UNIVERSITY OF HERTFORDSHIRE

BUSINESS AND SOCIAL HUB

Drainage Strategy Report

Ref: 180149/J Courtney
Approved By: T Gavaza
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1.0 EXECUTIVE SUMMARY

Conisbee have been appointed by Willmott Dixon Construction Limited to prepare a drainage strategy for the proposed new social and business centre on the University of Hertfordshire de Havilland campus.

This design report provides an overview of the drainage principles to be used for the proposed development.

The development comprises of a new three storey building and associated hard landscaping to provide access to the building.

The site is currently 'greenfield' and the surface water discharge rates from the site will be reduced to as close the Q1 greenfield rate as viable. Surface water attenuation will be provided for all storms up to the 1 in 100 year + 40% climate change event.

The site is located in EA Flood Zone 1 and a flood risk assessment is not required for the site.

2.0 LIMITATIONS

The conclusions and recommendations contained within this report are based upon information provided by others and upon the assumption that all relevant information received is accurate and correct.

We have not visited the site in the preparation of the report.

3.0 EXISTING SITE CONDITIONS AND DRAINAGE

3.1 Existing Site Conditions

The site is located with the University of Hertfordshire's de Havilland campus (NGR 521026, 208466).

The existing site is a rectangular grassed area of open space, consisting of a series of undulations approximately 1.2m high from trough to crest.

Based on the existing topographical survey (Appendix A), the site slopes by approximately 1.3m from the southern boundary to the northern. The area to be developed is roughly 2014m² and is currently entirely permeable.

Based on flood maps from The Environment Agency, the site is located in Flood Zone 1 with low probability of flooding. Environment Agency mapping also indicates that the site is in an area with a low risk of flooding from surface water.

3.2 Geotechnical and Groundwater Information

Intrusive ground investigations have been carried out on the site and confirmed that the geological sequence comprises: Made Ground (0.6m to 2.6m thick) overlying Lowestoft Formation (up to 21.2 m thick), the bedrock consists of chalk.

The Lowestoft Formation is described as a mixture of granular and cohesive material. The cohesive and granular layers are interbedded, the cohesive layers are found at 1.2m to 2.7m bgl and 11.3 to 16.8m bgl. The granular layers are found at 2.6 to 12.5m bgl and 16.1 to 22.8m bgl.

Groundwater monitoring has been carried out as part of the investigations and the findings indicate that the water table in the Lowestoft Formation is at a depth of 3.47 to 13.73m bgl.

3.3 Existing Drainage

A utility survey of the site has been carried out which has identified existing storm and foul drainage along the southern edge of the site, this is part of the wider drainage network serving the de Havilland Campus and is assumed to connect into the Thames Water sewers at the boundary of the university site.

4.0 PROPOSED SURFACE WATER DRAINAGE STRATEGY

4.1 Surface Water Drainage strategy

The Surface Water Drainage strategy for the site has been developed based upon the following design standards aimed at providing a Sustainable Drainage System:

- Building Regulations – Part H
- BS EN 752, BS EN 12056
- National Planning Policy Framework (NPPF, March 2012)
- National Planning Practice Guidance NPPG
- The SuDS Manual – CIRIA 753
- SuDS Design Guidance for Hertfordshire March 2015 V2-Publication date 1st April 2015
- Lead Local Flood Authority SuDS Policy Statement Revision 1 March 2017
- LLFA Summary Guidance for developers
- Sustainable Drainage Systems Non-statutory technical standards for sustainable drainage systems March 2015

In line with the current best practice for SuDS hierarchy, the development targets various methods of source control in order to limit surface water peak flows at the source and therefore reduce the overall discharge from the site

The following section set out the technical details of the existing site and proposed development in accordance with the requirements of the *SuDs Design Guidance for Hertfordshire.*

4.2 The site details based on Hertfordshire form :

Site name **University of Hertfordshire Social Hub**
Total site area **0.2014Ha**
Site area which is positively drained **0.1937ha**
Developed area **0.2014 ha**
Predevelopment use **Greenfield**

Existing Impermeable Area = 0m^2
Proposed impermeable area = 1937m^2
Net increase in the impermeable area after development = 1937m^2

Site constraints

- Limited space adjacent to the proposed building.
- Cohesive soils underlying the development site.

Type of discharge **Sewer**

4.2.1 Flow control

Flow control type **fixed**
Greenfield flow Q1 **0.3 l/s** for the site
Greenfield flow Q100 **1.2 l/s** for the site
SAAR **697 mm**
Soil 0.3

Table 1 Existing and proposed volumes and discharge rates compared for 360 minutes storm.

