year 960 minute summer	8.076	2.127
2 year 960 minute winter	5.350	2.127
2 year 1440 minute summer	5.877	1.575
2 year 1440 minute winter	3.950	1.575
30 year 15 minute summer	277.701	78.580
30 year 15 minute winter	194.878	78.580
30 year 30 minute summer	183.735	51.991
30 year 30 minute winter	128.937	51.991
30 year 60 minute summer	123.881	32.738

Copyright © 1988-2023 Causeway Technologies Ltd

30 year 60 minute winter	82.303	32.738
30 year 120 minute summer	73.182	19.340
30 year 120 minute winter	48.620	19.340
30 year 180 minute summer	55.070	14.171
30 year 180 minute winter	35.797	14.171
30 year 240 minute summer	42.961	11.353
30 year 240 minute winter	28.543	11.353
30 year 360 minute summer	32.236	8.295
30 year 360 minute winter	20.954	8.295
30 year 480 minute summer	25.109	6.636
30 year 480 minute winter	16.682	6.636
30 year 600 minute summer	20.394	5.578
30 year 600 minute winter	13.934	5.578
30 year 720 minute summer	18.056	4.839
30 year 720 minute winter	12.135	4.839
30 year 960 minute summer	14.674	3.864
30 year 960 minute winter	9.720	3.864
30 year 1440 minute summer	10.514	2.818
30 year 1440 minute winter	7.066	2.818
30 year +25% CC 15 minute summer	347.126	98.225
30 year +25% CC 15 minute winter	243.597	98.225
30 year +25% CC 30 minute summer	229.669	64.988
30 year +25% CC 30 minute winter	161.171	64.988
30 year +25% CC 60 minute summer	154.851	40.922
30 year +25% CC 60 minute winter	102.879	40.922
30 year +25% CC 120 minute summer	91.477	24.175
30 year +25% CC 120 minute winter	60.775	24.175
30 year +25% CC 180 minute summer	68.838	17.714
30 year +25% CC 180 minute winter	44.746	17.714
30 year +25% CC 240 minute summer	53.702	14.192
30 year +25% CC 240 minute winter	35.678	14.192
30 year +25% CC 360 minute summer	40.295	10.369

Copyright © 1988-2023 Causeway Technologies Ltd

30 year +25% CC 360 minute winter	26.193	10.369
30 year +25% CC 480 minute summer	31.386	8.294
30 year +25% CC 480 minute winter	20.852	8.294
30 year +25% CC 600 minute summer	25.492	6.973
30 year +25% CC 600 minute winter	17.418	6.973
30 year +25% CC 720 minute summer	22.570	6.049
30 year +25% CC 720 minute winter	15.168	6.049
30 year +25% CC 960 minute summer	18.343	4.830
30 year +25% CC 960 minute winter	12.151	4.830
30 year +25% CC 1440 minute summer	13.143	3.522
30 year +25% CC 1440 minute winter	8.833	3.522
100 year 15 minute summer	349.959	99.026
100 year 15 minute winter	245.585	99.026
100 year 30 minute summer	233.116	65.964
100 year 30 minute winter	163.590	65.964
100 year 60 minute summer	158.695	41.938
100 year 60 minute winter	105.433	41.938
100 year 120 minute summer	91.976	24.307
100 year 120 minute winter	61.107	24.307
100 year 180 minute summer	68.671	17.671
100 year 180 minute winter	44.638	17.671
100 year 240 minute summer	53.350	14.099
100 year 240 minute winter	35.444	14.099
100 year 360 minute summer	39.877	10.262
100 year 360 minute winter	25.921	10.262
100 year 480 minute summer	31.011	8.195
100 year 480 minute winter	20.603	8.195
100 year 600 minute summer	25.179	6.887
100 year 600 minute winter	17.204	6.887
100 year 720 minute summer	22.302	5.977
100 year 720 minute winter	14.988	5.977
100 year 960 minute summer	18.174	4.786

Copyright © 1988-2023 Causeway Technologies Ltd

100 year 960 minute winter	12.039	4.786
100 year 1440 minute summer	13.036	3.494
100 year 1440 minute winter	8.761	3.494
100 year +40% CC 15 minute summer	489.942	138.637
100 year +40% CC 15 minute winter	343.819	138.637
100 year +40% CC 30 minute summer	326.362	92.349
100 year +40% CC 30 minute winter	229.026	92.349
100 year +40% CC 60 minute summer	222.173	58.714
100 year +40% CC 60 minute winter	147.607	58.714
100 year +40% CC 120 minute summer	128.766	34.029
100 year +40% CC 120 minute winter	85.549	34.029
100 year +40% CC 180 minute summer	96.140	24.740
100 year +40% CC 180 minute winter	62.493	24.740
100 year +40% CC 240 minute summer	74.690	19.738
100 year +40% CC 240 minute winter	49.622	19.738
100 year +40% CC 360 minute summer	55.827	14.366
100 year +40% CC 360 minute winter	36.289	14.366
100 year +40% CC 480 minute summer	43.415	11.473
100 year +40% CC 480 minute winter	28.844	11.473
100 year +40% CC 600 minute summer	35.250	9.642
100 year +40% CC 600 minute winter	24.085	9.642
100 year +40% CC 720 minute summer	31.223	8.368
100 year +40% CC 720 minute winter	20.984	8.368
100 year +40% CC 960 minute summer	25.444	6.700
100 year +40% CC 960 minute winter	16.854	6.700
100 year +40% CC 1440 minute summer	18.251	4.891
100 year +40% CC 1440 minute winter	12.266	4.891
100 year +45% CC 15 minute summer	507.440	143.588
100 year +45% CC 15 minute winter	356.098	143.588
100 year +45% CC 30 minute summer	338.018	95.647
100 year +45% CC 30 minute winter	237.206	95.647
100 year +45% CC 60 minute summer	230.108	60.811

Copyright © 1988-2023 Causeway Technologies Ltd

100 year +45% CC 60 minute winter	152.878	60.811
100 year +45% CC 120 minute summer	133.365	35.244
100 year +45% CC 120 minute winter	88.605	35.244
100 year +45% CC 180 minute summer	99.573	25.624
100 year +45% CC 180 minute winter	64.725	25.624
100 year +45% CC 240 minute summer	77.357	20.443
100 year +45% CC 240 minute winter	51.394	20.443
100 year +45% CC 360 minute summer	57.821	14.879
100 year +45% CC 360 minute winter	37.585	14.879
100 year +45% CC 480 minute summer	44.965	11.883
100 year +45% CC 480 minute winter	29.874	11.883
100 year +45% CC 600 minute summer	36.509	9.986
100 year +45% CC 600 minute winter	24.945	9.986
100 year +45% CC 720 minute summer	32.338	8.667
100 year +45% CC 720 minute winter	21.733	8.667
100 year +45% CC 960 minute summer	26.353	6.939
100 year +45% CC 960 minute winter	17.456	6.939
100 year +45% CC 1440 minute summer	18.903	5.066
100 year +45% CC 1440 minute winter	12.704	5.066

