

**PHASE 4 DRAINAGE TECHNICAL NOTE
RESPONSE TO LLFA QUERIES
REFERENCE: DC/24/1158**

**Southwater,
Phase 4**

**Prepared for
St Edward Homes
Limited**

by

**Stuart Michael
Associates Limited**



March 2025

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SMA Ref: S832-STU05-XX-XX-RP-C-075-005

Issue Status: 01

DOCUMENT CONTROL			
Project	Southwater, Phase 4		
Job No.	S832-STU05-XX-XX-RP-C-075-005		
Document Title	PHASE 4 TECHNICAL NOTE		
File Location	N:\Admin Project\7300 to 7399\7324 - Southwater LLF Response\Reports\Phase 4 Response to LLFA Technical Note		
Prepared by	Th Epuran	Date	05/03/2025
Reviewed by	M Russell	Date	05/03/2025
Approved by	M Russell	Date	05/03/2025
Document Issue	Description / Changes	Revised by	Date
Issue 01	Issued for approval	-	05/03/2025



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1.0 INTRODUCTION

- 1.1 Stuart Michael Associates Limited, consulting engineers, has been commissioned by St Edward Homes Limited (hereafter referred to as the 'Client') to prepare this Drainage Technical Note for the residential development known as Southwater.
- 1.2 This Phase 4 Drainage Technical Note comes in response to the objection by the West Sussex County Council, which acts as the Lead Local Flood Authority (hereafter referred to as the LLFA), referenced **DC/24/1158 – Berkeley Homes Development Site Phase 4 and 5, Worthing Road, Southwater, West Sussex**, and dated 9th of October 2024. For avoidance of doubt, this letter can be found in **Appendix 1**.
- 1.3 This Phase 4 Drainage Technical Note takes into consideration and comes in to complement the information provided in the Flood Risk Assessment prepared by Patrick Parsons, Revision 4.0, dated 28.06.2024.



2.0 LLFA REQUIREMENTS

As listed in the LLFA letter, referenced in section 1.2 above, the below requirements will be addressed in the present Technical Note.

- 2.1 *An updated drainage strategy for Phase 5 is required as this has not been provided. It must be demonstrated each phase (4 and 5) can standalone if future phases are not built as planned.*
- 2.2 *A Cv value of 1 for summer and winter is required in calculations.*
- 2.3 *For the basin, cross sections are required to ensure suitable side slopes and depths are being used. 2m is very deep for a basin, as an authority we suggest 1m for safety, amenity and biodiversity reasons but we appreciate this may be difficult to achieve for this site. Additionally, the basin is in a flow path which will reduce its' capacity in storm events. The cross sections must clearly show areas proposed to always be wet compared to areas proposed to be dry except for storm events.*
- 2.4 *The proposed discharge rate means in the 2-year rainfall event the site will be discharging at the 100 year greenfield runoff rate which increases flood risk elsewhere. Rates should be restricted to Qbar in accordance with SuDS Non-Statutory Technical Standards and NPPF.*
- 2.5 *An exceedance plan showing depth, area and direction of flooding in 1 in 100 + climate change allowance event is required.*
- 2.6 *It is disappointing to see the permeable paving proposed previously is now not included in the most recent plans. The use of source control SuDS is encouraged, such as tree pits, bioretention areas/rain gardens, swales and permeable paving.*



3.0 STUART MICHAEL ASSOCIATED RESPONSE

Response to Section 2.1

- 3.1 *An updated drainage strategy for Phase 5 is required as this has not been provided. It must be demonstrated each phase (4 and 5) can standalone if future phases are not built as planned.*
- 3.2 Phases 4 and 5 are separate, with separate discharge points, therefore, they “can standalone if future phases are built as planned”. In addition, we wish to confirm that each phase of the development caters for all attenuation within its own parcel, therefore there are no common/shared infrastructure between the two. This can be reviewed in **Appendix 2**.

Response to Section 2.2

- 3.3 *A Cv value of 1 for summer and winter is required in calculations.*
- 3.4 The Cv value, has been updated in the hydraulic calculations, to reflect a value of 1 for both summer and winter. Hydraulic calculations can be reviewed in **Appendix 3**.
- 3.5 As a result of the above amendment as well as addressing requirements on section 2.4 (Qbar value), some of the pipes had to be upsized, attenuation tanks had to be provided on branch 6.000 internally under an estate road, however, the attenuation volume within the main pond has remained the same, and its originally proposed size and scale can remain the same. The drainage system performs as it should in all storm events and retains a freeboard of 216mm in the most critical storm event.

Response to Section 2.3

- 3.6 *For the basin, cross sections are required to ensure suitable side slopes and depths are being used. 2m is very deep for a basin, as an authority we suggest 1m for safety, amenity and biodiversity reasons but we appreciate this may be difficult to achieve for this site. Additionally, the basin is in a flow path which will reduce its' capacity in storm events. The cross sections must clearly show areas proposed to always be wet compared to areas proposed to be dry except for storm events.*
- 3.7 Considering requirements on sections 2.2 as well as 2.4, it would not be possible to reduce the size of the pond/basin in any way. From a design perspective, the pond is a key feature of the development, central to the open space strategy to the development, any reduction in scale would be viewed negatively in terms of landscaping and placemaking. However, a balanced view was taken by the design team in terms of upsizing the pond due to the requirements of 2.2 & 2.4 above, hence additional attenuation has been dealt with by way of surface water storage crates.
- 3.8 Cross-section have been provided in **Appendix 4** for review.

Response to Section 2.4

- 3.9 *The proposed discharge rate means in the 2-year rainfall event the site will be discharging at the 100 year greenfield runoff rate which increases flood risk elsewhere. Rates should be restricted to Qbar in accordance with SuDS Non-Statutory Technical Standards and NPPF.*
- 3.10 Stuart Michael Associated have re-run the greenfield run-off calculations and the value for Qbar, determined on UK SuDS website, was 52.63l/s for the total site area of 7.445ha. Greenfield run-off rates can be reviewed in **Appendix 5**.



- 3.11 The previous discharge rate, according to the FRA mentioned above, was 65.66l/s and that value was further used in the previous hydraulic calculations. Besides the Cv value updated to 1, Stuart Michael Associates have also updated the discharge rate at the new value of 52.63l/s.
- 3.12 We appreciate that the UK SuDS soil type value was automated to 4, however, on a closer review of the site investigation report, that can be reviewed in Appendix C of the FRA report mentioned above, it is be noted that the site is underlain by a layer of very stiff orange brown clay. In the virtue of the above, we have upgraded the soil type to 5.

Response to Section 2.5

- 3.13 *An exceedance plan showing depth, area and direction of flooding in 1 in 100 + climate change allowance event is required.*
- 3.14 An Exceedance Flow Route Plan can be reviewed in **Appendix 6**.

Response to Section 2.6

- 3.15 *It is disappointing to see the permeable paving proposed previously is now not included in the most recent plans. The use of source control SuDS is encouraged, such as tree pits, bioretention areas/rain gardens, swales and permeable paving.*
- 3.16 Given the constraints of the site layout, we believe that the SuDS system proposals is more suited to utilise swales and basins/ponds as means of source control as well as treatment, towards the lower end / discharge point of the site. If at source SuDs systems are utilised for treatment, this is negated as the surface water renters the piped network where road gullies discharge into the system and thus re-contaminating the surface runoff from roads.
- 3.17 Therefore, in virtue of the above point, we have allowed for 2 swales as a means of conveyance and treatment, located upstream of the attenuation basin. This can be reviewed the overall Phase 4 Drainage Layout, in **Appendix 7**.



4.0 CONCLUSION

- 4.1 The Technical Note has addressed each LLFA point listed the in their letter referenced **DC/24/1158 – Berkeley Homes Development Site Phase 4 and 5, Worthing Road, Southwater, West Sussex**, and dated 9th of October 2024, for Phase 4 of the development site.
- 4.2 It has been demonstrated that the proposed drainage proposals can manage run-off for up to a 1 in 100 years plus 40% climate change storm event with a Cv of 1 for both summer and winter and a discharge rate restricted at Qbar 52.63l/s.



APPENDIX 1

LLFA Objection Letter

Ground Floor
Northleigh
County Hall
Chichester
West Sussex
PO19 1RH



Lead Local Flood Authority

Date 9th October 2024

Matthew Porter
Development Control
Horsham District Council
Parkside
Chart Way
Horsham
RH14 1RL

Dear Matthew,

RE: DC/24/1158 – Berkeley Homes Development Site Phase 4 and 5, Worthing Road, Southwater, West Sussex

Thank you for your consultation on the above site, received on 3rd September 2024. We have reviewed the application as submitted and wish to make the following comments.

This is a Minor Material Amendment (Section 73) to vary condition 2 of application reference DC/24/0772 (non-material amendment to previously approved application DC/18/1246) to The development hereby approved comprises 199 no. residential dwellings including 61 affordable dwellings and vary the plans approved under condition 1 of application reference DC/18/1246.

As the current layout is significantly different from the previous permission DC/18/1246 the layout is being reviewed fresh rather than comparing differences between plans.

We **maintain our objection** to this planning application in the absence of an acceptable Flood Risk Assessment (FRA) relating to:

- The application is not in accordance with the NPPF, PPG Flood Risk and Coastal Change or Policy 38 in Horsham District Planning Framework.

Reason

To prevent flooding in accordance with National Planning Policy Framework paragraph 173, 175 and 180 by ensuring the satisfactory management of local flood risk, surface water flow paths, storage and disposal of surface water from the site in a range of rainfall events and ensuring the SuDS proposed operates as designed for the lifetime of the development.

We will consider reviewing this objection if the issues highlighted below are adequately addressed:

1. An updated drainage strategy for Phase 5 is required as this has not been provided. It must be demonstrated each phase (4 and 5) can standalone if future phases are not built as planned.
2. A Cv value of 1 for summer and winter is required in calculations.
3. For the basin, cross sections are required to ensure suitable side slopes and depths are being used. 2m is very deep for a basin, as an authority we suggest 1m for safety, amenity and biodiversity reasons but we appreciate this may be difficult to achieve for this site. Additionally the basin is in a flow path which will reduce its' capacity in storm events. The cross sections must clearly show areas proposed to always be wet compared to areas proposed to be dry except for storm events.
4. The proposed discharge rate means in the 2-year rainfall event the site will be discharging at the 100 year greenfield runoff rate which increases flood risk elsewhere. Rates should be restricted to Qbar in accordance with SuDS Non-Statutory Technical Standards and NPPF.
5. An exceedance plan showing depth, area and direction of flooding in 1 in 100 + climate change allowance event is required.
6. It is disappointing to see the permeable paving proposed previously is now not included in the most recent plans. The use of source control SuDS is encouraged, such as tree pits, bioretention areas/rain gardens, swales and permeable paving.