Return period	Existing discharge volumes m^3	Existing discharge rate l/s	Proposed discharge volumes m^3	Proposed discharge rate l/s
1 in 1	12.7	0.3	17.2	2
1 in 30	28.1	0.8	55.7	2
1 in 100	36.5	1.2	82.2	2

4.2.2 Site storage volume

Source control provided **NO**
Approach used to calculate storage **2**
Storage - 1 in 1 year **20m^3** for the site
Storage – 1 in 30 year **60m^3** for the site
Storage - 1 in 100 year plus CC **126m^3** for the site
Long term storage **not required**
Total site storage **126 m^3**

4.2.3 Design checks

Time taken for 50% of storage to drain down **552min**
All SuDS storage located outside Q100 floodplain **Yes**
Provision for blockage / design exceedance **Yes**

4.3 Surface Water Drainage strategy description

In accordance with Hertfordshire guidance a variety of SUDS measures have been considered to attenuate and treat surface water from the site before discharging it to the surface water sewer. The layout of the site and the surrounding campus present a significant constraint which needs to be borne in mind when assessing the suitable SUDS options for the scheme. Primarily there is a steep fall across the plot which combined with the lack of open space prohibits the use of traditional above ground solutions such as swales and ponds. Permeable paving has also been considered for the scheme but as can be seen from the proposed drainage plan there are existing services present beneath the proposed hard paved areas, these services would either interfere directly with the permeable pavement when it was being laid, or else the paving would considerably complicate future access and maintenance.

For the reasons discussed above it is considered that a below ground attenuation tank is the only suitable SUDS option to attenuate storm water on the site. A MicroDrainage Source Control model has been constructed for the site and used to size the tank to provide sufficient storage for all storm events up to the 1 in 100 year +40% storm.

In line with Hertfordshire guidance the discharge rates will be restricted to as close to the 1 in 1 year greenfield runoff rate as possible. Hertfordshire guidance recognises that at low flow rates flow controls can be prone to blockage which causes problems with potential robustness and long term maintenance, and increases the risk of flooding to the site. On this basis it is not considered that 0.3l/s is a sustainable discharge rate and it is proposed to limit the site to 2l/s, which is the lowest discharge rate which can be achieved without an unacceptable risk of blockage, this rate has been agreed with the LLFA. This discharge rate can be achieved by a hydrobrake with a 69mm orifice size.

A calculation for the attenuation is provided in Appendix C. The proposed drainage strategy is included in Appendix B.

To ensure the long term maintenance of the scheme a Sustainable Drainage Maintenance Plan has been prepared for the site and is included in Appendix D.

5.0 PROPOSED FOUL WATER DRAINAGE STRATEGY

Foul water from the new building will be connected into the existing drainage serving the de Havilland campus.

APPENDIX A TOPOGRAPHICAL SURVEY

TOPOGRAPHICAL & MEASURED BUILDING SURVEYS

ABBREVIATIONS & SYMBOLS

AH	Arch Head Height	FH	Fire Hydrant	RSJ	Rolled Steel Joist
AR	Assumed Route	FBD	Floor Board Direction	SI	Spot Post
AV	Air Valve	FH	Fire Hydrant	SP	Arch Spring Point Height
BB	Belisha Beacon	FL	Floor Level	SV	Stop Valve
BH	Bore Hole	FP	Flag Pole	SW	Surface Water
BL	Bed Level	FW	Foul Water	SY	Stay
BO	Bollard	GG	Gully Grate	Tac	Tactile Paving
B/P	Brace Post	GV	Gas Valve	TC	Telecom Cover
BS	Bus Stop	HH	Head Height	TH	Trial Pit
BU	Bush	IC	Inspection Cover	THL	Threshold Level
B/W	Barbed Wire Fence	IL	Invert Level	TL	Traffic Light
BX	Box (Utilities)	IR	Iron Railings	ToW	Top of Well
C/B	Close Board Fence	KO	Kerb Outlet	TP	Telegraph Pole
CH	Crt Height	LP	Lamp Post	TV	Cable TV Cover
CL	Cover Level	MH	Manhole	UI	Universal Beam
CL	Chain Link Fence	MP	Marker Post	UC	Unknown Cover
C.Lev	Ceiling Level	MB	Meter Board	UK	Unknown Tower
Col	Column	OHL	Overhead Line (approx)	USB	Under Side Beam
C/P	Chestnut Paling Fence	Pan	Panel Fence	UTL	Unable To Lift
CR	Cable Riser	PB	Post Box	VP	Vent Pipe
DC	Drainage Channel	PM	Parking Meter	WB	Waste Bin
DH	Door Head Height	PO	Post	WH	Weep Hole
DP	Down Pipe	P/R	Post & Rail Fence	WL	Water Level
DR	Drain	P/W	Post & Wire Fence	WM	Water Meter
EL	Eaves Level	PWall	Partition Wall	WO	Wash Out
EP	Electric Pole	RE	Rodding Eye		Floor to Ceiling Height
ER	Earth Rod	RL	Ridge Level		F/C Floor to False Ceiling Ht
ET	Elt^Transformer	RP	Reflector Post		Survey Control Station
FB	Flower Bed	RS	Road Sign		
FBD	Floor Board Direction	RSD	Roller Shutter Door		

DRAWING NOTE

Topographical Surveys

Trees are drawn to scale showing the average canopy spread. Descriptions and heights should be used as a guide only.

