AC22260: Willow Way, Sydenham – Surface and Foul Water Drainage Strategy – Technical Note

1. Introduction

ABSTRUCT Consulting were appointed by Kitewood Estates Ltd (Kitewood), the applicant, to undertake a Drainage Strategy to support their planning application (DC/22/129789). This was submitted as report AC22260-ABS-XX-XX-RP-C-5800, along with supporting drawings and calculations.

We have received comments back from the Lead Local Flood Authority (LLFA) on 16th March 2023, a copy of which can be found in Appendix A. The purpose of this document is to respond to the points raised within this document as the LPA did not allow time to respond prior to the determination of the application on 23rd March 2023.

2. Response to Requests for Further Information

The below contains our response to each of the bullet points raised under the section "To address the above, please can the applicant submit information which:"

2.1. Demonstrates that they have considered smaller scale rainwater harvesting features.

The majority of the roof area for the proposed development will be green roofed, and therefore very little rainfall will run-off from the roof, instead being captured at source and absorbed by the planting.

However, there are some areas of roof which do not have the extensive green roof elements we have shown on our drawing within the report. These areas are a communal roof space for the residents and include intensive planting built up using the ZinCo Green Roof system or similar. These are acting as Rain Gardens in these areas and contain a layer to hold back surface water within the build up to irrigate these areas during drier periods of little or no rain.

Therefore further use of the roof water has been considered and is being used, as demonstrated by the additional information contained within Appendix B.

2.2. Confirms whether the proposed surface water discharge is to a watercourse or combined sewer, with consideration given to the statement in page 6 of the Surface Water Drainage Strategy Report.

This is a typo within the report, the surface water will discharge to the Thames Water Combined Sewer as per the drawing contained within the appendix to report AC22260-ABS-XX-XX-RP-C-5800.

2.3. Ensures the proposed runoff rates listed in the report align with those detailed in the calculations.

There is a typo within Table 3 for the 1:30 year proposed Post Development Runoff Rate. The table states 1.9l/s, whilst the calculations show 2.0l/s. However as this rate is still equal to or lower than the practical minimum chosen of 2l/s, and represents only 4.1% of the pre-development flow rate of 48.9l/s (as opposed to the 3.9% stated), this still represents a large reduction that would be suitable for this development.

2.4. Provides the greenfield runoff volume.

The greenfield runoff volume for the 1:100 year event, 6 hour storm is 14m.1m³. Calculations demonstrating this can be found in Appendix C.

2.5. Clearly states the proposed area and attenuation volume for each SuDS feature. Clarifies the site area for the proposed development. Includes the whole site area in the drainage calculations, as infiltration is not being pursued as a method of surface water discharge.

The only SUDS featured modelled within the calculations at present is the attenuation tank. For this purpose we have currently assumed 100% runoff from the roof to ensure that there is sufficient room on site for the attenuation tank in the worst case scenario. More detailed calculations will be produced at Stage 4 to confirm the full design once it has been completed. We would normally expect Surface Water

calculations and final details to be covered by a suitable pre commencement condition as we have demonstrated that surface water can be controlled on site.

There appears to be some confusion as to the site area. Please note that our Drainage Strategy only covers Site A of the multi phase development. Therefore our total site area of 2,239m² is appropriate as this is the area of Site A, as demonstrated on our drawing AC22260-ABS-XX-XX-DR-5101.

We note the requirement to include areas of greenfield within the calculations as we are not including these areas within our calculations currently as they are not directly positively drained. We have therefore updated our offsite flow rates summary sheet to include the remaining 344m² of green space to the final outflow from the site.

These calculations are included within Appendix D and demonstrate that the offsite flow rates are changed to 1.9l/s in the 1:1 year event, 2.1l/s in the 1:30 year event, and 2.2l/s in the 1:100 year event with a 40% allowance for climate change. Very small increase and still far lower than the pre development offsite flow rates. The table below is an updated version of Table 3 within the Drainage Strategy Report demonstrating the amended flow rates.

Return Period	Greenfield Runoff Rate (ls^{-1})	Pre Development Runoff Rate (ls^{-1})	Post Development Runoff Rate including uncontrolled Green Areas (ls^{-1})	% of Pre Development Runoff Rate
1:1 year	0.3	19.9	1.9	9.5%
1:30 year	0.8	48.9	2.1	4.3%
1:100 year	1.2	63.5	2.2	3.5%

Table 3 – Pre / Post Development Offsite Flow Rates

2.6. Demonstrates updates to the drainage calculations (detailing the changes made) to ensure the half-drain times are reduced to less than 24 hours, to ensure that the proposed drainage strategy will remain operational in the case of consecutive storm events. Demonstrates where the exceedance flows are on a drawing.

The calculations have been rerun to ensure that the 24 hour half drain time is correctly calculated. These have been included in Appendix E and demonstrate that the half drain times are all below 24 hours.

Exceedance Flow Arrows have been added to the Drainage Layout AC22260-ABS-XX-XX-DR-C-5100 which can be found in Appendix F.

