



Westbury Hospital, Wiltshire

Drainage Technical Note

Project No.	0654
Revision	F
Date	9 th August 2023
Client	Backhouse (Westbury) JV limited
Prepared	J Hutt
Checked	J De La Croix
Authorised	R Mackay
File Ref.	p:\0654 westbury hospital\c documents\reports\0654 westbury hospital - drainage strategy technical note.docx

1 Introduction

- 1.1 The proposed drainage arrangements have been prepared to discharge Conditions 5, 6 and 7 of the outline planning approval for up to 56 dwellings, public open space and associated access and drainage works, at the former Westbury Hospital site (Wiltshire Council planning reference 15/11604/OUT).

2 Approved Outline Strategy

- 2.1 The 2016 Jubb's 'Flood Risk Assessment and Drainage Strategy' (V7) submitted to support the outline application proposed the use of a fully infiltrating SuDS scheme, comprising on-plot soakaways, permeable pavements and infiltration basins.
- 2.2 Whilst an infiltration scheme follows the hierarchal approach for new drainage systems, as promoted by the 'Planning Practice Guidance – Flood Risk and Coastal Change' (Para. 80), a detailed review of the

approved strategy concludes that infiltration is not a practicable solution for development flows at this site.

- 2.3 The MicroDrainage models appended to the approved 'Flood Risk Assessment and Drainage Strategy' (V7) demonstrated that the infiltration systems had capacity to attenuate runoff up to the 100 year return period, with 30% allowance for climate change, however the half-drain times are in excess of 7 days. The report references CIRIA C753 (The SuDS Manual, Para 13.4.1), which suggests that the usual half-drain time of <24 hours should only be applied up to the 30 year return period storm, however the report fails to include evidence that the infiltration basins achieve the 24 hour requirement for the 30 year return period storm, or lower.
- 2.4 The on-plot cellular soakaway calculations for the 30 year return period identify a half-drain time up to 274 hours (11 days). Furthermore, having re-created Jubb's model for 'Infiltration Basin 1', we have identified that even a 1 year return period storm would exceed 7 day's half-drain time.
- 2.5 The above findings are to be expected, given the infiltration design rate used within the soakaway models is below 2×10^{-6} m/s (6mm per hour), which with a Factor of Safety of 10, equates to an equivalent infiltration of just 0.6mm per hour.
- 2.6 Further soakaway testing was undertaken by Ruddlesden Geotechnical within October 2017, providing the following conclusion (which is broadly consistent with the above):
- 2.7 *"Whilst up to around 800mm of infiltration was achieved over the course of the day at several of the soakaway test locations, sufficient infiltration was not achieved to calculate a soil infiltration value (none of the tests achieved 75% of their effective test depth). Longer testing (testing carried out over a period of three to four days) would likely show that the Upper Greensand has a soil infiltration rate of around 1×10^{-6} m/s, and this value may be used for preliminary design purposes."*
- 2.8 Due to the above, it is considered that infiltration does not present a viable method of surface water disposal for this site. Instead, on-site attenuation combined with off-site discharge is considered to be the most appropriate drainage solution.
- 2.9 Notwithstanding the above, it is accepted that the 3no. infiltration basins proposed for the southern corner of the site can be retained (equating to 500m³ attenuation storage) as these replicate the existing on-site arrangements for the management of runoff from the upstream

catchment, ensuring no increased flood risk from upstream sources (refer to drawing 0654-XS-101 and associated calculation reports within Appendix A).

3 Reserved Matters Drainage Proposals

Development Drainage (Condition 6)

3.1 The preliminary drainage layout which accompanies this technical note (ref. 0654-PDL-101 within Appendix B) has been prepared to enable the discharge of Conditions 5, 6 and 7 of the outline approval and comprises a network of the following drainage features;

- Adoptable and non-adoptable belowground sewerage
- Cut-off ditch (*to intercept upstream flows and protect development*)
- Infiltration basins (*for management of upstream flows, as existing*)
- Geo-cellular soakaway (*for management of upstream flows*)
- Swales (*for conveyance of upstream flows*)
- Geo-cellular Attenuation (*for attenuation of development flows*)
- Rain-garden (*for attenuation of development flows*)
- Hydraulic Controls (*to restrict development flows*)

3.1 In accordance with 'Planning Practice Guidance – Flood Risk and Coastal Change' (Para. 80), where infiltration is not deemed practicable, developments should instead seek to discharge attenuated flows to an existing watercourse, or where this is not available, to an existing sewer network.

3.2 Given there are no available watercourses within the locality of the site, the strategy proposes an attenuated discharge to an existing off-site sewer network.

3.3 The topographical survey identifies downpipes, gullies and storm water manholes. A drainage tracing survey was undertaken by OnSpot Surveys Ltd in December 2017 to determine where the downstream connectivity of the existing site drainage.

- 3.4 The survey confirms that most of the hardstanding areas drain unattenuated to the public foul sewer beneath The Butts, with some roof areas draining to the existing land drain at the western boundary of the site. The land-drain discharges to the highway drain beneath The Butts, which is believed to discharge to the public storm sewer at the junction of Warminster Road and Orchard Road. Both of these existing drainage arrangements are unsatisfactory and have potential to overwhelm the receiving systems, contributing towards an increased flood risk for downstream properties.

- 3.5 Through consultation with Wiltshire Council it has been advised that any existing connections to highway drainage cannot be retained, irrespective of any flow limitations, without full system appraisal and condition survey. Given the extensive scope and timescales involved in preparing such a model, combined with the unknown risk of remedial works/costs to satisfy any agreement, it is considered that the most practicable solution would be to discharge both foul and storm flows to downstream adopted networks.

- 3.6 Through agreement with Wessex Water, the proposed drainage strategy will provide 80% betterment (reduction) over existing conditions (equating to 10 l/s peak flow).

- 3.7 Copies of our correspondence with WW have been included within Appendix D of this report.

- 3.7 Attenuation of development flows will ensure that future runoff is safely managed within the site, offering a reduction in exceedance flooding which currently impacts the downstream catchment.

- 3.8 The proposed drainage strategy also includes 40% allowance for the predicted effects of climate change, which will offer further betterment over the existing site.

- 3.9 The proposed scheme offers availability for a new raingarden area for the attenuation and treatment of runoff. This feature would be implemented in conjunction with a series of separate geo-cellular attenuation tanks. All future attenuation features would be retained under private ownership and would be maintained in accordance with 'CIRIA C753 – The SuDS Manual' by an appointment management company.

- 3.10 The management of flows from the attenuation features would be controlled by independent hydraulic controls, designed to manage runoff in up to the 100 year (+40% climate change) design flow.

- 3.11 The MicroDrainage Source Control module has been used to assess the attenuation requirements for the proposed development (based on a peak discharge of 10 l/s). The output of these models has been included within Appendix C and can be seen summarised within Table 3.1 below.

Table 3.1 – Attenuation Summary

Attenuation Feature	Max. Attenuation Volume
Attenuation Tank 01 (Cellular Storage)	160
Attenuation Tank 02 (Cellular Storage)	274
Attenuation Tank 03 (Cellular Storage)	133
Attenuation Tank 04 (Cellular Storage)	30
Rain Garden	52
Total	649

- 3.12 Notwithstanding the above strategy, should issues arise, preventing connectivity to the foul network at 10 l/s, there is an alternative drainage scheme which could be issued to planning as a variation. The alternative solution would be to requisition flows to the nearest adopted storm sewer at Warminster Road, with an allowable discharge of 12 l/s. Whilst this option would reduce the volume of on-site attenuation it will require significant off-site works.
- 3.13 During exceedance events, beyond the 100 year critical storm, surface water runoff will overflow from the aforementioned systems. Initially any freeboard allowances within the raingarden will be utilised by the upper catchment, beyond which flows will follow the adoptable road network towards the site access.
- 3.14 The initial 45m of access road will grade at 1 in 8, reducing to 1 in 50 from Plot 1 onwards. The belowground drainage network will broadly follow the gradient of the carriageway and therefore any throttling of flows or surcharge would first occur at this flatter pipe, where there is less hydraulic capacity. The preliminary drainage layout identifies a combined kerb and drainage system in this area to take exceedance flows off the carriageway and into the open space in the north-west corner of the site.
- 3.15 Localised earthworks within the north-western corner of the site will provide a holding area for exceedance flows. These areas will rely on natural infiltration to drain-down, which whilst known to be poor, provides some reduction in exceedance flows which might otherwise enter the highway network at The Butts.

Management of Upstream Flows (Condition 5)

- 3.16 In addition to the management of development flows, a series of interception measures will be constructed across the south eastern boundary to intercept runoff from the upstream catchment and to protect properties from surface water flooding. This includes a new cut-off swale and linear drainage channel.
- 3.17 Intercepted runoff will drain to 2no. infiltration basins in the southern corner of the site. The capacity of these features equates to 500m³ attenuation storage, which is equivalent to the 100 year 360 minute winter runoff from the upstream catchment (refer to drawing 0654-XS-101 in Appendix A).
- 3.18 This arrangement replicates the existing on-site storage provision for the management of runoff from the upstream catchment, but offers a greater wetted perimeter to increase infiltration potential overall, so that the residual risk of flooding from upstream sources can be reduced.
- 3.19 The existing infiltration basin includes an existing land-drain overflow, which connects to the adopted highway network at The Butts. The proposed scheme proposes to reconfigure the overflow so that exceedance runoff is directed towards the open-space at the north-western corner of the site, freeing capacity within the existing highway drain at The Butts.
- 3.20 As already discussed within this technical note, localised earthworks within the north-western corner of the site will provide a holding area for exceedance flows. These areas will rely on natural infiltration to drain-down, which whilst known to be poor, provides some reduction in exceedance flows which might otherwise enter the highway network at The Butts.