All building names, descriptions, number of storeys, construction type including roof line details are indicative only and taken externally from ground level.

All below ground details including drainage, voids and services have been identified from above ground and therefore all details relating to these features including: sizes, depth, description etc will be approximate only. All critical dimensions and connections should be checked and verified prior to starting work.

Detail, services and features may not have been surveyed if obstructed or not reasonably visible at the time of the survey.

Measured Building Surveys

Measurements to internal walls are taken to the wall finishes at approx 1m above the floor level and the wall assumed to be vertical.

Cill heights are measured as floor to the cill and head heights are measured from cill to the top of window.

General

The contractor must check and verify all site and building dimensions, levels, utilities and drainage details and connections prior to commencing work. Any errors or discrepancies must be notified to Survey Solutions immediately.

The accuracy of the digital data is the same as the plotting scale implies. All dimensions are in metres unless otherwise stated.

The survey control listed is only to be used for topographical surveys at the stated scale. All control must be checked and verified prior to use.

Do not scale from this drawing.

UOH-WDC-V0-XX-DR-SU-0001-Topographical Survey

The coordinate system established for this survey is related to Ordnance Survey (OS) national grid at a single point using Smartnet, then orientated to grid north with a scale factor of 1.000

The level datum established for this survey is related to Ordnance Survey (OS) using GPS Smartnet.

To avoid discrepancies any coordinated data used in conjunction with this survey must be derived directly from this control data.

CONTROL CO-ORDINATES

STATIONS	EASTINGS	NORTHINGS	LEVEL	DESCRIPTION
ST01	521026.957	208463.057	76.160	Pk nail
ST02	521026.431	208466.318	76.334	Pk nail
ST03	521063.522	208511.271	74.696	Pk nail
ST04	521109.506	208536.773	75.465	Pk nail

REV	DESCRIPTION	DRAWN	APPR	DATE

SURVEY SOLUTIONS

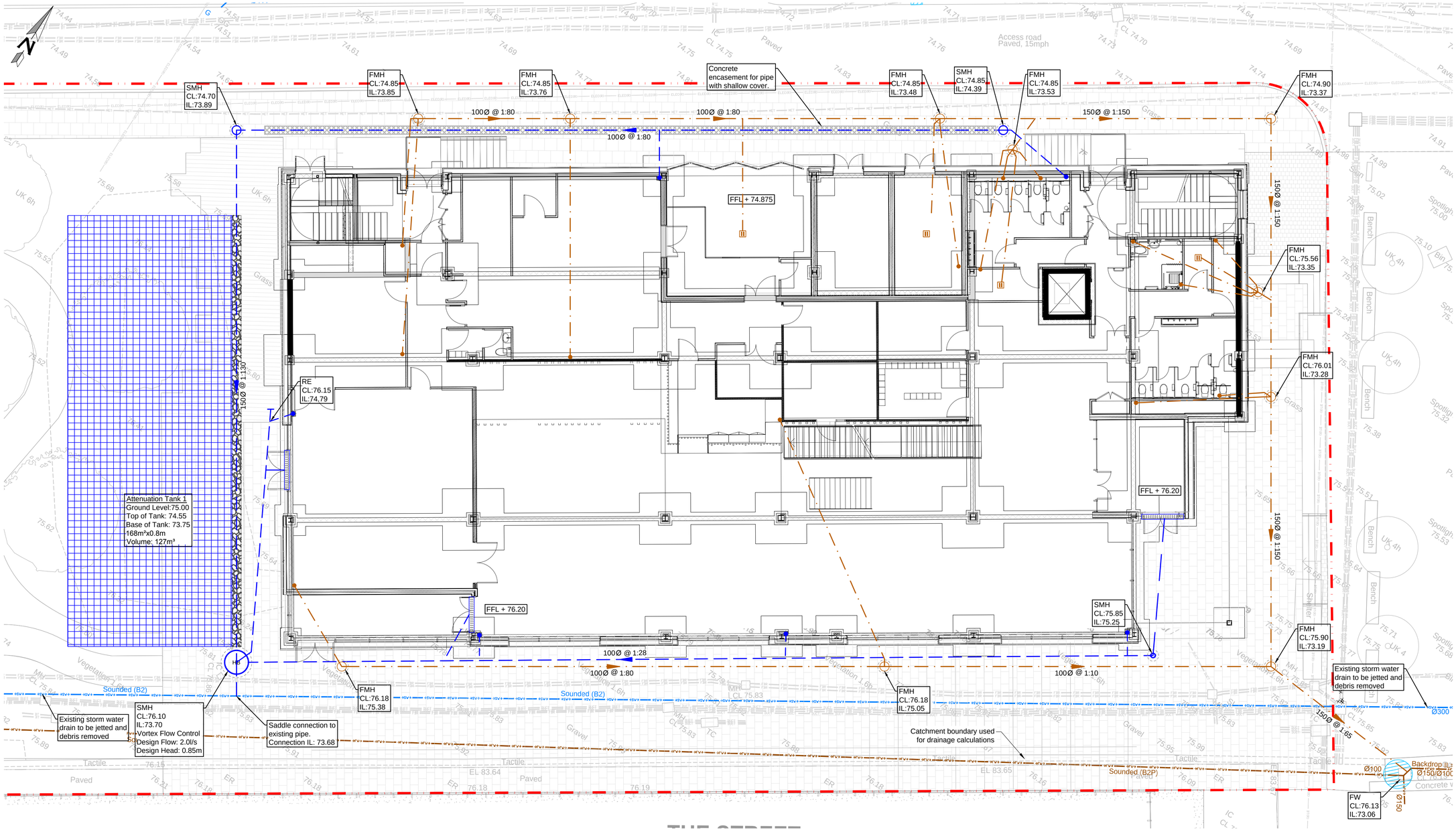
Ipswich Coventry Yeovil Norwich Perth Nottingham Brentwood