2.7. Provides the maintenance tasks and strategies for the green roofs.

The green roofs will require the following basic maintenance tasks. A full list will be provided with the O&M Manual at Stage 6, once the final design is completed during Stages 4 and 5.

Drainage Element	Inspection Requirements	Maintenance Requirements	Inspection Schedule
Green Roofs	Visual inspection to check for blockages to any drain channels and outlets, check for erosion within the substrate, check all components for damage, and planting for any dead areas.	Remove debris and litter, replace dead plants, remove weeds (where present), and cut any grass.	Six monthly, and after severe storms.

2.8. States a maintenance owner.

The maintenance owner will be the eventual building maintenance and management company that will be set up by Kitewood during the development to look after the building post construction during use.

2.9. Demonstrates that Thames Water has been consulted regarding the proposed connection to the combined sewer.

We have submitted a Pre Development Enquiry application with Thames Water and have received a request for further information / clarification, which has been responded to. It should be noted though, that as per our report, we have reduced the flow rate to the public sewer significantly over the current pre development situation.

Appendix A – LLFA Comments

Flood Risk Comments

Review Summary

This application is proposing the following key items:

- Type of development: Major
- Flood risk: Low, Flood Zone 1
- Types of conveyance / attenuation features: Green roofs, permeable paving, attenuation tank.
- Runoff rate restriction (l/s): 2 l/s, this is greater than the greenfield rates, however provides significant betterment compared to the existing runoff rates. however within 3x greenfield rates .
- Runoff attenuation volume (m3): 159.6
- Maintenance plan: A maintenance plan has been provided, but with no tasks / frequencies for the green roofs. A maintenance owner has not been provided.

Recommendation and Requests

This application has not sufficiently demonstrated the use of the London Plan's drainage hierarchy. We object to the application for the following reasons:

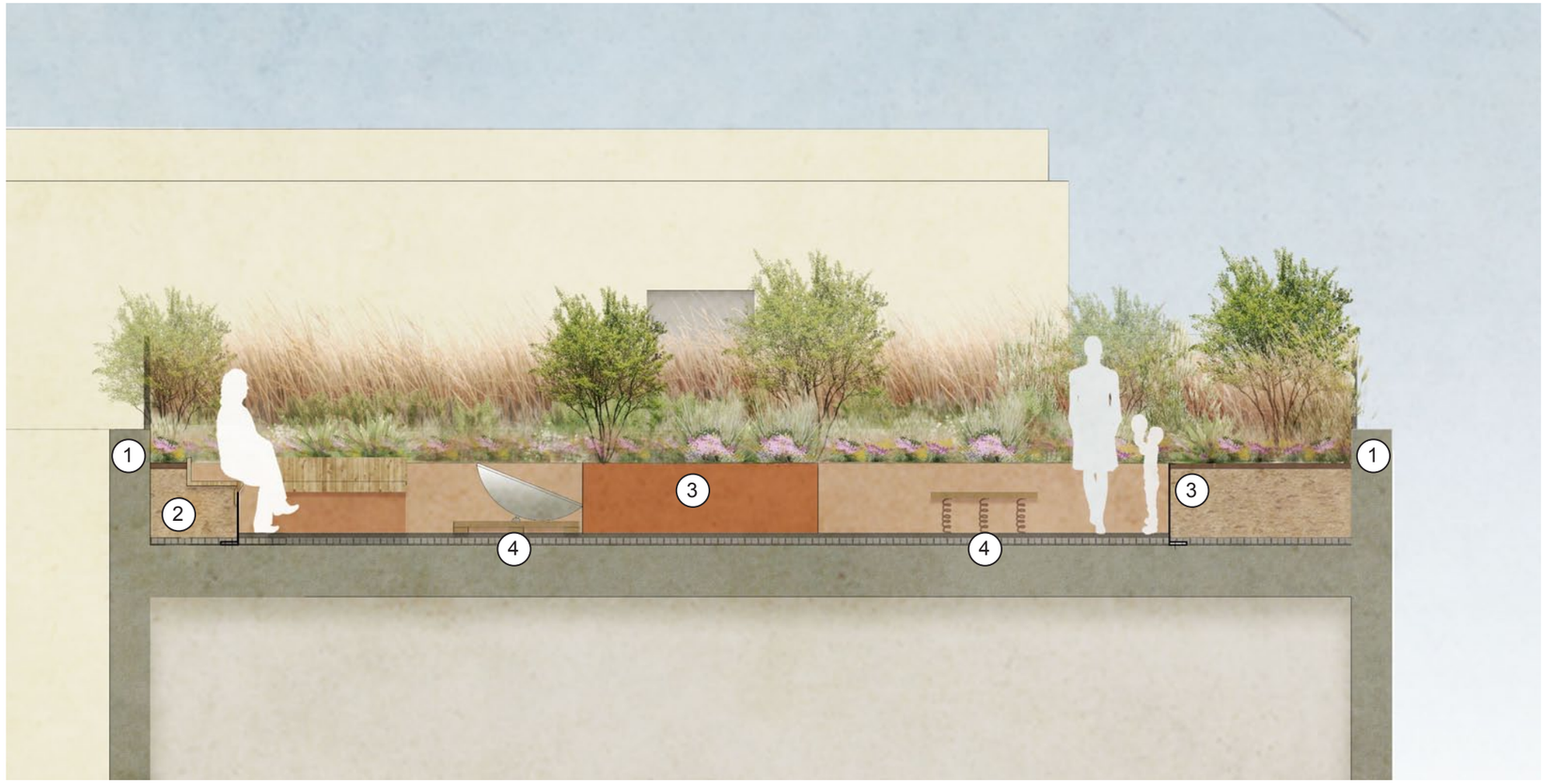
- The applicant has not provided sufficient justification for the non-inclusion of rainwater harvesting techniques. The applicant should consider the use of water butts / raingardens.
- The applicant states on page 6 of the Surface Water Drainage Strategy Report that "Temporary storage will be provided within the attenuation tank to balance the volumes prior to discharge to the watercourse." However, elsewhere within the report, the proposed discharge is noted as being to the Thames Water combined sewer.
- The applicant states a proposed runoff rate of 2.0l/s in the 1 in 30-year storm. However, the calculations provided in Appendix H of the Surface Water Drainage Strategy Report show a discharge rate of 2.0l/s in the 1 in 30-year storm
- The applicant has not provided the greenfield runoff volume.
- The applicant has not clearly stated the proposed area and attenuation volume for each SuDS feature.
- The Surface Water Drainage Strategy Report lists a site area of 2,239m2. However, the application form states an area of 7,251m2.
- The drainage calculations only account for the impermeable area, and not the whole site area.
- The drainage calculations provided state that the "Half Drain Time has not been calculated as the structure is too full". The applicant is required to provide a drawing showing exceedance flows.
- The maintenance strategy does not contain the maintenance tasks and strategies for the green roofs.
- A maintenance owner has not been stated.
- Thames Water has not been consulted regarding the proposed connection to the combined sewer.