Yours sincerely,

Eleanor Read
Flood Risk Management Team
FRM@westsussex.gov.uk

Annex

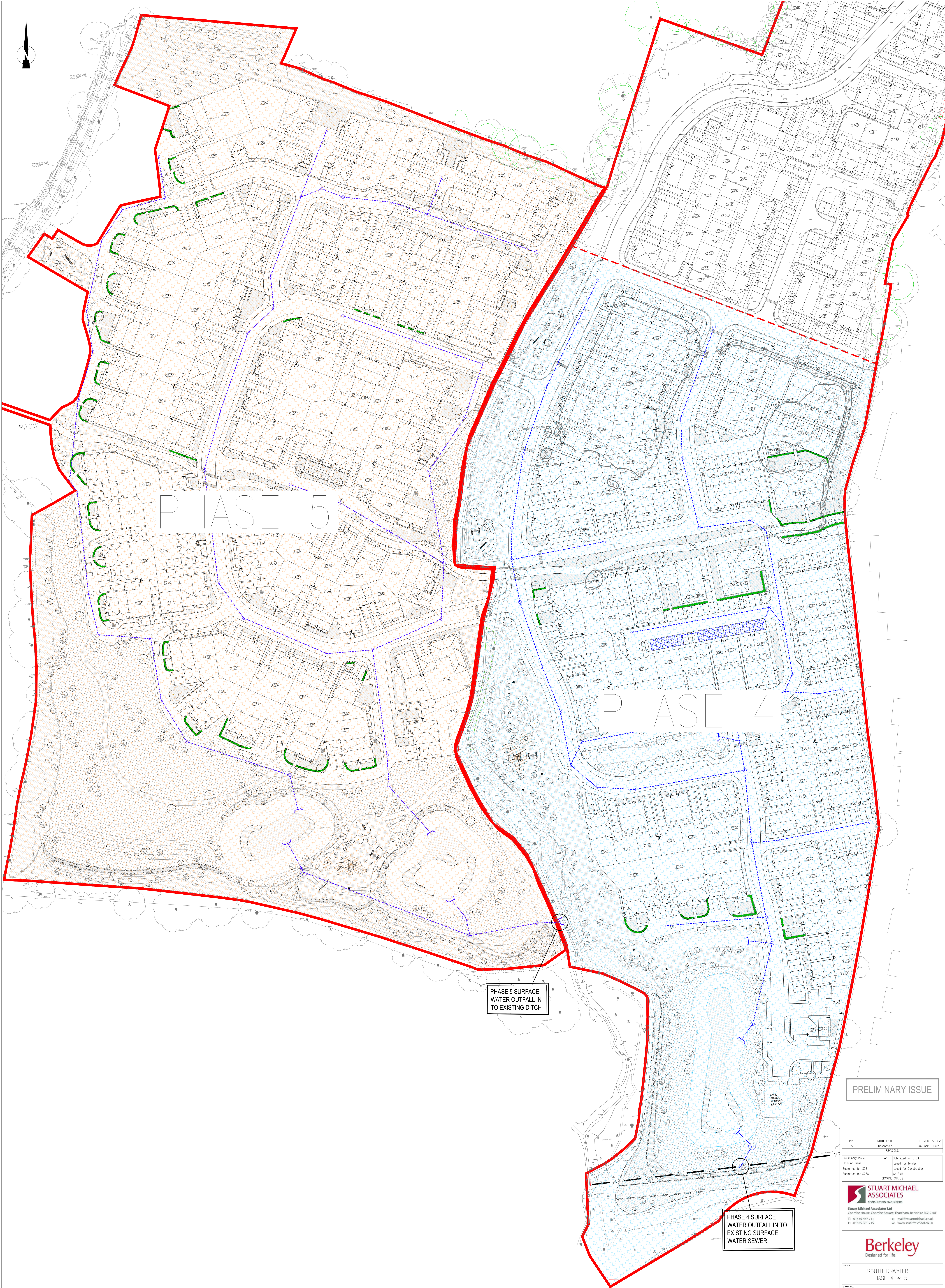
The following documents have been reviewed, which have been submitted to support the application;

- Flood Risk Assessment for Phase 4, 28.06.2024, revision 4.0



APPENDIX 2

Phase 4 and 5 General Arrangement Layout



PHASE 5 SURFACE
WATER OUTFALL IN
TO EXISTING DITCH

PHASE 4 SURFACE
WATER OUTFALL IN TO
EXISTING SURFACE
WATER SEWER

PRELIMINARY ISSUE

ST Rev	DESCRIPTION	DATE
1	PRELIMINARY ISSUE	15/03/25

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Berkeley
Designed for life

SOUTHERN WATER
PHASE 4 & 5

SURFACE WATER
GENERAL ARRANGEMENT
LAYOUT

DATE: MARCH 2025 DRAWN BY: FP CHECKED BY: MSR SCALE: 1/500 © 2025
PROJECT: S212-2105-XX-XX-DR-C-075-205_P01 SHEET: 50
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APPENDIX 3

Hydraulic Calculations

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	999.00	Preferred Cover Depth (m)	1.200
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	x
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	1.000		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SE1	0.049	5.00	60.652	Manhole	Adoptable	1350	515206.523	126162.123	2.452
SE2	0.050	5.00	59.387	Manhole	Adoptable	1350	515179.609	126119.884	2.287
SE3	0.050	5.00	58.499	Manhole	Adoptable	1350	515166.175	126092.686	1.949
SE4	0.067	5.00	57.824	Manhole	Adoptable	1350	515157.645	126062.003	1.649
SE20	0.065	5.00	58.509	Manhole	Adoptable	1350	515195.821	126051.543	1.759
SE5	0.067	5.00	57.584	Manhole	Adoptable	1350	515156.479	126048.823	1.609
SE6	0.135	5.00	57.244	Manhole	Adoptable	1350	515157.178	126030.448	2.269
SE7	0.131	5.00	56.629	Manhole	Adoptable	1350	515163.275	126001.763	2.054
SE8	0.078	5.00	56.190	Manhole	Adoptable	1350	515168.546	125982.138	1.890
SE40	0.076	5.00	57.143	Manhole	Adoptable	1350	515225.300	125971.340	1.693
SE41	0.078	5.00	56.032	Manhole	Adoptable	1350	515175.983	125968.131	1.757
SE9	0.000	5.00	55.667	Manhole	Adoptable	1350	515170.134	125958.936	1.742
SE10	0.078	5.00	55.562	Manhole	Adoptable	1350	515180.030	125948.244	1.737
SE11	0.076	5.00	55.757	Manhole	Adoptable	1350	515195.703	125945.333	2.042
SE50	0.078	5.00	59.997	Manhole	Adoptable	1350	515253.384	126136.414	1.402
SE51	0.076	5.00	59.464	Manhole	Adoptable	1350	515234.613	126099.858	1.614
SE52	0.078	5.00	59.327	Manhole	Adoptable	1200	515233.133	126082.582	1.707
SE53	0.076	5.00	58.990	Manhole	Adoptable	1200	515236.628	126052.422	1.875
SE54	0.078	5.00	58.758	Manhole	Adoptable	1200	515258.737	126053.000	2.013
SE55	0.076	5.00	58.653	Manhole	Adoptable	1200	515264.743	126047.929	2.038
SE60	0.104	5.00	57.594	Manhole	Adoptable	1350	515202.983	126011.829	1.144
SE61	0.025	5.00	58.243	Manhole	Adoptable	1200	515262.244	126015.227	2.243

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SE56	0.088	5.00	58.134	Manhole	Adoptable	1200	515267.415	126006.585	2.384
SE57	0.136	5.00	57.636	Manhole	Adoptable	1200	515268.465	125985.925	2.056
SE70	0.078	5.00	57.367	Manhole	Adoptable	1350	515288.849	125976.923	1.362
SE71	0.076	5.00	57.480	Manhole	Adoptable	1350	515278.668	125976.239	1.655
SE58	0.087	5.00	57.432	Manhole	Adoptable	1200	515264.331	125978.919	2.062
SE59	0.085	5.00	56.997	Manhole	Adoptable	1200	515247.319	125974.941	1.997
SE501	0.077	5.00	56.805	Manhole	Adoptable	1350	515242.217	125967.192	2.030
SE12	0.075	5.00	56.367	Manhole	Adoptable	1500	515243.360	125947.737	2.992
SE80	0.077	5.00	56.599	Manhole	Adoptable	1350	515292.955	125919.366	1.749
SE81	0.075	5.00	55.635	Manhole	Adoptable	1350	515253.824	125916.421	1.885
SE13	0.077	5.00	55.388	Manhole	Adoptable	1500	515242.534	125916.702	2.313
SE90	0.065	5.00	53.486	Manhole	Adoptable	1350	515202.451	125886.135	0.901
SE14	0.067	5.00	54.312	Manhole	Adoptable	1500	515244.673	125884.651	2.602
SE15	0.065	5.00	53.947	Manhole	Adoptable	1500	515245.964	125873.198	2.327
SE16	0.067	5.00	52.463	Manhole	Adoptable	1500	515233.590	125840.216	1.813
SE17 Headwall			52.000	Junction			515228.229	125834.309	2.410
SE18 Headwall		5.00	51.500	Junction			515221.844	125795.306	1.950
SE19 FCC			52.500	Manhole	Adoptable	3000	515226.885	125788.542	3.025
SE Outlet Headwall			50.800	Junction			515232.759	125780.659	1.925

Links

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)
1.000	SE1	SE2	50.085	0.600	Colebrook-White	58.200	57.175	1.025	48.9	225	Circular	5.45	50.0
1.001	SE2	SE3	30.334	0.600	Colebrook-White	57.100	56.550	0.550	55.2	300	Circular	5.68	50.0
1.002	SE3	SE4	31.847	0.600	Colebrook-White	56.550	56.175	0.375	84.9	300	Circular	5.99	50.0
1.003	SE4	SE5	13.231	0.600	Colebrook-White	56.175	56.050	0.125	105.8	300	Circular	6.14	50.0
2.000	SE20	SE5	39.436	0.600	Colebrook-White	56.750	56.125	0.625	63.1	225	Circular	5.40	50.0
1.004	SE5	SE6	18.389	0.600	Colebrook-White	55.975	55.500	0.475	38.7	375	Circular	6.24	50.0
1.005	SE6	SE7	29.326	0.600	Colebrook-White	54.975	54.575	0.400	73.3	525	Circular	6.43	50.0
1.006	SE7	SE8	20.320	0.600	Colebrook-White	54.575	54.300	0.275	73.9	525	Circular	6.56	50.0
1.007	SE8	SE9	23.256	0.600	Colebrook-White	54.300	54.000	0.300	77.5	525	Circular	6.71	50.0
4.000	SE40	SE41	49.421	0.600	Colebrook-White	55.450	54.350	1.100	44.9	225	Circular	5.42	50.0
4.001	SE41	SE9	10.898	0.600	Colebrook-White	54.275	54.150	0.125	87.2	300	Circular	5.53	50.0
1.008	SE9	SE10	14.570	0.600	Colebrook-White	53.925	53.825	0.100	145.7	750	Circular	6.82	50.0
1.009	SE10	SE11	15.941	0.600	Colebrook-White	53.825	53.715	0.110	144.9	750	Circular	6.93	50.0

Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	SE1	SE2	1.875	74.6	8.9	2.227	1.987	1.987	2.227	0.049	0.0
1.001	SE2	SE3	2.121	149.9	17.9	1.987	1.649	1.649	1.987	0.099	0.0
1.002	SE3	SE4	1.707	120.7	26.9	1.649	1.349	1.349	1.649	0.149	0.0
1.003	SE4	SE5	1.528	108.0	39.0	1.349	1.234	1.234	1.349	0.216	0.0
2.000	SE20	SE5	1.649	65.6	11.7	1.534	1.234	1.234	1.534	0.065	0.0
1.004	SE5	SE6	2.919	322.4	62.9	1.234	1.369	1.234	1.369	0.348	0.0
1.005	SE6	SE7	2.618	566.7	87.3	1.744	1.529	1.529	1.744	0.483	0.0
1.006	SE7	SE8	2.608	564.5	110.9	1.529	1.365	1.365	1.529	0.614	0.0
1.007	SE8	SE9	2.545	551.0	125.0	1.365	1.142	1.142	1.365	0.692	0.0
4.000	SE40	SE41	1.956	77.8	13.7	1.468	1.457	1.457	1.468	0.076	0.0
4.001	SE41	SE9	1.684	119.1	27.8	1.457	1.217	1.217	1.457	0.154	0.0
1.008	SE9	SE10	2.316	1023.2	152.9	0.992	0.987	0.987	0.992	0.846	0.0
1.009	SE10	SE11	2.322	1025.9	167.0	0.987	1.292	0.987	1.292	0.924	0.0

Links

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)
1.010	SE11	SE12	47.718	0.600	Colebrook-White	53.715	53.375	0.340	140.3	750	Circular	7.27	50.0
5.000	SE50	SE51	41.093	0.600	Colebrook-White	58.595	57.925	0.670	61.3	300	Circular	5.34	50.0
5.001	SE51	SE52	17.339	0.600	Colebrook-White	57.850	57.620	0.230	75.4	375	Circular	5.48	50.0
5.002	SE52	SE53	30.362	0.600	Colebrook-White	57.620	57.115	0.505	60.1	375	Circular	5.70	50.0
5.003	SE53	SE54	22.116	0.600	Colebrook-White	57.115	56.745	0.370	59.8	450	Circular	5.84	50.0
5.004	SE54	SE55	7.860	0.600	Colebrook-White	56.745	56.615	0.130	60.5	450	Circular	5.89	50.0
5.005	SE55	SE56	41.430	0.600	Colebrook-White	56.615	55.750	0.865	47.9	450	Circular	6.12	50.0
6.000	SE60	SE61	59.358	0.600	Colebrook-White	56.450	56.000	0.450	131.9	300	Circular	5.72	50.0
6.001	SE61	SE56	10.071	0.600	Colebrook-White	56.000	55.900	0.100	100.7	450	Circular	5.81	50.0
5.006	SE56	SE57	20.687	0.600	Colebrook-White	55.750	55.580	0.170	121.7	450	Circular	6.31	50.0
5.007	SE57	SE58	8.135	0.600	Colebrook-White	55.580	55.445	0.135	60.3	450	Circular	6.36	50.0
7.000	SE70	SE71	10.204	0.600	Colebrook-White	56.005	55.900	0.105	97.2	300	Circular	5.11	50.0
7.001	SE71	SE58	14.586	0.600	Colebrook-White	55.825	55.600	0.225	64.8	300	Circular	5.23	50.0
5.008	SE58	SE59	17.471	0.600	Colebrook-White	55.370	55.000	0.370	47.2	525	Circular	6.45	50.0

Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.010	SE11	SE12	2.360	1042.6	180.7	1.292	2.242	1.292	2.242	1.000	0.0
5.000	SE50	SE51	2.011	142.1	14.1	1.102	1.239	1.102	1.239	0.078	0.0
5.001	SE51	SE52	2.088	230.7	27.8	1.239	1.332	1.239	1.332	0.154	0.0
5.002	SE52	SE53	2.340	258.4	41.9	1.332	1.500	1.332	1.500	0.232	0.0
5.003	SE53	SE54	2.633	418.8	55.7	1.425	1.563	1.425	1.563	0.308	0.0
5.004	SE54	SE55	2.618	416.4	69.8	1.563	1.588	1.563	1.588	0.386	0.0
5.005	SE55	SE56	2.943	468.1	83.5	1.588	1.934	1.588	1.934	0.462	0.0
6.000	SE60	SE61	1.367	96.6	18.8	0.844	1.943	0.844	1.943	0.104	0.0
6.001	SE61	SE56	2.026	322.1	23.3	1.793	1.784	1.784	1.793	0.129	0.0
5.006	SE56	SE57	1.842	292.9	122.7	1.934	1.606	1.606	1.934	0.679	0.0
5.007	SE57	SE58	2.622	417.1	147.3	1.606	1.537	1.537	1.606	0.815	0.0
7.000	SE70	SE71	1.595	112.7	14.1	1.062	1.280	1.062	1.280	0.078	0.0
7.001	SE71	SE58	1.955	138.2	27.8	1.355	1.532	1.355	1.532	0.154	0.0
5.008	SE58	SE59	3.265	706.8	190.8	1.537	1.472	1.472	1.537	1.056	0.0

Links

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)
5.009	SE59	SE501	9.277	0.600	Colebrook-White	55.000	54.775	0.225	41.2	525	Circular	6.49	50.0
5.010	SE501	SE12	19.489	0.600	Colebrook-White	54.775	53.450	1.325	14.7	525	Circular	6.55	50.0
1.011	SE12	SE13	31.046	0.600	Colebrook-White	53.375	53.075	0.300	103.5	750	Circular	7.46	50.0
8.000	SE80	SE81	39.242	0.600	Colebrook-White	54.850	53.825	1.025	38.3	225	Circular	5.31	50.0
8.001	SE81	SE13	11.293	0.600	Colebrook-White	53.750	53.375	0.375	30.1	300	Circular	5.37	50.0
1.012	SE13	SE14	32.122	0.600	Colebrook-White	53.075	51.710	1.365	23.5	750	Circular	7.55	50.0
9.000	SE90	SE14	42.248	0.600	Colebrook-White	52.585	52.085	0.500	84.5	450	Circular	5.32	50.0
1.013	SE14	SE15	11.525	0.600	Colebrook-White	51.710	51.620	0.090	128.1	750	Circular	7.63	50.0
1.014	SE15	SE16	35.227	0.600	Colebrook-White	51.620	50.650	0.970	36.3	750	Circular	7.75	50.0
1.015	SE16	SE17 Headwall	7.976	0.600	Colebrook-White	50.650	50.550	0.100	79.8	750	Circular	7.80	50.0
1.017	SE18 Headwall	SE19 FCC	8.436	0.600	Colebrook-White	49.550	49.475	0.075	112.5	450	Circular	5.07	50.0
1.018	SE19 FCC	SE Outlet Headwall	9.831	0.600	Colebrook-White	49.475	48.875	0.600	16.4	375	Circular	5.11	50.0

Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
5.009	SE59	SE501	3.495	756.6	206.2	1.472	1.505	1.472	1.505	1.141	0.0
5.010	SE501	SE12	5.861	1268.7	220.1	1.505	2.392	1.505	2.392	1.218	0.0
1.011	SE12	SE13	2.750	1215.1	414.3	2.242	1.563	1.563	2.242	2.293	0.0
8.000	SE80	SE81	2.120	84.3	13.9	1.524	1.585	1.524	1.585	0.077	0.0
8.001	SE81	SE13	2.875	203.2	27.5	1.585	1.713	1.585	1.713	0.152	0.0
1.012	SE13	SE14	5.782	2554.5	455.7	1.563	1.852	1.563	1.852	2.522	0.0
9.000	SE90	SE14	2.213	351.9	11.7	0.451	1.777	0.451	1.777	0.065	0.0
1.013	SE14	SE15	2.471	1091.7	479.6	1.852	1.577	1.577	1.852	2.654	0.0
1.014	SE15	SE16	4.652	2055.1	491.3	1.577	1.063	1.063	1.577	2.719	0.0
1.015	SE16	SE17 Headwall	3.135	1384.9	503.4	1.063	0.700	0.700	1.063	2.786	0.0
1.017	SE18 Headwall	SE19 FCC	1.916	304.7	0.0	1.500	2.575	1.500	2.575	0.000	0.0
1.018	SE19 FCC	SE Outlet Headwall	4.494	496.4	0.0	2.650	1.550	1.550	2.650	0.000	0.0

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	1.000	Drain Down Time (mins)	10080	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	Check Discharge Volume	x
Summer CV	1.000	Skip Steady State	x	Starting Level (m)			

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	40	0	0
30	35	0	0				

Node SE19 FCC Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	49.475	Product Number	CTL-SHE-0291-5260-1800-5260
Design Depth (m)	1.800	Min Outlet Diameter (m)	0.375
Design Flow (l/s)	52.6	Min Node Diameter (mm)	2100

Node SE18 Headwall Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	20.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	49.550	Main Channel Slope (1:X)	500.0
Safety Factor	1.0	Time to half empty (mins)	264	Main Channel n	0.600

Inlets

SE17 Headwall

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	660.3	0.0	0.400	840.9	0.0	0.800	1031.3	0.0	1.200	1230.7	0.0	1.600	1439.2	0.0	2.000	1656.7	0.0
0.100	704.0	0.0	0.500	887.6	0.0	0.900	1080.3	0.0	1.300	1282.0	0.0	1.700	1492.7	0.0			
0.200	749.0	0.0	0.600	934.9	0.0	1.000	1129.9	0.0	1.400	1333.8	0.0	1.800	1546.8	0.0			
0.300	794.7	0.0	0.700	982.8	0.0	1.100	1180.0	0.0	1.500	1386.2	0.0	1.900	1601.5	0.0			

Node SE61 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	56.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	6