Tel No: 0845 0405 969 Fax No: 0845 0405 970
www.survey-solutions.co.uk enquiries@survey-solutions.co.uk

LAND SURVEYING BUILDING SURVEYING UNDERGROUND SURVEYING

PROJECT TITLE: THE UNIVERSITY OF HERTFORDSHIRE, DE HAVILLAND CAMPUS ,HATFIELD, AL10 9AB			
DRAWING DETAIL: TOPOGRAPHICAL SURVEY Sheet 1 of 1			
CLIENT: WILLMOTT DIXON CONSTRUCTION LIMITED			SCALE: 1:200
SURVEYOR: MA	SURVEY DATE: 2/7/2018	CHECKED BY: PDS	APPROVED BY: PDS	DWG STATUS: FINAL
DRAWING NUMBER: 22281cv-01		REVISION:	ISSUE DATE: 3/7/2018

APPENDIX B DRAINAGE STRATEGY LAYOUTS



Design Notes:	
Site Area:	2,014 m²
Greenfield runoff rates:	
For 1 in 1 year storm event =	0.3 l/s
For 1 in 30 year storm event =	0.8 l/s
For 1 in 100 year storm event =	1.2 l/s
Qbar =	0.4 l/s
Total Existing Impermeable Area:	0 m²
Total Proposed Impermeable Area:	1,937 m²
Proposed restricted Surface Water discharge rate:	2.0 l/s
Infiltration rates:	unknown
Total Attenuation for 100YS + 40%CC:	**127 m³**
Foul Water Discharge:	**1 l/sec**

Attenuation Notes	
Attenuation Tank	168m²x0.8m **Total = 127m³**
TOTAL ATTENUATION	**Total = 127 m³**

0 1 2 3 4 5 6
Meters 1:100

LEGEND

- SW — EXISTING STORM SEWER
- FW — EXISTING FOUL SEWER
- PROPOSED FOUL WATER PIPE
- PROPOSED STORM WATER PIPE
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED FOUL WATER MANHOLE
- SVP — SOIL VENT PIPE
- RWP — PROPOSED RAINWATER PIPE
- CHANNEL DRAIN
- ATTENUATION TANK

GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS
2. DO NOT SCALE FROM THIS DRAWING IN EITHER PAPER OR DIGITAL FORM. USE WRITTEN DIMENSIONS ONLY.