To address the above, please can the applicant submit information which:

- Demonstrates that they have considered smaller scale rainwater harvesting features.
- Confirms whether the proposed surface water discharge is to a watercourse or combined sewer, with consideration given to the statement in page 6 of the Surface Water Drainage Strategy Report.
- Ensures the proposed runoff rates listed in the report align with those detailed in the calculations.
- Provides the greenfield runoff volume.
- Clearly states the proposed area and attenuation volume for each SuDS feature. Clarifies the site area for the proposed development. Includes the whole site area in the drainage calculations, as infiltration is not being pursued as a method of surface water discharge.
- Demonstrates updates to the drainage calculations (detailing the changes made) to ensure the half-drain times are reduced to less than 24 hours, to ensure that the proposed drainage strategy will remain operational in the case of consecutive storm events. Demonstrates where the exceedance flows are on a drawing.
- Provides the maintenance tasks and strategies for the green roofs.
- States a maintenance owner.
- Demonstrates that Thames Water has been consulted regarding the proposed connection to the combined sewer.

Appendix B – Intensive Roofing System and Layout

Section BB **Scale 1:50@A3**



KEY

1. Parapet edge with barrier to be 1100mm high above soil level.
2. Proposed steel planters with integral seating.
3. Proposed steel planters
4. Proposed elements of age appropriate play equipment

Section BB shows a typical section through the south roof terrace shared amenity space.

The design intention for this roof terrace space is to provide a visually pleasing space that incorporates elements of play whilst providing an attractive space in which all members of this new development can sit and relax.

This roof terrace space is enclosed by a raised planter. Within the planter edge integral seating elements are accommodated in a number of locations.

Particular attention has been given to the south east boundary. In this location the depth and height of planting will be sufficient so as to obscure views from this level 4 amenity space towards the private rear gardens of the dwellings along Sydenham Park.

Section Location Plan **Scale 1:1000@A3**

System Build-up "Roof Garden"

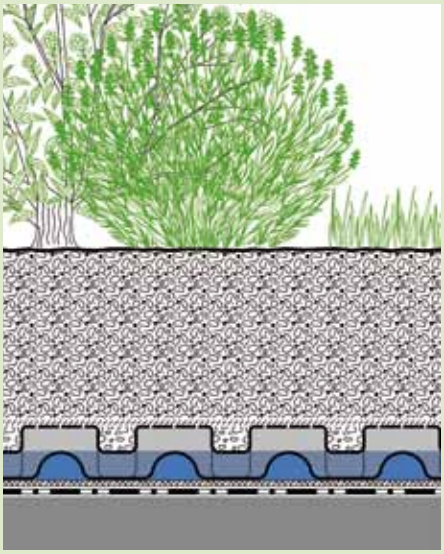
The "Roof Garden" is a multifunctional Green Roof build-up with high water storage. It is suitable for lawns, perennial plants, and with deeper system substrate, for shrubs and trees. The Roof Garden build-up allows a variety of design concepts, even waterfeatures. It is also possible to integrate hard landscapes, such as walkways, terraces, driveways or play areas, etc.

