now part of

Cowley Conservative Club, Between Towns Road, Oxford

Surface and Foul Water Management Strategy

On behalf of **Cantay Estates Ltd.**

CANTAY ESTATES LTD

Project Ref: 46381/2001/R001 | Rev: B | Date: September 2019

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Document Control Sheet

Project Name: **Cowley Conservative Club, Between Towns Road, Oxford**

Project Ref: **46381**

Report Title: **Surface and Foul Water Management Strategy**

Doc Ref: **2001/R001**

Date: **September 2019**

	Name	Position	Signature	Date
Prepared by:	Jasper Syms	Graduate Engineer	JS	September 2019
Reviewed by:	Georgios Roinas	Principal Engineer	GR	September 2019
Approved by:	Simon Hudson	Associate	SH	September 2019
For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved
A	29/11/2019	Revisions to level of detail provided by document following planning comments.	Jasper Syms	Georgios Roinas	Simon Hudson
B	08/02/2021	Revised Site Layout	Jasper Syms	Simon Hudson	Simon Hudson

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1 Introduction

1.1 Summary

1.1.1 Peter Brett Associates LLP (PBA) have been commissioned by Cantay Estates Ltd. to assist with the planning application drainage input for the proposed redevelopment of the current Cowley Conservative Club site into student accommodation.

1.1.2 The purpose of this report is to identify and describe the proposed site drainage, with consideration to ground conditions, geology, contamination, ground water across the site; and best Sustainable Drainage (SuDS) practice.

1.2 Site Proposals

1.2.1 The proposal for the site is to demolish the existing building and erect a 5-storey building for student accommodation, consisting of approximately 200 bedrooms, a café, common rooms and laundry facilities. As a result of the design proposals, the impermeable area will be reduced from 3,140m² (100% of site area) to 2,560m² (80% of site area) by incorporating green spaces and permeable paving into the design. In addition to ground level improvements to the impermeable area, there is potential for green roofs to be installed to parts of the roof structure to intercept and reduce run-off via evapotranspiration.

1.2.2 The surrounding area includes further community centres, residential developments and two shopping centres; Templars Square and Templars Shopping Park.

1.3 Reference Documents

1.3.1 This surface water and foul water management strategy has been designed and prepared with reference to documents and information sources provided and/or published by the following bodies:

a. CIRIA C753 – The SUDs Manual and SUDs Hierarchy;

b. National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG);

c. Oxfordshire County Council - Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire (November 2018);

d. Environment Agency (EA) Standing Advice;

e. Thames Water;

f. Sewers for Adoption where applicable;

g. Relevant Building Regulations where applicable; and

h. Best practice.

2 Site Context

2.1 Site Description and Location

2.1.1 The site is located within the Temple Cowley area of Oxford, on the corner of Between Towns Road and St Luke Road. The postcode is OX4 3LX and the National Grid Reference (NGR) is 454459E 204106N. The area of the site is 3,140m^2 (0.31 ha).

2.1.2 The existing site consists of a 2-storey building with multiple extensions and parking. There are no trees present on the site and the whole site is impermeable surfacing or buildings.

2.2 Flood Risk

2.2.1 A site-specific Flood Risk Assessment (FRA) is not required as Environment Agency (EA) standing advice, updated October 2015, states that an FRA is only required when the development area is greater than 1 ha for a proposed development within Flood Zone 1.

2.2.2 The site is located entirely within Flood Zone 1 and therefore has a low probability of flooding from nearby watercourses. The nearest watercourse is a small tributary to the River Thames, located 700m to the north of the site. Figure 2.1, below, shows the site on the EA flood mapping service.

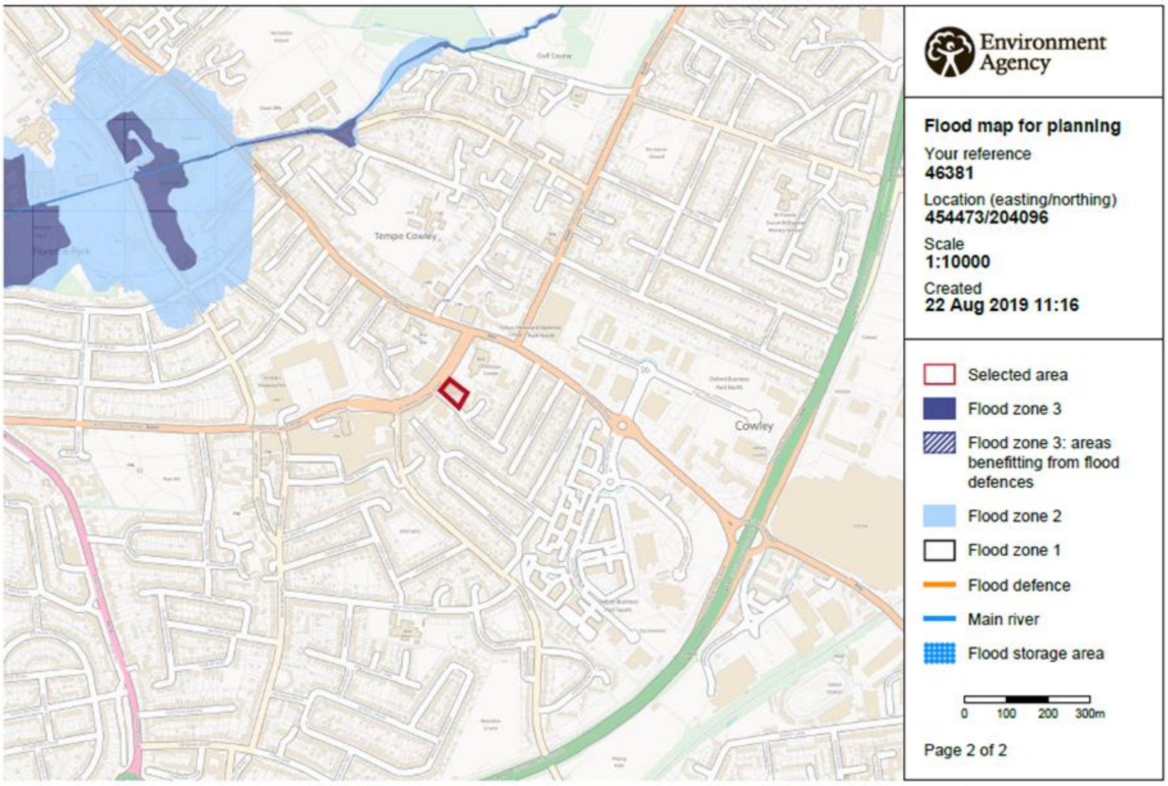


Figure 2.1 – Site Location and Flood Zones (.gov.uk flood map)

2.2.3 The *Long Term Flood Risk Map for England* (gov.uk) shows the site to be at negligible to no risk of flooding from rivers, the sea or reservoirs. However, the mapping tool does show the site to be at low to medium risk of surface water flooding across part of its extent. The flood risk map is based on mathematical modelling, considering surfaces, topology and existing land uses.

This modelling suggests the site has some surface water flooding, which is shown to originate from the existing development only (see Figure 2.2, below). The proposed design for the site does not produce any surface flooding in the 1 in 100 year (+ 40% climate change allowance). Consequently, there should be no source for this flooding post-development.