GENERAL DRAINAGE NOTES

1. Invert levels and positions of existing drains / chambers / sewers where new connections are to be made must be checked and confirmed to the engineer prior to the commencement of any works.
2. All drainage works shall be carried out in accordance with the requirements of the local authority, the environment agency and in conjunction with all relevant British Standards, codes of practice and 'Sewers for Adoption' 7th edition and any addendums as appropriate.
3. All drainage shall comply with the typical details and the requirements of BS EN 752 and part H of the building regulations.
4. Any part of the existing drainage system to be retained as part of the new scheme shall be cleaned and inspected. Any structural defects shall be repaired using appropriate and approved means.
5. For setting-out dimensions of SVP's, RWP's etc, refer to architect's or mechanical engineer's drawings. positions shown are indicative and subject to final design.
6. All foul and RWP connections shall be 100mm diameter unless otherwise specified.
7. All precast concrete units used in the drainage works shall be manufactured using sulphate resisting cement.
8. Manhole covers and frames shall be to BS EN 124 and shall be kitemarked. Covers and frames shall be heavy duty D400 in carriageways and vehicular areas and medium duty B125 in footways and soft landscaping. In block/concrete paved areas covers shall be recessed fabricated steel. All recessed covers shall in accordance with the FACTA association gradings.
9. All internal inspection chambers to be recessed, double sealed with screw down covers.
10. Cover levels are to be adjusted locally to suit finished ground levels.
11. At least one soil pipe at the head of each foul run shall vent to the atmosphere.
12. Existing drainage to be removed is to be broken out to bed level and void backfilled with granular material, compacted in layers not exceeding 250mm.
13. All drain runs from SVP's, stub stacks or FW gullies to be laid at 1:40 gradient unless otherwise stated. All RWP's to be laid 1:80 min unless otherwise stated.
14. All manholes / inspection chambers in block paved areas, to have recessed covers. MH covers in paved areas to have cover & frame orientated 'square' with paving to minimise cut slabs or blocks.
15. All private drainage to be laid to levels shown using flexibly jointed pipes, either UPVC to BS 4660 and BS 5481 or vitrified clayware to BS EN 295. pipes below structural building slabs or basements shall be cast iron to BS 437.
16. Rodding eyes, etc are to be laid to manufacturers minimum cover and depth to allow adequate fall from adjoining unit.
17. All proposed trees to have appropriate tree barrier details linking pits to ensure roots are directed away from drainage.
18. Where new sewers are constructed within 5m of a new or existing tree the sewer shall be concrete encased against root intrusion. refer to drainage details.
19. All new drainage to be jetted and CCTV surveyed on completion. Contractor to make sure that the drainage is fully operational. Refer to drainage maintenance manual for maintenance details.
20. All runs connecting into the public drainage network to be vitrified clay, extra length to BS EN 295 or BS65 with plain sleeved or socketed flexible joints.
21. CDM note: all pipework, silt traps, catchpits, trapped gullies and attenuation tanks to be regularly inspected every three months and cleared out on a regular frequency for the first nine months. After this period the frequency can be reduced to every six months. Porous surface to be regularly swept three times a year to remove the silt.
22. This drawing is to be read in conjunction with all relevant Conisbee drawings.
23. Health and safety: the works shall be carried out by specialist competent and experienced contractors who are members of a recognised national organisation.operatives shall have received full and appropriate training for the operations they are to undertake. all work shall be carried out in accordance with all pertinent health and safety regulations.

NOT FOR CONSTRUCTION

Rev	Date	Description	Drawn	Check
P3	09.10.18	Revised following LLFA comments	WB	JC
P2	13.09.18	Issued for Stage 3	WB	JC
P1	14.08.18	Issued for information	JC	TG

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Drawing Status
S2 - FOR INFORMATION

Project
UNIVERSITY OF HERTFORDSHIRE
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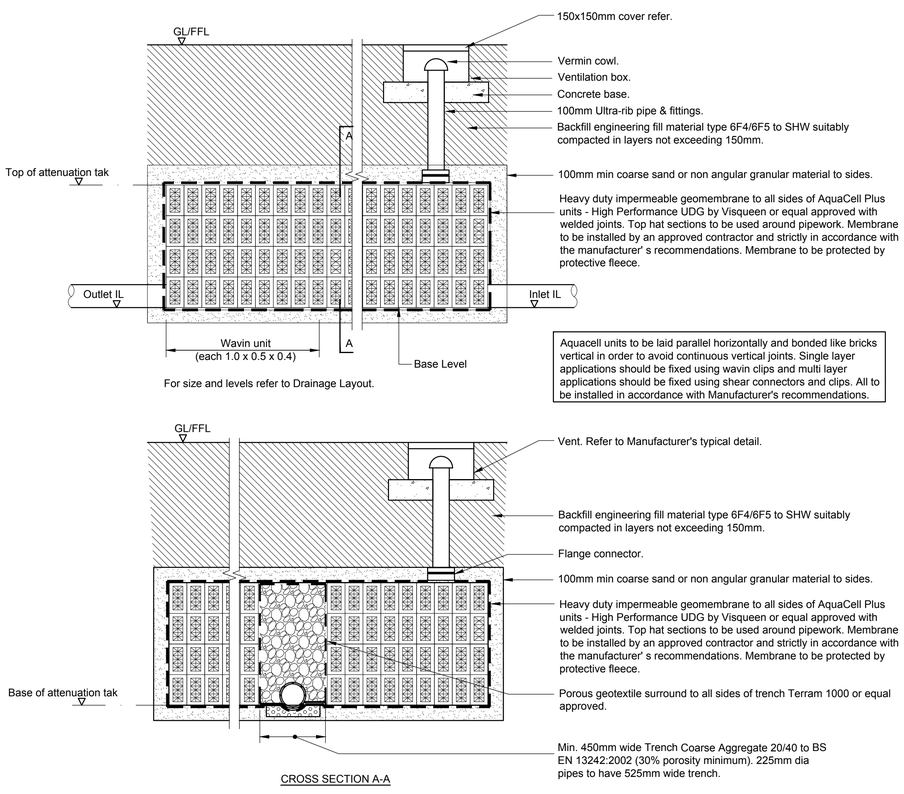
Title
DRAINAGE STRATEGY