Within the Roof Garden, it is useful to store as much rainwater as possible to reduce the need for additional watering. The spacious channels forming the underside of the Floradrain® FD 60 provide for a 40 mm deep water reservoir underneath the system substrate throughout the roof area. This water reaches the plants by capillary action and diffusion. Water storage can also be easily achieved by installing roof dam elements above the roof outlets. A roof laid at 0° fall is required to include this system, along with a suitable waterproofing membrane for such use. Inspection chambers make it possible to examine and maintain the roof dam elements at any time. With automatic irrigation, a minimum water storage can be maintained even in periods of drought.

System Build-up "Roof Garden"

Features:

- Multifunctional Green Roof System Build-up with high water retention capacity and roof dam irrigation.
- Suitable for lawn and perennials; with a deeper substrate level also for bushes, small trees etc.
- Various combinations are possible, for example with walkways, patios, driveways or playgrounds.
- Floradrain® FD 60 can be filled with concrete as a sub-construction for driveways without penetrating the waterproofing or interrupting the drainage.



Lawn and perennials; with a deeper substrate level, bushes and small trees

System Substrate "Roof Garden"
≥ 200 mm

Filter Sheet SF
Floradrain® FD 60 with Zincolit® Plus infill
Protection Mat ISM 50

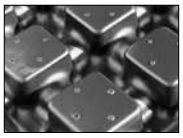
Root Barrier WSB 100-PO,
if waterproofing is not root-resistant

Suitable plants for the System Build-up "Roof Garden" are available at perennial or tree nurseries.

	Unit	Art.-No.	Unit	Art.-No.
System Substrate "Roof Garden"	big bag	616101	bulk	616201

	Art.-No.	Dimensions	Unit	Pallet
Filter Sheet SF	2100	ca. 2.00 m x 100.00 m	200 m^2 -roll	4600 m^2
	2102	ca. 1.00 m x 100.00 m	100 m^2-roll	2500 m^2
	2101	ca. 2.00 m x 10.00 m	20 m^2	

	Unit	Art.-No.	Unit	Art.-No.	Unit	Art.-No.
Zincolit® Plus	big bag	607102	bulk	607202	silo	607302



	Art.-No.	Dimensions	Unit	Pallet
Floradrain® FD 60	3060	ca. 1.00 m x 2.00 m	2 m^2-board	100 boards

	Art.-No.	Dimensions	Unit
Protection Mat ISM 50	2050	ca. 2.00 m x 25.00 m	50 m^2-roll

	Art.-No.	Dimensions	Unit	Pallet
Root Barrier WSB 100-PO	1084	ca. 2.44 m x 30.50 m	74.4 m^2-roll	1116 m^2

Appendix C – Greenfield Runoff Volume

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	20.000
Ratio R	0.441
Areal Reduction Factor	1.00
Area (ha)	0.190
SAAR (mm)	631
CWI	92.580
Urban	0.750
SPR	0.000

Results

Percentage Runoff (%)	12.32
Greenfield Runoff Volume (m^3)	14.084

Appendix D – Offsite Flow Rate Calculations Sheet

abstruct consulting Structural & Civil Engineers	File Name: AC22260-ABS-XX-XX-CA-C-5500	Project: Willow Way, Sydenham	Job No: AC22260
Title: Pre / Post Development Offsite Flows		By: MH	Date: 16/12/2022	Sheet No: 1 of 1

Pre Development Offsite Flows

Rev P02

Impermeable area = 2,239 m²

Micro Drainage Rainfall Profiles

1:1 year, 15 minute storm	32.012	$mmhr^{-1}$
1:30 year, 15 minute storm	78.580	$mmhr^{-1}$
1:100 year, 15 minute storm	102.102	$mmhr^{-1}$
1:100 year, 6 hour storm	10.026	$mmhr^{-1}$

Offsite Flow Rates

1:1 year, 15 minute storm	19.9	ls^{-1}
1:30 year, 15 minute storm	48.9	ls^{-1}
1:100 year, 15 minute storm	63.5	ls^{-1}

Offsite Flow Volume

1:100 year, 6 hour storm	134.7	m³

Greenfield Runoff Rates

IH 124 gives greenfield runoff rates for a 50ha site, guidance for sites smaller than this is to linearly interpolate down to the site size (2,239m² drained area), greenfield rates calculated using Micro Drainage.

	1 year		30 year		100 year	
IH 124 (50ha)	68.6	ls-1	182.9	ls-1	257.4	ls-1
Site Specific (2,239m²)	0.3	ls-1	0.8	ls-1	1.2	ls-1

Post Development Offsite Flows

Micro Drainage Model Results

Impermeable area = 1,895 m²

1:1 year event	1.9	ls^{-1}
1:30 year event	2.0	ls^{-1}
1:100 +40% allowance for c.c.	2.0	ls^{-1}

Remaining Uncontrolled Greenfield Runoff

Impermeable area = 344 m²

			Total Offsite Flow Rates	
1:1 year, 15 minute storm	0.05	ls^{-1}	1.9	ls^{-1}
1:30 year, 15 minute storm	0.13	ls^{-1}	2.1	ls^{-1}
1:100 year, 15 minute storm +40%	0.18	ls^{-1}	2.2	ls^{-1}