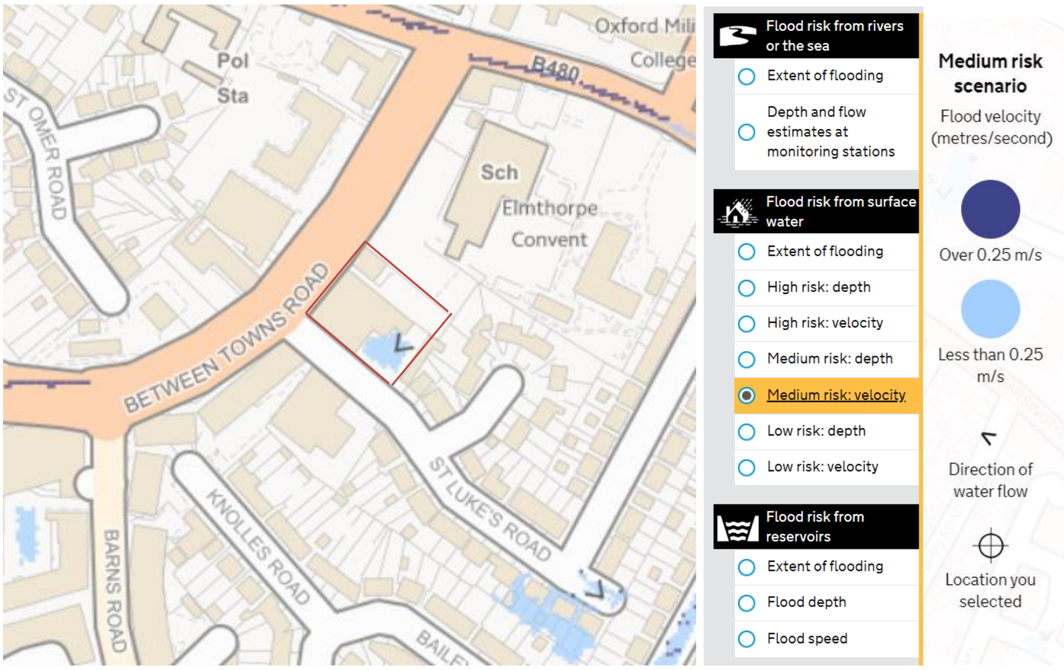


Figure 2.2 - Extract of the Long Term Flood Risk Map for England (gov.uk), site outline in red

2.3 Site Topography and Drainage

2.3.1 The existing topography across the site indicates that the site is relatively flat, with levels ranging from 74.4m to 74.9m AOD. The whole site is currently buildings or hard standing with the impermeable area reaching 100%. The surface water run-off from the site is assumed to be directed into the Thames Water sewers beneath Between Towns Road and/or St Luke’s Road.

2.4 Geology and Hydrology

2.4.1 Ground investigation surveys from nearby sites have shown the groundwater levels in the area can be anticipated to be approximately 3m below the surface. Borehole log data can be found in Appendix A. The geological record data indicates that the bedrock geology is sandstone, however the borehole log data shows strata of hard limestone with silty sand layers.

2.4.2 Previous experience of the Beckley Sand strata on neighbouring sites shows it does not provide practical options for the disposal of surface water drainage through infiltration due to low infiltration rates. Further investigation will be required to confirm ground water levels and infiltration rates on site. See Figure 2.3 for British Geological Society mapping.

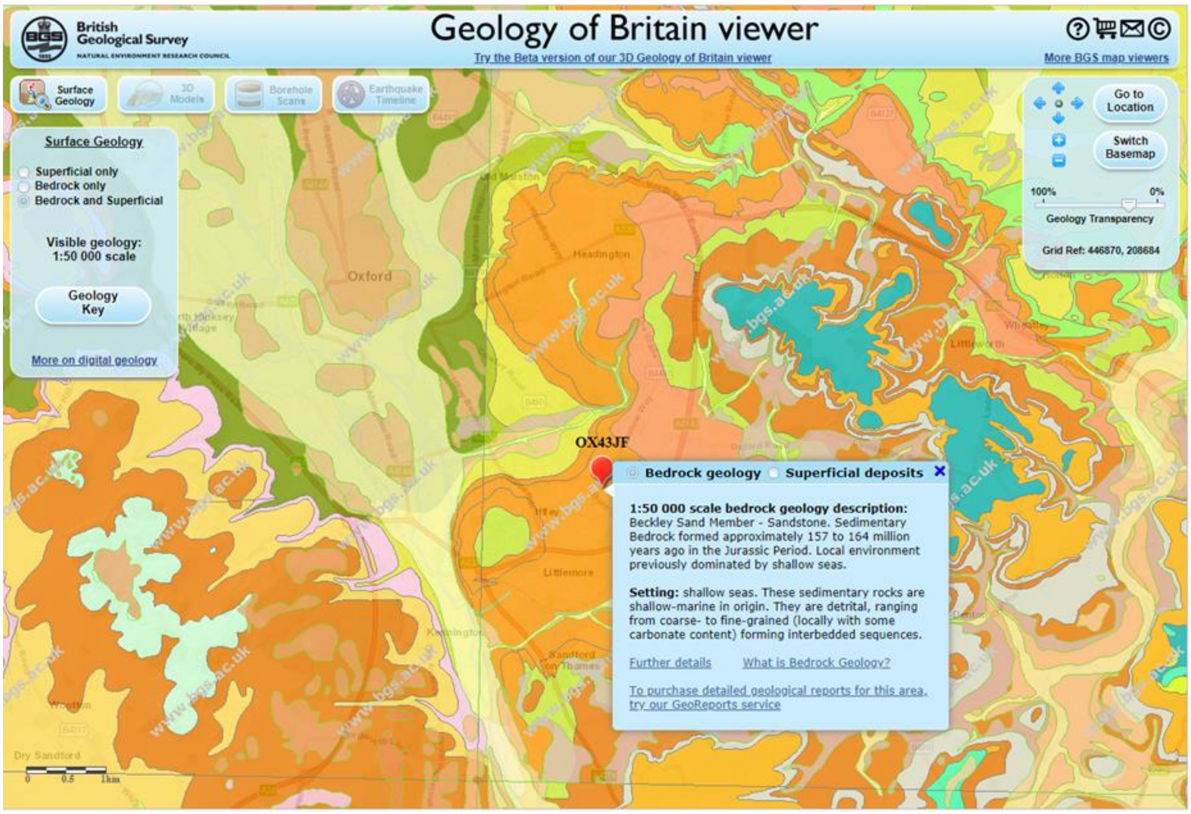


Figure 2.3 – BGS Surface Geology Mapping

2.4.3 EA data suggests that the site lies outside of Groundwater Nitrate Vulnerable Zone and Surface Water Nitrate Vulnerable Zone. There is no nearby groundwater source protection zone.

2.5 Existing Drainage Regime

2.5.1 The site is currently 100% brownfield. Brownfield discharge rates for the site were calculated using FEH data and Microdrainage to determine the present discharge rates from the site. These can be seen in Table 2.1, below.

Table 2.1: Brownfield Discharge Rates for the Existing Site.

Return Period (Years)	Brownfield Discharge Rate (l/s)	40% Betterment (l/s)
1 in 1 (100% AEP)	40.3	24.2
1 in 2.3 (44% AEP)	50.6	30.4
1 in 30 (3.3% AEP)	92.4	55.4
1 in 100 (1% AEP)	102.1	61.3

2.5.2 The Rural Run-off function within Microdrainage was used to determine the calculated Greenfield Run-off rate of the site, noting the site covers 0.31ha, shown in Table 2.2, below. Refer to Microdrainage Greenfield Runoff Calculations in Appendix B.

Table 2.2: Greenfield Rates for the Existing Site.

Return Period (Years)	Greenfield Run-off Rate	
	Per Hectare (l/s/ha)	For the Site (l/s) (0.31ha)
1 in 1 (100% AEP)	3.2	1.0
QBAR	3.8	1.2
1 in 30 (3.3% AEP)	8.7	2.7
1 in 100 (1% AEP)	12.2	3.8

3 Surface Water Drainage

3.1 Existing Surface Water Drainage

3.1.1 The existing site is constituted of 100% impermeable area, totalling 3,140m^2. It is understood to drain directly to Thames Water sewers located in Between Towns Road and St Luke's Road.