Drawing No
UHER-CON-00-GF-DR-C-1000

Date AUG 2018
Scale 1:100@A1
Drawn JC
Engineer TG
Project No **180149**
Revision **P3**



Aquacell units to be laid parallel horizontally and bonded like bricks vertical in order to avoid continuous vertical joints. Single layer applications should be fixed using wavin clips and multi layer applications should be fixed using shear connectors and clips. All to be installed in accordance with Manufacturer's recommendations.

TYPICAL STORM WATER ATTENUATION TANK DETAIL

SCALE NTS

GENERAL NOTES

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2. DO NOT SCALE FROM THIS DRAWING IN EITHER PAPER OR DIGITAL FORM. USE WRITTEN DIMENSIONS ONLY.

DRAINAGE DETAIL NOTES

1. CDM NOTE: ALL PIPEWORK, SILT TRAPS, CATCHPITS, TRAPPED GULLIES, ATTENUATION TANKS AND PUMP CHAMBERS TO BE REGULARLY INSPECTED EVERY THREE MONTHS AND CLEARED OUT ON A REGULAR FREQUENCY FOR THE FIRST NINE MONTHS. AFTER THIS PERIOD THE FREQUENCY CAN BE REDUCED TO EVERY SIX MONTHS. PUMP SETS TO BE INSPECTED AND MAINTAINED IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE MANUFACTURER/PUMP PROVIDER. POROUS SURFACE TO BE REGULARLY SWEPT THREE TIMES A YEAR TO REMOVE THE SILT. GREASE TRAPS/INTERCEPTORS ARE TO BE INSTECTED/EMPTIED AT LEAST ONCE A MOTH AND, PREFERABLY, EVERY TWO WEEKS.
2. HEALTH AND SAFETY: THE WORKS SHALL BE CARRIED OUT BY SPECIALIST COMPETENT AND EXPERIENCED CONTRACTORS WHO ARE MEMBERS OF A RECOGNISED NATIONAL ORGANISATION.OPERATIVES SHALL HAVE RECEIVED FULL AND APPROPRIATE TRAINING FOR THE OPERATIONS THEY ARE TO UNDERTAKE. ALL WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH ALL PERTINENT HEALTH AND SAFETY REGULATIONS.
3. REFER TO THE MANUFACTURER'S INSTALLATION GUIDANCE FOR ALL SPECIFIED PRODUCTS.

NOT FOR CONSTRUCTION

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Meters 1:20

Rev	Date	Description	Drawn	Check
P1	14.08.18	Issued for information	RAD	JC

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Drawing Status
S2-FOR INFORMATION

Project
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Title
SUDS DETAILS

Drawing No
UHER-CON-00-XX-DR-C-1300

Date AUG 2018
Scale AS SHOWN
Drawn RAD
Engineer JC
Project No
180149
Revision
P1

APPENDIX C MICRODRAINAGE CALCULATION

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 552 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	74.166	0.416	0.0	2.0	2.0	66.0	O K
30 min Summer	74.286	0.536	0.0	2.0	2.0	85.0	O K
60 min Summer	74.397	0.647	0.0	2.0	2.0	102.7	O K
120 min Summer	74.489	0.739	0.0	2.0	2.0	117.3	O K
180 min Summer	74.527	0.777	0.0	2.0	2.0	123.2	O K
240 min Summer	74.541	0.791	0.0	2.0	2.0	125.5	O K
360 min Summer	74.540	0.790	0.0	2.0	2.0	125.3	O K
480 min Summer	74.523	0.773	0.0	2.0	2.0	122.6	O K
600 min Summer	74.501	0.751	0.0	2.0	2.0	119.1	O K
720 min Summer	74.481	0.731	0.0	2.0	2.0	115.9	O K
960 min Summer	74.443	0.693	0.0	2.0	2.0	110.0	O K
1440 min Summer	74.378	0.628	0.0	2.0	2.0	99.7	O K
2160 min Summer	74.291	0.541	0.0	2.0	2.0	85.8	O K
2880 min Summer	74.196	0.446	0.0	2.0	2.0	70.8	O K
4320 min Summer	74.043	0.293	0.0	2.0	2.0	46.5	O K
5760 min Summer	73.939	0.189	0.0	2.0	2.0	30.0	O K
7200 min Summer	73.872	0.122	0.0	1.9	1.9	19.3	O K
8640 min Summer	73.830	0.080	0.0	1.9	1.9	12.7	O K
10080 min Summer	73.804	0.054	0.0	1.8	1.8	8.5	O K
15 min Winter	74.166	0.416	0.0	2.0	2.0	66.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	142.375	0.0	69.0	30
30 min Summer	92.110	0.0	89.3	44
60 min Summer	56.713	0.0	109.9	74
120 min Summer	33.760	0.0	130.9	130
180 min Summer	24.618	0.0	143.2	188
240 min Summer	19.574	0.0	151.8	246
360 min Summer	14.099	0.0	164.0	364
480 min Summer	11.177	0.0	173.4	480
600 min Summer	9.329	0.0	180.9	530
720 min Summer	8.044	0.0	187.2	592
960 min Summer	6.364	0.0	197.5	720
1440 min Summer	4.567	0.0	212.6	992
2160 min Summer	3.274	0.0	228.5	1408
2880 min Summer	2.583	0.0	240.4	1796
4320 min Summer	1.847	0.0	257.9	2512
5760 min Summer	1.455	0.0	270.8	3184
7200 min Summer	1.208	0.0	281.2	3888
8640 min Summer	1.038	0.0	289.9	4512
10080 min Summer	0.912	0.0	297.3	5240
15 min Winter	142.375	0.0	69.0	30