Offsite Flow Volume

1:100 year, 6 hour storm +40%	188.6	m³

Appendix E – Updated MicroDrainage Calculations

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.125	4-8	0.064

Total Area Contributing (ha) = 0.190

Total Pipe Volume (m^3) = 5.465

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
S1.000	18.840	0.250	75.4	0.013	5.00	0.0	0.600	o	150	Pipe/Conduit
S2.000	14.214	0.175	81.2	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit
S1.001	12.660	0.200	63.3	0.012	0.00	0.0	0.600	o	150	Pipe/Conduit
S1.002	3.015	0.075	40.2	0.006	0.00	0.0	0.600	o	150	Pipe/Conduit
S3.000	21.424	0.525	40.8	0.022	5.00	0.0	0.600	o	150	Pipe/Conduit
S1.003	16.656	0.200	83.3	0.014	0.00	0.0	0.600	o	225	Pipe/Conduit
S4.000	25.107	0.725	34.6	0.024	5.00	0.0	0.600	o	150	Pipe/Conduit
S1.004	21.200	0.100	212.0	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit
S5.000	24.408	0.500	48.8	0.027	5.00	0.0	0.600	o	150	Pipe/Conduit
S5.001	9.953	0.200	49.8	0.019	0.00	0.0	0.600	o	150	Pipe/Conduit
S1.005	23.606	0.200	118.0	0.021	0.00	0.0	0.600	o	150	Pipe/Conduit
S6.000	34.413	0.450	76.5	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
S1.000	57.900	0.013	0.0	1.16	20.5
S2.000	57.900	0.011	0.0	1.12	19.7
S1.001	57.650	0.035	0.0	1.27	22.4
S1.002	57.450	0.042	0.0	1.59	28.1
S3.000	57.900	0.022	0.0	1.58	27.9
S1.003	57.300	0.078	0.0	1.43	57.0
S4.000	57.900	0.024	0.0	1.72	30.3
S1.004	57.100	0.123	0.0	0.89	35.5
S5.000	57.900	0.027	0.0	1.44	25.5
S5.001	57.400	0.046	0.0	1.43	25.3
S1.005	57.000	0.190	0.0	0.92	16.3
S6.000	57.800	0.000	0.0	1.15	20.3

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
S7.000	7.230	0.150	48.2	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit
S6.001	19.119	0.500	38.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
S6.002	2.121	0.050	42.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
S1.006	7.950	0.100	79.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
S7.000	57.500	0.000	0.0	1.45	25.7
S6.001	57.350	0.000	0.0	1.63	28.9
S6.002	56.850	0.000	0.0	1.55	27.4
S1.006	56.800	0.190	0.0	1.13	19.9

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.013	0.013	0.013
2.000	User	-	100	0.011	0.011	0.011
1.001	User	-	100	0.012	0.012	0.012
1.002	User	-	100	0.006	0.006	0.006
3.000	User	-	100	0.022	0.022	0.022
1.003	User	-	100	0.014	0.014	0.014
4.000	User	-	100	0.024	0.024	0.024
1.004	User	-	100	0.022	0.022	0.022
5.000	User	-	100	0.027	0.027	0.027
5.001	User	-	100	0.019	0.019	0.019
1.005	User	-	100	0.021	0.021	0.021
6.000	-	-	100	0.000	0.000	0.000
7.000	-	-	100	0.000	0.000	0.000
6.001	-	-	100	0.000	0.000	0.000
6.002	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.190	0.190	0.190

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.006	Sewer	58.000	56.700	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.441		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: HB1, DS/PN: S1.005, Volume (m³): 2.7

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	57.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0
Flush-Flo™	0.240	2.0
Kick-Flo®	0.504	1.6
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)
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

Storage Structures for Storm

Cellular Storage Manhole: HB1, DS/PN: S1.005

Invert Level (m) 57.050 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	132.4	0.0	0.751	0.0	0.0
0.750	132.4	0.0			

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.441
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S8	15 Winter	1	+0%	100/15 Summer				57.931
S2.000	RE7.1	15 Winter	1	+0%	100/15 Summer				57.929
S1.001	S7	15 Winter	1	+0%	100/15 Summer				57.699
S1.002	S6	15 Winter	1	+0%	100/15 Summer				57.509
S3.000	RE5.1	15 Winter	1	+0%					57.935
S1.003	S5	15 Winter	1	+0%	100/15 Summer				57.369
S4.000	RE4.1	15 Winter	1	+0%					57.934
S1.004	CP4	15 Winter	1	+0%	30/15 Summer				57.214
S5.000	S3	15 Winter	1	+0%					57.940
S5.001	S2	15 Winter	1	+0%	100/15 Summer				57.454
S1.005	HB1	60 Winter	1	+0%	1/30 Winter				57.163
S6.000	F4	15 Summer	1	+0%					57.800
S7.000	F3	15 Summer	1	+0%					57.500
S6.001	F2	15 Summer	1	+0%					57.350
S6.002	F1	15 Summer	1	+0%					56.850
S1.006	C1	60 Winter	1	+0%					56.833