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	207.0	0.0	0.400	207.0	0.0	0.401	0.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	114.182	32.310	2 year 480 minute winter	9.188	3.655
2 year 15 minute winter	80.128	32.310	2 year 600 minute summer	11.303	3.092
2 year 30 minute summer	74.054	20.955	2 year 600 minute winter	7.723	3.092
2 year 30 minute winter	51.968	20.955	2 year 720 minute summer	10.047	2.693
2 year 60 minute summer	50.242	13.277	2 year 720 minute winter	6.752	2.693
2 year 60 minute winter	33.379	13.277	2 year 960 minute summer	8.217	2.164
2 year 120 minute summer	35.064	9.266	2 year 960 minute winter	5.443	2.164
2 year 120 minute winter	23.296	9.266	2 year 1440 minute summer	5.942	1.593
2 year 180 minute summer	28.161	7.247	2 year 1440 minute winter	3.993	1.593
2 year 180 minute winter	18.305	7.247	30 year +35% CC 15 minute summer	402.465	113.884
2 year 240 minute summer	22.715	6.003	30 year +35% CC 15 minute winter	282.431	113.884
2 year 240 minute winter	15.091	6.003	30 year +35% CC 30 minute summer	266.229	75.334
2 year 360 minute summer	17.551	4.516	30 year +35% CC 30 minute winter	186.827	75.334
2 year 360 minute winter	11.409	4.516	30 year +35% CC 60 minute summer	180.437	47.684
2 year 480 minute summer	13.830	3.655	30 year +35% CC 60 minute winter	119.878	47.684

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +35% CC 120 minute summer	109.710	28.993	100 year +40% CC 30 minute winter	246.579	99.427
30 year +35% CC 120 minute winter	72.889	28.993	100 year +40% CC 60 minute summer	239.797	63.371
30 year +35% CC 180 minute summer	83.183	21.406	100 year +40% CC 60 minute winter	159.315	63.371
30 year +35% CC 180 minute winter	54.071	21.406	100 year +40% CC 120 minute summer	143.032	37.799
30 year +35% CC 240 minute summer	64.975	17.171	100 year +40% CC 120 minute winter	95.027	37.799
30 year +35% CC 240 minute winter	43.168	17.171	100 year +40% CC 180 minute summer	107.722	27.721
30 year +35% CC 360 minute summer	48.553	12.494	100 year +40% CC 180 minute winter	70.022	27.721
30 year +35% CC 360 minute winter	31.561	12.494	100 year +40% CC 240 minute summer	83.924	22.179
30 year +35% CC 480 minute summer	37.523	9.916	100 year +40% CC 240 minute winter	55.757	22.179
30 year +35% CC 480 minute winter	24.929	9.916	100 year +40% CC 360 minute summer	62.697	16.134
30 year +35% CC 600 minute summer	30.254	8.275	100 year +40% CC 360 minute winter	40.755	16.134
30 year +35% CC 600 minute winter	20.672	8.275	100 year +40% CC 480 minute summer	48.585	12.840
30 year +35% CC 720 minute summer	26.616	7.133	100 year +40% CC 480 minute winter	32.279	12.840
30 year +35% CC 720 minute winter	17.888	7.133	100 year +40% CC 600 minute summer	39.281	10.744
30 year +35% CC 960 minute summer	21.436	5.645	100 year +40% CC 600 minute winter	26.839	10.744
30 year +35% CC 960 minute winter	14.200	5.645	100 year +40% CC 720 minute summer	34.641	9.284
30 year +35% CC 1440 minute summer	15.153	4.061	100 year +40% CC 720 minute winter	23.281	9.284
30 year +35% CC 1440 minute winter	10.184	4.061	100 year +40% CC 960 minute summer	27.987	7.370
100 year +40% CC 15 minute summer	526.631	149.018	100 year +40% CC 960 minute winter	18.539	7.370
100 year +40% CC 15 minute winter	369.565	149.018	100 year +40% CC 1440 minute summer	19.862	5.323
100 year +40% CC 30 minute summer	351.375	99.427	100 year +40% CC 1440 minute winter	13.348	5.323

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SE1	11	58.253	0.053	9.1	0.0754	0.0000	OK
15 minute summer	SE2	10	57.169	0.069	18.1	0.0994	0.0000	OK
15 minute summer	SE3	11	56.645	0.095	27.2	0.1366	0.0000	OK
15 minute summer	SE4	11	56.311	0.136	39.1	0.1945	0.0000	OK
15 minute summer	SE20	10	56.816	0.066	12.1	0.0941	0.0000	OK
15 minute summer	SE5	11	56.095	0.120	62.9	0.1720	0.0000	OK
15 minute summer	SE6	11	55.118	0.143	87.1	0.2042	0.0000	OK
15 minute summer	SE7	11	54.745	0.170	110.7	0.2438	0.0000	OK
15 minute summer	SE8	11	54.484	0.184	125.2	0.2633	0.0000	OK
15 minute summer	SE40	10	55.515	0.065	14.2	0.0930	0.0000	OK
15 minute summer	SE41	10	54.383	0.108	28.3	0.1546	0.0000	OK
15 minute summer	SE9	11	54.152	0.227	153.8	0.3254	0.0000	OK
15 minute summer	SE10	11	54.055	0.230	168.0	0.3288	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SE1	1.000	SE2	8.9	1.264	0.119	0.3509	
15 minute summer	SE2	1.001	SE3	17.9	1.144	0.119	0.4789	
15 minute summer	SE3	1.002	SE4	27.0	1.077	0.223	0.8006	
15 minute summer	SE4	1.003	SE5	39.2	1.342	0.363	0.3861	
15 minute summer	SE20	2.000	SE5	11.8	1.248	0.180	0.3743	
15 minute summer	SE5	1.004	SE6	63.1	2.188	0.196	0.5305	
15 minute summer	SE6	1.005	SE7	87.4	1.621	0.154	1.5840	
15 minute summer	SE7	1.006	SE8	111.3	1.739	0.197	1.3010	
15 minute summer	SE8	1.007	SE9	125.9	1.991	0.229	1.4719	
15 minute summer	SE40	4.000	SE41	13.8	1.477	0.177	0.4629	
15 minute summer	SE41	4.001	SE9	28.0	1.312	0.236	0.2335	
15 minute summer	SE9	1.008	SE10	154.1	1.359	0.151	1.6520	
15 minute summer	SE10	1.009	SE11	168.3	1.544	0.164	1.7374	

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SE11	11	53.930	0.215	181.8	0.3071	0.0000	OK
15 minute summer	SE50	10	58.660	0.065	14.5	0.0928	0.0000	OK
15 minute summer	SE51	10	57.942	0.092	28.4	0.1314	0.0000	OK
15 minute summer	SE52	10	57.724	0.104	42.7	0.1181	0.0000	OK
15 minute summer	SE53	10	57.229	0.114	56.5	0.1286	0.0000	OK
15 minute summer	SE54	11	56.890	0.145	70.4	0.1635	0.0000	OK
15 minute summer	SE55	11	56.742	0.127	84.0	0.1440	0.0000	OK
15 minute summer	SE60	10	56.561	0.111	19.4	0.1583	0.0000	OK
120 minute summer	SE61	72	56.050	0.050	12.1	9.8341	0.0000	OK
15 minute summer	SE56	11	55.952	0.202	102.3	0.2289	0.0000	OK
15 minute summer	SE57	11	55.784	0.204	126.9	0.2308	0.0000	OK
15 minute summer	SE70	10	56.082	0.077	14.5	0.1105	0.0000	OK
15 minute summer	SE71	10	55.924	0.099	28.6	0.1411	0.0000	OK
15 minute summer	SE58	11	55.564	0.194	170.3	0.2197	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SE11	1.010	SE12	181.3	1.279	0.174	6.8257	
15 minute summer	SE50	5.000	SE51	14.2	1.290	0.100	0.4526	
15 minute summer	SE51	5.001	SE52	28.2	1.230	0.122	0.3978	
15 minute summer	SE52	5.002	SE53	42.3	1.596	0.164	0.8073	
15 minute summer	SE53	5.003	SE54	56.0	1.498	0.134	0.8326	
15 minute summer	SE54	5.004	SE55	70.3	1.746	0.169	0.3171	
15 minute summer	SE55	5.005	SE56	84.2	1.614	0.180	2.1933	
15 minute summer	SE60	6.000	SE61	19.5	1.705	0.202	0.7644	
120 minute summer	SE61	6.001	SE56	7.7	0.837	0.024	0.0922	
15 minute summer	SE56	5.006	SE57	102.7	1.481	0.351	1.4373	
15 minute summer	SE57	5.007	SE58	127.1	2.058	0.305	0.5027	
15 minute summer	SE70	7.000	SE71	14.4	1.057	0.128	0.1389	
15 minute summer	SE71	7.001	SE58	28.4	1.483	0.205	0.2790	
15 minute summer	SE58	5.008	SE59	170.5	2.173	0.241	1.3716	

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SE59	11	55.218	0.217	185.6	0.2460	0.0000	OK
15 minute summer	SE501	11	54.913	0.138	199.5	0.1979	0.0000	OK
15 minute summer	SE12	11	53.699	0.324	394.2	0.5730	0.0000	OK
15 minute summer	SE80	10	54.913	0.063	14.4	0.0906	0.0000	OK
15 minute summer	SE81	10	53.831	0.081	28.1	0.1157	0.0000	OK
15 minute summer	SE13	11	53.280	0.205	434.4	0.3623	0.0000	OK
15 minute summer	SE90	10	52.642	0.057	12.1	0.0810	0.0000	OK
15 minute summer	SE14	11	52.088	0.378	457.5	0.6685	0.0000	OK
15 minute summer	SE15	11	51.873	0.253	467.4	0.4477	0.0000	OK
15 minute summer	SE16	11	50.989	0.339	477.9	0.5985	0.0000	OK
180 minute summer	SE17 Headwall	124	49.979	0.389	198.9	0.0000	0.0000	OK
180 minute summer	SE18 Headwall	124	49.978	0.428	134.7	0.0000	0.0000	OK
180 minute summer	SE19 FCC	124	49.975	0.500	117.7	3.5346	0.0000	SURCHARGED
15 minute summer	SE Outlet Headwall	1	48.875	0.000	51.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SE59	5.009	SE501	185.8	2.887	0.246	0.6020	
15 minute summer	SE501	5.010	SE12	199.6	2.903	0.157	1.4257	
15 minute summer	SE12	1.011	SE13	393.3	2.844	0.324	4.3418	
15 minute summer	SE80	8.000	SE81	14.1	1.567	0.168	0.3537	
15 minute summer	SE81	8.001	SE13	27.9	1.933	0.138	0.1633	
15 minute summer	SE13	1.012	SE14	433.8	2.741	0.170	5.1395	
15 minute summer	SE90	9.000	SE14	11.8	1.039	0.034	0.4802	
15 minute summer	SE14	1.013	SE15	455.8	2.597	0.417	2.0360	
15 minute summer	SE15	1.014	SE16	466.0	2.890	0.227	5.7026	
15 minute summer	SE16	1.015	SE17 Headwall	474.4	2.699	0.343	1.4078	
180 minute summer	SE17 Headwall	Flow through pond	SE18 Headwall	134.7	0.016	0.013	307.5058	
180 minute summer	SE18 Headwall	1.017	SE19 FCC	117.7	0.893	0.386	1.3250	
180 minute summer	SE19 FCC	Hydro-Brake®	SE Outlet Headwall	52.3				605.3