Foul Drainage

- 3.21 A pre-development capacity enquiry has been submitted to Wessex Water. Their response has confirmed the former hospital site benefited from connections to the existing 225mm/175mm diameter public foul sewer at The Butts and that any new foul connections will need to be to this same network.
- 3.22 Foul flows generated by the development will route through a new adoptable foul water network towards the north-western edge of the site before being requisitioned to the existing foul manhole near the site access.

3.23 We have shown an indicative alignment for the new adoptable foul sewerage system on the preliminary drainage layout included within Appendix B of this report.

3.24 Copies of our correspondence with WW have been included within Appendix D of this report.

Drainage Maintenance (Condition 7)

3.25 Any adoptable sewerage networks will be designed in accordance with Sewers for Adoption (SfA) and will be offered to Wessex Water for adoption.

3.26 Any storm drainage which solely serves the adopted highway will be offered to Wiltshire Council for adoption.

3.27 Any private drainage will be designed in accordance with Building Regulations Part H and will become the responsibility of the respective homeowner, or where communal, an appointed management company.

3.28 The 'Drainage Maintenance Plan' included within Appendix E of this Technical Note provides information on the operation and maintenance of the proposed drainage features, based on the guidance set by 'CIRIA C753 – The SUDS Manual, Chapter 32 – Operation and Maintenance'.

4 Conclusion

4.1 The use of infiltration, as promoted by the outline scheme, is not practicable for this site. Instead, on-site attenuation combined with off-site discharge is considered to be the most appropriate drainage solution.

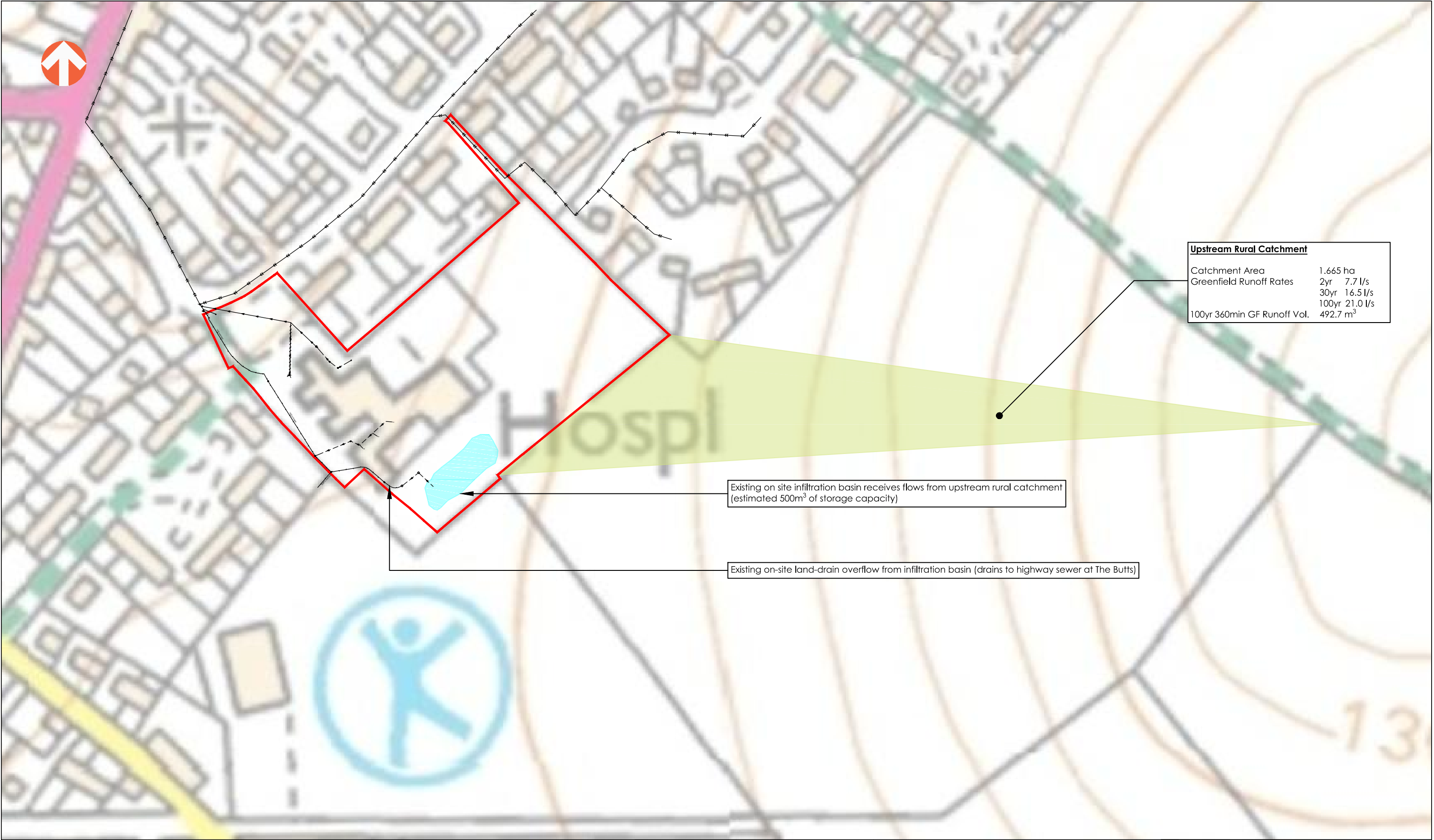
4.2 The proposed surface water strategy will retain existing connectivity to the adopted foul sewer at The Butts but will incorporate a series of private geo-cellular attenuation tanks, together with an above-ground rain garden, to offer the necessary flow attenuation, providing 80% reduction in peak flows entering the off-site foul drainage network at The Butts, as agreed with Wessex Water (100 year +40% climate change peak discharge of 10 l/s).

4.3 Attenuated flows will be held on site, offering significant betterment over existing site conditions, where the belowground drainage network is frequently overwhelmed and exceedance flows have been reported to impact downstream properties. Furthermore, the inclusion of climate change allowances will offer further betterment over existing site conditions.

- 4.4 In addition to providing on-site attenuation, the use of a raingarden also offers water quality enhancement, together with biodiversity and ecological gains.
- 4.5 A series of interception measures will be constructed across the south-eastern boundary to intercept runoff from the upstream catchment and to protect properties from surface water flooding.
- 4.6 Intercepted flows will route to a series of infiltration basins at the southern corner of the site. Whilst infiltration is not suitable for design purposes, this arrangement retains and seeks to improve upon the existing provisions within the site, so that the downstream risk of flooding from upstream sources can be reduced.
- 4.7 The existing land-drain overflow will be reconfigured to direct exceedance runoff directed towards the open-space at the north-western corner of the site, freeing capacity within the existing highway drain at The Butts.
- 4.8 Localised earthworks within the north-western corner of the site will provide a holding area for exceedance flows.
- 4.9 Wessex Water have confirmed that foul flows generated by the site can retain the existing sites connection to the 225mm/175mm public foul sewer beneath The Butts.
- 4.10 The operation and maintenance of the proposed drainage scheme is set out within the site-specific 'Drainage Maintenance Plan', prepared in accordance with 'CIRIA C753 – The SUDS Manual, Chapter 32 – Operation and Maintenance'
- 4.11 The development will be safe from flooding throughout its 100 year lifetime and will actively reduce flood risk to properties in the downstream catchment, whilst also reducing current loads on downstream drainage infrastructure.
- 4.12 It is considered the drainage arrangements promoted by this Technical Note, together with the appended plans and other documentation, should enable the Local Planning Authority to confirm that Planning Conditions 5, 6 and 7 can be discharged.