3.1.2 The existing site is comprised of multiple properties, which include 17, 17B and 19 Between Towns Road. Therefore, it is expected that there may be multiple connections out to Thames Water sewers. Whilst Oxfordshire County Council guidance suggests it is always preferable to reuse existing drainage where possible, the existing connections are not proposed to be reused as it is expected they will fall under the footprint of the proposed building. Similarly, all existing drainage pipes are expected to be abandoned and replaced with the proposed network, as the existing network provides no water treatment or attenuation to limit discharge rates.

3.2 Proposed Surface Water Drainage

3.2.1 The proposals for the site include a 5 storey building with soft and hard landscaping forming gardens, access/parking and outdoor seating.

3.2.2 SuDS features proposed for use on site include permeable pavements, filter drains and approximately 250m^2 of green roof. Refer to Appendix C for the proposed Surface Water Drainage Strategy drawing.

3.2.3 External paving is proposed to be of a permeable build-up; consisting of areas of resin bound gravel and block paved surfaces, with filter drains running beneath to facilitate dispersal and transfer of surface water through the network.

3.2.4 The infiltration rate for the site is unknown and expected to be low given the geology of the area. The proposed building is to be built on piled foundations, although buildings in close proximity to the site boundary will fall within 5m of the proposed permeable surfaces. Consequently, the filter drain and porous paving within the courtyard can be lined with a permeable membrane, but the attenuation crates, car parking, porous paving and filter drains around the perimeter will be lined with an impermeable membrane. This will allow the strategy to maximise any potential for infiltration on site.

3.2.5 The redevelopment of the site will reduce the impermeable area to 2,560m^2 representing 80% of the total site area (neglecting the potential for infiltration in the central courtyard from the base of the porous paving, to ensure robust calculations). A 10% urban creep factor has not been included within the modelling, as the site is not a residential development so an uncontrolled increase in impermeable area is not expected.

3.2.6 Rainwater falling on the roofs of the building will be captured by the rainwater pipes and green roofs, before discharging to the filter drains and permeable paving around the building.

3.2.7 A total of 675m^2 of the porous paving will be utilised to provide attenuation storage and treatment of surface water flows. The minimum thickness of sub-base for hydraulic design will range from 200mm to 300mm between the front courtyard and the rear parking areas. A total of 52m^3 of attenuation storage will be provided by the porous sub-base of the paved areas. The filter drains will provide an additional 20m^3 of attenuation storage within their granular fill.

3.2.8 In order to further reduce the run-off rate from the site it was necessary to provide additional attenuation storage to supplement the permeable paving and the filter drains. Therefore, a geo-cellular system providing 51m^3 of attenuation in a 135m^2 area with 0.4m deep crates beneath the car parking on the southern side of the site is suggested. As a result, the surface water runoff collected by the filter drains and the permeable pavement will discharge to this geo-cellular storage before flow controlled discharge to St Luke's Road. This geo-cellular storage will be overlaid by porous paving, as discussed above in section 3.2.7, providing treatment to surface water collected from the car parking before it enters into the geo-cellular crates.

3.2.9 The discharge rate of the proposed development will be restricted with the use of an orifice plate. Restricted flows will be conveyed to the existing Thames Water sewer in St Luke's Road.

3.2.10 The proposed surface water network has been designed to surcharge during the 1 in 30 year rainfall event (3.3% Annual Exceedance Probability (AEP)) and to operate at a flood risk in a 1 in 100 year rainfall event (1% AEP) plus 40% climate change. No surcharging occurs in the 1 in 1 year rainfall event. Table 3.1, below, shows the outfall rates achieved by the orifice plate in comparison to the existing brownfield run-off rate.

Table 3.1: Proposed Discharge Rates and Betterment Achieved over Existing.

Return Period	Existing Brownfield Run-off Rate (l/s)	Proposed Discharge Rate (l/s)	Betterment Achieved
1 in 1 year (100% AEP)	40.3	2.7	93%
1 in 30 year (3.3% AEP)	92.4	5.0	95%
1 in 100 year (1% AEP) (+40% Climate Change)	102.1	6.0	94%

3.2.11 The design of this surface water network has sought to achieve the principles of SuDS, to provide water treatment and limit outflows to greenfield run-off rates. The proposed development makes extensive use of permeable paving and filter drains to attenuate and treat flows at source. To limit flows further geo-cellular storage crates have been included as part of the surface water drainage strategy. These may not provide any treatment, but they provide attenuation to reduce the final discharge rates.

3.2.12 It has proven impractical to reduce the discharge rates to greenfield rates (see Table 2.2) due to the small size of the site, however a betterment of 94-96% over the existing discharge rates has been achieved between 100% AEP and 1% AEP plus 40% climate change.

3.2.13 The proposed surface water network can be seen on drawing 46381/2001/002 (Appendix C). Guidance on maintenance of this system can be found in Appendix D and supporting Microdrainage calculations can be found in Appendix E. A flood exceedance plan is included in Appendix F, showing that any potential flooding will be directed away from the building. The direction of flows is as to be expected as Between Towns Road falls across the frontage of the site, towards central Temple Cowley, and St Luke's Road falls down to Between Towns Road.

3.2.14 A pre-planning enquiry has been submitted to Thames Water, but a response is still pending.

3.3 Volumetric Run-off Coefficient

3.3.1 In considering suitable C_v values for the development we consulted Oxfordshire County Council's *Local Standards and Guidance for Surface Water Drainage on Major Development in*

Oxfordshire document; however, no guidance on C_v values suitable for use locally in Oxfordshire was suggested.

3.3.2 The Wallingford Procedure Volume 4 states the average value of the Volumetric Run-off Coefficient (C_v) is 0.75. This value reflects the loss of some rainfall from impervious areas through cracks, into depressions and by drainage onto pervious areas. We have included an uplift in the value of C_v to 0.84 for winter rainfall events to reflect the higher antecedent wetness of the soils due to winter weather conditions.

3.3.3 Whilst in some situations C_v values up to 0.95 may be necessary, this is commonly used where a roof catchment is collected directly into a sealed network via rainwater pipes. All external surfacing will be of a permeable build-up, so these areas additionally will not pass all surface water through the network as some will evaporate, infiltrate or run-off on to soft landscaping areas. Consequently, we are confident in using a C_v of 0.84 during winter events, when the soil is expected to be more saturated, and a C_v value of 0.75 during summer events.

4 Foul Water Drainage

4.1 Existing Foul Water System

4.1.1 We assume that the existing buildings on the site utilises several foul water sewer connections into Thames Water assets on Between Towns Road or St Luke's Road. The existing site use has an estimated peak foul discharge of 0.12 l/s. The existing network and connections will be abandoned as they will not be suitable for use within the redeveloped site.

4.2 Proposed Foul Water System

4.2.1 The student accommodation proposed is estimated to have an anticipated peak foul discharge of approximately 2.6 l/s, based on 224 persons, each producing 150 l/day of foul water. The proposed foul drainage for the development will collect foul water from the soil vent pipes (SVPs), and discharge via a new gravity connection in St Luke's Road. This outfall route is being suggested to avoid passing the outfall sewer beneath the proposed development.

4.2.2 The foul water strategy is presented on drawing 46381/2001/002 (Appendix C).

5 Summary

5.1 Conclusions

5.1.1 It is proposed to build student accommodation for approximately 200 students as the redevelopment of a brownfield site on Between Towns Road, Oxford. Proposals will reduce the impermeable area of the site from 100% impermeable to 80% impermeable area, 2,560m^2. This new impermeable area will be drained with the use of SuDS features, via a flow controlled outfall to St Luke’s Road.