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SE1	10	58.305	0.105	32.2	0.1496	0.0000	OK
15 minute summer	SE2	10	57.236	0.136	64.4	0.1952	0.0000	OK
15 minute summer	SE3	11	56.879	0.329	97.0	0.4705	0.0000	SURCHARGED
15 minute summer	SE4	11	56.610	0.435	133.0	0.6222	0.0000	SURCHARGED
15 minute summer	SE20	10	56.886	0.136	42.7	0.1951	0.0000	OK
15 minute summer	SE5	10	56.237	0.262	217.0	0.3748	0.0000	OK
15 minute summer	SE6	10	55.292	0.317	304.0	0.4535	0.0000	OK
15 minute summer	SE7	10	54.981	0.406	387.2	0.5803	0.0000	OK
15 minute summer	SE8	11	54.744	0.444	434.8	0.6358	0.0000	OK
15 minute summer	SE40	10	55.580	0.130	50.0	0.1854	0.0000	OK
15 minute summer	SE41	11	54.592	0.317	100.9	0.4538	0.0000	SURCHARGED
15 minute summer	SE9	11	54.461	0.536	534.3	0.7664	0.0000	OK
15 minute summer	SE10	11	54.370	0.545	582.5	0.7794	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SE1	1.000	SE2	31.5	1.783	0.423	0.8866	
15 minute summer	SE2	1.001	SE3	64.1	1.506	0.427	1.5303	
15 minute summer	SE3	1.002	SE4	91.6	1.301	0.759	2.2426	
15 minute summer	SE4	1.003	SE5	132.5	1.882	1.227	0.9107	
15 minute summer	SE20	2.000	SE5	42.0	1.721	0.640	0.9635	
15 minute summer	SE5	1.004	SE6	215.5	2.883	0.668	1.3749	
15 minute summer	SE6	1.005	SE7	301.1	1.965	0.531	4.6223	
15 minute summer	SE7	1.006	SE8	385.5	2.088	0.683	3.7970	
15 minute summer	SE8	1.007	SE9	437.1	2.246	0.793	4.6016	
15 minute summer	SE40	4.000	SE41	49.6	1.825	0.637	1.5533	
15 minute summer	SE41	4.001	SE9	97.3	1.586	0.817	0.7674	
15 minute summer	SE9	1.008	SE10	533.6	1.610	0.522	4.9461	
15 minute summer	SE10	1.009	SE11	577.3	1.807	0.563	5.4628	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SE11	11	54.260	0.545	625.0	0.7800	0.0000	OK
15 minute summer	SE50	10	58.723	0.128	51.3	0.1830	0.0000	OK
15 minute summer	SE51	10	58.045	0.195	100.5	0.2797	0.0000	OK
15 minute summer	SE52	10	57.841	0.221	151.3	0.2495	0.0000	OK
15 minute summer	SE53	10	57.366	0.251	200.2	0.2834	0.0000	OK
15 minute summer	SE54	10	57.070	0.325	250.0	0.3671	0.0000	OK
15 minute summer	SE55	10	56.889	0.274	298.9	0.3100	0.0000	OK
15 minute summer	SE60	9	56.657	0.207	68.4	0.2955	0.0000	OK
15 minute summer	SE61	13	56.217	0.217	183.1	42.8893	0.0000	OK
15 minute summer	SE56	11	56.258	0.508	355.0	0.5743	0.0000	SURCHARGED
15 minute summer	SE57	11	56.045	0.465	353.5	0.5254	0.0000	SURCHARGED
15 minute summer	SE70	10	56.165	0.160	51.3	0.2291	0.0000	OK
15 minute summer	SE71	10	56.045	0.220	101.0	0.3147	0.0000	OK
15 minute summer	SE58	10	55.805	0.435	508.5	0.4922	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SE11	1.010	SE12	615.9	1.665	0.591	18.6806	
15 minute summer	SE50	5.000	SE51	50.5	1.817	0.355	1.1428	
15 minute summer	SE51	5.001	SE52	100.0	1.601	0.434	1.0875	
15 minute summer	SE52	5.002	SE53	150.2	2.069	0.581	2.2108	
15 minute summer	SE53	5.003	SE54	198.7	1.867	0.475	2.3565	
15 minute summer	SE54	5.004	SE55	248.9	2.226	0.598	0.8785	
15 minute summer	SE55	5.005	SE56	298.1	2.067	0.637	5.3764	
15 minute summer	SE60	6.000	SE61	69.4	2.050	0.718	2.6644	
15 minute summer	SE61	6.001	SE56	-97.3	1.628	-0.302	0.9311	
15 minute summer	SE56	5.006	SE57	276.5	1.868	0.944	3.2777	
15 minute summer	SE57	5.007	SE58	354.1	2.532	0.849	1.1977	
15 minute summer	SE70	7.000	SE71	51.0	1.436	0.453	0.3670	
15 minute summer	SE71	7.001	SE58	100.4	1.913	0.726	0.7782	
15 minute summer	SE58	5.008	SE59	508.2	2.598	0.719	3.4224	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SE59	10	55.459	0.459	564.1	0.5196	0.0000	OK
15 minute summer	SE501	11	55.078	0.303	613.9	0.4342	0.0000	OK
15 minute summer	SE12	11	54.161	0.786	1256.8	1.3888	0.0000	SURCHARGED
15 minute summer	SE80	10	54.980	0.130	50.6	0.1856	0.0000	OK
15 minute summer	SE81	10	53.920	0.170	99.2	0.2430	0.0000	OK
15 minute summer	SE13	11	53.590	0.515	1400.9	0.9092	0.0000	OK
15 minute summer	SE90	11	52.752	0.167	42.7	0.2396	0.0000	OK
15 minute summer	SE14	12	52.742	1.032	1465.5	1.8228	0.0000	SURCHARGED
15 minute summer	SE15	12	52.252	0.632	1501.9	1.1159	0.0000	OK
15 minute summer	SE16	11	51.554	0.904	1541.2	1.5979	0.0000	SURCHARGED
180 minute winter	SE17 Headwall	180	50.930	1.340	411.0	0.0000	0.0000	OK
180 minute winter	SE18 Headwall	180	50.930	1.380	233.2	0.0000	0.0000	SURCHARGED
180 minute winter	SE19 FCC	180	50.926	1.451	92.0	10.2568	0.0000	SURCHARGED
15 minute summer	SE Outlet Headwall	1	48.875	0.000	52.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SE59	5.009	SE501	563.3	3.420	0.745	1.5241	
15 minute summer	SE501	5.010	SE12	612.0	3.182	0.482	3.3646	
15 minute summer	SE12	1.011	SE13	1256.4	3.410	1.034	11.8310	
15 minute summer	SE80	8.000	SE81	49.9	2.169	0.592	0.9036	
15 minute summer	SE81	8.001	SE13	99.0	2.550	0.487	0.5294	
15 minute summer	SE13	1.012	SE14	1400.6	3.375	0.548	12.2411	
15 minute summer	SE90	9.000	SE14	44.9	1.133	0.128	4.4809	
15 minute summer	SE14	1.013	SE15	1468.4	3.364	1.345	4.8163	
15 minute summer	SE15	1.014	SE16	1506.8	3.452	0.733	14.7215	
15 minute summer	SE16	1.015	SE17 Headwall	1542.5	3.505	1.114	3.4715	
180 minute winter	SE17 Headwall	Flow through pond	SE18 Headwall	233.2	0.021	0.022	1329.6779	
180 minute winter	SE18 Headwall	1.017	SE19 FCC	92.0	0.696	0.302	1.3366	
180 minute winter	SE19 FCC	Hydro-Brake®	SE Outlet Headwall	52.5				1789.5

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SE1	10	58.323	0.123	42.1	0.1758	0.0000	OK
15 minute summer	SE2	12	57.584	0.484	85.4	0.6924	0.0000	SURCHARGED
15 minute summer	SE3	12	57.419	0.869	118.1	1.2434	0.0000	SURCHARGED
15 minute summer	SE4	12	57.038	0.863	169.4	1.2350	0.0000	SURCHARGED
15 minute summer	SE20	12	57.028	0.278	55.9	0.3979	0.0000	SURCHARGED
15 minute summer	SE5	11	56.647	0.672	281.4	0.9621	0.0000	SURCHARGED
15 minute summer	SE6	11	56.239	1.264	391.8	1.8093	0.0000	SURCHARGED
15 minute summer	SE7	11	56.021	1.446	473.8	2.0695	0.0000	SURCHARGED
15 minute summer	SE8	11	55.734	1.434	518.1	2.0523	0.0000	SURCHARGED
15 minute summer	SE40	12	56.161	0.711	65.4	1.0179	0.0000	SURCHARGED
15 minute summer	SE41	11	55.506	1.231	126.3	1.7621	0.0000	SURCHARGED
15 minute summer	SE9	11	55.335	1.410	621.7	2.0184	0.0000	SURCHARGED
15 minute summer	SE10	11	55.251	1.426	680.1	2.0403	0.0000	SURCHARGED
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SE1	1.000	SE2	42.4	1.845	0.568	1.5203	
15 minute summer	SE2	1.001	SE3	88.6	1.477	0.591	2.1361	
15 minute summer	SE3	1.002	SE4	117.4	1.668	0.973	2.2426	
15 minute summer	SE4	1.003	SE5	168.1	2.388	1.557	0.9317	
15 minute summer	SE20	2.000	SE5	55.7	1.765	0.849	1.5684	
15 minute summer	SE5	1.004	SE6	275.8	3.065	0.855	2.0283	
15 minute summer	SE6	1.005	SE7	361.1	1.905	0.637	6.3354	
15 minute summer	SE7	1.006	SE8	451.1	2.088	0.799	4.3898	
15 minute summer	SE8	1.007	SE9	509.8	2.360	0.925	5.0241	
15 minute summer	SE40	4.000	SE41	60.0	1.748	0.771	1.9655	
15 minute summer	SE41	4.001	SE9	115.7	1.643	0.972	0.7674	
15 minute summer	SE9	1.008	SE10	627.5	1.621	0.613	6.4126	
15 minute summer	SE10	1.009	SE11	685.8	1.798	0.668	7.0160	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SE11	11	55.145	1.430	737.0	2.0467	0.0000	SURCHARGED
15 minute summer	SE50	10	58.743	0.148	67.1	0.2114	0.0000	OK
15 minute summer	SE51	10	58.089	0.239	132.0	0.3417	0.0000	OK
15 minute summer	SE52	10	57.892	0.272	197.9	0.3079	0.0000	OK
15 minute summer	SE53	10	57.428	0.313	262.0	0.3539	0.0000	OK
15 minute summer	SE54	11	57.284	0.539	328.5	0.6099	0.0000	SURCHARGED
15 minute summer	SE55	11	57.113	0.498	388.4	0.5632	0.0000	SURCHARGED
15 minute summer	SE60	13	56.702	0.251	89.4	0.3599	0.0000	OK
15 minute summer	SE61	13	56.638	0.638	329.4	79.4803	0.0000	SURCHARGED
15 minute summer	SE56	13	56.675	0.925	460.3	1.0458	0.0000	SURCHARGED
15 minute summer	SE57	11	56.305	0.725	427.9	0.8195	0.0000	SURCHARGED
15 minute summer	SE70	11	56.427	0.422	67.1	0.6040	0.0000	SURCHARGED
15 minute summer	SE71	11	56.372	0.547	126.8	0.7826	0.0000	SURCHARGED
15 minute summer	SE58	11	56.118	0.748	556.7	0.8457	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SE11	1.010	SE12	742.6	1.687	0.712	21.0017	
15 minute summer	SE50	5.000	SE51	66.6	1.845	0.469	1.5179	
15 minute summer	SE51	5.001	SE52	130.8	1.647	0.567	1.3850	
15 minute summer	SE52	5.002	SE53	196.6	2.147	0.761	2.7931	
15 minute summer	SE53	5.003	SE54	261.4	1.858	0.624	3.0354	
15 minute summer	SE54	5.004	SE55	323.0	2.176	0.776	1.2454	
15 minute summer	SE55	5.005	SE56	384.7	2.453	0.822	6.5643	
15 minute summer	SE60	6.000	SE61	89.9	2.054	0.930	3.9612	
15 minute summer	SE61	6.001	SE56	-218.4	1.883	-0.678	1.5957	
15 minute summer	SE56	5.006	SE57	371.2	2.343	1.268	3.2777	
15 minute summer	SE57	5.007	SE58	432.9	2.732	1.038	1.2889	
15 minute summer	SE70	7.000	SE71	62.1	1.418	0.551	0.7186	
15 minute summer	SE71	7.001	SE58	123.5	1.935	0.893	1.0271	
15 minute summer	SE58	5.008	SE59	562.5	2.633	0.796	3.7743	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.94%