Appendix A Existing Site Plan – Upstream Runoff



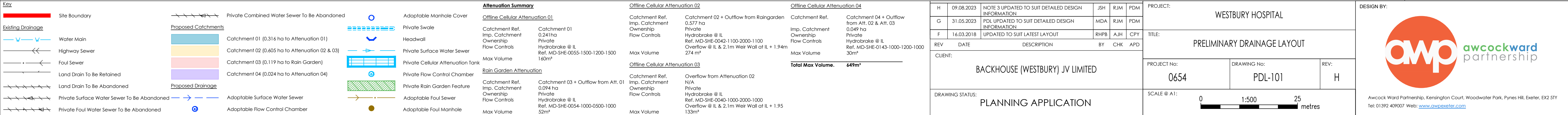
Key

- Site Boundary
- Upstream Rural Catchment
- Existing Highway Sewer
- Existing Private Land Drain
- Assumed Continuation of Existing Private Land Drain

C26.02.2017CLIENT UPDATEDTMRCPYCPY B21.12.2017EXISTING DRAINAGE UPDATEDAJHCPYCPY A15.12.2017INITIAL ISSUETMRCPYCPY REVDATEDESCRIPTIONBYCHKAPD						PROJECT: WESTBURY HOSPITAL, WILTSHIRE		
CLIENT: BACKHOUSE (WESTBURY) JV LIMITED						TITLE: EXISTING SITE PLAN - UPSTREAM RURAL RUNOFF		
DRAWING STATUS: PLANNING APPLICATION						PROJECT No: 0654 DRAWING No: XS-101 REV: C		
SCALE @ A3: 0 1:2000 100 metres						awcockward partnership Awcock Ward Partnership, Kensington Court, Woodwater Park, Pynes Hill, Exeter, EX2 5TY Tel: 01392 409007 Web: www.awpexeter.com		



Appendix B Preliminary Drainage Layout



Appendix C Microdrainage Calculations

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Kensington Court Woodwater Park Pynes Hill Exeter EX2 5TY	0654 Westbury Surface Water Network	
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XP Solutions	Network 2017.1.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Water Network 1

Pipe Sizes SFA7 Manhole Sizes SFA7

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	19.300	Add Flow / Climate Change (%)	0
Ratio R	0.363	Minimum Backdrop Height (m)	5.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	6.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.300
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.840	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Surface Water Network 1

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.584	4-8	0.375

Total Area Contributing (ha) = 0.959

Total Pipe Volume (m³) = 22.746

Network Design Table for Surface Water Network 1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	28.644	2.572	11.1	0.065	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	24.038	0.142	169.3	0.130	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	23.293	0.928	25.1	0.046	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	9.594	0.020	479.7	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	21.567	0.255	84.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.16	97.255	0.065	0.0	0.0	0.0	3.04	53.7	9.9
2.000	50.00	5.40	94.750	0.130	0.0	0.0	0.0	1.00	39.8	19.7
1.001	50.00	5.55	94.608	0.241	0.0	0.0	0.0	2.62	104.3	36.6
3.000	50.00	5.22	93.700	0.000	0.0	0.0	0.0	0.71	50.3	0.0
1.002	50.00	5.80	93.680	0.241	0.0	0.0	0.0	1.42	56.6	36.6

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XP Solutions	Network 2017.1.1	

Network Design Table for Surface Water Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
4.000	4.300	0.060	71.7	0.092	5.00	0.0	0.600	o	225	Pipe/Conduit	
4.001	7.557	0.940	8.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	9.501	0.537	17.7	0.007	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	27.217	2.538	10.7	0.073	5.00	0.0	0.600	o	150	Pipe/Conduit	
5.001	19.675	0.116	170.0	0.065	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.002	22.328	0.131	170.0	0.024	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	21.481	0.463	46.4	0.043	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	13.875	0.150	92.5	0.047	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	23.837	1.249	19.1	0.027	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	8.872	0.598	14.8	0.027	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	38.816	0.413	94.0	0.077	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	12.633	0.189	66.8	0.104	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	26.993	0.790	34.2	0.022	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.009	15.959	1.131	14.1	0.061	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.010	18.724	1.955	9.6	0.019	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.011	20.459	2.630	7.8	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.012	9.743	0.749	13.0	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.000	24.473	1.145	21.4	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
7.001	16.662	2.525	6.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
4.000	50.00	5.05	94.500	0.092	0.0	0.0	0.0	1.55	61.5	14.0
4.001	50.00	5.08	94.440	0.092	0.0	0.0	0.0	3.58	63.2	14.0
1.003	50.00	5.84	93.350	0.340	0.0	0.0	0.0	3.76	265.5	51.6
5.000	50.00	5.15	95.748	0.073	0.0	0.0	0.0	3.09	54.7	11.1
5.001	50.00	5.47	93.135	0.138	0.0	0.0	0.0	1.00	39.8	20.9
5.002	50.00	5.85	93.019	0.162	0.0	0.0	0.0	1.00	39.8	24.6
1.004	50.00	6.00	92.813	0.545	0.0	0.0	0.0	2.31	163.6	82.7
1.005	50.00	6.14	92.350	0.592	0.0	0.0	0.0	1.64	115.6	89.8
6.000	50.00	5.17	94.197	0.027	0.0	0.0	0.0	2.32	40.9	4.1
6.001	50.00	5.23	92.948	0.054	0.0	0.0	0.0	2.63	46.5	8.2
1.006	50.00	6.54	92.200	0.723	0.0	0.0	0.0	1.62	114.7	109.7
1.007	50.00	6.65	91.787	0.827	0.0	0.0	0.0	1.93	136.1	125.4
1.008	50.00	6.82	91.598	0.849	0.0	0.0	0.0	2.70	190.8	128.8
1.009	50.00	6.88	90.808	0.910	0.0	0.0	0.0	4.21	297.4	138.0
1.010	50.00	6.98	89.677	0.929	0.0	0.0	0.0	3.28	57.9<	140.9
1.011	50.00	7.05	87.647	0.944	0.0	0.0	0.0	4.72	187.7	143.2
1.012	50.00	7.09	85.017	0.959	0.0	0.0	0.0	3.65	145.0<	145.4
7.000	50.00	5.12	89.620	0.000	0.0	0.0	0.0	3.42	241.4	0.0
7.001	50.00	5.17	88.475	0.000	0.0	0.0	0.0	5.13	203.8	0.0

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Network Design Table for Surface Water Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
7.002	16.014	1.610	9.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.003	11.235	0.072	156.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.013	14.841	0.638	23.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
7.002	50.00	5.24	85.950	0.000	0.0	0.0	0.0	4.17	165.9	0.0
7.003	50.00	5.39	84.340	0.000	0.0	0.0	0.0	1.26	88.8	0.0
1.013	50.00	7.18	84.268	0.959	0.0	0.0	0.0	2.72	108.3«	145.4

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Manhole Schedules for Surface Water Network 1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S101	98.705	1.450	Open Manhole	1200	1.000	97.255	150				
S201	96.919	2.169	Open Manhole	1200	2.000	94.750	225				
S102	97.740	3.132	Open Manhole	1200	1.001	94.608	225	1.000	94.683	150	
								2.000	94.608	225	
S301	95.900	2.200	Open Manhole	1200	3.000	93.700	300				
S103	95.910	2.230	Open Manhole	1500	1.002	93.680	225	1.001	93.680	225	
								3.000	93.680	300	
S401	95.000	0.500	Open Manhole	1200	4.000	94.500	225				
S402	95.000	0.560	Open Manhole	1200	4.001	94.440	150	4.000	94.440	225	
S104	94.850	1.500	Open Manhole	1200	1.003	93.350	300	1.002	93.425	225	
								4.001	93.500	150	
S501	97.198	1.450	Open Manhole	1200	5.000	95.748	150				
S502	95.359	2.224	Open Manhole	1200	5.001	93.135	225	5.000	93.210	150	
S503	95.029	2.010	Open Manhole	1200	5.002	93.019	225	5.001	93.019	225	
S105	94.657	1.844	Open Manhole	1200	1.004	92.813	300	1.003	92.813	300	
								5.002	92.888	225	
S106	94.304	1.954	Open Manhole	1200	1.005	92.350	300	1.004	92.350	300	
S601	95.647	1.450	Open Manhole	1200	6.000	94.197	150				
S602	94.398	1.450	Open Manhole	1200	6.001	92.948	150	6.000	92.948	150	
S107	94.050	1.850	Open Manhole	1200	1.006	92.200	300	1.005	92.200	300	
								6.001	92.350	150	
S108	93.582	1.795	Open Manhole	1200	1.007	91.787	300	1.006	91.787	300	
S109	93.198	1.600	Open Manhole	1200	1.008	91.598	300	1.007	91.598	300	
S110	92.408	1.600	Open Manhole	1200	1.009	90.808	300	1.008	90.808	300	
S111	91.577	1.900	Open Manhole	1500	1.010	89.677	150	1.009	89.677	300	
S112	89.322	1.675	Open Manhole	1200	1.011	87.647	225	1.010	87.722	150	
S113	86.709	1.692	Open Manhole	1200	1.012	85.017	225	1.011	85.017	225	
S701	91.620	2.000	Open Manhole	1200	7.000	89.620	300				
S702	90.950	2.475	Open Manhole	2100	7.001	88.475	225	7.000	88.475	300	
S703	88.450	2.500	Open Manhole	2100	7.002	85.950	225	7.001	85.950	225	
S704	88.000	3.660	Open Manhole	1200	7.003	84.340	300	7.002	84.340	225	
S114	87.317	3.049	Open Manhole	1500	1.013	84.268	225	1.012	84.268	225	
								7.003	84.268	300	
EX FOUL MH	84.530	0.900	Open Manhole	1200		OUTFALL		1.013	83.630	225	