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	74.286	0.536	0.0	2.0	2.0	85.1	O K
60 min Winter	74.398	0.648	0.0	2.0	2.0	102.8	O K
120 min Winter	74.492	0.742	0.0	2.0	2.0	117.7	O K
180 min Winter	74.530	0.780	0.0	2.0	2.0	123.8	O K
240 min Winter	74.546	0.796	0.0	2.0	2.0	126.3	O K
360 min Winter	74.547	0.797	0.0	2.0	2.0	126.4	O K
480 min Winter	74.532	0.782	0.0	2.0	2.0	124.1	O K
600 min Winter	74.509	0.759	0.0	2.0	2.0	120.4	O K
720 min Winter	74.483	0.733	0.0	2.0	2.0	116.2	O K
960 min Winter	74.439	0.689	0.0	2.0	2.0	109.2	O K
1440 min Winter	74.351	0.601	0.0	2.0	2.0	95.4	O K
2160 min Winter	74.211	0.461	0.0	2.0	2.0	73.2	O K
2880 min Winter	74.078	0.328	0.0	2.0	2.0	52.1	O K
4320 min Winter	73.904	0.154	0.0	2.0	2.0	24.4	O K
5760 min Winter	73.819	0.069	0.0	1.8	1.8	11.0	O K
7200 min Winter	73.787	0.037	0.0	1.6	1.6	5.8	O K
8640 min Winter	73.774	0.024	0.0	1.4	1.4	3.8	O K
10080 min Winter	73.765	0.015	0.0	1.2	1.2	2.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	92.110	0.0	89.3	44
60 min Winter	56.713	0.0	110.0	72
120 min Winter	33.760	0.0	130.9	128
180 min Winter	24.618	0.0	143.2	186
240 min Winter	19.574	0.0	151.8	242
360 min Winter	14.099	0.0	164.0	356
480 min Winter	11.177	0.0	173.4	466
600 min Winter	9.329	0.0	180.8	570
720 min Winter	8.044	0.0	187.1	648
960 min Winter	6.364	0.0	197.5	748
1440 min Winter	4.567	0.0	212.6	1060
2160 min Winter	3.274	0.0	228.6	1504
2880 min Winter	2.583	0.0	240.4	1856
4320 min Winter	1.847	0.0	257.9	2520
5760 min Winter	1.455	0.0	270.8	3168
7200 min Winter	1.208	0.0	281.2	3752
8640 min Winter	1.038	0.0	289.8	4488
10080 min Winter	0.912	0.0	297.3	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.436	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.194

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.049	4	8	0.049	8	12	0.048	12	16	0.048

Model Details

Storage is Online Cover Level (m) 75.000

Cellular Storage Structure

Invert Level (m) 73.750 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	167.0	0.0	1.300	0.0	0.0
0.100	167.0	0.0	1.400	0.0	0.0
0.200	167.0	0.0	1.500	0.0	0.0
0.300	167.0	0.0	1.600	0.0	0.0
0.400	167.0	0.0	1.700	0.0	0.0
0.500	167.0	0.0	1.800	0.0	0.0
0.600	167.0	0.0	1.900	0.0	0.0
0.700	167.0	0.0	2.000	0.0	0.0
0.800	167.0	0.0	2.100	0.0	0.0
0.801	0.0	0.0	2.200	0.0	0.0
1.000	0.0	0.0	2.300	0.0	0.0
1.100	0.0	0.0	2.400	0.0	0.0
1.200	0.0	0.0	2.500	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0069-2000-0850-2000
Design Head (m)	0.850
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	69
Invert Level (m)	73.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.850	2.0
Flush-Flo™	0.257	2.0
Kick-Flo®	0.535	1.6
Mean Flow over Head Range	-	1.8