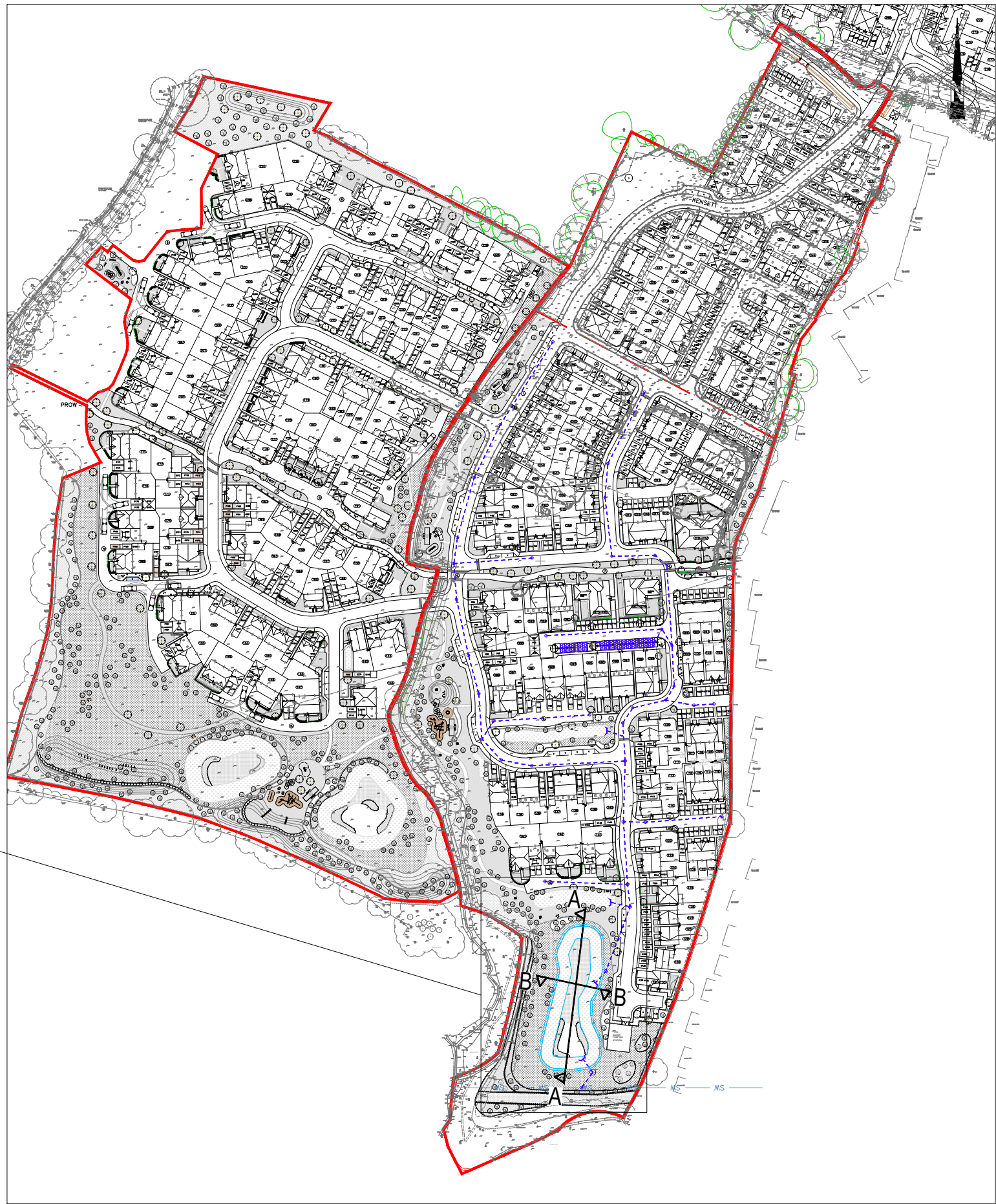
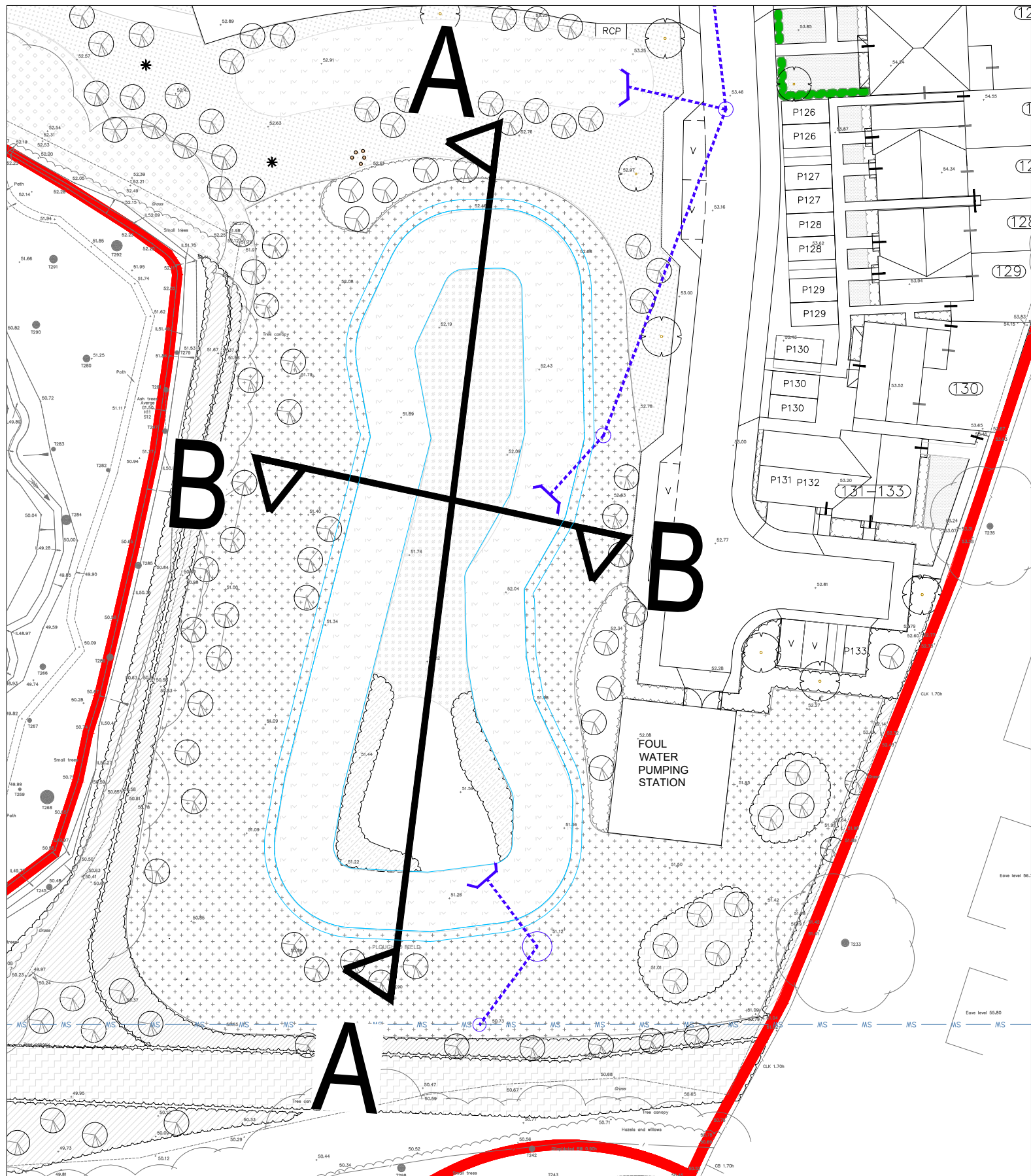
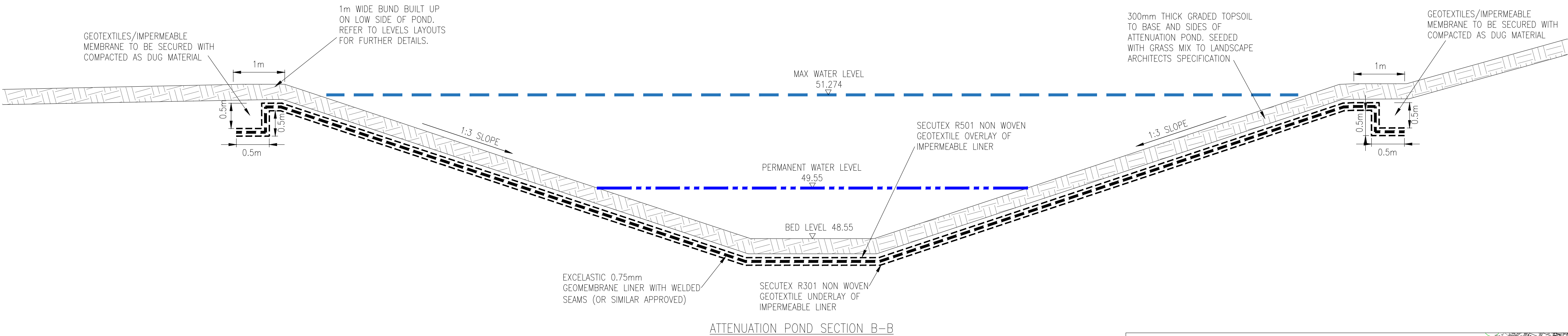
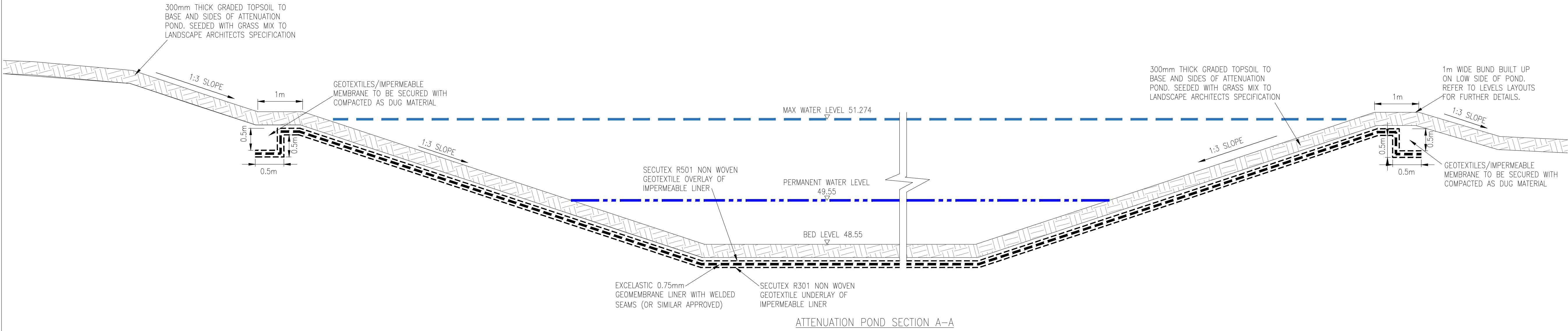
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SE59	11	55.781	0.781	626.6	0.8829	0.0000	SURCHARGED
15 minute summer	SE501	11	55.466	0.691	691.2	0.9894	0.0000	SURCHARGED
15 minute summer	SE12	11	54.911	1.536	1442.7	2.7138	0.0000	SURCHARGED
15 minute summer	SE80	11	55.018	0.168	66.2	0.2402	0.0000	OK
15 minute summer	SE81	11	54.428	0.678	129.8	0.9704	0.0000	SURCHARGED
15 minute summer	SE13	11	54.242	1.167	1622.8	2.0616	0.0000	SURCHARGED
15 minute summer	SE90	11	53.376	0.791	65.0	1.1324	0.0000	FLOOD RISK
15 minute summer	SE14	11	53.379	1.669	1704.4	2.9492	0.0000	SURCHARGED
15 minute summer	SE15	11	52.781	1.161	1758.0	2.0513	0.0000	SURCHARGED
15 minute summer	SE16	11	51.670	1.020	1813.9	1.8029	0.0000	SURCHARGED
180 minute winter	SE17 Headwall	180	51.274	1.684	533.2	0.0000	0.0000	OK
180 minute winter	SE18 Headwall	180	51.274	1.724	293.0	0.0000	0.0000	FLOOD RISK
180 minute winter	SE19 FCC	180	51.270	1.795	97.1	12.6907	0.0000	SURCHARGED
15 minute summer	SE Outlet Headwall	1	48.875	0.000	52.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SE59	5.009	SE501	625.1	3.412	0.826	2.0041	
15 minute summer	SE501	5.010	SE12	685.8	3.399	0.541	4.2103	
15 minute summer	SE12	1.011	SE13	1429.2	3.532	1.176	13.6640	
15 minute summer	SE80	8.000	SE81	65.3	2.283	0.775	1.4037	
15 minute summer	SE81	8.001	SE13	127.4	2.542	0.627	0.7952	
15 minute summer	SE13	1.012	SE14	1603.4	3.644	0.628	14.1376	
15 minute summer	SE90	9.000	SE14	89.3	1.091	0.254	6.6939	
15 minute summer	SE14	1.013	SE15	1704.7	3.874	1.561	5.0724	
15 minute summer	SE15	1.014	SE16	1758.9	3.997	0.856	15.5041	
15 minute summer	SE16	1.015	SE17 Headwall	1814.0	4.122	1.310	3.4749	
180 minute winter	SE17 Headwall	Flow through pond	SE18 Headwall	293.0	0.023	0.028	1812.7969	
180 minute winter	SE18 Headwall	1.017	SE19 FCC	97.1	0.880	0.319	1.3366	
180 minute winter	SE19 FCC	Hydro-Brake®	SE Outlet Headwall	52.5				2317.2