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S8	-0.119	0.000	0.09			1.8	OK	
S2.000	RE7.1	-0.121	0.000	0.08			1.5	OK	
S1.001	S7	-0.101	0.000	0.23			4.7	OK	
S1.002	S6	-0.091	0.000	0.32			5.6	OK	
S3.000	RE5.1	-0.115	0.000	0.12			3.2	OK	
S1.003	S5	-0.156	0.000	0.20			10.4	OK	
S4.000	RE4.1	-0.116	0.000	0.12			3.4	OK	
S1.004	CP4	-0.111	0.000	0.50			16.3	OK	
S5.000	S3	-0.110	0.000	0.16			3.9	OK	
S5.001	S2	-0.096	0.000	0.27			6.1	OK	
S1.005	HB1	0.013	0.000	0.13		71	1.9	SURCHARGED	
S6.000	F4	-0.150	0.000	0.00			0.0	OK	
S7.000	F3	-0.150	0.000	0.00			0.0	OK	
S6.001	F2	-0.150	0.000	0.00			0.0	OK	
S6.002	F1	-0.150	0.000	0.00			0.0	OK	
S1.006	C1	-0.117	0.000	0.11			1.9	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.441
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S8	15 Winter	30	+0%	100/15 Summer				57.949
S2.000	RE7.1	15 Winter	30	+0%	100/15 Summer				57.946
S1.001	S7	15 Winter	30	+0%	100/15 Summer				57.736
S1.002	S6	15 Winter	30	+0%	100/15 Summer				57.560
S3.000	RE5.1	15 Winter	30	+0%					57.956
S1.003	S5	15 Winter	30	+0%	100/15 Summer				57.451
S4.000	RE4.1	15 Winter	30	+0%					57.955
S1.004	CP4	180 Winter	30	+0%	30/15 Summer				57.404
S5.000	S3	15 Winter	30	+0%					57.966
S5.001	S2	15 Winter	30	+0%	100/15 Summer				57.497
S1.005	HB1	180 Winter	30	+0%	1/30 Winter				57.401
S6.000	F4	15 Summer	30	+0%					57.800
S7.000	F3	15 Summer	30	+0%					57.500
S6.001	F2	15 Summer	30	+0%					57.350
S6.002	F1	15 Summer	30	+0%					56.850
S1.006	C1	960 Summer	30	+0%					56.834

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S8	-0.101	0.000	0.23			4.4	OK	
S2.000	RE7.1	-0.104	0.000	0.21			3.8	OK	
S1.001	S7	-0.064	0.000	0.62			12.6	OK	
S1.002	S6	-0.040	0.000	0.87			14.9	OK	
S3.000	RE5.1	-0.094	0.000	0.30			7.9	OK	
S1.003	S5	-0.074	0.000	0.54			27.3	OK	
S4.000	RE4.1	-0.095	0.000	0.29			8.3	OK	
S1.004	CP4	0.079	0.000	0.29			9.3	SURCHARGED	
S5.000	S3	-0.084	0.000	0.39			9.5	OK	
S5.001	S2	-0.053	0.000	0.74			16.5	OK	
S1.005	HB1	0.251	0.000	0.13		224	2.0	SURCHARGED	
S6.000	F4	-0.150	0.000	0.00			0.0	OK	
S7.000	F3	-0.150	0.000	0.00			0.0	OK	
S6.001	F2	-0.150	0.000	0.00			0.0	OK	
S6.002	F1	-0.150	0.000	0.00			0.0	OK	
S1.006	C1	-0.116	0.000	0.11			2.0	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.441
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S8	15 Winter	100	+40%	100/15 Summer				58.222
S2.000	RE7.1	15 Winter	100	+40%	100/15 Summer				58.213
S1.001	S7	15 Winter	100	+40%	100/15 Summer				58.189
S1.002	S6	15 Winter	100	+40%	100/15 Summer				58.001
S3.000	RE5.1	15 Winter	100	+40%					57.992
S1.003	S5	15 Winter	100	+40%	100/15 Summer				57.866
S4.000	RE4.1	15 Winter	100	+40%					57.978
S1.004	CP4	240 Winter	100	+40%	30/15 Summer				57.796
S5.000	S3	15 Winter	100	+40%					57.995
S5.001	S2	240 Winter	100	+40%	100/15 Summer				57.794
S1.005	HB1	240 Winter	100	+40%	1/30 Winter				57.793
S6.000	F4	15 Summer	100	+40%					57.800
S7.000	F3	15 Summer	100	+40%					57.500
S6.001	F2	15 Summer	100	+40%					57.350
S6.002	F1	15 Summer	100	+40%					56.850
S1.006	C1	240 Winter	100	+40%					56.834