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PIPELINE SCHEDULES for Surface Water Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	S101	98.705	97.255	1.300	Open Manhole	1200
2.000	o	225	S201	96.919	94.750	1.944	Open Manhole	1200
1.001	o	225	S102	97.740	94.608	2.907	Open Manhole	1200
3.000	o	300	S301	95.900	93.700	1.900	Open Manhole	1200
1.002	o	225	S103	95.910	93.680	2.005	Open Manhole	1500
4.000	o	225	S401	95.000	94.500	0.275	Open Manhole	1200
4.001	o	150	S402	95.000	94.440	0.410	Open Manhole	1200
1.003	o	300	S104	94.850	93.350	1.200	Open Manhole	1200
5.000	o	150	S501	97.198	95.748	1.300	Open Manhole	1200
5.001	o	225	S502	95.359	93.135	1.999	Open Manhole	1200
5.002	o	225	S503	95.029	93.019	1.785	Open Manhole	1200
1.004	o	300	S105	94.657	92.813	1.544	Open Manhole	1200
1.005	o	300	S106	94.304	92.350	1.654	Open Manhole	1200
6.000	o	150	S601	95.647	94.197	1.300	Open Manhole	1200
6.001	o	150	S602	94.398	92.948	1.300	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	28.644	11.1	S102	97.740	94.683	2.907	Open Manhole	1200
2.000	24.038	169.3	S102	97.740	94.608	2.907	Open Manhole	1200
1.001	23.293	25.1	S103	95.910	93.680	2.005	Open Manhole	1500
3.000	9.594	479.7	S103	95.910	93.680	1.930	Open Manhole	1500
1.002	21.567	84.6	S104	94.850	93.425	1.200	Open Manhole	1200
4.000	4.300	71.7	S402	95.000	94.440	0.335	Open Manhole	1200
4.001	7.557	8.0	S104	94.850	93.500	1.200	Open Manhole	1200
1.003	9.501	17.7	S105	94.657	92.813	1.544	Open Manhole	1200
5.000	27.217	10.7	S502	95.359	93.210	1.999	Open Manhole	1200
5.001	19.675	170.0	S503	95.029	93.019	1.785	Open Manhole	1200
5.002	22.328	170.0	S105	94.657	92.888	1.544	Open Manhole	1200
1.004	21.481	46.4	S106	94.304	92.350	1.654	Open Manhole	1200
1.005	13.875	92.5	S107	94.050	92.200	1.550	Open Manhole	1200
6.000	23.837	19.1	S602	94.398	92.948	1.300	Open Manhole	1200
6.001	8.872	14.8	S107	94.050	92.350	1.550	Open Manhole	1200

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PIPELINE SCHEDULES for Surface Water Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.006	o	300	S107	94.050	92.200	1.550	Open Manhole	1200
1.007	o	300	S108	93.582	91.787	1.495	Open Manhole	1200
1.008	o	300	S109	93.198	91.598	1.300	Open Manhole	1200
1.009	o	300	S110	92.408	90.808	1.300	Open Manhole	1200
1.010	o	150	S111	91.577	89.677	1.750	Open Manhole	1500
1.011	o	225	S112	89.322	87.647	1.450	Open Manhole	1200
1.012	o	225	S113	86.709	85.017	1.467	Open Manhole	1200
7.000	o	300	S701	91.620	89.620	1.700	Open Manhole	1200
7.001	o	225	S702	90.950	88.475	2.250	Open Manhole	2100
7.002	o	225	S703	88.450	85.950	2.275	Open Manhole	2100
7.003	o	300	S704	88.000	84.340	3.360	Open Manhole	1200
1.013	o	225	S114	87.317	84.268	2.824	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.006	38.816	94.0	S108	93.582	91.787	1.495	Open Manhole	1200
1.007	12.633	66.8	S109	93.198	91.598	1.300	Open Manhole	1200
1.008	26.993	34.2	S110	92.408	90.808	1.300	Open Manhole	1200
1.009	15.959	14.1	S111	91.577	89.677	1.600	Open Manhole	1500
1.010	18.724	9.6	S112	89.322	87.722	1.450	Open Manhole	1200
1.011	20.459	7.8	S113	86.709	85.017	1.467	Open Manhole	1200
1.012	9.743	13.0	S114	87.317	84.268	2.824	Open Manhole	1500
7.000	24.473	21.4	S702	90.950	88.475	2.175	Open Manhole	2100
7.001	16.662	6.6	S703	88.450	85.950	2.275	Open Manhole	2100
7.002	16.014	9.9	S704	88.000	84.340	3.435	Open Manhole	1200
7.003	11.235	156.0	S114	87.317	84.268	2.749	Open Manhole	1500
1.013	14.841	23.3	EX FOUL MH	84.530	83.630	0.675	Open Manhole	1200

Setting Out Information - True Coordinates (Surface Water Network 1)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
1.000	S101	1200		387402.755	150705.190	
2.000	S201	1200		387362.716	150670.953	
1.001	S102	1200		387380.985	150686.575	
3.000	S301	1200		387372.500	150711.017	
1.002	S103	1500		387365.848	150704.279	
4.000	S401	1200		387361.173	150721.286	
4.001	S402	1200		387358.379	150724.554	
1.003	S104	1200		387351.832	150720.671	
5.000	S501	1200		387395.272	150734.498	
5.001	S502	1200		387377.585	150755.184	
5.002	S503	1200		387362.622	150742.408	
1.004	S105	1200		387345.657	150727.892	
1.005	S106	1200		387329.335	150713.927	
6.000	S601	1200		387345.614	150686.141	
6.001	S602	1200		387330.097	150704.236	
1.006	S107	1200		387321.386	150702.555	
1.007	S108	1200		387291.702	150677.544	
1.008	S109	1200		387279.395	150674.694	
1.009	S110	1200		387255.736	150687.689	

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Setting Out Information - True Coordinates (Surface Water Network 1)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
1.010	S111	1500		387240.217	150691.409	
1.011	S112	1200		387223.304	150699.442	
1.012	S113	1200		387211.679	150716.277	
7.000	S701	1200		387241.911	150698.643	
7.001	S702	2100		387247.110	150722.557	
7.002	S703	2100		387237.852	150736.410	
7.003	S704	1200		387224.538	150727.512	
1.013	S114	1500		387213.425	150725.862	
PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
1.013	EX FOUL MH	1200		387199.223	150730.160	

Free Flowing Outfall Details for Surface Water Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.013	EX FOUL MH	84.530	83.630	83.630	1200	0

Simulation Criteria for Surface Water Network 1

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 6 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 100

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Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.840
M5-60 (mm)	19.300	Cv (Winter)	0.840
Ratio R	0.363	Storm Duration (mins)	30
Profile Type	Summer		

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Online Controls for Surface Water Network 1

Hydro-Brake® Optimum Manhole: S103, DS/PN: 1.002, Volume (m³): 5.4

Unit Reference	MD-SHE-0055-1500-1200-1500
Design Head (m)	1.200
Design Flow (l/s)	1.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	55
Invert Level (m)	93.680
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.5	Kick-Flo®	0.493	1.0
Flush-Flo™	0.242	1.2	Mean Flow over Head Range	-	1.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.1	0.800	1.2	2.000	1.9	4.000	2.6	7.000	3.4
0.200	1.2	1.000	1.4	2.200	2.0	4.500	2.7	7.500	3.5
0.300	1.2	1.200	1.5	2.400	2.1	5.000	2.9	8.000	3.6
0.400	1.2	1.400	1.6	2.600	2.1	5.500	3.0	8.500	3.7
0.500	1.0	1.600	1.7	3.000	2.3	6.000	3.1	9.000	3.8
0.600	1.1	1.800	1.8	3.500	2.4	6.500	3.3	9.500	3.9

Hydro-Brake® Optimum Manhole: S402, DS/PN: 4.001, Volume (m³): 0.8

Unit Reference	MD-SHE-0054-1000-0500-1000
Design Head (m)	0.500
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	54
Invert Level (m)	94.440
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	1.0	Kick-Flo®	0.332	0.8
Flush-Flo™	0.151	1.0	Mean Flow over Head Range	-	0.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.0	0.200	1.0	0.300	0.9	0.400	0.9	0.500	1.0

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Hydro-Brake® Optimum Manhole: S402, DS/PN: 4.001, Volume (m³): 0.8

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.600	1.1	1.600	1.7	2.600	2.1	5.000	2.8	7.500	3.5
0.800	1.2	1.800	1.8	3.000	2.2	5.500	3.0	8.000	3.6
1.000	1.4	2.000	1.9	3.500	2.4	6.000	3.1	8.500	3.7
1.200	1.5	2.200	1.9	4.000	2.6	6.500	3.2	9.000	3.8
1.400	1.6	2.400	2.0	4.500	2.7	7.000	3.4	9.500	3.9

Hydro-Brake® Optimum Manhole: S111, DS/PN: 1.010, Volume (m³): 4.4

Unit Reference	MD-SHE-0076-2000-0400-2000
Design Head (m)	0.400
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	76
Invert Level (m)	89.677
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	2.0	Kick-Flo®	0.286	1.7
Flush-Flo™	0.124	2.0	Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	0.800	2.7	2.000	4.2	4.000	5.8	7.000	7.6
0.200	1.9	1.000	3.0	2.200	4.4	4.500	6.1	7.500	7.9
0.300	1.8	1.200	3.3	2.400	4.6	5.000	6.5	8.000	8.2
0.400	2.0	1.400	3.5	2.600	4.7	5.500	6.8	8.500	8.4
0.500	2.2	1.600	3.8	3.000	5.1	6.000	7.1	9.000	8.7
0.600	2.4	1.800	4.0	3.500	5.4	6.500	7.4	9.500	8.9