5.1.2 The surface water drainage strategy for this development will utilise a system of filter drains, permeable paving and geo-cellular storage crates to treat and attenuate surface water run-off before discharge into Thames Water sewers. This will provide a 93-95% betterment in discharge rates and an improvement in water quality over existing brownfield run-off rates.

5.1.3 The presented drainage strategy demonstrates that the site boundary can be drained in a sustainable manner without increasing the risk of flooding to neighbouring properties for events up to and including the 1% annual probability event storm, plus 40% climate change. No surcharging of the network occurs during for a 1 in 1 year (100% AEP) rainfall event.

5.1.4 Foul water produced by the development will be discharged to the Thames Water sewer in St Luke’s Road via a gravity connection.

5.1.5 This surface water and foul drainage strategy has been prepared to demonstrate that the proposed development can meet national and local requirements.

Appendix A Borehole Logs

Version 2.0.6

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 335673 : BGS Reference: SP50SW209
British National Grid (27700) : 454420,204160
Report an issue with this borehole

Geotechnical Engineering Ltd

SP 50SW / 209

BOREHOLE LOG

5442 0416

CLIENT BEECHER STAMFORD ASSOCIATES
SITE COWLEY CENTRE DEVELOPMENT

BOREHOLE No. A
GROUND LEVEL
DATE 21·10·68
SCALE 0·2" : 1'0"

geological classification	description	level	legend	core/ sample	depth	thickness	S.P./vane test	depth to water
Corallian - Lower Calcareous grit	Sandy TOP SOIL.			DRILLED DRY	1'3"	1'3"		
	Yellow brown clayey medium and fine SAND				7'6"	6'3"	N=6 N=12	7'6" Encountered
	Yellow brown clayey medium and fine SAND with some medium and fine GRAVEL				9'0"	1'6"	N 50/6"	
	Yellow brown clayey medium and fine SAND				14'6"	5'6" (seen)	N=21 N 50/9"	8'0" on Completion
	End of Borehole							

Beckley Sands

MDRS 8/89

© T.L. Ltd. W.37

● disturbed sample ▌ core/undisturbed sample ▲ water sample st. pen. test + vane test

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Version 2.0.6

BGS ID: 335819 : BGS Reference: SP50SW355
British National Grid (27700) : 454380,204060
Report an issue with this borehole

White · Young and Partners

CONSULTING ENGINEERS Tel. Stevenage 50261

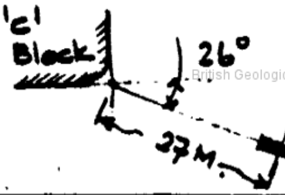
Sheet No. 2
Prepared by Exr
Date MAR 82
Job No. 31350

Title of Scheme: COWLEY PHASE 2 - TRIAL HOLE Nº 1

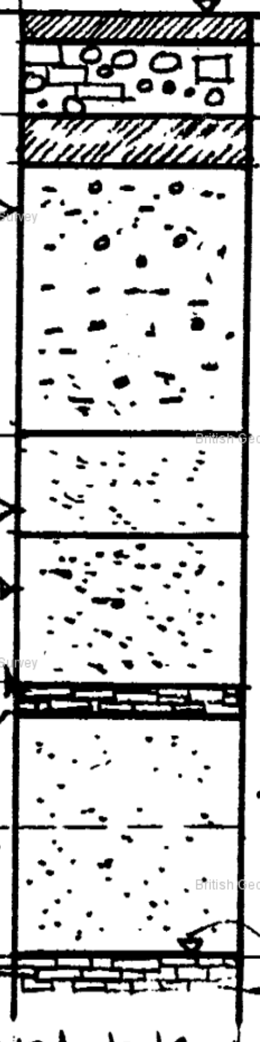
SP50SW 355
5438 0406

Location

Key Plan



73.500	Top of hole
-0.100	Asphalt / Macadam.
-0.400	Stone Cobbles (140) & hard cordle
-0.600	Fine brown loamy soil.
Sample. 1	Sandy clayey moist material mouldable in fingers
-1.700	Yellow brown sandy clay (more sand than clay)
Sample 2. -2.000	
Sample 3 (-2.300)	Silty Yellow brown sand.
-2.700 Sample 4	layer of hard limestone
-2.850	Moist to Saturated Yellow Silty sand
-3.450 approx water level at hole closure	
-3.800	Bottom of hole
+69.7	Hard limestone bed.



Beckley Sand Member

water entered hole immediately 3.8 M was reached. similar to hole Nº - 1. Water was continuing to enter the hole at closure after 45 minutes

London

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Version 2.0.6

BGS ID: 335820 : BGS Reference: SP50SW356
British National Grid (27700) : 454360,204050
Report an issue with this borehole

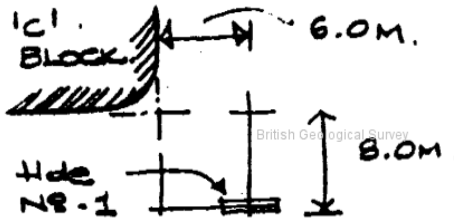
CONSULTING ENGINEERS Tel. Stevenage 59451

Prepared by EH
Date MAR 82

Title of Scheme COWLEY PHASE 2 – TRIAL HOLE No 2 Job No. 31350

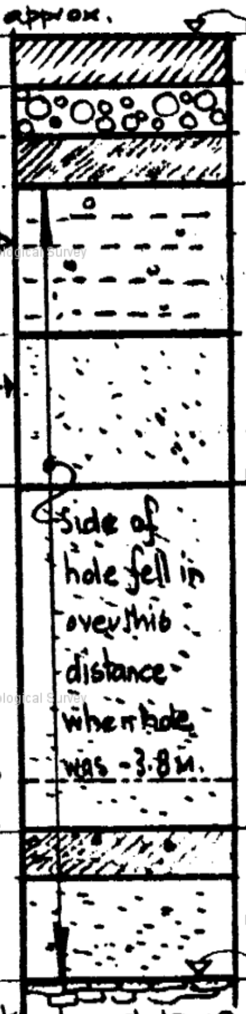
SP50SW 356
5436 0405

Location Key Plan.



73.800 approx. — Top of hole.

- 0.200 — Asphalt /Macadam.
- 0.400 — Hardcore mixture 40 max, 20 av.
- 0.600 — Fine brown loamy soil.
sample — Mixture of yellowish sand & clay mouldable in the fingers.
- 1.200
sample — Mixture of yellow silty sand & clay. More sand proportion than -0.6 to -1.2.
- 1.800
Beckley Sand Member — Very Moist and unstable silty sand.
- 3.000 — Stable water level after 3 hours
- 3.200
- 3.400 — Seam of silty blue sand.
Saturated silty yellow sand
- 3800 — Bottom of hole



+70.0 A chalky hard layer was visible at -3.8M level and confirmed by probing full area of hole bottom.