APPENDIX 4

Attenuation Basin Cross-Sections



- NOTES:
1. DO NOT SCALE FROM THIS DRAWING.
 2. ALL DIMENSIONS ARE IN MILLIMETRES, UNLESS STATED OTHERWISE.
 3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT SCHEME DRAWINGS AND SPECIFICATIONS.
 4. ALL WORKS WITHIN THE PUBLIC HIGHWAY SHALL BE CARRIED OUT AND COMPLY WITH THE REQUIREMENTS OF THE DTP "TRAFFIC SIGNS MANUAL CHAPTER 8 - TRAFFIC SAFETY MEASURES AND SIGNS FOR ROAD WORKS AND TEMPORARY SITUATION".
 5. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY OCCURRENCES OF SOFT SPOTS IN THE SUBGRADE MATERIAL WITHIN THE CARRIAGEWAY NOTIONAL LOAD LINE. SOFT SPOTS SHALL BE REMOVED AND REPLACED WITH COMPACTED CAPPING MATERIAL AS AGREED WITH THE ENGINEER.
 9. HANDLING OF KERBS, EDGINGS AND PAVINGS (I.E. LIFTING, PLACING, MANOEUVRING) ABOVE 20KG WEIGHT SHALL BE BY MECHANICAL OR SIMILAR PLANT APPARATUS.
 10. ALL PROPRIETARY PRODUCTS TO BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.

PRELIMINARY ISSUE

ST	Rev	INITIAL ISSUE	FP	MSR	05.03.25
REVISIONS					
Description					
Date					
Submitted for S104					
Submitted for Tender					
Submitted for S38					
Submitted for Construction					
Submitted for S278					
As Built					
DRAWING STATUS					

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JOB TITLE

SOUTHERNWATER
PHASE 4 & 5

DRAWING TITLE

PHASE 4
ATTENUATION POND SECTIONS

DATE	30/03/2025	DATE	FP	DATE	MSR	SCALE	NTS	BY	MSR	CHKD	MSR	DATE	05/03/25
DRAWING NO.													
S832-STU05-XX-XX-DR-C-075-203 P01 SO													
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APPENDIX 5

Greenfield Run-off Rate

Calculated by:	Theo Epuran
Site name:	
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.02129° N
Longitude:	0.35841° W
Reference:	1438677651
Date:	Mar 03 2025 14:22

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	7.445
-----------------------	-------

Methodology

Q _{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

Soil characteristics

	Default	Edited
SOIL type:	4	5
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.53

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

Hydrological characteristics

	Default	Edited
SAAR (mm):	776	776
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

Default

Edited

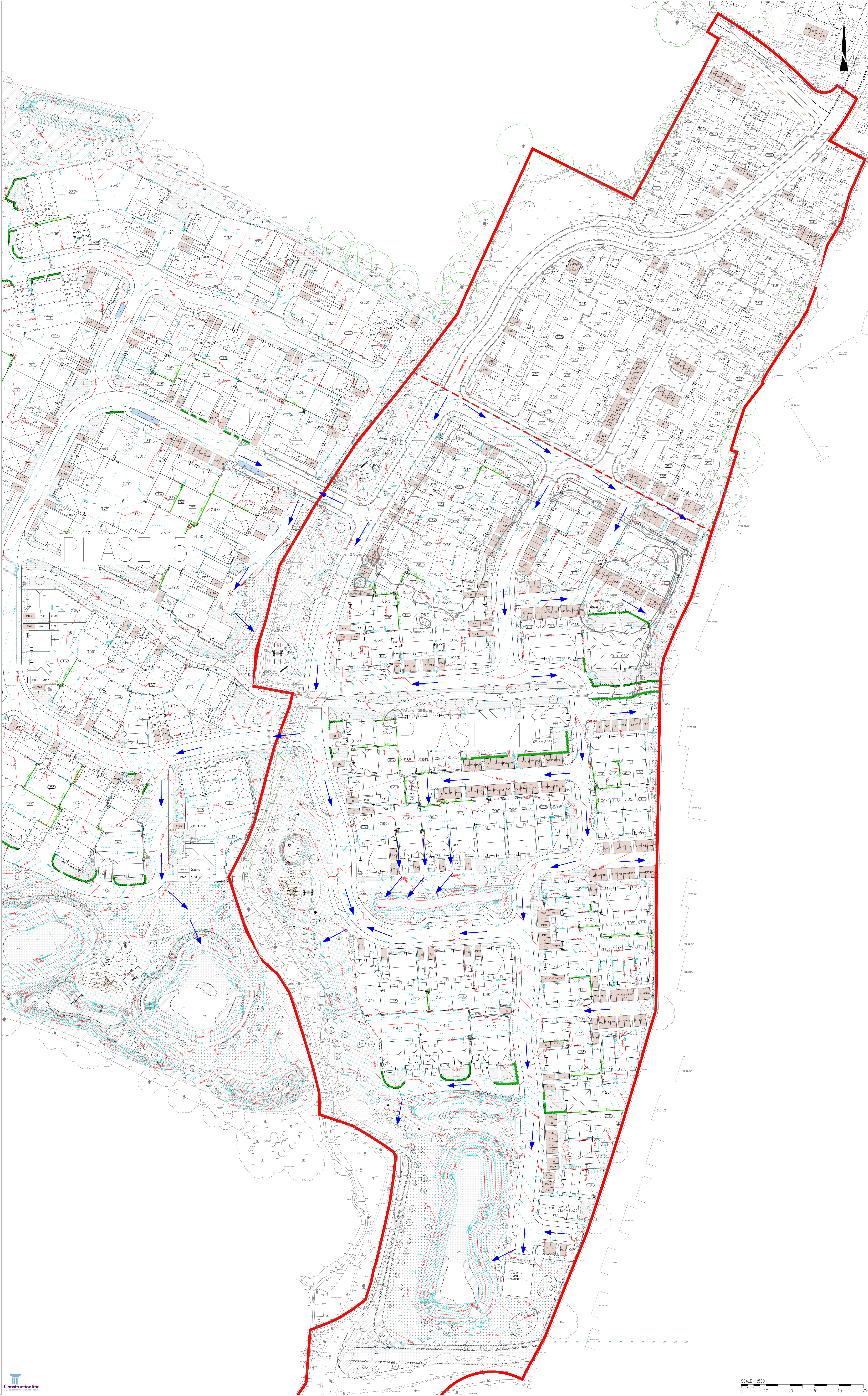
Q_{BAR} (l/s):	40.55	52.63
1 in 1 year (l/s):	34.47	44.73
1 in 30 years (l/s):	93.27	121.04
1 in 100 year (l/s):	129.35	167.88
1 in 200 years (l/s):	151.66	196.83

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.