Complex Manhole: S702, DS/PN: 7.001, Volume (m³): 10.2

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0042-1100-2000-1100
Design Head (m)	2.000
Design Flow (l/s)	1.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	42
Invert Level (m)	88.475
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	1.1	Kick-Flo®	0.373	0.5
Flush-Flo™	0.181	0.6	Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.6	0.800	0.7	2.000	1.1	4.000	1.5	7.000	1.9
0.200	0.6	1.000	0.8	2.200	1.1	4.500	1.6	7.500	2.0
0.300	0.6	1.200	0.9	2.400	1.2	5.000	1.7	8.000	2.1
0.400	0.5	1.400	0.9	2.600	1.2	5.500	1.7	8.500	2.1
0.500	0.6	1.600	1.0	3.000	1.3	6.000	1.8	9.000	2.2
0.600	0.6	1.800	1.0	3.500	1.4	6.500	1.9	9.500	2.2

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Discharge Coef 0.544 Width (m) 2.100 Invert Level (m) 90.415

Complex Manhole: S703, DS/PN: 7.002, Volume (m³): 9.2

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0040-1000-2000-1000
Design Head (m)	2.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	40
Invert Level (m)	85.950
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	1.0	Kick-Flo®	0.355	0.5
Flush-Flo™	0.173	0.6	Mean Flow over Head Range	-	0.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.5	0.800	0.7	2.000	1.0	4.000	1.4	7.000	1.8
0.200	0.6	1.000	0.7	2.200	1.0	4.500	1.4	7.500	1.8
0.300	0.5	1.200	0.8	2.400	1.1	5.000	1.5	8.000	1.9
0.400	0.5	1.400	0.9	2.600	1.1	5.500	1.6	8.500	1.9
0.500	0.5	1.600	0.9	3.000	1.2	6.000	1.6	9.000	2.0
0.600	0.6	1.800	1.0	3.500	1.3	6.500	1.7	9.500	2.0

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Discharge Coef 0.544 Width (m) 2.100 Invert Level (m) 87.900

Hydro-Brake® Optimum Manhole: S114, DS/PN: 1.013, Volume (m³): 6.4

Unit Reference	MD-SHE-0143-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	143
Invert Level (m)	84.268
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	10.0	Kick-Flo®	0.778	8.2
Flush-Flo™	0.357	10.0	Mean Flow over Head Range	-	8.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.1	0.800	8.3	2.000	12.7	4.000	17.7	7.000	23.2
0.200	9.4	1.000	9.2	2.200	13.3	4.500	18.7	7.500	23.9
0.300	9.9	1.200	10.0	2.400	13.9	5.000	19.7	8.000	24.7
0.400	10.0	1.400	10.8	2.600	14.4	5.500	20.6	8.500	25.4
0.500	9.8	1.600	11.5	3.000	15.4	6.000	21.5	9.000	26.1
0.600	9.5	1.800	12.1	3.500	16.6	6.500	22.3	9.500	26.8

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Offline Controls for Surface Water Network 1

Pipe Manhole: S111, DS/PN: 1.010, Loop to PN: 7.001

Diameter (m)	0.450	Roughness k (mm)	0.600
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500
Slope (1:X)	150.0	Coefficient of Contraction	0.600
Length (m)	13.000	Upstream Invert Level (m)	89.677

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Storage Structures for Surface Water Network 1

Cellular Storage Manhole: S103, DS/PN: 1.002

Invert Level (m) 93.680 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

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	139.5	0.0	1.200	139.5	0.0	1.201	0.0	0.0

Tank or Pond Manhole: S402, DS/PN: 4.001

Invert Level (m) 94.440

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	130.0	0.400	130.0	0.401	0.0

Cellular Storage Manhole: S702, DS/PN: 7.001

Invert Level (m) 88.480 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

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	144.0	0.0	2.000	144.0	0.0	2.001	0.0	0.0

Cellular Storage Manhole: S703, DS/PN: 7.002

Invert Level (m) 86.050 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

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	70.0	0.0	2.000	70.0	0.0	2.001	0.0	0.0

Cellular Storage Manhole: S114, DS/PN: 1.013

Invert Level (m) 84.268 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

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	26.0	0.0	1.200	26.0	0.0	1.201	0.0	0.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Water Network 1

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 6 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.300 Cv (Summer) 0.840
Region England and Wales Ratio R 0.363 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960,
1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S101	15 Summer	1	+40%					97.305	-0.100
2.000	S201	15 Summer	1	+40%	30/15 Summer				94.889	-0.086
1.001	S102	15 Summer	1	+40%	30/15 Summer				94.718	-0.115
3.000	S301	600 Summer	1	+40%	1/360 Summer				94.012	0.012
1.002	S103	600 Summer	1	+40%	1/60 Summer				94.012	0.107
4.000	S401	15 Summer	1	+40%	30/15 Summer				94.616	-0.109
4.001	S402	360 Summer	1	+40%	30/30 Summer				94.549	-0.041
1.003	S104	60 Summer	1	+40%	100/15 Summer				93.371	-0.279
5.000	S501	15 Summer	1	+40%	100/15 Summer				95.801	-0.097
5.001	S502	15 Summer	1	+40%	30/15 Summer				93.274	-0.086
5.002	S503	15 Summer	1	+40%	30/15 Summer				93.170	-0.074
1.004	S105	15 Summer	1	+40%	30/15 Summer				92.917	-0.196
1.005	S106	15 Summer	1	+40%	30/15 Summer				92.494	-0.156
6.000	S601	15 Summer	1	+40%					94.234	-0.113
6.001	S602	15 Summer	1	+40%	30/15 Summer				92.998	-0.100
1.006	S107	15 Summer	1	+40%	30/15 Summer				92.371	-0.129
1.007	S108	15 Summer	1	+40%	30/15 Summer				91.982	-0.105
1.008	S109	15 Summer	1	+40%	30/15 Summer				91.747	-0.151
1.009	S110	15 Summer	1	+40%	100/15 Summer				90.935	-0.173
1.010	S111	2880 Winter	1	+40%	1/15 Summer	1/15 Summer		114	89.929	0.102
1.011	S112	15 Summer	1	+40%					87.671	-0.201
1.012	S113	15 Summer	1	+40%	100/1440 Summer				85.052	-0.190
7.000	S701	2880 Winter	1	+40%	1/2880 Winter				89.929	0.009
7.001	S702	2880 Winter	1	+40%	1/15 Summer				89.929	1.229
7.002	S703	10080 Winter	1	+40%	1/480 Summer				87.001	0.826
7.003	S704	60 Summer	1	+40%	100/600 Winter				84.372	-0.268
1.013	S114	60 Summer	1	+40%	100/480 Summer				84.368	-0.125

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Water Network 1

PN	US/MH Name	Flooded		Pipe		Status	Level Exceeded
		Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)		
1.000	S101	0.000	0.25		12.6	OK	
2.000	S201	0.000	0.68		24.9	OK	
1.001	S102	0.000	0.47		44.9	OK	
3.000	S301	0.000	0.00		0.0	SURCHARGED	
1.002	S103	0.000	0.02		1.2	SURCHARGED	
4.000	S401	0.000	0.51		17.6	OK	
4.001	S402	0.000	0.02		1.0	OK	
1.003	S104	0.000	0.01		2.7	OK	
5.000	S501	0.000	0.27		14.2	OK	
5.001	S502	0.000	0.68		24.5	OK	
5.002	S503	0.000	0.78		28.3	OK	
1.004	S105	0.000	0.26		37.2	OK	
1.005	S106	0.000	0.46		44.4	OK	
6.000	S601	0.000	0.13		5.2	OK	
6.001	S602	0.000	0.24		9.6	OK	
1.006	S107	0.000	0.61		64.9	OK	
1.007	S108	0.000	0.74		80.3	OK	
1.008	S109	0.000	0.49		83.5	OK	
1.009	S110	0.000	0.37		92.4	OK	
1.010	S111	0.000	0.04	5.0	2.0	SURCHARGED	
1.011	S112	0.000	0.03		4.4	OK	
1.012	S113	0.000	0.06		6.9	OK	
7.000	S701	0.000	0.00		0.0	SURCHARGED	
7.001	S702	0.000	0.01		1.0	SURCHARGED	
7.002	S703	0.000	0.01		0.7	SURCHARGED	
7.003	S704	0.000	0.01		0.5	OK	
1.013	S114	0.000	0.05		5.2	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
 Number of Online Controls 6 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.300 Cv (Summer) 0.840
 Region England and Wales Ratio R 0.363 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960,
 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S101	15 Summer	30	+40%					97.340	-0.065
2.000	S201	15 Summer	30	+40%	30/15 Summer				95.422	0.447
1.001	S102	15 Summer	30	+40%	30/15 Summer				95.063	0.230
3.000	S301	600 Winter	30	+40%	1/360 Summer				94.558	0.558
1.002	S103	600 Winter	30	+40%	1/60 Summer				94.558	0.653
4.000	S401	15 Summer	30	+40%	30/15 Summer				94.752	0.027
4.001	S402	360 Summer	30	+40%	30/30 Summer				94.718	0.128
1.003	S104	15 Summer	30	+40%	100/15 Summer				93.592	-0.058
5.000	S501	15 Summer	30	+40%	100/15 Summer				95.838	-0.060
5.001	S502	15 Summer	30	+40%	30/15 Summer				94.317	0.957
5.002	S503	15 Summer	30	+40%	30/15 Summer				94.022	0.778
1.004	S105	15 Summer	30	+40%	30/15 Summer				93.604	0.491
1.005	S106	15 Summer	30	+40%	30/15 Summer				93.470	0.820
6.000	S601	15 Summer	30	+40%					94.257	-0.090
6.001	S602	15 Summer	30	+40%	30/15 Summer				93.461	0.363
1.006	S107	15 Summer	30	+40%	30/15 Summer				93.325	0.825
1.007	S108	15 Summer	30	+40%	30/15 Summer				92.587	0.500
1.008	S109	15 Summer	30	+40%	30/15 Summer				92.055	0.157
1.009	S110	15 Summer	30	+40%	100/15 Summer				91.022	-0.086
1.010	S111	960 Summer	30	+40%	1/15 Summer		1/15 Summer	114	90.447	0.620
1.011	S112	15 Summer	30	+40%					87.682	-0.190
1.012	S113	15 Summer	30	+40%	100/1440 Summer				85.074	-0.168
7.000	S701	960 Summer	30	+40%	1/2880 Winter				90.441	0.521
7.001	S702	960 Summer	30	+40%	1/15 Summer				90.441	1.741
7.002	S703	4320 Summer	30	+40%	1/480 Summer				87.908	1.733
7.003	S704	30 Summer	30	+40%	100/600 Winter				84.437	-0.203
1.013	S114	30 Summer	30	+40%	100/480 Summer				84.437	-0.056