London Leeds Newcastle Stevenage Cleveland Lytham St. Annes

Appendix B Greenfield Run-off Calculation

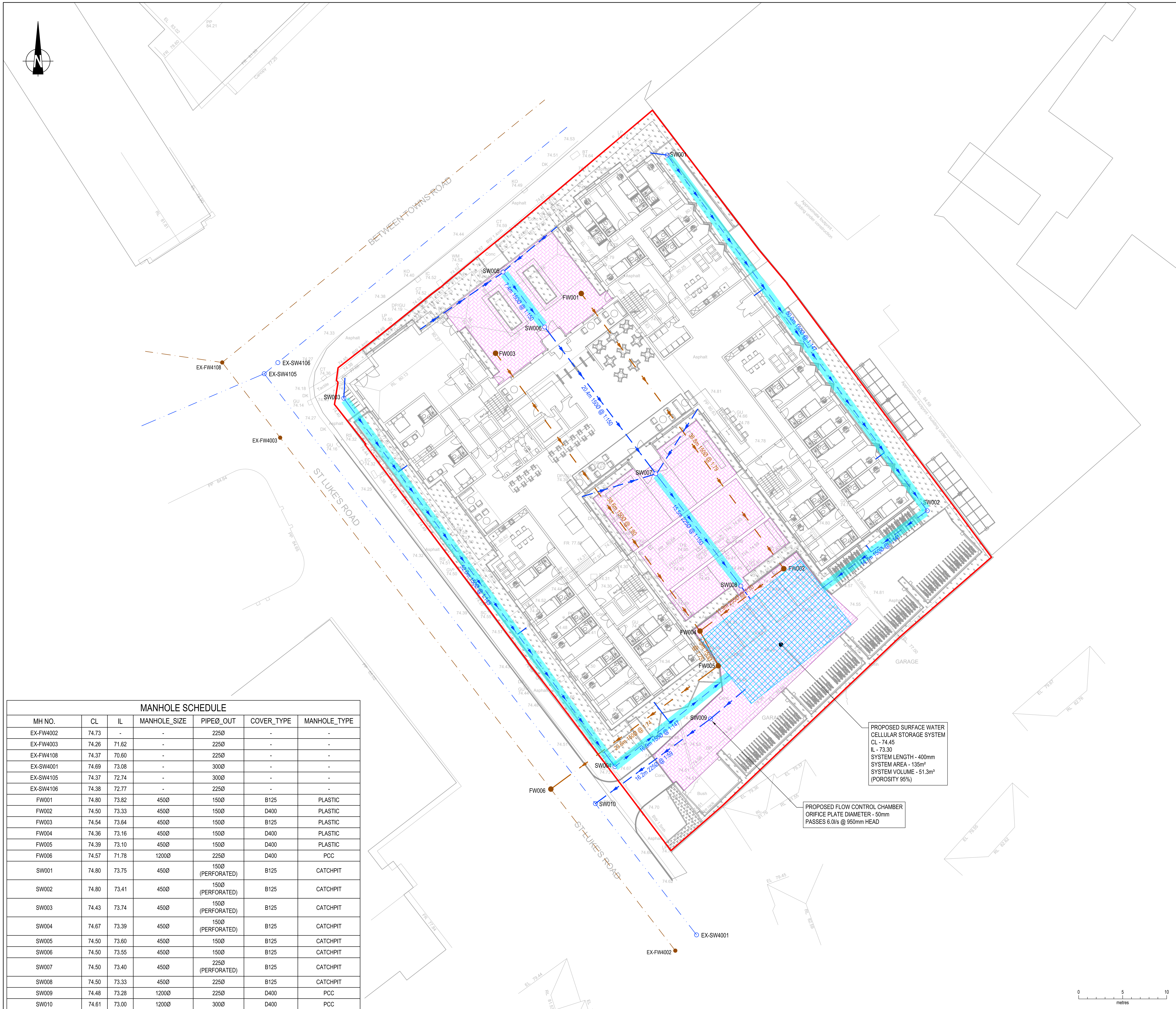
ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	SAAR (mm)	621	Urban	0.000
Area (ha)	1.000	Soil	0.450	Region Number	Region 6

Results	**l/s**
QBAR Rural	3.8
QBAR Urban	3.8
Q2 years	3.4
Q1 year	3.2
Q30 years	8.7
Q100 years	12.2

Appendix C SW and FW Drainage Strategy drawing 46381/2001/002



NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTS AND SPECIFICATIONS. ANY DISCREPANCIES BETWEEN THIS DRAWING AND ANY OTHER RELEVANT ENGINEERING DRAWING SHOULD BE REPORTED TO THE DESIGN ENGINEER IMMEDIATELY.
2. DO NOT SCALE FROM THIS DRAWING.
3. ALL DIMENSIONS ARE IN m UNLESS OTHERWISE STATED.
4. ALL LEVELS ARE IN m AOD.
5. THIS DRAWING HAS BEEN PRODUCED IN COLOUR AND SHOULD BE REPRODUCED IN COLOUR.
6. TOPOGRAPHICAL INFORMATION TAKEN FROM GLANVILLE DRAWING NUMBER 8190128/4101 DATED JANUARY 2019.
7. LANDSCAPE PLAN TAKEN FROM PENWARDENHALE ARCHITECTS DRAWING NUMBER 2513-PHA-00-SI-DR-A-0100-P6, DATED 02/02/21.
8. ALL WORKS TO THAMES WATER SEWERS TO BE CARRIED OUT IN ACCORDANCE WITH CODE FOR ADOPTION (SfA WAS SUPERSEDED BY CfA INAPRIL 2020). NEW CONNECTIONS ARE TO BE MADE WITH APPROPRIATE LENGTHS OF ROCKER PIPES AND COUPLINGS TO THAMES WATER APPROVAL.
9. DRAINAGE CONNECTIONS TO ADOPTED THAMES WATER SEWERS TO BE STRICTLY IN ACCORDANCE WITH NOTE 8 AND SECTION 106 OF THE WATER INDUSTRY ACT.
10. INVERT LEVEL, SIZE AND COVER LEVELS TO EXISTING MANHOLES AND SEWERS TO BE CHECKED PRIOR TO CONSTRUCTION. ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY.
11. EXISTING SURFACE AND FOUL DRAINAGE RUNS HAVE BEEN ASSUMED AND SO SHOULD BE CHECKED ON SITE PRIOR TO CONSTRUCTION.
12. ALL MATERIAL USED IN THE CONSTRUCTION OF DRAINS AND MANHOLES SHALL COMPLY TO THE RELEVANT BRITISH STANDARDS AND BE KITE MARKED WHERE APPROPRIATE.
13. ALL SVP CONNECTIONS TO BE LAID AT A MINIMUM GRADIENT OF 1:40, UNLESS OTHERWISE SPECIFIED.
14. ALL RWP CONNECTIONS TO BE 100mm AT A MINIMUM GRADIENT OF 1:100, UNLESS OTHERWISE SPECIFIED.
15. ALL SVPS SHALL HAVE RODDING ACCESS PLATES FITTED AT THEIR BASES (GROUND FLOOR LEVEL).
16. CONTRACTOR TO VERIFY MANHOLE LOCATIONS, PIPE DIAMETERS AND LEVELS PRIOR TO MAKING ANY CONNECTIONS TO EXISTING SEWERS AND DRAINS, AND CONFIRM FINDINGS TO THE ENGINEER.
17. ALL EXISTING DRAINAGE WITHIN THE SITE BOUNDARY TO BE ABANDONED OR REMOVED.