Copyright © 1988-2023 Causeway Technologies Ltd

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Outflow)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	S1	23	4.024	0.036	5.2	2.4929	0.0000	OK	30 minute winter	1.000	S2	2.4	0.350	0.030	0.1767	
30 minute winter	S2	21	3.925	0.059	7.9	2.1160	0.0000	OK	30 minute winter	1.001	S3	6.6	0.673	0.085	0.3034	
30 minute winter	S3	25	3.788	0.067	11.8	4.5914	0.0000	OK	30 minute winter	1.002	S4	7.9	0.700	0.101	0.1368	
30 minute winter	S4	23	3.610	0.099	18.0	0.1122	0.0000	OK	30 minute winter	1.003	S5	18.0	0.701	0.100	0.5382	
180 minute winter	S5	140	3.545	0.100	15.7	6.3458	0.0000	OK	30 minute winter	1.004	S6	21.6	0.689	0.108	1.9930	
180 minute winter	S6	140	3.544	0.256	16.4	0.2900	0.0000	OK	60 minute summer	1.005	S7	29.9	0.458	0.181	2.6322	
180 minute winter	S7	140	3.544	0.332	26.0	0.3759	0.0000	OK	60 minute summer	1.006	S8	25.6	0.468	0.156	1.7029	
180 minute winter	S8	140	3.544	0.370	25.7	0.4183	0.0000	OK	180 minute winter	1.007	S9	25.4	0.242	0.155	2.3426	
180 minute winter	S9	140	3.543	0.411	26.5	0.7270	0.0000	SURCHARGED	180 minute winter	Hydro-Brake®	EXS	19.1				253.8
30 minute winter	S10	21	4.087	0.045	5.4	1.9237	0.0000	OK	30 minute winter	2.000	S11	3.8	0.572	0.089	0.1368	
30 minute winter	S11	23	3.967	0.058	7.9	2.4902	0.0000	OK	30 minute winter	2.001	S12	5.9	0.740	0.140	0.1274	
30 minute winter	S12	24	3.794	0.066	9.0	2.6819	0.0000	OK	30 minute winter	2.002	S4	7.6	0.693	0.098	0.1492	
15 minute winter	S13	11	3.964	0.089	14.5	0.1010	0.0000	OK	15 minute winter	3.000	S14	14.1	0.814	0.189	0.7101	
15 minute winter	S14	10	3.765	0.151	28.2	0.1704	0.0000	OK	15 minute winter	4.001	S15	28.1	0.679	0.224	0.2789	
15 minute winter	S15	10	3.745	0.157	40.6	0.1770	0.0000	OK	15 minute winter	4.002	S19	40.5	0.804	0.321	1.4380	
15 minute summer	S16	9	3.691	0.275	56.1	0.3108	0.0000	OK	15 minute winter	4.004	TANK	62.3	2.073	0.505	0.1818	
15 minute winter	S17	11	4.029	0.059	5.7	0.0666	0.0000	OK	15 minute winter	4.000	S18	5.5	0.677	0.147	0.2627	
15 minute winter	S18	11	3.772	0.046	5.5	0.0522	0.0000	OK	15 minute winter	5.001	S20	5.5	0.867	0.052	0.2094	
15 minute winter	S19	9	3.711	0.229	53.0	0.2589	0.0000	OK	15 minute summer	4.003	S16	55.6	0.862	0.441	1.2745	
15 minute winter	S20	12	3.643	0.085	26.6	5.5211	0.0000	OK	15 minute winter	5.002	S16	-16.6	0.719	-0.213	0.5326	
15 minute winter	S21	10	3.916	0.055	8.8	0.0617	0.0000	OK	15 minute winter	5.000	S22	8.7	0.643	0.073	0.2083	
15 minute winter	S22	10	3.782	0.094	17.5	0.1065	0.0000	OK	15 minute winter	6.001	S23	17.1	0.696	0.218	0.7981	
15 minute winter	S23	11	3.662	0.135	25.9	0.1532	0.0000	OK	15 minute winter	6.002	S24	25.6	0.861	0.328	0.1855	
15 minute winter	S24	11	3.624	0.128	25.6	0.1445	0.0000	OK	15 minute winter	6.003	TANK	25.7	0.952	0.330	0.2615	
15 minute winter	S25	10	3.763	0.084	16.1	0.0947	0.0000	OK	15 minute winter	7.000	S27	15.9	0.664	0.173	0.5251	
15 minute winter	S26	10	3.694	0.124	16.1	0.1403	0.0000	OK	15 minute winter	9.000	S27	15.8	0.532	0.294	0.5074	
15 minute winter	S27	10	3.671	0.141	31.7	0.1590	0.0000	OK	15 minute winter	8.001	S32	31.5	0.992	0.404	0.6977	
15 minute winter	S28	10	3.733	0.056	6.2	0.0632	0.0000	OK	15 minute winter	8.000	S29	6.0	0.434	0.077	0.5857	
15 minute winter	S29	8	3.651	0.132	12.2	0.1496	0.0000	OK	15 minute summer	7.001	S30	12.8	0.484	0.164	0.3948	
15 minute winter	S30	8	3.630	0.172	32.6	0.1942	0.0000	OK	15 minute winter	7.002	S31	32.9	0.957	0.418	0.3049	
15 minute winter	S31	7	3.617	0.194	32.9	0.2197	0.0000	OK	15 minute winter	7.003	TANK 2	33.8	1.785	0.434	0.2545	
15 minute winter	S32	7	3.626	0.196	31.5	0.2215	0.0000	OK	15 minute winter	8.002	TANK 2	32.1	1.736	0.401	0.2770	
15 minute winter	S33	10	3.995	0.045	3.8	0.0513	0.0000	OK	15 minute winter	10.000	S4	3.7	0.858	0.184	0.0464	
15 minute summer	EXS	1	3.100	0.000	18.8	0.0000	0.0000	OK								
180 minute winter	TANK	140	3.544	0.144	29.3	72.7866	0.0000	OK	480 minute winter	4.005	S7	26.4	0.856	0.121	0.4396	
180 minute winter	TANK 2	140	3.544	0.173	22.7	43.5449	0.0000	OK	60 minute winter	7.004	S9	17.2	0.689	0.219	0.8435	