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

PN	US/MH Name	Flooded		Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
		Volume (m³)	Flow			Flow (l/s)		
1.000	S101	0.000	0.60			31.0	OK	
2.000	S201	0.000	1.59			58.3	SURCHARGED	
1.001	S102	0.000	1.11			106.5	SURCHARGED	
3.000	S301	0.000	0.00			0.0	SURCHARGED	
1.002	S103	0.000	0.03			1.3	SURCHARGED	
4.000	S401	0.000	1.25			43.3	FLOOD RISK	
4.001	S402	0.000	0.02			1.0	FLOOD RISK	
1.003	S104	0.000	0.05			8.7	OK	
5.000	S501	0.000	0.67			34.8	OK	
5.001	S502	0.000	1.67			60.1	SURCHARGED	
5.002	S503	0.000	1.79			64.9	SURCHARGED	
1.004	S105	0.000	0.60			86.3	SURCHARGED	
1.005	S106	0.000	1.05			100.2	SURCHARGED	
6.000	S601	0.000	0.33			12.9	OK	
6.001	S602	0.000	0.60			24.6	SURCHARGED	
1.006	S107	0.000	1.34			142.1	SURCHARGED	
1.007	S108	0.000	1.63			178.0	SURCHARGED	
1.008	S109	0.000	1.09			186.5	SURCHARGED	
1.009	S110	0.000	0.83			207.9	OK	
1.010	S111	0.000	0.05	28.1		2.7	SURCHARGED	
1.011	S112	0.000	0.06			9.7	OK	
1.012	S113	0.000	0.15			17.8	OK	
7.000	S701	0.000	0.00			0.0	SURCHARGED	
7.001	S702	0.000	0.09			15.8	SURCHARGED	
7.002	S703	0.000	0.02			3.3	SURCHARGED	
7.003	S704	0.000	0.01			0.7	OK	
1.013	S114	0.000	0.09			8.8	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 6 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.300 Cv (Summer) 0.840
Region England and Wales Ratio R 0.363 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960,
1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S101	15 Summer	100	+40%					97.356	-0.049
2.000	S201	15 Summer	100	+40%	30/15 Summer				96.259	1.284
1.001	S102	15 Summer	100	+40%	30/15 Summer				95.715	0.882
3.000	S301	720 Winter	100	+40%	1/360 Summer				94.851	0.851
1.002	S103	720 Winter	100	+40%	1/60 Summer				94.851	0.946
4.000	S401	360 Winter	100	+40%	30/15 Summer				94.830	0.105
4.001	S402	360 Winter	100	+40%	30/30 Summer				94.829	0.239
1.003	S104	15 Summer	100	+40%	100/15 Summer				94.368	0.718
5.000	S501	15 Summer	100	+40%	100/15 Summer				96.313	0.415
5.001	S502	15 Summer	100	+40%	30/15 Summer				95.202	1.842
5.002	S503	15 Summer	100	+40%	30/15 Summer				94.854	1.610
1.004	S105	15 Summer	100	+40%	30/15 Summer				94.372	1.259
1.005	S106	15 Summer	100	+40%	30/15 Summer				94.214	1.564
6.000	S601	15 Summer	100	+40%					94.321	-0.026
6.001	S602	15 Summer	100	+40%	30/15 Summer				94.207	1.109
1.006	S107	15 Summer	100	+40%	30/15 Summer				94.040	1.540
1.007	S108	15 Summer	100	+40%	30/15 Summer				93.121	1.034
1.008	S109	15 Summer	100	+40%	30/15 Summer				92.442	0.544
1.009	S110	15 Summer	100	+40%	100/15 Summer				91.208	0.100
1.010	S111	240 Summer	100	+40%	1/15 Summer		1/15 Summer	114	90.487	0.660
1.011	S112	15 Summer	100	+40%					87.686	-0.186
1.012	S113	2160 Summer	100	+40%	100/1440 Summer				85.461	0.219
7.000	S701	240 Summer	100	+40%	1/2880 Winter				90.470	0.550
7.001	S702	240 Summer	100	+40%	1/15 Summer				90.470	1.770
7.002	S703	1440 Summer	100	+40%	1/480 Summer				87.924	1.749
7.003	S704	2160 Summer	100	+40%	100/600 Winter				85.462	0.822
1.013	S114	2160 Summer	100	+40%	100/480 Summer				85.457	0.964

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

PN	US/MH Name	Flooded		Overflow (l/s)	Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap.		Flow (l/s)		
1.000	S101	0.000	0.78	105.1	40.1	OK	
2.000	S201	0.000	1.97		72.1	SURCHARGED	
1.001	S102	0.000	1.36		130.5	SURCHARGED	
3.000	S301	0.000	0.00		0.0	SURCHARGED	
1.002	S103	0.000	0.03		1.5	SURCHARGED	
4.000	S401	0.000	0.22		7.6	FLOOD RISK	
4.001	S402	0.000	0.02		1.0	FLOOD RISK	
1.003	S104	0.000	0.11		20.1	SURCHARGED	
5.000	S501	0.000	0.78		40.8	SURCHARGED	
5.001	S502	0.000	1.84		66.3	FLOOD RISK	
5.002	S503	0.000	1.95		70.8	FLOOD RISK	
1.004	S105	0.000	0.67		96.2	FLOOD RISK	
1.005	S106	0.000	1.16		110.8	FLOOD RISK	
6.000	S601	0.000	0.43		16.6	OK	
6.001	S602	0.000	0.64		26.1	FLOOD RISK	
1.006	S107	0.000	1.53		162.5	FLOOD RISK	
1.007	S108	0.000	1.86		202.2	SURCHARGED	
1.008	S109	0.000	1.24		213.4	SURCHARGED	
1.009	S110	0.000	0.96		241.8	SURCHARGED	
1.010	S111	0.000	0.05		2.8	SURCHARGED	
1.011	S112	0.000	0.07	11.7	OK		
1.012	S113	0.000	0.03	3.7	SURCHARGED		
7.000	S701	0.000	0.00	0.0	SURCHARGED		
7.001	S702	0.000	0.26	46.7	SURCHARGED		
7.002	S703	0.000	0.09	12.9	SURCHARGED		
7.003	S704	0.000	0.18	11.9	SURCHARGED		
1.013	S114	0.000	0.10	10.0	SURCHARGED		

Appendix D Wessex Water Correspondence

Jacob De La Croix

From: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Sent: 23 October 2018 15:53
To: Chris Yalden
Subject: RE: SW CAP RESP WW/ST85SE/ 461 : Westbury Hospital surface water Drainage Options

Hello Chris,

Many thanks for your email. As requested I can confirm the maximum allowable discharge we can accept from the site will be up to 10 l/s .

Although I am apprehensive to agree the above flow rate. We understand significant betterment has been provided as well as a separation of SW flows to the foul.

I hope the above response answers your enquiry for now.

Kind regards

Teddy Amuah

From: Chris Yalden <Chris.Yalden@awpexeter.com>
Sent: 18 October 2018 14:48
To: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Subject: RE: SW CAP RESP WW/ST85SE/ 461 : Westbury Hospital surface water Drainage Options

Teddy,

In the first instance we liaised with Wiltshire CC to establish whether we could discharge to the existing highway network, however they advised this would be subject to a full network condition survey and design model to verify capacities. Their drainage engineer suggested that the network is known to be under capacity so the likelihood is the model will conclude we are unable to form a new connection – making it a meaningless task!

Connection to the foul sewer is the only viable option. Whilst 5 l/s has been agreed, the volumes required to achieve this are vast. We are simply hoping for a slight increase in flow to cater for greater return period storms (those which have a much lower probability of occurrence).