KEY:

- SITE BOUNDARY
- EXISTING THAMES WATER ADOPTED SURFACE WATER SEWER
- EXISTING THAMES WATER ADOPTED FOUL WATER SEWER
- PROPOSED SURFACE WATER DRAIN
- PROPOSED FOUL WATER DRAIN
- EX-SWXXXXX EXISTING THAMES WATER SURFACE WATER MANHOLE
- EX-FWXXXXX EXISTING THAMES WATER FOUL WATER MANHOLE
- SW00X PROPOSED SURFACE WATER MANHOLE
- FW00X PROPOSED FOUL WATER MANHOLE
- PROPOSED SURFACE WATER CELLULAR STORAGE
- PROPOSED POROUS PAVING
- PROPOSED FILTER DRAIN

MINIMUM POROUS SUB-BASE THICKNESS (FOR HYDRAULIC DESIGN)	
FRONT COURTYARD	200mm
REAR COURTYARD	250mm
CAR PARK	300mm

MANHOLE SCHEDULE

MH NO.	CL	IL	MANHOLE_SIZE	PIPEØ_OUT	COVER_TYPE	MANHOLE_TYPE
EX-FW4002	74.73	-	-	225Ø	-	-
EX-FW4003	74.26	71.62	-	225Ø	-	-
EX-FW4108	74.37	70.60	-	225Ø	-	-
EX-SW4001	74.69	73.08	-	300Ø	-	-
EX-SW4105	74.37	72.74	-	300Ø	-	-
EX-SW4106	74.38	72.77	-	225Ø	-	-
FW001	74.80	73.82	450Ø	150Ø	B125	PLASTIC
FW002	74.50	73.33	450Ø	150Ø	D400	PLASTIC
FW003	74.54	73.64	450Ø	150Ø	B125	PLASTIC
FW004	74.36	73.16	450Ø	150Ø	D400	PLASTIC
FW005	74.39	73.10	450Ø	150Ø	D400	PLASTIC
FW006	74.57	71.78	1200Ø	225Ø	D400	PCC
SW001	74.80	73.75	450Ø	150Ø (PERFORATED)	B125	CATCHPIT
SW002	74.80	73.41	450Ø	150Ø (PERFORATED)	B125	CATCHPIT
SW003	74.43	73.74	450Ø	150Ø (PERFORATED)	B125	CATCHPIT
SW004	74.67	73.39	450Ø	150Ø (PERFORATED)	B125	CATCHPIT
SW005	74.50	73.60	450Ø	150Ø	B125	CATCHPIT
SW006	74.50	73.55	450Ø	150Ø	B125	CATCHPIT
SW007	74.50	73.40	450Ø	225Ø (PERFORATED)	B125	CATCHPIT
SW008	74.50	73.33	450Ø	225Ø	B125	CATCHPIT
SW009	74.48	73.28	1200Ø	225Ø	D400	PCC
SW010	74.61	73.00	1200Ø	300Ø	D400	PCC

user name: taylor, vanessa

Mark	Revision	Date	Drawn	Chkd	Appd
B	REVISED ARCHITECTS LAYOUT	05.02.21	VT	JS	SH
A	UPDATED TO SUIT LANDSCAPE PLAN	03.12.19	GM	JS	SH

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Drawing Issue Status

PRELIMINARY

COWLEY CONSERVATIVE CLUB

PROPOSED FW AND SW NETWORKS

Client

CANTAY ESTATES

Date of 1st Issue	Designed	Drawn
04.09.2019	JS	GM
A1 Scale	**Checked**	**Approved**
1:200	GR	SH

Drawing Number: 46381/2001/002

Revision: B

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OXFORD
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File Location: \\pba\oxf\projects\46381 - between towns road\200 - design (all drawings)\201 - all pba drawings\2000 - civils\dwgs\46381_2001_002.dwg

Appendix D Maintenance and Management Strategy

1 Maintenance Requirements

1.1 Types of maintenance

1.1.1 Maintenance requirements for the elements set out above are included below:

- Regular Maintenance: consists of basic tasks carried out to a frequent and predictable schedule, including inspections/monitoring, silt or oil removal if required more frequently than once per year, vegetation management, sweeping of surfaces and litter and debris removal.
- Occasional Maintenance: comprises tasks that are likely to be required periodically, but on a much less frequent (typically less than yearly) and much less predictable basis than the regular tasks. Tasks considered occasional maintenance include sediment removal and filter replacement.
- Remedial Actions: describes the intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design, construction and regular maintenance activities. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and so timings are difficult to predict. Remedial maintenance can comprise activities such as: inlet and outlet repairs, erosion repairs, reinstatement or realignment of edgings, barriers, rip-rap or other erosion control, infiltration surface rehabilitation, replacement of blocked filter materials/fabrics, construction stage sediment removal (although this activity should have been undertaken before the start of the maintenance contract), system rehabilitation immediately following a pollution event.

1.2 Attenuation Tanks

1.2.1 Regular inspection and maintenance are required to ensure the effective long-term operation of below-ground storage systems. Maintenance responsibility for systems should be placed with a responsible organisation. The table below provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive, and some actions may not always be required.

Maintenance Schedule	Required Action	Typical 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 required
Remedial actions	Repair/rehabilitate inlets, outlet, overflow 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
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

1.3 Catchpits

1.3.1 Regular inspection and maintenance are required to ensure the effective long-term operation of below-ground storage systems, of which catchpits play a key part providing a pre-treatment to the surface water before it reaches the attenuation crates. Maintenance responsibility for systems should be placed with a responsible organisation. The table below provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive, and some actions may not always be required.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove sediment from catchpits (and certainly if catchpit is greater than 50% full).	Annually, or as required
	Remove debris from the catchment surface (where it may cause risks to performance).	Monthly
Remedial actions	Repair/rehabilitate inlets, outlet, overflow 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, and silt accumulation is not excessive.	Annually

1.4 Orifice Plates

1.4.1 Flow control devices required regular inspection for blockages to ensure they perform as intended. The table below provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive, and some actions may not always be required.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Removal of debris blocking or restricting flow control device.	As required
Monitoring	Inspect chamber and flow device regularly for blockages and high water levels.	Monthly, or as required if more frequent.

1.5 Filter Drains

1.5.1 Filter drains will require regular maintenance to ensure continuing operation to design performance standards, and all designers should provide detailed specifications and frequencies for the required maintenance activities along with likely machinery requirements and typical annual costs – within the Maintenance Plan. The treatment performance of filter drains is dependent on maintenance, and robust management plans will be required to ensure that maintenance is carried out in the long term. Different designs will have different operation and maintenance requirements, but this section gives some generic guidance.

1.5.2 Regular inspection and maintenance is important for the effective operation of filter drains as designed. Maintenance responsibility for a filter drain should always be placed with an appropriate organisation.

1.5.3 Adequate access should always be provided to the filter drain for inspection and maintenance. If filter drains are implemented within private property, owners should be educated on their routine maintenance needs, and should understand the long-term Maintenance Plan and any legally binding maintenance agreement.

1.5.4 Litter (including leaf litter) and debris removal should be undertaken as part of general landscape maintenance for the site and before any other SuDS management task. All litter should be removed from site.

1.5.5 The below table provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly

	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional Maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

1.6 Porous Paving

1.6.1 Regular inspection and maintenance is important for the effective operation of pervious pavements. Maintenance responsibility for a pervious pavement and its surrounding area should be placed with an appropriate responsible organisation. Before handing over the pavement to the client, it should be inspected for clogging, litter, weeds and water ponding, and all failures should be rectified. After handover, the pavement should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

1.6.2 Pervious pavements need to be regularly cleaned of silt and other sediments to preserve their infiltration capacity. Extensive experience suggests that sweeping once per year should be sufficient to maintain an acceptable infiltration rate on most sites. However, in some instances, more or less sweeping may be required and the frequency should be adjusted to suit site-specific circumstances and should be informed by inspection reports.

1.6.3 A brush and suction cleaner (which can be a lorry-mounted device or a smaller precinct sweeper) should be used for regular sweeping. Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material. Any lost material should be replaced. It is also possible to clean the surface using lightweight rotating brush cleaners combined with power spraying using hot water.

1.6.4 If the surface has clogged then a more specialist sweeper with water jetting and oscillating and rotating brushes may be required, especially for porous asphalt surfaces, to restore the surface infiltration rate to an acceptable level. The specialist equipment should be adjusted so that it does not strip binder from the aggregate in the asphalt.