Copyright © 1988-2023 Causeway Technologies Ltd

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Outflow)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	S1	21	4.055	0.067	12.8	4.6728	0.0000	OK	30 minute winter	1.000	S2	8.6	0.519	0.110	0.4235	
15 minute winter	S2	13	3.976	0.110	25.5	3.9391	0.0000	OK	15 minute winter	1.001	S3	21.5	0.910	0.275	0.7318	
30 minute winter	S3	23	3.856	0.135	35.0	9.2184	0.0000	OK	30 minute winter	1.002	S4	28.6	0.985	0.366	0.3508	
120 minute winter	S4	118	3.795	0.284	35.9	0.3213	0.0000	OK	30 minute winter	1.003	S5	63.5	0.960	0.352	1.6651	
120 minute winter	S5	120	3.795	0.350	44.9	22.1788	0.0000	OK	15 minute winter	1.004	S6	67.6	0.805	0.338	3.9438	
120 minute winter	S6	120	3.795	0.507	37.1	0.5733	0.0000	SURCHARGED	15 minute winter	1.005	S7	71.1	0.590	0.430	4.0582	
180 minute winter	S7	172	3.799	0.587	28.7	0.6644	0.0000	SURCHARGED	30 minute summer	1.006	S8	37.6	0.502	0.229	2.3175	
120 minute winter	S8	120	3.794	0.620	21.5	0.7015	0.0000	SURCHARGED	30 minute summer	1.007	S9	39.1	0.376	0.238	2.5479	
180 minute winter	S9	172	3.794	0.662	25.0	1.1704	0.0000	SURCHARGED	120 minute summer	Hydro-Brake®	EXS	19.1				372.1
15 minute winter	S10	12	4.126	0.084	17.2	3.5845	0.0000	OK	15 minute winter	2.000	S11	12.3	0.766	0.290	0.3270	
30 minute winter	S11	21	4.022	0.113	22.5	4.8003	0.0000	OK	30 minute winter	2.001	S12	19.2	1.009	0.455	0.3046	
30 minute winter	S12	22	3.856	0.128	28.6	5.2358	0.0000	OK	30 minute winter	2.002	S4	26.4	0.966	0.339	0.3698	
15 minute winter	S13	10	4.017	0.142	35.4	0.1608	0.0000	OK	15 minute winter	3.000	S14	34.8	0.824	0.467	1.8151	
15 minute winter	S14	11	3.912	0.298	70.2	0.3373	0.0000	OK	15 minute winter	4.001	S15	68.1	0.720	0.543	0.6241	
15 minute winter	S15	11	3.893	0.305	97.7	0.3448	0.0000	OK	15 minute winter	4.002	S19	97.3	0.962	0.771	2.6641	
120 minute winter	S16	120	3.795	0.379	48.7	0.4286	0.0000	SURCHARGED	15 minute winter	4.004	TANK	152.0	2.589	1.232	0.2817	
15 minute winter	S17	10	4.066	0.096	13.9	0.1081	0.0000	OK	15 minute winter	4.000	S18	13.5	0.863	0.359	0.5034	
15 minute winter	S18	11	3.798	0.072	13.5	0.0810	0.0000	OK	15 minute winter	5.001	S20	13.5	0.928	0.127	0.5100	
15 minute winter	S19	11	3.825	0.343	126.0	0.3876	0.0000	OK	15 minute winter	4.003	S16	126.1	1.263	0.999	1.6494	
120 minute winter	S20	120	3.795	0.237	10.1	15.4195	0.0000	OK	15 minute winter	5.002	S16	34.0	0.811	0.435	0.9013	
15 minute winter	S21	10	3.946	0.085	21.5	0.0964	0.0000	OK	15 minute winter	5.000	S22	21.4	0.806	0.179	0.4043	
15 minute winter	S22	10	3.845	0.157	42.9	0.1770	0.0000	OK	15 minute winter	6.001	S23	41.8	0.831	0.533	1.5926	
120 minute winter	S23	120	3.795	0.268	20.1	0.3029	0.0000	OK	15 minute winter	6.002	S24	62.4	1.046	0.799	0.3727	
120 minute winter	S24	120	3.795	0.299	20.0	0.3380	0.0000	OK	15 minute winter	6.003	TANK	62.8	1.187	0.805	0.5109	
15 minute winter	S25	10	3.819	0.140	39.3	0.1578	0.0000	OK	15 minute winter	7.000	S27	38.6	0.798	0.420	1.0472	
15 minute winter	S26	10	3.815	0.245	39.3	0.2770	0.0000	OK	15 minute winter	9.000	S27	38.5	0.610	0.719	1.0714	
120 minute winter	S27	118	3.794	0.264	24.8	0.2989	0.0000	OK	15 minute winter	8.001	S32	76.0	1.252	0.974	1.2169	
120 minute winter	S28	118	3.794	0.117	4.7	0.1326	0.0000	OK	15 minute winter	8.000	S29	14.7	0.416	0.188	1.1273	
120 minute winter	S29	122	3.795	0.276	9.4	0.3117	0.0000	OK	15 minute winter	7.001	S30	29.5	0.498	0.379	0.7435	
120 minute winter	S30	118	3.795	0.337	24.1	0.3808	0.0000	SURCHARGED	15 minute winter	7.002	S31	76.0	1.238	0.965	0.4231	
120 minute winter	S31	118	3.795	0.372	23.7	0.4205	0.0000	SURCHARGED	15 minute winter	7.003	TANK 2	75.8	2.055	0.973	0.6036	
120 minute winter	S32	118	3.794	0.364	24.9	0.4120	0.0000	SURCHARGED	15 minute winter	8.002	TANK 2	76.1	2.013	0.951	0.6394	
15 minute winter	S33	10	4.026	0.076	9.3	0.0855	0.0000	OK	15 minute winter	10.000	S4	9.2	1.079	0.452	0.0905	
15 minute summer	EXS	1	3.100	0.000	19.1	0.0000	0.0000	OK								
120 minute winter	TANK	120	3.795	0.395	88.2	199.3138	0.0000	SURCHARGED	30 minute winter	4.005	S7	-52.1	0.717	-0.239	0.9770	
120 minute winter	TANK 2	118	3.794	0.423	47.0	106.6252	0.0000	SURCHARGED	15 minute summer	7.004	S9	22.0	0.681	0.281	1.1456	