Regards,

Chris Yalden
Associate
MICE, IEng



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AWP is a regional engineering consultancy providing development planning and infrastructure services to developers and house builders across the south west.

From: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Sent: 18 October 2018 14:38
To: Chris Yalden <Chris.Yalden@awpexeter.com>
Subject: RE: SW CAP RESP WW/ST85SE/ 461 : Westbury Hospital surface water Drainage Options

Hello Chris,

Many thanks for this. I am briefly going to double check with our development engineer. However, the concern initially raised was discharging the flows to the highways drains to SW after redevelopment. Can you please provide the drainage connectivity survey as previously advised ?

Kind regards

Teddy Amuah

From: Chris Yalden <Chris.Yalden@awpexeter.com>
Sent: 18 October 2018 14:32
To: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Subject: RE: SW CAP RESP WW/ST85SE/ 461 : Westbury Hospital surface water Drainage Options

Hi Teddy,

See my comments below in red.

Regards,

Chris Yalden
Associate
MICE, IEng



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From: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Sent: 18 October 2018 13:39
To: Chris Yalden <Chris.Yalden@awpexeter.com>
Subject: SW CAP RESP WW/ST85SE/ 461 : Westbury Hospital surface water Drainage Options

Hello Chris,

Many thanks for the below. As requested. Can you please review the comments below and advise further.

SW disposal

The initial survey undertaken at the planning stage identified that runoff from existing hardstanding areas drained to the public foul network beneath 'The Butts'. Roof areas were found to discharge to a land drainage system that connects to the highway network.

- We acknowledge some previous SW connections to our assets and some highways network. Please note WW will only review previous flows to our network and as such your proposed flows need to reflect a betterment on only the connections to the public foul network.
- A minimum betterment of 30 % is also required over ONLY the flows to the foul which we believe will be significantly lower than proposed.

We appointed On-Spot Surveys Ltd to complete an impermeable area and drainage connectivity survey. The output of this exercise can be found attached. The zone identified measures 0.6 ha, with 0.5ha of impermeable area draining to a 150mm diameter drain, which in turn discharges to the public foul network. We have assessed the QBar flow (c.2 year storm; 50% annual probability) from the existing catchment and established that this would run full bore through the 150mm pipe, at a maximum flow of 49 l/s. Based on your email comments, this would utilise any free capacity within your receiving network before surcharging upstream and flooding out of the nearest manhole, gully etc.

Our proposal intends to exceed the minimum 30% betterment. We are proposing 70% betterment in peak flow with a future peak discharge of 15 l/s. This discharge would be set for the 100 year return period (1% annual probability), with 40% allowance for climate change. All lower return period storms, without the effects of climate change, will discharge at lower rates (to a minimum of 5 l/s).

We are now progressing detailed design and a more detailed drainage survey has confirmed that the site connection is a 150mm diameter and on this basis, with a gradient of 1 in 10, the existing peak flow would be 49 l/s. The pipe would run full bore on a regular basis given connectivity of c.0.6ha catchment.

- WW do not believe the above flow rate discharged from the site into the receiving 150 mm foul sewers in the Butts.
- The aforementioned private 150 mm dia (with maximum capacity – 49 l/s) subsequently connects into our 150 mm dia which already serves 27 connections with a maximum capacity of about 29 l/s on average.
- Previous flows from the site cannot be based solely on pipe gradients and size of the area of development. This should only serve as the bases for subsequent surveys (IAS) which confirm exactly which parts drained into the receiving foul sewer.

As above, this survey has been completed.

Regular rainfall events will not deliver 49 l/s. Statistically, this storm would only occur once every 2 years.

You previously advised that we could utilise a discharge of 5 l/s. However based on the findings of our latest investigation and the mandatory 30% betterment, we believe a discharge should be agreeable up to 34 l/s. That said, we fully acknowledge that 34 l/s is excessive and on this basis we were hopeful that you might agree an allowable peak rate of 15 l/s, which is equivalent to an 70% betterment on existing arrangements.

- We acknowledge the provision of a much greater betterment / attenuation. However, WW will advise to review the above and advise further.

We would like to understand whether you can agree any increase over 5 l/s, given the attenuation requirements are proving to be considerable (c.1,500m³). Ideally we were hoping to agree 15 l/s however any increase on the 5 l/s will be of great use to increase the viability of the scheme.

I hope the above answers your email for now. Please review and get back to me with any additional info and I'll review and advise ASAP.

Kind regards

Teddy Amuah

From: Chris Yalden
Sent: 26 September 2018 16:20
To: 'Teddy Takyi-Amuah' <Teddy.Takyi-Amuah@wessexwater.co.uk>
Cc: Adam Avery <Adam.Avery@wessexwater.co.uk>
Subject: RE: SW CAP RESP : Westbury Hospital surface water Drainage Options

Hi Teddy,

Cast your mind back to last year and you may recall the below email conversation regarding discharge of surface water runoff from the former Westbury Hospital site.

The initial survey undertaken at the planning stage identified that runoff from existing hardstanding areas drained to the public foul network beneath 'The Butts'. Roof areas were found to discharge to a land drainage system that connects to the highway network.

We are now progressing detailed design and a more detailed drainage survey has confirmed that the site connection is a 150mm diameter and on this basis, with a gradient of 1 in 10, the existing peak flow would be 49 l/s. The pipe would run full bore on a regular basis given connectivity of c.0.6ha catchment.

You previously advised that we could utilise a discharge of 5 l/s. However based on the findings of our latest investigation and the mandatory 30% betterment, we believe a discharge should be agreeable up to 34 l/s. That said, we fully acknowledge that 34 l/s is excessive and on this basis we were hopeful that you might agree an allowable peak rate of 15 l/s, which is equivalent to an 70% betterment on existing arrangements.

Could you please advise.

Many thanks,

Chris Yalden
Associate
MICE, IEng



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Mobile: 07843 107790
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web: www.awpexeter.com

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From: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Sent: 21 December 2017 08:19
To: Chris Yalden <Chris.Yalden@awpexeter.com>
Cc: Adam Avery <Adam.Avery@wessexwater.co.uk>
Subject: SW CAP RESP : Westbury Hospital surface water Drainage Options

Good Morning Chris et al,

Many thanks for your email. As requested, We have reviewed your proposal to discharge SW and can provide the comments below for your attention.

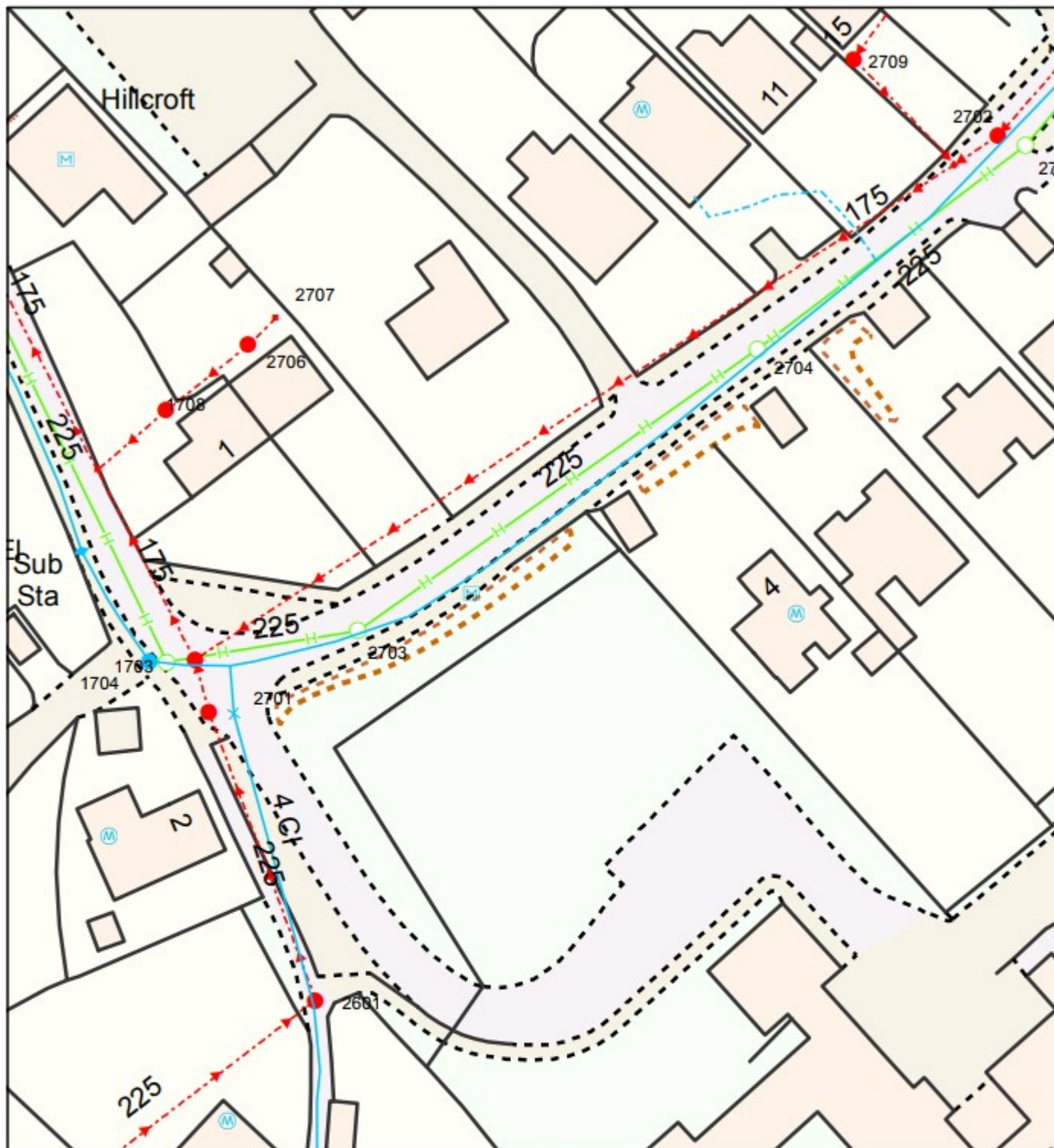
SW Disposal

Your drainage survey , this appraisal and our billing records confirms that no more than approximately 7 l/s of SW drained into the receiving FWS (13 .2 l/s if all the site drained to the sewers) .