1.6.5 The likely design life of grass reinforcement will be dictated by trafficking and is likely to be about 20 years if designed correctly. For concrete block permeable paving the design life should be no different from standard paving, assuming that an effective maintenance regime is in place to minimise risks of infiltration clogging. Porous asphalt will lose strength and begin to fatigue due to oxidation of the binder. This is likely to occur slightly faster in porous asphalt than normal asphalt, so the design life will be reduced slightly. Porous concrete should have a similar design life to a normal concrete slab.

1.6.6 The reconstruction of failed areas of concrete block pavement should be less costly and disruptive than the rehabilitation of continuous concrete or asphalt porous surfaces due to the reduced area that is likely to be affected. Materials removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and may need to be disposed of as controlled waste. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

1.6.7 Maintenance Plans and schedules should be prepared during the design phase. Specific maintenance needs of the pervious pavement should be monitored, and maintenance schedules adjusted to suit requirements.

1.6.8 Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy) and therefore, if litter management is already required at site, this should have marginal cost implications.

1.6.9 Generally, pervious pavements require less frequent gritting in winter to prevent ice formation. There is also less risk of ice formation after snow melt, as the melt water drains directly into the underlying sub- base and does not have chance to refreeze. A slight frost may occur more frequently on the surface of pervious pavements compared to adjacent impermeable surfaces, but this is only likely to last for a few hours. It does not happen in all installations and, if necessary, this can be dealt with by application of salt. It is not likely to pose a hazard to vehicle movements.

1.6.10 The below table provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required

	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chamber	Annually

1.7 Green Roofs

1.7.1 Intensive green roofs are likely to require regular inspection and maintenance. Grassed areas may require mowing weekly or fortnightly, plant beds may require weeding on a weekly or fortnightly basis during the growing season, and wildflower meadows may require annual mowing with the cuttings removed. Extensive green roofs should normally only require biannual or annual visits to remove litter, check fire breaks and drains and, in some cases, remove unwanted invasive plants. The most maintenance is generally required during the establishment stage (12 to 15 months), and this should usually be made the responsibility of the green roof provider. Maintenance contractors with specialist training in green roof care should be used, where possible.

1.7.2 If mechanical systems are located on the roof, then spill prevention measures should be exercised to ensure that roof runoff is not contaminated. The mechanical system area should be bunded and provided with separate drainage.

1.7.3 All maintenance actions carried out at roof level must be in full compliance with the appropriate health and safety regulations, and particularly those specifically dealing with working at height. Training and guidance information on operating and maintaining the roof should be provided to all property owners and tenants. Safety fastenings will be required for personnel working on the roof.

1.7.4 Access routes to the roof should be designed and maintained to be safe and efficient, and walkways should always be kept clear of obstructions. Secure points for harness attachments should be provided when access near to the roof edges is required.

1.7.5 Specific maintenance needs of the green roof should be monitored and maintenance schedules adjusted to suit requirements.

1.7.6 The below table provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required. Actual requirements will depend on the planting, the desired aesthetic and visual effect and the biodiversity objectives for the system. Maintenance specifications and schedules should therefore be specified for any individual green roof with the manufacturer of the green roof system.

Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular Maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where > 5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed	Six monthly or as required

	and not allowed to accumulate	
Remedial Actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

Appendix E Proposed Surface Water Drainage Network Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.600
Maximum Rainfall (mm/hr)	550	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.212	4-8	0.040

Total Area Contributing (ha) = 0.252

Total Pipe Volume (m³) = 3.165

Network Design Table for Storm

- Indicates pipe length does not match coordinates

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	32.000#	0.213	150.2	0.054	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	5.000#	0.057	87.7	0.077	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	1.000#	0.007	142.9	0.010	4.00	0.0	0.600	o	100	Pipe/Conduit	
2.001	1.000#	0.007	142.9	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	1.000#	0.007	142.9	0.010	4.00	0.0	0.600	o	100	Pipe/Conduit	
3.001	1.000#	0.463	2.2	0.025	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	16.692	0.099	168.6	0.051	0.00	0.0	0.600	o	300	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	72.39	4.65	73.550	0.054	0.0	0.0	0.0	0.82	14.4	10.6
1.001	72.02	4.71	73.262	0.131	0.0	0.0	0.0	1.40	55.5	25.6
2.000	76.65	4.03	74.120	0.010	0.0	0.0	0.0	0.64	5.0	2.1
2.001	76.51	4.05	74.063	0.035	0.0	0.0	0.0	0.84	14.8	7.3
3.000	76.65	4.03	73.800	0.010	0.0	0.0	0.0	0.64	5.0	2.1
3.001	76.63	4.03	73.793	0.035	0.0	0.0	0.0	5.31	41.7	7.3
1.002	70.60	4.94	73.130	0.252	0.0	0.0	0.0	1.21	85.4	48.2

Network Design Table 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	Auto Design
1.003	16.692	0.099	168.6	0.000	0.00	0.0	0.600	o	300	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)
1.003	69.25	5.17	73.031	0.252	0.0	0.0	0.0	1.21	85.4	48.2

Manhole Schedules for Storm

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)
2	74.500	0.950	Open Manhole	450	1.000	73.550	150				
2	74.430	1.168	Open Manhole	450	1.001	73.262	225	1.000	73.337	150	
3	74.720	0.600	Open Manhole	450	2.000	74.120	100				
4	74.550	0.487	Open Manhole	450	2.001	74.063	150	2.000	74.113	100	
5	74.420	0.620	Open Manhole	450	3.000	73.800	100				
6	74.700	0.907	Open Manhole	450	3.001	73.793	100	3.000	73.793	100	
3	74.550	1.420	Open Manhole	450	1.002	73.130	300	1.001	73.205	225	
								2.001	74.056	150	776
								3.001	73.330	100	
4	74.550	1.519	Open Manhole	1200	1.003	73.031	300	1.002	73.031	300	
	74.550	1.618	Open Manhole	0		OUTFALL		1.003	72.932	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
2	509.964	258.762	509.964	258.762	Required	
2	522.031	244.612	522.031	244.612	Required	
3	516.593	280.463	516.593	280.463	Required	
4	545.217	243.420	545.217	243.420	Required	
5	483.638	256.890	483.638	256.890	Required	
6	509.256	221.410	509.256	221.410	Required	
3	530.456	234.275	530.456	234.275	Required	
4	518.283	222.854	518.283	222.854	Required	
	506.110	211.433			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

- Indicates pipe length does not match coordinates

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	2	74.500	73.550	0.800	Open Manhole	450
1.001	o	225	2	74.430	73.262	0.943	Open Manhole	450
2.000	o	100	3	74.720	74.120	0.500	Open Manhole	450
2.001	o	150	4	74.550	74.063	0.337	Open Manhole	450
3.000	o	100	5	74.420	73.800	0.520	Open Manhole	450
3.001	o	100	6	74.700	73.793	0.807	Open Manhole	450
1.002	o	300	3	74.550	73.130	1.120	Open Manhole	450
1.003	o	300	4	74.550	73.031	1.219	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	32.000#	150.2	2	74.430	73.337	0.943	Open Manhole	450
1.001	5.000#	87.7	3	74.550	73.205	1.120	Open Manhole	450
2.000	1.000#	142.9	4	74.550	74.113	0.337	Open Manhole	450
2.001	1.000#	142.9	3	74.550	74.056	0.344	Open Manhole	450
3.000	1.000#	142.9	6	74.700	73.793	0.807	Open Manhole	450
3.001	1.000#	2.2	3	74.550	73.330	1.120	Open Manhole	450
1.002	16.692	168.6	4	74.550	73.031	1.219	Open Manhole	1200
1.003	16.692	168.6		74.550	72.932	1.318	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.054	0.054	0.054
1.001	-	-	100	0.077	0.077	0.077
2.000	-	-	100	0.010	0.010	0.010
2.001	-	-	100	0.025	0.025	0.025
3.000	-	-	100	0.010	0.010	0.010
3.001	-	-	100	0.025	0.025	0.025
1.002	-	-	100	0.051	0.051	0.051
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.252	0.252	0.252