Copyright © 1988-2023 Causeway Technologies Ltd

Results for 30 year +25% CC Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Outflow)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	S1	21	4.065	0.077	16.1	5.4115	0.0000	OK	30 minute winter	1.000	S2	11.5	0.561	0.148	0.5189	
15 minute winter	S2	13	3.995	0.129	33.2	4.6214	0.0000	OK	15 minute winter	1.001	S3	28.7	0.953	0.366	0.9217	
180 minute winter	S3	176	3.918	0.197	16.2	13.4872	0.0000	OK	30 minute winter	1.002	S4	37.8	1.053	0.484	0.4337	
180 minute winter	S4	176	3.918	0.407	34.4	0.4603	0.0000	OK	30 minute winter	1.003	S5	83.2	0.992	0.461	2.4331	
180 minute winter	S5	176	3.918	0.473	42.3	28.5650	0.0000	SURCHARGED	15 minute winter	1.004	S6	82.9	0.834	0.415	5.0573	
180 minute winter	S6	176	3.918	0.630	34.2	0.7123	0.0000	SURCHARGED	15 minute summer	1.005	S7	80.3	0.602	0.486	4.2892	
180 minute winter	S7	176	3.918	0.706	35.7	0.7981	0.0000	SURCHARGED	30 minute summer	1.006	S8	40.9	0.493	0.250	2.3176	
180 minute winter	S8	176	3.917	0.743	22.0	0.8406	0.0000	SURCHARGED	30 minute summer	1.007	S9	41.9	0.369	0.255	2.5479	
180 minute winter	S9	176	3.917	0.785	22.7	1.3869	0.0000	SURCHARGED	30 minute summer	Hydro-Brake®	EXS	19.1				294.9
15 minute winter	S10	12	4.140	0.098	21.5	4.1906	0.0000	OK	15 minute winter	2.000	S11	16.0	0.807	0.378	0.4052	
30 minute winter	S11	21	4.042	0.133	28.6	5.6498	0.0000	OK	30 minute winter	2.001	S12	24.9	1.071	0.590	0.3719	
180 minute winter	S12	176	3.918	0.190	13.4	7.7683	0.0000	OK	30 minute winter	2.002	S4	34.4	1.032	0.442	0.4515	
15 minute winter	S13	11	4.102	0.227	44.2	0.2571	0.0000	OK	15 minute winter	3.000	S14	42.6	0.825	0.572	2.6216	
15 minute winter	S14	11	4.052	0.438	83.1	0.4958	0.0000	SURCHARGED	15 minute winter	4.001	S15	82.8	0.751	0.661	0.7248	
15 minute winter	S15	11	4.026	0.438	118.6	0.4958	0.0000	SURCHARGED	15 minute winter	4.002	S19	118.5	1.074	0.939	2.9148	
120 minute winter	S16	132	3.933	0.517	55.6	0.5849	0.0000	SURCHARGED	15 minute winter	4.004	TANK	184.4	2.706	1.494	0.3717	
15 minute winter	S17	10	4.079	0.109	17.4	0.1233	0.0000	OK	15 minute winter	4.000	S18	16.9	0.914	0.449	0.5965	
180 minute winter	S18	176	3.918	0.192	4.0	0.2171	0.0000	OK	15 minute winter	5.001	S20	17.0	0.960	0.159	0.6229	
180 minute winter	S19	176	3.918	0.436	37.9	0.4930	0.0000	SURCHARGED	15 minute winter	4.003	S16	154.2	1.406	1.222	1.7637	
180 minute winter	S20	176	3.918	0.360	9.9	23.4235	0.0000	SURCHARGED	15 minute winter	5.002	S16	41.9	0.794	0.536	1.0470	
15 minute winter	S21	10	3.957	0.096	26.8	0.1081	0.0000	OK	15 minute winter	5.000	S22	26.6	0.827	0.224	0.5150	
180 minute winter	S22	176	3.918	0.230	12.4	0.2601	0.0000	OK	15 minute winter	6.001	S23	51.5	0.844	0.657	1.9293	
180 minute winter	S23	176	3.918	0.391	18.6	0.4419	0.0000	SURCHARGED	15 minute winter	6.002	S24	77.0	1.121	0.987	0.4249	
180 minute winter	S24	176	3.918	0.422	17.9	0.4777	0.0000	SURCHARGED	15 minute winter	6.003	TANK	77.3	1.274	0.991	0.5829	
180 minute winter	S25	176	3.918	0.239	11.3	0.2698	0.0000	OK	15 minute winter	7.000	S27	47.1	0.798	0.512	1.4095	
15 minute winter	S26	11	3.919	0.349	49.2	0.3952	0.0000	SURCHARGED	15 minute winter	9.000	S27	48.2	0.684	0.900	1.1931	
180 minute winter	S27	176	3.918	0.388	22.3	0.4383	0.0000	SURCHARGED	15 minute winter	8.001	S32	94.0	1.339	1.205	1.3779	
180 minute winter	S28	176	3.917	0.240	4.3	0.2716	0.0000	OK	15 minute winter	8.000	S29	18.3	0.406	0.234	1.5887	
180 minute winter	S29	176	3.917	0.398	8.6	0.4505	0.0000	SURCHARGED	15 minute winter	7.001	S30	36.0	0.516	0.462	0.8630	
180 minute winter	S30	176	3.918	0.460	21.6	0.5202	0.0000	SURCHARGED	15 minute winter	7.002	S31	93.2	1.329	1.185	0.4754	
180 minute winter	S31	180	3.917	0.494	21.0	0.5592	0.0000	SURCHARGED	15 minute winter	7.003	TANK 2	92.9	2.127	1.191	0.7155	
180 minute winter	S32	176	3.917	0.487	21.4	0.5513	0.0000	SURCHARGED	15 minute winter	8.002	TANK 2	93.6	2.069	1.171	0.7644	
15 minute winter	S33	10	4.037	0.087	11.6	0.0983	0.0000	OK	15 minute winter	10.000	S4	11.4	1.135	0.563	0.1072	
15 minute summer	EXS	1	3.100	0.000	19.1	0.0000	0.0000	OK								
180 minute winter	TANK	176	3.918	0.518	72.8	261.3629	0.0000	SURCHARGED	30 minute winter	4.005	S7	-74.6	-0.709	-0.342	1.0484	
180 minute winter	TANK 2	176	3.917	0.546	40.8	137.6383	0.0000	SURCHARGED	15 minute summer	7.004	S9	22.1	0.719	0.282	1.2448	