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S8	0.172	0.000	0.38			7.3	FLOOD RISK	
S2.000	RE7.1	0.163	0.000	0.35			6.3	FLOOD RISK	
S1.001	S7	0.389	0.000	0.94			19.2	SURCHARGED	
S1.002	S6	0.401	0.000	1.30			22.4	SURCHARGED	
S3.000	RE5.1	-0.058	0.000	0.55			14.4	OK	
S1.003	S5	0.341	0.000	0.83			42.1	SURCHARGED	
S4.000	RE4.1	-0.072	0.000	0.52			15.1	OK	
S1.004	CP4	0.471	0.000	0.41			13.3	SURCHARGED	
S5.000	S3	-0.055	0.000	0.71			17.3	OK	
S5.001	S2	0.244	0.000	0.23			5.3	SURCHARGED	
S1.005	HB1	0.643	0.000	0.13		473	2.0	SURCHARGED	
S6.000	F4	-0.150	0.000	0.00			0.0	OK	
S7.000	F3	-0.150	0.000	0.00			0.0	OK	
S6.001	F2	-0.150	0.000	0.00			0.0	OK	
S6.002	F1	-0.150	0.000	0.00			0.0	OK	
S1.006	C1	-0.116	0.000	0.12			2.0	OK	

Appendix F – Drainage Layout

KEY:

PRIVATE DRAINAGE

ALL BELOW GROUND PIPEWORK TO BE 100Ø UNLESS NOTED OTHERWISE

150Ø, 1:80 — -SURFACE WATER DRAIN.
— — -SURFACE WATER CHAMBER.
S1 — -SURFACE WATER CATCHPIT CHAMBER.
RE — -RODDING EYE.
CP1 HB — -HYDRO-BRAKE FLOW CONTROL MANHOLE.
-PERMEABLE PAVING (TANKED).
-BELOW GROUND GEOLIGHT SURFACE WATER ATTENUATION STORAGE SYSTEM BY SDS (TEL: 01934 751 303).
RAT — -REVERSE ACTION INTERCEPTOR REF. RI ?/? BY HEPWORTH OR EQUIVALENT.
150Ø, 1:80 — -FOUL WATER DRAIN.
F1 — -FOUL WATER CHAMBER.
150Ø, 1:80 — -COMBINED DRAIN.
C1 — -COMBINED CHAMBER.

EXISTING DRAINAGE

305Ø — -COMBINED DRAIN TO REMAIN.
Ex. — -COMBINED DRAIN CHAMBER.

GENERAL

-EXISTING LEVEL.
× (50.00) -EXISTING LEVEL INTERPOLATED.
× 50.00 -PROPOSED LEVEL.
1:50 -PROPOSED FALL.
-PROPOSED VALLEY / RIDGE LINE.
-EXCEEDANCE FLOOD ROUTING.

0m 2 4 6 8 10m 12 14 16 18 20m
1:200 SCALE

CHAMBER HB1 FITTED WITH HYDRO-BRAKE FLOW CONTROL.
DESIGN HEAD = 0.80m
DESIGN FLOW = 2l/s
MODEL: MD-SHE-0066-2000-1050-2000

THE USE OF ANY OTHER FLOW CONTROL WILL INVALIDATE ANY DESIGN BASED ON THIS DATA AND COULD CONSTITUTE A FLOOD RISK. IF ALTERNATIVE PRODUCT IS PROPOSED THEN ABSTRUCT CONSULTING TO BE ADVISED PRIOR TO START OF CONSTRUCTION SO THAT PROPOSED DESIGN CHANGE CAN BE REVIEWED AND VALIDATED.

BELOW GROUND GEOLIGHT SURFACE WATER ATTENUATION SYSTEM
18m LONG x 8m WIDE x 0.75m EFFECTIVE DEPTH
(94.33m³ OF STORAGE VOLUME)

ATTENUATION TANK FORMED USING SDS GEOLIGHT UNITS, FULLY TANKED AND CROSS VENTED AND INSTALLED FULLY IN ACCORDANCE WITH SDS RECOMMENDATIONS AND SPECIFICATIONS.
SDS TEL: 01934 751 303

HARD PAVED AREAS FALL TOWARDS TANKED PERMEABLE PAVED PARKING BAYS.

PAVING TO DISCHARGE TO SURFACE WATER DRAINAGE SYSTEM.

SOLID HATCHED AREA IS POTENTIAL FUTURE PARKING THAT WILL NOT BE INSTALLED AT FIRST.

PARKING BAYS WILL BE PERMEABLE TO MATCH THOSE SHOWN, IMPERMEABLE AREA IS INCLUDED WITHIN THE CALCULATIONS FOR THE ATTENUATION TANK SO REMEDIAL WORKS WILL NOT BE REQUIRED TO THE TANK TO ACCOMMODATE THE ADDITIONAL HARD PAVED AREA.