Based on the above and Adam's initial correspondence. WW can advise that will accept a maximum discharge of 5 l/s into the receiving sewers if previous connections are being proposed to be used.

Please note as previously advised that capacity is very limited within the catchment and downstream public foul sewers . The above rate has been considered based on available capacity, a betterment of 30 % coupled with any proposed foul flows.

Any connections for SW are subject to agreement with Wessex Water on confirmation of a POC & flow rates with agreed flood risk measures approved and confirmed by the Lead Local Flood Authority.



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WATER MAINS		SEWERS	PUBLIC	PRIVATE	SECTION 104	OTHER WESSEX PIPES	NON-WESSEX / UN
	Distribution Main						
	Washout Main						
	Raw Water Main						
	Abandoned Main						
	Private Main						
SITES		STRUCTURES		OTHER STRUCTURES		OTHER STRUCTURES	
	Source		Manhole - Foul		Pumping Station - Surface		Attenuation Tank
	Reservoir		Manhole - Surface		Pumping Stn - Foul/Combined		Storage Tank
	Pump		Manhole - Combined		Gully		Cham
	Treatment Works		Outfall		Vent Column		Tunne
FITTINGS			Inlet		Rodding Eye		Inter
	Valve - Open		Lamphole		Catchpit		
	Valve - Closed		Bifurcation - Foul		Flushing Chamber		
			Bifurcation - Surface		Soakaway		
			Bifurcation - Combined		Non Return Valve		
			Combined Sewage Overflow		Washout		
					Air Valve		
					Hatch Box		

Colours generally indicate the use of the sewer/drain (i.e. Red - Foul, Dark Blue - Surface, Magenta - Combined/Dual Use, Light Green - Highway Drain, Mid Green - Overflow) styles of line are shown on the key in sample/typical

Information in this plan is provided for identification purposes only. No warranty as to accuracy is given or implied. The precise route of pipe work may not exactly match that shown. Wessex Water does not accept liability for inaccuracies. Sewers and lateral drains adopted by



Appendix E Drainage Maintenance Plan

Westbury Hospital, Wiltshire

Backhouse Housing Limited

Drainage Maintenance Plan



1 Overview of Maintenance required for Sustainable Drainage Systems (SuDS)

- 1.1 It is important to ensure that thought is given to the long-term maintenance of SuDS features during the feasibility and planning stages. By ensuring SuDS features are correctly monitored and maintained throughout their lifetime, the amount of deterioration in performance that could occur over time is prevented or limited. This ensures that the feature will continue to work at full capacity as required in the design.
- 1.2 The type of required maintenance is determined by many factors, including;
 - Type of SuDS scheme
 - The size of the contributing catchment relating to each SuDS component
 - Land-use associated with contributing catchment
 - Level of construction ongoing within the contributing catchment
 - Planting types
 - Habitat types that have been created
 - Amenity and visual requirements of the area
- 1.3 Maintenance regimes should be regularly assessed to make sure that the approach is still meeting the drainage, landscape and any other objectives.
- 1.4 In accordance with CIRIA C753 – ‘The SuDS Manual’, maintenance can be split into three main categories; Regular maintenance (including inspections and monitoring), Occasional maintenance and Remedial maintenance.
- 1.5 Regular maintenance covers basic tasks which are carried out on a predictable and frequent schedule. Such activities include inspections, vegetation management and litter/debris removal.
- 1.6 Occasional maintenance includes tasks which are likely to be required infrequently and cannot be predicted as easily as regular maintenance tasks. This covers tasks such as sediment removal.
- 1.7 Remedial maintenance covers tasks which are required to resolve faults within the system found during regular inspections. Although in good design the requirement of this type of maintenance is limited, faults still occur. These faults and the corresponding maintenance actions required are generally site specific and difficult to predict.
- 1.8 Detailed information for the maintenance required for the SuDS features applicable to this project can be found in the following sections of this document.

2 Adopted Drainage

- 2.1 The adopted site drainage will be designed and installed in accordance with the local Water Authority and Highway Authority guidelines and specifications.
- 2.2 The local Water Authority adopts the drainage infrastructure under Section 104 of the Water Industry Act and the local Highway Authority adopts the drainage infrastructure under Section 38 of the Highways Act.
- 2.3 Once adopted, the local Water Authority and Highway Authority maintain the drainage infrastructure in line with their own maintenance regimes.

3 Private Drainage

- 3.1 The private drainage will be designed and installed in accordance with Part H of the Building Regulations. Once the drainage is approved by Building Control it is maintained by the respective property owner(s) or appointed Management Company.
- 3.2 This private drainage would be maintained using the following regime;

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required take remedial action.	Monthly for 3 months, then six monthly
	Remove debris from gullies, manholes, headwalls and flow controls.	Every 6 months
	Remove debris from catchpits upstream of private attenuation/soakaways.	Every 6 months
	Inspect gullies, manholes, headwalls, flow controls, attenuation and soakaways.	Annually
	Jetting of pipes.	Every 5 years
	Internal inspection of pipes (CCTV).	Every 10 years
Occasional	Repair/rehabilitate gullies, pipes, manholes, headwalls and flow controls.	As required

Maintenance	Repair/rehabilitate private attenuation/soakaways.	As required
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4 Geocellular/modular crates

4.1 Geocellular crates are modular, high void ratio, systems used to create an underground storage structure.

4.2 Geocellular/modular crated systems are designed in accordance with CIRIA guidelines and should be maintained using the following regime;

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance).	Monthly
	Where rainfall infiltrates into blocks from above, check surface or filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms)
	Remove sediment from pre-treatment structures.	Annually, or as required
Remedial Actions	Repair/ rehabilitation of inlets, outlet, overflows and vents.	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually and after large storms

5 Swales

5.1 Swales are used to convey surface water drainage or intercept overland run-off from both urban and rural catchments.

5.2 Swales are designed in accordance with CIRIA guidelines and should be maintained using the following regime;

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Litter and debris removal.	Monthly, or as required
	Grass cutting – to retain specified design height.	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect infiltration surfaces for ponding, compaction and silt accumulation. Record areas where water is ponding for > 48 hours.	Monthly or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 year, then half yearly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly
Occasional Maintenance	Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, if required.	Annually, or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeded.	As required
	Re-level uneven surfaces and reinstate design levels.	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil	As required

Maintenance Schedule	Required Action	Recommended Frequency
	surface.	
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required
	Remove and dispose of oils or petrol residues using safe, standard practices.	As required

6 Rain Gardens

- 6.1 Areas of shallowed landscape depressions which are typically underdrained and rely on engineered soils and enhanced vegetation and filtration to reduce runoff downstream.
- 6.2 Bioretention areas are designed in accordance with CIRIA guidelines and should be maintained using the following regime;

Maintenance Schedule	Required Action	Recommended Frequency
Regular Inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockages	Quarterly
Regular Maintenance	Litter and debris removal.	Quarterly (or more frequently for aesthetic reasons)

Maintenance Schedule	Required Action	Recommended Frequency
	Replace any plants, to maintain planting density.	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional Maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial Actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

7 Infiltration Basins

- 7.1 Infiltration basins are designed to store runoff in vegetated depressions and gradually infiltrate it into the ground.
- 7.2 Infiltration basins are designed in accordance with CIRIA guidelines and should be maintained using the following regime;

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Litter, debris and trash removal.	Monthly
	Grass cutting – for landscaped areas and access routes.	Monthly (during growing season), or as required
	Grass cutting- meadow grass in and around basin.	Half yearly (spring before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required)

Maintenance Schedule	Required Action	Recommended Frequency
Occasional Maintenance	Re-seed areas of poor vegetation growth.	Annually, or as required
	Prune and trim trees and remove cuttings.	As required
	Remove sediment from pre-treatment system when 50% full.	As required
Remedial Actions	Repair of erosion or other damage by re-seeding or re-turfing.	As required
	Realignment of rip-rap.	As required
	Repair/rehabilitation of inlets, outlets and overflows.	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates.	As required
	Re-level uneven surfaces and reinstate design levels.	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc. for evidence of physical damage.	Monthly
	Inspect inlets and pre-treatment systems for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly
	Inspect infiltration surfaces for compaction and ponding.	Monthly