Copyright © 1988-2023 Causeway Technologies Ltd

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Outflow)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	S1	21	4.066	0.078	16.3	5.4574	0.0000	OK	30 minute winter	1.000	S2	11.7	0.563	0.150	0.5250	
15 minute winter	S2	13	3.996	0.130	33.5	4.6465	0.0000	OK	15 minute winter	1.001	S3	28.9	0.955	0.369	0.9291	
180 minute winter	S3	176	3.917	0.196	16.2	13.3929	0.0000	OK	30 minute winter	1.002	S4	38.5	1.057	0.493	0.4394	
180 minute winter	S4	176	3.917	0.406	34.3	0.4587	0.0000	OK	30 minute winter	1.003	S5	84.5	0.994	0.469	2.4888	
180 minute winter	S5	176	3.917	0.472	42.3	28.5635	0.0000	SURCHARGED	15 minute winter	1.004	S6	83.5	0.834	0.418	5.0995	
180 minute winter	S6	176	3.916	0.628	34.2	0.7104	0.0000	SURCHARGED	15 minute winter	1.005	S7	81.1	0.605	0.490	4.4628	
180 minute winter	S7	176	3.917	0.705	35.6	0.7971	0.0000	SURCHARGED	15 minute summer	1.006	S8	40.6	0.600	0.248	2.3164	
180 minute winter	S8	176	3.915	0.741	22.2	0.8385	0.0000	SURCHARGED	30 minute summer	1.007	S9	42.1	0.369	0.257	2.5479	
180 minute winter	S9	176	3.915	0.783	22.8	1.3844	0.0000	SURCHARGED	60 minute summer	Hydro-Brake®	EXS	19.1				320.5
15 minute winter	S10	12	4.141	0.099	21.6	4.2120	0.0000	OK	15 minute winter	2.000	S11	16.1	0.809	0.381	0.4079	
30 minute winter	S11	21	4.043	0.134	29.0	5.7051	0.0000	OK	30 minute winter	2.001	S12	25.3	1.075	0.599	0.3762	
180 minute winter	S12	176	3.917	0.189	13.4	7.7100	0.0000	OK	30 minute winter	2.002	S4	34.9	1.036	0.449	0.4569	
15 minute winter	S13	11	4.111	0.236	44.6	0.2674	0.0000	OK	15 minute winter	3.000	S14	43.2	0.827	0.579	2.6684	
15 minute winter	S14	11	4.059	0.445	83.8	0.5038	0.0000	SURCHARGED	15 minute winter	4.001	S15	83.6	0.758	0.667	0.7248	
15 minute winter	S15	11	4.033	0.445	119.6	0.5032	0.0000	SURCHARGED	15 minute winter	4.002	S19	119.6	1.084	0.947	2.9148	
180 minute winter	S16	176	3.917	0.501	39.2	0.5669	0.0000	SURCHARGED	15 minute winter	4.004	TANK	185.7	2.710	1.505	0.3749	
15 minute winter	S17	10	4.080	0.110	17.6	0.1240	0.0000	OK	15 minute winter	4.000	S18	17.0	0.916	0.453	0.6007	
180 minute winter	S18	176	3.917	0.191	4.0	0.2156	0.0000	OK	15 minute winter	5.001	S20	17.1	0.963	0.161	0.6274	
180 minute winter	S19	176	3.917	0.435	37.7	0.4914	0.0000	SURCHARGED	15 minute winter	4.003	S16	155.5	1.411	1.232	1.7672	
180 minute winter	S20	176	3.917	0.359	9.9	23.3263	0.0000	SURCHARGED	15 minute winter	5.002	S16	42.3	0.793	0.541	1.0527	
15 minute winter	S21	10	3.957	0.096	27.0	0.1085	0.0000	OK	15 minute winter	5.000	S22	26.8	0.827	0.225	0.5218	
180 minute winter	S22	176	3.917	0.229	12.4	0.2585	0.0000	OK	15 minute winter	6.001	S23	51.9	0.844	0.662	1.9427	
180 minute winter	S23	176	3.916	0.389	18.6	0.4405	0.0000	SURCHARGED	15 minute winter	6.002	S24	77.6	1.125	0.994	0.4259	
180 minute winter	S24	176	3.917	0.421	17.9	0.4762	0.0000	SURCHARGED	15 minute winter	6.003	TANK	77.8	1.277	0.998	0.5853	
15 minute winter	S25	11	3.922	0.243	49.6	0.2748	0.0000	OK	15 minute winter	7.000	S27	47.5	0.798	0.517	1.4261	
15 minute winter	S26	11	3.925	0.355	49.6	0.4015	0.0000	SURCHARGED	15 minute winter	9.000	S27	48.5	0.688	0.905	1.1931	
180 minute winter	S27	176	3.916	0.386	22.3	0.4365	0.0000	SURCHARGED	15 minute winter	8.001	S32	94.8	1.348	1.215	1.3832	
180 minute winter	S28	176	3.916	0.239	4.3	0.2700	0.0000	OK	15 minute winter	8.000	S29	18.4	0.402	0.236	1.6094	
180 minute winter	S29	180	3.916	0.397	8.6	0.4493	0.0000	SURCHARGED	15 minute winter	7.001	S30	36.1	0.514	0.464	0.8649	
180 minute winter	S30	184	3.917	0.459	21.6	0.5192	0.0000	SURCHARGED	15 minute winter	7.002	S31	93.9	1.336	1.193	0.4772	
180 minute winter	S31	176	3.917	0.494	21.0	0.5584	0.0000	SURCHARGED	15 minute winter	7.003	TANK 2	93.6	2.130	1.200	0.7178	
180 minute winter	S32	176	3.916	0.486	21.2	0.5495	0.0000	SURCHARGED	15 minute winter	8.002	TANK 2	94.4	2.072	1.181	0.7671	
15 minute winter	S33	10	4.037	0.087	11.7	0.0989	0.0000	OK	15 minute winter	10.000	S4	11.5	1.137	0.568	0.1079	
15 minute summer	EXS	1	3.100	0.000	19.1	0.0000	0.0000	OK								
180 minute winter	TANK	176	3.916	0.516	72.7	260.6158	0.0000	SURCHARGED	30 minute winter	4.005	S7	-76.3	-0.721	-0.349	1.0484	
180 minute winter	TANK 2	176	3.916	0.545	40.8	137.2370	0.0000	SURCHARGED	15 minute summer	7.004	S9	22.3	0.717	0.285	1.2472	