HB1 CL 58.50 IL 57.00
CP4 CL 58.50 IL 57.10
S2 CL 58.50 IL 57.40
F3 CL 58.50 IL 57.80
F2 CL 58.50 IL 57.35
F1 CL 58.50 IL 56.85
F4 CL 58.50 IL 57.80
S5 CL 58.50 IL 57.30
S6 CL 58.50 IL 57.45
S7 CL 58.50 IL 57.60
S8 CL 58.50 IL 57.90
S3 CL 58.50 IL 57.90
C2 CL 58.50 IL 56.80
C1 CL 58.79 IL 56.70
Ex. 0101 CL 58.52 IL 56.79

225Ø, 1:215
150Ø, 1:80
150Ø, 1:50
150Ø, 1:40
150Ø, 1:25
150Ø, 1:29
150Ø, 1:120
150Ø, 1:35
150Ø, 1:100
150Ø
305Ø

AMENITY
PLANT
SUB-STATION
RAT
RE4.1
RE5.1
RE7.1

Unit 1
Commercial
300m²

Unit 2
Commercial

Unit 3
Commercial
195m²

INTERNAL FOUL WATER CHAMBERS LIKELY REQUIRED. LOCATIONS AND NUMBERS TO BE CONFIRMED DURING STAGE 4 DESIGN.

THAMES WATER SEWER SHOWN ON SEWER RECORDS. SEWER TO BE INVESTIGATED TO ENSURE IT ONLY TAKES FLOWS FROM THE DEVELOPMENT SITE.

IF NO OTHER FLOWS FOUND THEN SEWER TO BE DIVESTED AND REMOVED.

THAMES WATER PUBLIC SEWER LOCATED WITHIN FOOTWAY. NEW DEVELOPMENT WILL REQUIRE BUILD OVER / NEAR AGREEMENT WITH THAMES WATER.

NEW CONNECTION TO THE THAMES WATER COMBINED SEWER.

CONNECTION WILL REQUIRE A S106 AGREEMENT WITH THAMES WATER.

Ex. 011C
Ex. 011B
WILLOW WAY
LOADING BAY
RESERVED

NOTES

1. DO NOT SCALE THIS DRAWING.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEER'S AND ARCHITECT'S DRAWINGS AND SPECIFICATIONS.
3. PUBLIC SEWER INFORMATION, AND STATUTORY SERVICE INFORMATION IF SHOWN IS BASED ON INFORMATION PROVIDED BY OR INTERPOLATED FROM PUBLIC SEWER AUTHORITY AND SERVICE PROVIDERS RECORDS. ALL INFORMATION RELATING TO SEWERS AND SERVICES TO BE VERIFIED ON SITE BY CONTRACTOR AND ENGINEER INFORMED IF INFORMATION DIFFERS FROM THAT SHOWN.
4. INVERT LEVELS OF EXISTING DRAINAGE AT PROPOSED OUTFALL TO BE VERIFIED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION OF ANY DRAINAGE AND FINDINGS REPORTED TO ENGINEER FOR REVIEW AND ACTION IF REQUIRED.
5. ALL WORK TO PUBLIC SEWER NETWORK, INCLUDING MATERIALS, CONNECTIONS TO EXISTING MANHOLES, NEW MANHOLES AND ARRANGEMENT OF PIPE JUNCTIONS WITHIN MANHOLES TO BE FULLY IN ACCORDANCE WITH CURRENT EDITION OF SEWERS FOR ADOPTION AND SEWER UNDERTAKERS REQUIREMENTS UNLESS NOTED OTHERWISE.

NON AMENTIY SECTIONS OF ROOF TO HAVE EXTENSIVE (SEEDUM OF SIMILAR) GREEN ROOF COVERING.

NON AMENTIY SECTIONS OF ROOF TO HAVE EXTENSIVE (SEEDUM OF SIMILAR) GREEN ROOF COVERING.

ROOF PLAN

CDM REGULATIONS 2015 RESIDUAL HAZARDS

RESIDUAL HAZARDS IDENTIFIED ⚠

CONSTRUCTION

1. NO SIGNIFICANT RESIDUAL HAZARDS BEYOND THOSE KNOWN TO AN EXPERIENCED CONTRACTOR.

FUTURE DEMOLITION

A. NO SIGNIFICANT RESIDUAL HAZARDS BEYOND THOSE KNOWN TO AN EXPERIENCED CONTRACTOR.

THIS REGISTER IS A NON-EXHAUSTIVE LIST OF RESIDUAL HAZARDS RELATING TO THE WORKS SHOWN ON THIS DRAWING THAT HAVE BEEN IDENTIFIED DURING THE DESIGN STAGE.

IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A CONTRACTOR WITH THE APPROPRIATE SKILLS, KNOWLEDGE & EXPERIENCE, AND IF THEY ARE AN ORGANISATION, THE ORGANISATIONAL CAPABILITY NECESSARY TO FULFILL THE ROLE.

PRELIMINARY ISSUE

Mark	Date	By	Chkd	Revision notes
P02	05/05/23	MH	MH	EXCEEDANCE FLOW ARROWS ADDED.
P01	16/12/22	MH	MH	PRELIMINARY ISSUE.

abstruct consulting
Structural & Civil Engineers
T: 01732 838050 E: info@abstruct-consult.com www.abstruct-consult.com

Job Title: WILLOW WAY, SYDENHAM.

Drawing Title: DRAINAGE LAYOUT.

Client: KITEWOOD.

Abstruct Job No	Drawn	Checked
AC22260	MH	MH
Scale @ A1	Date	Date
1:200	DEC'22	DEC'22
File Name		Revision
AC22260-ABS-XX-XX-DR-C-5100		P02