APPENDIX 6

Exceedance Flow Routes



- GENERAL NOTES:
- DO NOT SCALE FROM THIS DRAWING.
 - ALL DIMENSIONS ARE IN METRES, UNLESS STATED OTHERWISE.
 - LEVELS ARE IN METRES AND ARE RELATED TO GPS DATUM.
 - THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT SCHEME DRAWINGS AND SPECIFICATIONS.
 - ALL WORKS TO BE CARRIED OUT IN STRICT ACCORDANCE WITH THE SPECIFICATION FOR HIGHWAY WORKS - MODIFIED AND EXTENDED, INCLUDING BATH & NORTH EAST SOMERSET COUNCIL SUPPLEMENTARY CLAUSES.
 - ALL WORKS WITHIN THE PUBLIC HIGHWAY SHALL BE CARRIED OUT AND COMPLY WITH THE REQUIREMENTS OF THE DTP 'TRAFFIC SIGNS MANUAL, CHAPTER 8 - TRAFFIC SAFETY MEASURES AND SIGNS FOR ROAD WORKS AND TEMPORARY SITUATION'.
 - ALL EXISTING LEVELS TO BE CONFIRMED ON SITE PRIOR TO COMMENCEMENT OF ANY WORKS.

KEY:
→ FLOW EXCEEDANCE ROUTE

PRELIMINARY ISSUE

ST	Rev	DESCRIPTION	DATE
1	1	PRELIMINARY ISSUE	15/03/25

REVISIONS	DATE
1. Substituted for S104	
2. Issued for Tender	
3. Issued for Construction	
4. As Built	

DRAWING STATUS

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Berkeley
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SOUTHERNWATER
PHASE 4 & 5

EXCEEDANCE FLOW
ROUTES LAYOUT

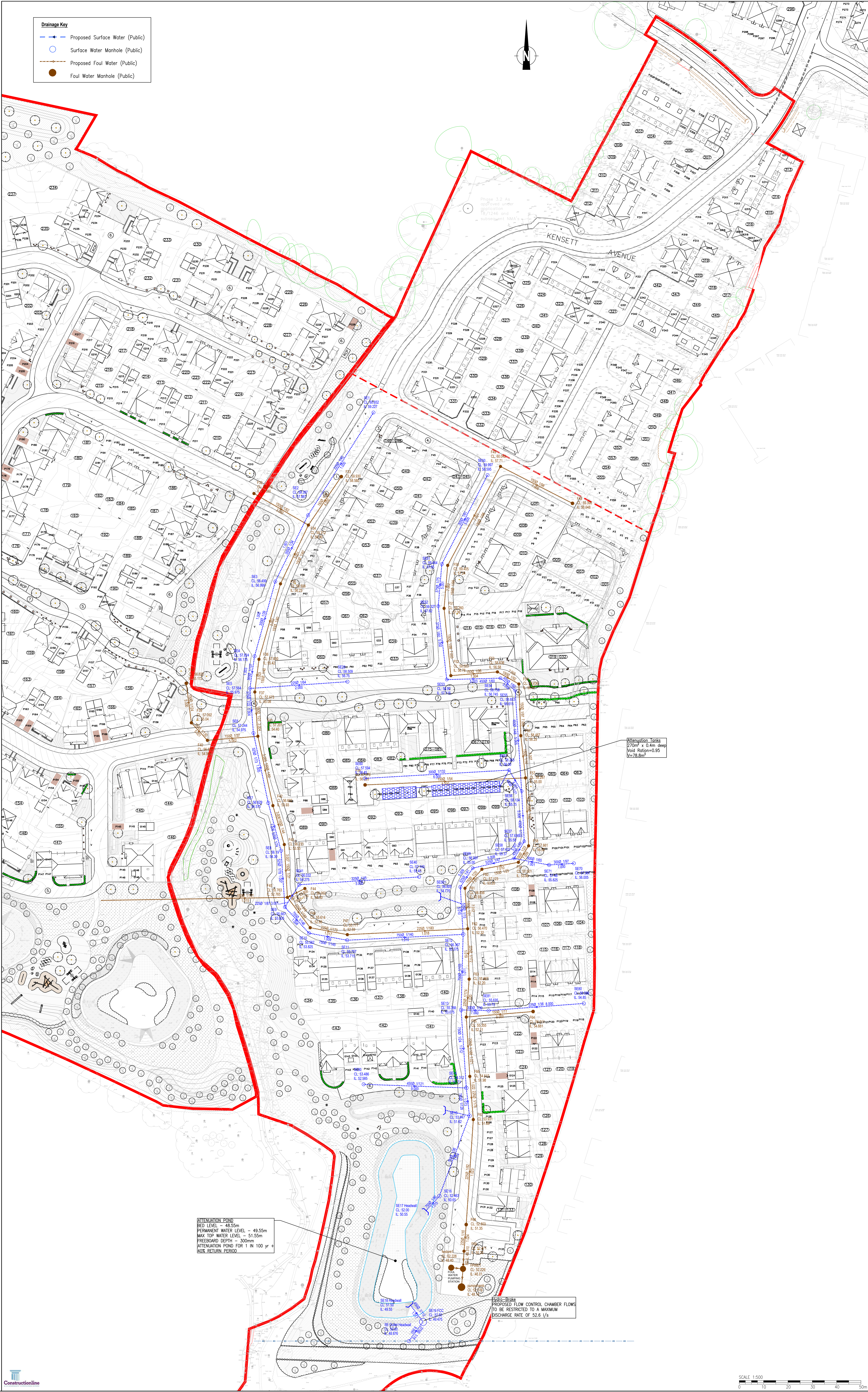
DATE	MARCH 2025	DATE	FP	MSR	DATE	1/500	DATE	04/0
REVISION	SS102-STU05-XX-XX-DR-C-075-202	REVISION	P01	SD				

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APPENDIX 7

Phase 4 Drainage Layout



Drainage Key

- Proposed Surface Water (Public)
- Surface Water Manhole (Public)
- Proposed Foul Water (Public)
- Foul Water Manhole (Public)

- GENERAL NOTES**
- 1.1. THIS DRAWING IS COPYRIGHT AND SHOULD NOT BE REPRODUCED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF PMPC GROUP LTD.
 - 1.2. ALL DIMENSIONS TO BE CHECKED ON SITE AND CO-ORDINATE WITH RELEVANT ARCHITECT'S DRAWINGS. ANY DISCREPANCIES TO BE REPORTED TO THE ENGINEER PRIOR TO CONSTRUCTION.
 - 1.3. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
 - 1.4. ALL LEVELS IN METRES.
 - 1.5. USER'S VERSION SHALL NOT BE MODIFIED WITHOUT THE WRITTEN APPROVAL OF THE ENGINEER.
 - 1.6. THIS DRAWING IS TO BE USED IN CONJUNCTION WITH ALL RELEVANT ENGINEERS DRAWINGS & SPECIFICATIONS.
- Drainage Construction Notes**
1. All materials and workmanship related to private sewers shall be in accordance with Part 11 of the Building Regulations and BS EN752 and best practice.
 2. All materials and workmanship related to adoptable sewers shall be in accordance with the Design and Construction Guidance 2020 as published by the Water Services Association and any subsequent revisions shown by the water authority.
 3. All sustainable drainage systems to be designed and maintained in accordance with CWA C753 The SuDS Manual and best practice guidance.
 4. All paths and external surfaces to drain away from building thresholds unless explicitly noted on the plan.
 5. All downpipes with pathways falling towards them to be fitted with threshold drains to be connected to nearest SW inspection chamber or pipe.
 6. All parking areas to be porous paving.
 7. Where practicable rainwater pipes to discharge onto parking areas or into diffuser.
 8. Land drainage to be provided in gardens where the gradient falls towards a property.

ATTENUATION POND
BED LEVEL - 48.55m
PERMANENT WATER LEVEL - 49.55m
MAX TOP WATER LEVEL - 51.55m
FREEDBOARD DEPTH - 300mm
ATTENUATION POND FOR 1 IN 100 yr + 40% RETURN PERIOD

Attenuation tanks
270m² x 0.4m deep
Void Ratio=0.95
V=78.6m³

Hydro-Breaks
PROPOSED FLOW CONTROL CHAMBER FLOWS TO BE RESTRICTED TO A MAXIMUM DISCHARGE RATE OF 52.6 l/s

PROJ	SEW UPGRADE, SOME PIPES UPGRADES	TE	MSR	20.03.20
PROJ	ATTENUATION DAM ADDED ON 1.006	AM	SR	16.06.24
PROJ	MINOR AMENDMENTS	AM	SR	16.06.24
PROJ	INITIAL ISSUE	AM	SR	16.06.24
PROJ	DESCRIPTION	DR	DR	DATE

REVISIONS

Revision Issue	✓	Submitted for S104
Planning Issue		Issued for Tender
Submitted for S104		Issued for Construction
Submitted for S104		As Built

DRAWING STATUS

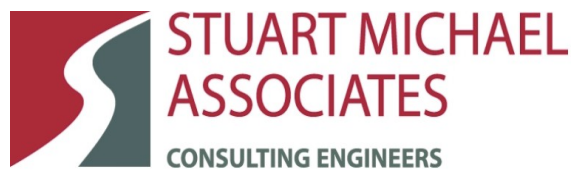
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Berkeley
Designed for life

SOUTHERN WATER
PHASE 4 & 5

STRATEGY SURFACE WATER LAYOUT
OVERVIEW - PHASE 4
SHEET 1

JUNE 2024
SOU-PPC-00-XX-DR-C-0201
P03 SD
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