Copyright © 1988-2023 Causeway Technologies Ltd

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Outflow)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	S1	236	4.178	0.190	6.8	13.3443	0.0000	OK	15 minute winter	1.000	S2	18.0	0.607	0.230	0.7357	
240 minute winter	S2	236	4.178	0.312	11.8	11.1439	0.0000	SURCHARGED	15 minute winter	1.001	S3	43.4	1.016	0.555	1.3070	
240 minute winter	S3	236	4.178	0.457	18.4	30.8582	0.0000	SURCHARGED	15 minute winter	1.002	S4	52.7	1.128	0.675	0.6466	
240 minute winter	S4	236	4.179	0.668	37.1	0.7550	0.0000	SURCHARGED	15 minute winter	1.003	S5	117.6	1.059	0.652	3.1168	
240 minute winter	S5	236	4.178	0.733	45.9	28.8590	0.0000	SURCHARGED	30 minute winter	1.004	S6	103.5	0.754	0.518	6.4583	
240 minute winter	S6	236	4.178	0.890	37.5	1.0065	0.0000	SURCHARGED	30 minute winter	1.005	S7	112.3	0.709	0.679	4.5464	
240 minute winter	S7	236	4.178	0.966	40.0	1.0925	0.0000	SURCHARGED	15 minute winter	1.006	S8	48.5	0.613	0.296	2.3176	
240 minute winter	S8	236	4.178	1.004	22.5	1.1353	0.0000	SURCHARGED	15 minute summer	1.007	S9	52.9	0.452	0.322	2.5479	
240 minute winter	S9	240	4.177	1.045	22.5	1.8465	0.0000	SURCHARGED	15 minute summer	Hydro-Brake®	EXS	19.1				282.3
240 minute winter	S10	240	4.178	0.136	5.6	5.8015	0.0000	OK	15 minute winter	2.000	S11	23.7	0.871	0.561	0.5534	
240 minute winter	S11	240	4.178	0.269	10.5	11.4579	0.0000	SURCHARGED	15 minute winter	2.001	S12	36.7	1.151	0.868	0.5092	
240 minute winter	S12	236	4.178	0.450	15.3	18.3952	0.0000	SURCHARGED	15 minute winter	2.002	S4	48.1	1.092	0.618	0.6976	
15 minute winter	S13	10	4.610	0.735	62.4	0.8311	0.0000	SURCHARGED	15 minute winter	3.000	S14	60.0	0.853	0.806	2.8911	
15 minute winter	S14	11	4.466	0.852	122.4	0.9635	0.0000	SURCHARGED	15 minute winter	4.001	S15	120.5	1.093	0.962	0.7248	
15 minute winter	S15	11	4.413	0.825	174.1	0.9325	0.0000	SURCHARGED	15 minute winter	4.002	S19	172.3	1.563	1.365	2.9148	
240 minute winter	S16	236	4.180	0.764	39.0	0.8640	0.0000	SURCHARGED	15 minute winter	4.004	TANK	240.1	2.712	1.946	0.4599	
240 minute winter	S17	236	4.179	0.209	4.5	0.2359	0.0000	OK	15 minute winter	4.000	S18	23.9	0.990	0.636	0.7794	
240 minute winter	S18	240	4.180	0.454	4.5	0.5133	0.0000	SURCHARGED	15 minute winter	5.001	S20	24.4	0.974	0.229	0.9974	
240 minute winter	S19	236	4.178	0.696	40.1	0.7875	0.0000	SURCHARGED	15 minute winter	4.003	S16	224.5	2.036	1.779	1.8152	
240 minute winter	S20	240	4.179	0.621	11.7	29.5027	0.0000	SURCHARGED	15 minute summer	5.002	S16	62.4	0.892	0.798	1.2152	
15 minute winter	S21	11	4.183	0.322	37.8	0.3645	0.0000	SURCHARGED	15 minute winter	5.000	S22	36.6	0.846	0.307	1.0619	
240 minute winter	S22	236	4.178	0.490	13.8	0.5542	0.0000	SURCHARGED	15 minute winter	6.001	S23	72.7	1.032	0.927	2.2635	
240 minute winter	S23	240	4.178	0.651	20.6	0.7362	0.0000	SURCHARGED	15 minute winter	6.002	S24	108.7	1.544	1.393	0.4393	
240 minute winter	S24	236	4.179	0.683	19.6	0.7728	0.0000	SURCHARGED	15 minute winter	6.003	TANK	109.1	1.561	1.399	0.6816	
15 minute winter	S25	11	4.367	0.688	69.4	0.7776	0.0000	SURCHARGED	15 minute winter	7.000	S27	66.9	0.950	0.728	1.5270	
15 minute winter	S26	11	4.350	0.780	69.4	0.8817	0.0000	SURCHARGED	15 minute winter	9.000	S27	66.9	0.951	1.250	1.1931	
15 minute winter	S27	11	4.267	0.737	133.8	0.8331	0.0000	SURCHARGED	15 minute winter	8.001	S32	131.8	1.872	1.689	1.4180	
240 minute winter	S28	236	4.178	0.501	4.9	0.5666	0.0000	SURCHARGED	15 minute winter	8.000	S29	25.1	0.426	0.321	2.2312	
240 minute winter	S29	240	4.178	0.659	8.8	0.7449	0.0000	SURCHARGED	15 minute winter	7.001	S30	50.1	0.712	0.644	0.8695	
240 minute winter	S30	232	4.178	0.720	23.9	0.8141	0.0000	SURCHARGED	15 minute winter	7.002	S31	132.4	1.881	1.683	0.4882	
240 minute winter	S31	240	4.178	0.755	23.7	0.8534	0.0000	SURCHARGED	15 minute winter	7.003	TANK 2	131.1	2.182	1.682	0.7389	
240 minute winter	S32	236	4.178	0.748	24.0	0.8457	0.0000	SURCHARGED	15 minute winter	8.002	TANK 2	131.6	2.136	1.646	0.7970	
240 minute winter	S33	236	4.178	0.228	3.0	0.2578	0.0000	SURCHARGED	15 minute winter	10.000	S4	16.2	1.214	0.795	0.1414	
15 minute summer	EXS	1	3.100	0.000	19.1	0.0000	0.0000	OK								
240 minute winter	TANK	236	4.178	0.778	80.8	392.6914	0.0000	SURCHARGED	30 minute winter	4.005	S7	-121.0	-1.097	-0.554	1.0484	
240 minute winter	TANK 2	236	4.178	0.807	47.3	203.2328	0.0000	SURCHARGED	15 minute summer	7.004	S9	-26.7	0.682	-0.341	1.2564	