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

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.7	1.200	2.3	3.000	3.6	7.000	5.3
0.200	2.0	1.400	2.5	3.500	3.8	7.500	5.5
0.300	2.0	1.600	2.7	4.000	4.1	8.000	5.7
0.400	1.9	1.800	2.8	4.500	4.3	8.500	5.8
0.500	1.7	2.000	3.0	5.000	4.5	9.000	6.0
0.600	1.7	2.200	3.1	5.500	4.7	9.500	6.1
0.800	1.9	2.400	3.2	6.000	4.9		
1.000	2.2	2.600	3.3	6.500	5.1		

APPENDIX D SUSTAINABLE DRAINAGE MAINTENANCE PLAN

conisbee | Consulting Structural Engineers
Consulting Civil Engineers

University of Hertfordshire - Social Hub

Sustainable Drainage Maintenance Plan

London
1–5 Offord Street
London N1 1DH
Telephone 020 7700 6666

Norwich
6 Upper King Street
Norwich NR3 1HA
Telephone 01603 628 074

Cambridge
16 Signet Court Swann Road
Cambridge CB5 8LA
Telephone 01223 656 058

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Approved By: T Gavaza
Date: 8 Oct 2018
Version: P1

Table of Contents

1.0 INTRODUCTION

The purpose of this document is to outline the proposed maintenance schedule for the drainage system and all SuDS features for the proposed Social Hub at the University of Hertfordshire Social Hub.

The maintenance schedule set out here complies with the CIRIA SuDS Manual (C753), which is identified as providing current best practice in the industry. The report does not replace manufacturers' requirements and these should be followed for each product in addition to the information in this document.

For the proposed extents of SuDS features on a plan drawing, please refer to the separate drainage layout plans and drainage strategy report.

2.0 ORGANISATION RESPONSIBLE

The University of Hertfordshire, will be responsible for undertaking maintenance of the proposed drainage for the whole life of the site.

3.0 CONVENTIONAL DRAINAGE SYSTEMS

3.1 Gullies, Silt Traps, Manholes, Catchpits & Pipework

On completion of construction, the internal surfaces of the sewers and manholes shall be thoroughly cleansed to remove all deleterious matter, without such matter being passed forward into the existing sewers.

All trapped gullies, silt traps, manholes and catchpits are to be regularly inspected every three months and cleared out on a regular frequency for the first nine months. After this period, the frequency can be reduced to every six months.

All drainage runs will be inspected once a year. The system is to be jetted clear if/when necessary.

3.2 Flow controls (including Hydrobrakes)

The manhole containing the flow control is to be regularly inspected once a year and any debris and silt are to be removed from the sump and manhole.

Hydrobrakes / vortex flow controls should be maintained in accordance with the manufacturer's requirements.

4.0 SUDS FEATURES

4.1 Introduction

The following SuDS measure is proposed for the Social Hub:-

- Below Ground Attenuation Tank

During the first year of the operation of all types of SuDS should be inspected at least monthly and after significant storm events to ensure that the system is functioning as designed and that no damage or faults are evident.

It is recommended that a report on the condition of the SuDS is undertaken further to an inspection at least once annually.

4.2 Below ground attenuation tank

Regular maintenance and inspection of below ground attenuation tanks are required to ensure the effective long term operation of attenuation tanks. The main activity is associated with dealing with debris and silt.

Before connecting a newly constructed upstream drainage system to an attenuation tank, the new drainage system should be jetted and cleaned thoroughly.

Table 1 provides the proposed operation and maintenance regime for the attenuation tanks. This is adapted from The SuDS Manual (C753).

Table 1: Operation and maintenance requirements for below ground attenuation tank

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually.
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter, remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays.	Annually, or as requested
Remedial	Repair/rehabilitate inlets, outlet, overflows and vents.	As required

actions		
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of the tank for sediment build –up and remove if necessary	Every 5 years or as required

5.0 SUDS PROGRAMME

The proposed SuDS for the site will come on line approximately Summer 2020.

The contractor should ensure that during the construction phase the SuDS are not damaged by construction works.

6.0 OPERATION AND MAINTENANCE MANUAL RECORDS

6.1 Documents to be handed over

Conisbee will provide this document to Willmott Dixon, who will provide the document to the construction contractor, Willmott Dixon will also include it in the Operation and Maintenance Manual to be handed over to the University of Hertfordshire.

The University of Hertfordshire will have copies of the drainage design drawings which show locations of the proposed SuDS and any ‘as-builts’ provided by the contractor.

6.2 Maintenance Records

The University of Hertfordshire will be provided with the standard proforma in Appendix B of The SuDS Manual to enable them to record the outcomes of inspections.