Copyright © 1988-2023 Causeway Technologies Ltd

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Outflow)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	S1	236	4.216	0.228	8.1	15.9754	0.0000	OK	15 minute winter	1.000	S2	18.8	0.613	0.241	0.7615	
240 minute winter	S2	236	4.215	0.349	12.2	12.4645	0.0000	SURCHARGED	15 minute winter	1.001	S3	45.2	1.023	0.578	1.3543	
240 minute winter	S3	236	4.216	0.495	19.1	30.9005	0.0000	SURCHARGED	15 minute winter	1.002	S4	53.8	1.109	0.689	0.6931	
240 minute winter	S4	240	4.216	0.705	38.0	0.7975	0.0000	SURCHARGED	15 minute winter	1.003	S5	120.8	1.068	0.670	3.2059	
240 minute winter	S5	236	4.216	0.771	46.8	28.9018	0.0000	SURCHARGED	30 minute winter	1.004	S6	106.3	0.759	0.532	6.4583	
240 minute winter	S6	240	4.214	0.926	37.5	1.0479	0.0000	SURCHARGED	30 minute winter	1.005	S7	111.9	0.707	0.677	4.5464	
240 minute winter	S7	236	4.216	1.004	40.3	1.1352	0.0000	SURCHARGED	15 minute summer	1.006	S8	43.9	0.598	0.268	2.3176	
240 minute winter	S8	236	4.214	1.040	22.8	1.1758	0.0000	SURCHARGED	15 minute winter	1.007	S9	49.3	0.454	0.300	2.5479	
240 minute winter	S9	236	4.214	1.082	22.3	1.9123	0.0000	SURCHARGED	15 minute summer	Hydro-Brake®	EXS	19.1				282.0
240 minute winter	S10	236	4.215	0.173	5.8	7.3735	0.0000	OK	15 minute winter	2.000	S11	24.6	0.876	0.582	0.5706	
240 minute winter	S11	236	4.215	0.306	10.9	13.0457	0.0000	SURCHARGED	15 minute winter	2.001	S12	37.9	1.157	0.898	0.5233	
240 minute winter	S12	236	4.216	0.488	15.9	18.4587	0.0000	SURCHARGED	15 minute winter	2.002	S4	49.1	1.102	0.630	0.7519	
15 minute winter	S13	10	4.680	0.805	64.7	0.9101	0.0000	SURCHARGED	15 minute winter	3.000	S14	62.1	0.883	0.834	2.8911	
15 minute winter	S14	11	4.525	0.911	126.7	1.0305	0.0000	SURCHARGED	15 minute winter	4.001	S15	124.6	1.129	0.994	0.7248	
15 minute winter	S15	11	4.468	0.880	180.0	0.9950	0.0000	SURCHARGED	15 minute winter	4.002	S19	178.0	1.614	1.411	2.9148	
240 minute winter	S16	236	4.216	0.800	40.9	0.9049	0.0000	SURCHARGED	15 minute winter	4.004	TANK	247.2	2.761	2.003	0.4599	
240 minute winter	S17	236	4.215	0.245	4.7	0.2772	0.0000	SURCHARGED	15 minute winter	4.000	S18	24.7	1.000	0.658	0.7993	
240 minute winter	S18	236	4.215	0.489	4.7	0.5531	0.0000	SURCHARGED	15 minute winter	5.001	S20	25.3	0.983	0.238	1.0332	
240 minute winter	S19	236	4.215	0.733	41.5	0.8286	0.0000	SURCHARGED	15 minute winter	4.003	S16	232.1	2.105	1.839	1.8152	
240 minute winter	S20	236	4.215	0.657	11.2	29.5433	0.0000	SURCHARGED	15 minute summer	5.002	S16	62.4	0.887	0.799	1.2155	
15 minute winter	S21	11	4.224	0.363	39.2	0.4101	0.0000	SURCHARGED	15 minute winter	5.000	S22	37.7	0.843	0.317	1.0619	
240 minute winter	S22	240	4.216	0.528	14.4	0.5969	0.0000	SURCHARGED	15 minute winter	6.001	S23	75.6	1.073	0.964	2.2635	
240 minute winter	S23	240	4.215	0.688	20.6	0.7784	0.0000	SURCHARGED	15 minute winter	6.002	S24	113.0	1.605	1.448	0.4393	
240 minute winter	S24	240	4.216	0.720	19.7	0.8141	0.0000	SURCHARGED	15 minute winter	6.003	TANK	113.4	1.618	1.454	0.6816	
15 minute winter	S25	11	4.426	0.747	71.9	0.8453	0.0000	SURCHARGED	15 minute winter	7.000	S27	69.2	0.983	0.753	1.5270	
15 minute winter	S26	11	4.408	0.838	71.9	0.9478	0.0000	SURCHARGED	15 minute winter	9.000	S27	69.3	0.984	1.294	1.1931	
15 minute winter	S27	11	4.319	0.789	138.5	0.8922	0.0000	SURCHARGED	15 minute winter	8.001	S32	136.6	1.941	1.751	1.4180	
240 minute winter	S28	232	4.213	0.536	5.0	0.6065	0.0000	SURCHARGED	15 minute winter	8.000	S29	26.0	0.428	0.332	2.2312	
240 minute winter	S29	236	4.214	0.695	9.2	0.7864	0.0000	SURCHARGED	15 minute winter	7.001	S30	52.1	0.740	0.669	0.8695	
240 minute winter	S30	240	4.216	0.758	24.9	0.8571	0.0000	SURCHARGED	15 minute winter	7.002	S31	137.3	1.950	1.745	0.4882	
240 minute winter	S31	236	4.214	0.791	24.7	0.8951	0.0000	SURCHARGED	15 minute winter	7.003	TANK 2	135.6	2.173	1.740	0.7389	
240 minute winter	S32	236	4.214	0.784	24.9	0.8870	0.0000	SURCHARGED	15 minute winter	8.002	TANK 2	136.3	2.145	1.704	0.7970	
240 minute winter	S33	236	4.215	0.265	3.1	0.3003	0.0000	SURCHARGED	15 minute winter	10.000	S4	16.8	1.220	0.824	0.1457	
15 minute summer	EXS	1	3.100	0.000	19.1	0.0000	0.0000	OK								
240 minute winter	TANK	236	4.215	0.815	84.4	411.2204	0.0000	SURCHARGED	30 minute winter	4.005	S7	-118.4	-1.074	-0.542	1.0484	
240 minute winter	TANK 2	236	4.214	0.843	49.3	212.4440	0.0000	SURCHARGED	15 minute summer	7.004	S9	-29.8	0.696	-0.381	1.2564	

Copyright © 1988-2023 Causeway Technologies Ltd

BAYNHAM MEIKLE

Consulting Civil and Structural Engineers

Havant Phase 2

Langstone Technology Park

SUDS Maintenance Plan

Project Ref: **AB/13508**

Issue: First Issue

February 2024

Client

XLB Limited

BAYNHAM MEIKLE

0121 434 4100

8 Meadow Road, Edgbaston, Birmingham, B17 8BU

Company Registration Number: 04124240

www.baynhammeikle.co.uk

BAYNHAM MEIKLE
Consulting Civil and Structural Engineers

SUSTAINABLE DRAINAGE AND LANDSCAPE MANAGEMENT PLAN FOR HAVANT PHASE 2.

An introduction to sustainable drainage systems or SuDS

- SuDS are a new environmentally friendly approach to managing rainfall that use landscape features to deal with surface water. SuDS aim to:
  - Control the flow, volume and frequency of water leaving a development area
  - Prevent pollution by intercepting silt and cleaning runoff from hard surfaces
  - Provide attractive surroundings for the community
  - Create opportunities for wildlife

1 SuDS Drainage Strategy

The proposed SuDS are designed to prevent flooding and control the flow of surface water using attractive landscape features.
It is proposed that drainage strategy incorporates cellular storage within service yard areas. This feature is the primary source of surface water storage for the site.
In addition to the cellular, storage is also provided by the use of porous car parking.

2 SuDS Management

The proposed SuDS measures, have been designed with easy maintenance in mind. Maintenance will generally fall into one of the three following categories:

- **Regular day to day care** - litter collection, grass cutting and checking the inlets and outlets where water enters or leaves a SuDS feature
- **Occasional tasks** - managing vegetation and removing any silt that builds up in the SuDS features also after flooding events.
- **Remedial work** - repairing damage where necessary

3 SuDS Maintenance – Summary

		Frequency	Unit Rate	Total
	REGULAR MAINTENANCE			
1.	LITTER MANAGEMENT			
1.1	Pick up all litter in SuDs and Landscape areas and removed from	12 visits monthly		
2	GRASS MAINTENANCE – all cutting to wildlife piles			
2.1	Mow all grass verges, paths and amenity at 35-60mm with 75mm max. Leaving grass in situ	As required or monthly		
4	HARD SERVICES			
4.1	Sweep all paving regularly. Sweep and suction brush. Permeable paving in autumn after leaf fall	1 visit		
	OCCASIONAL TASKS			
6	SILT MANAGEMENT			
6.1	Remove / clear out silt from silt collection traps in linear drainage channels	As required / after flood event.		
7	REMEDIAL WORK			
7.1	Inspect SuDs system regularly to check for damage or failure.	As required / after flood event.		

SuDS Features:

SuDS techniques include attenuation structures which assist in managing discharge of water from the site.

Cellular Tanks / Soakaways are used to manage and control surface runoff. Also, they are used to store surface water on site under the ground to slow discharge before it is discharge offsite.

Permeable surfaces as permeable ashpalt, gravel or free draining soils that allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc.

Inspection Chambers and rodding eyes are used on bends or where pipes come together. They allow cleaning of the system if necessary.

Overflows can be below ground through gratings and chambers or over grass weirs in the open They must be kept clear at all times to protect areas from flooding.

Flood routes (exceedance routes) allow water volumes exceeding the capacity of the SUDS system to escape from the site without causing damage to property. This route must be clear of obstructions at all times.

Green Roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover, over a drainage layer. They are designed to intercept and retain precipitation, reducing the volume of run-off and attenuation peak flows.

Sustainable Drainage Maintenance Specification

1.0 GENERAL REQUIREMENTS

Maintenance activities comprise: • Regular Maintenance • Occasional Task • Remedial Work	**Frequency**
Generally **Litter** Collect all litter or other debris and remove from site at each site visit	**Monthly**

- **Avoid** use of weed killers and pesticides to prevent chemical pollution
- **Avoid** de-icing agents wherever possible to allow bio-remediation of pollutants in permeable surfaces.
- **Protect** all permeable, porous and infiltration surfaces from silt, sand, mulch and other fine particles.

Exclusions:

- Maintenance of rainwater harvesting chambers, pumps, etc.

2.0 INLETS, OUTLETS, CONTROLS, AND INSPECTION CHAMBERS

- **Inlets and outlets structures** may be surface structures or conveyance pipes with guards or headwalls. They must be free from obstruction at all times.
- **SuDS flow control structures** can be protected orifices, slots weirs or other controls at or near the surface to be accessible and easy to maintain. They may be in baskets, in small chambers or in the open.
- **Inspection Chambers** and rodding eyes are used on bends or where pipes come together and allow cleaning of the system if necessary. They should be designed out of the system where possible.

INLETS, OUTLETS, CONTROLS AND INSPECTION CHAMBERS	
Regular Maintenance	**Frequency**
Inlets, outlets and surface control structures	
Inspect surface structures removing obstructions and silt as necessary. Check there is no physical damage.	Monthly
Strim vegetation 1m min. surround to structures and keep hard aprons free from silt and debris	Monthly
Inspection chambers and below ground control chambers	

Remove cover and inspect ensuring water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt. Undertake inspection after leaf fall in autumn	Annually
Occasional Maintenance	
Check topsoil levels are 20mm above edges of baskets and chambers to avoid mower damage	As necessary
Remedial work	**Frequency**
Unpack stone in basket features and unblock or repair and repack stone as design detail as necessary.	As required
Repair physical damage if necessary.	As required

3.0 OVERFLOWS AND FLOOD ROUTES

- **Overflows** are overland across weirs, through gratings or within chambers and must be kept clear at all times to protect areas from flooding. They allow onward flow when part of the SuDS system is blocked.
- **Flood routes (exceedance routes)** allow water volumes that exceed the capacity of the SuDS system to pass through or round the site without causing damage to property. These routes must be clear of obstructions at all times.

OVERFLOWS AND FLOOD ROUTES	
Regular Maintenance	**Frequency**
Overflows. Jet pipes leading from overflow structures annually and check by running water through the overflow. Check free flow at next SUDS feature – inlet to basin or chamber.	Annually
Overflows. Remove any accumulated grass cuttings or other debris on top of grass weirs or stone filled baskets overflows.	Monthly
Flood Routes. Make visual inspection. Check route is not blocked by new fences, walls, soil or other rubbish. Remove as necessary.	Monthly
Remedial	**Frequency**
Overflows. If overflow is not clear then dismantle structure and reassemble to design detail.	As required

4.0 Cellular Storage

Cellular Storage	
Regular Maintenance	**Frequency**
Inspect inlets, outlets and control structures and remove obstructions and silt as necessary.	Monthly
Remove cover and inspect ensuring water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt. Undertake inspection after leaf fall in autumn	Annually
Occasional Maintenance	
Remove silt from catchpits and cellular storage	As necessary
Remedial work	**Frequency**
Repair inlet/outlet, if necessary, removal of silt build up Repair physical damage if necessary.	As required As required

5.0 PERMEABLE SURFACES

- **Permeable surfaces** including permeable block paving, porous asphalt, gravel or free draining soils that allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc. Permeable block paving can be cleaned by suction brushing.

PERMEABLE AND POROUS SURFACES	
Regular Maintenance	**Frequency**
Cleaning Brush regularly and remove sweeping from all hard surface	Monthly
Occasional Tasks	**Frequency**
Permeable Tasks Brush and vacuum surface once and year to prevent still blockage and enhance design life	Annually
Remedial Work	**Frequency**
Monitor effectiveness of permeable pavement and when water does not infiltrate immediately advise client of possible need for reinstatement of top layers or specialist cleaning. Recent experience suggest jet washing and suction cleaning will substantially reinstate pavement to 90% efficiently	As required
After Flood Event	**Frequency**
Brush and vacuum surface to remove silt / debris. If water still does not infiltrate immediately advise client of possible need of reinstatement of top layers or specialist cleaning. Check perforated pipework and outlet sumps.	After the flooding has subsided and is safe to undertake.

6.0 GREEN ROOFS

The amount of maintenance required will depend on the type of green roof installed.

GREEN ROOF	
Regular Inspection	**Frequency**
Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural ability	Annually and after severe storms
Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
Inspect drains inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular Maintenance	**Frequency**
Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
During establishment (ie year one), replace dead plants as required.	Monthly (but usually responsibility of manufacturer)
Post establishment, replace dead plants as required (where >5% of coverage)	Annually (in autumn)
Remove fallen leaves and debris from deciduous plant foliage.	Six monthly or as required
Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate.	Six monthly or as required
Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
Remedial Actions	**Frequency**
If erosion channels are evident, these should be established with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled.	As required.
If drain inlet has settled, cracked or moved, investigate and repair as appropriate.	As required.

7.0 MANHOLES AND INSPECTION CHAMBERS

- **Manholes and Inspection Chambers** and rodding eyes are used on bends or where pipes come together and allow cleaning of the system if necessary. They should be designed out of the system where possible.

INLETS, OUTLETS, CONTROLS AND INSPECTION CHAMBERS	
Regular Maintenance	**Frequency**
Manholes and Inspection chambers and below ground control chambers	
Remove cover and inspect ensuring water is flowing freely and that the exit route for water is obstructed. Remove debris and silt. Undertake inspection after leaf fall in autumn.	Annually
Occasional Maintenance	**Frequency**
Check topsoil levels are 20mm above edges of baskets and chambers to avoid mower damage	As necessary
Remedial Work	**Frequency**
Unpack stone in basket features and unblock or repair and repack stone as design detail as necessary. Repair physical damage if necessary	As required

8.0 SPILLAGE – EMERGENCY ACTION

Most spillages on development sites are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency with residual spillage allowed to bio-remediate in the drainage system.

In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung(s). (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or close woven fabric.)

Contact the Environment Agency immediately.

9.0 QUERIES REGARDING A DESIGN FEATURE.

In the event of a concern or failure of a SuDs design feature contact The Baynham Meikle Partnership.

8 Meadow Road, Edgbaston, Birmingham B17 8BU

Tel: (0121) 434 4100

Email admin@bm-p.co.uk

10.0 RESPONSIBILITIES

The new on-site drainage will not be adopted, it is to remain in private ownership. The Tenant will be responsible for the maintenance and operations requirements of the SuDS features.