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	2	150	0.800	0.943	Unclassified	450	0	0.800	Unclassified
1.001	2	225	0.943	1.120	Unclassified	450	0	0.943	Unclassified
2.000	3	100	0.337	0.500	Unclassified	450	0	0.500	Unclassified
2.001	4	150	0.337	0.344	Unclassified	450	0	0.337	Unclassified
3.000	5	100	0.520	0.807	Unclassified	450	0	0.520	Unclassified
3.001	6	100	0.807	1.120	Unclassified	450	0	0.807	Unclassified
1.002	3	300	1.120	1.219	Unclassified	450	0	1.120	Unclassified
1.003	4	300	1.219	1.318	Unclassified	1200	0	1.219	Unclassified

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)
1.003		74.550	72.932	73.000	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 Offline Controls	0	Number of Time/Area Diagrams	6
Number of Online Controls	1	Number of Storage Structures	6	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for Storm

Orifice Manhole: 4, DS/PN: 1.003, Volume (m^3): 2.8

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 73.031

Storage Structures for Storm

Porous Car Park Manhole: 2, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	15.5
Max Percolation (l/s)	43.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	74.150	Cap Volume Depth (m)	0.200

Complex Manhole: 2, DS/PN: 1.001

Filter Drain

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	150.0
Invert Level (m)	73.407	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	13.3		

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	26.0
Max Percolation (l/s)	72.2	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	74.100	Cap Volume Depth (m)	0.250

Filter Drain Manhole: 4, DS/PN: 2.001

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	0.0
Invert Level (m)	74.113	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	62.0		

Filter Drain Manhole: 6, DS/PN: 3.001

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	150.0
Invert Level (m)	73.793	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	65.0		

Complex Manhole: 3, DS/PN: 1.002

Cellular Storage

Invert Level (m) 73.225 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	135.0	0.0	0.400	135.0	0.0	0.401	0.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	13.0
Max Percolation (l/s)	36.1	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	74.050	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: 4, DS/PN: 1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	13.0
Max Percolation (l/s)	36.1	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	74.190	Cap Volume Depth (m)	0.300

Time Area Diagram at Pipe Number 2.000 for Storm

Total Area (ha) 0.010

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.005	4	8	0.005

Time Area Diagram at Pipe Number 2.001 for Storm

Total Area (ha) 0.013

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.007	4	8	0.006

Time Area Diagram for Green Roof at Pipe Number 2.001 (Storm)

Area (m³) 120 Evaporation (mm/day) 2
Depression Storage (mm) 4 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	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	0.002181	24	28	0.000657	48	52	0.000198	72	76	0.000060	96	100	0.000018
4	8	0.001785	28	32	0.000538	52	56	0.000162	76	80	0.000049	100	104	0.000015
8	12	0.001462	32	36	0.000440	56	60	0.000133	80	84	0.000040	104	108	0.000012
12	16	0.001197	36	40	0.000360	60	64	0.000109	84	88	0.000033	108	112	0.000010
16	20	0.000980	40	44	0.000295	64	68	0.000089	88	92	0.000027	112	116	0.000008
20	24	0.000802	44	48	0.000242	68	72	0.000073	92	96	0.000022	116	120	0.000007

Time Area Diagram at Pipe Number 3.000 for Storm

Total Area (ha) 0.010

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.005	4	8	0.005

Time Area Diagram at Pipe Number 3.001 for Storm

Total Area (ha) 0.013

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.007	4	8	0.006

Time Area Diagram for Green Roof at Pipe Number 3.001 (Storm)

Area (m³) 120 Evaporation (mm/day) 2
Depression Storage (mm) 4 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	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	0.002181	24	28	0.000657	48	52	0.000198	72	76	0.000060	96	100	0.000018
4	8	0.001785	28	32	0.000538	52	56	0.000162	76	80	0.000049	100	104	0.000015
8	12	0.001462	32	36	0.000440	56	60	0.000133	80	84	0.000040	104	108	0.000012
12	16	0.001197	36	40	0.000360	60	64	0.000109	84	88	0.000033	108	112	0.000010
16	20	0.000980	40	44	0.000295	64	68	0.000089	88	92	0.000027	112	116	0.000008
20	24	0.000802	44	48	0.000242	68	72	0.000073	92	96	0.000022	116	120	0.000007

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
1.000	2	0.500
1.001	2	0.500
2.000	3	0.500
2.001	4	0.500
3.000	5	0.500
3.001	6	0.500
1.002	3	0.500
1.003	4	0.500

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.224
FEH Rainfall Version	1999	E (1km)	0.293
Site Location	GB 453800 204400 SP 53800 04400	F (1km)	2.464
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.351	Cv (Winter)	0.840
D2 (1km)	0.306		

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

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 (%)	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)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	2	15 Winter	1	+0%	30/15 Summer				73.629	-0.071	0.000	0.53
1.001	2	15 Summer	1	+0%	30/15 Summer				73.374	-0.113	0.000	0.46
2.000	3	15 Winter	1	+0%	100/15 Summer				74.155	-0.065	0.000	0.26
2.001	4	15 Winter	1	+0%	100/15 Summer				74.110	-0.103	0.000	0.22
3.000	5	15 Winter	1	+0%	30/480 Summer				73.835	-0.065	0.000	0.26
3.001	6	15 Winter	1	+0%	30/480 Summer				73.816	-0.077	0.000	0.12
1.002	3	180 Winter	1	+0%	30/15 Summer				73.332	-0.098	0.000	0.04
1.003	4	180 Winter	1	+0%	30/15 Summer				73.331	0.000	0.000	0.04

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	2		5	7.4	OK	
1.001	2		5	15.4	OK	
2.000	3			1.0	OK	
2.001	4		8	2.4	OK	
3.000	5			1.0	OK	
3.001	6		6	2.4	OK	
1.002	3		78	3.0	OK	
1.003	4		135	2.7	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 Offline Controls	0	Number of Time/Area Diagrams	6
Number of Online Controls	1	Number of Storage Structures	6	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.224
FEH Rainfall Version	1999	E (1km)	0.293
Site Location	GB 453800 204400 SP 53800 04400	F (1km)	2.464
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.351	Cv (Winter)	0.840
D2 (1km)	0.306		

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

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 (%)	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)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	2	480 Winter	30	+0%	30/15 Summer				74.130	0.430	0.000	0.16
1.001	2	480 Winter	30	+0%	30/15 Summer				74.119	0.632	0.000	0.14
2.000	3	15 Winter	30	+0%	100/15 Summer				74.187	-0.033	0.000	0.79
2.001	4	15 Winter	30	+0%	100/15 Summer				74.148	-0.065	0.000	0.61
3.000	5	480 Winter	30	+0%	30/480 Summer				74.120	0.220	0.000	0.10
3.001	6	480 Winter	30	+0%	30/480 Summer				74.119	0.226	0.000	0.08
1.002	3	480 Winter	30	+0%	30/15 Summer				74.128	0.698	0.000	0.08
1.003	4	480 Winter	30	+0%	30/15 Summer				74.218	0.887	0.000	0.07

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	2		120	2.2	SURCHARGED	
1.001	2			4.9	SURCHARGED	
2.000	3			3.1	OK	
2.001	4		6	6.6	OK	
3.000	5			0.4	SURCHARGED	
3.001	6		96	1.5	SURCHARGED	
1.002	3			5.7	SURCHARGED	
1.003	4		632	5.0	SURCHARGED	

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.224
FEH Rainfall Version 1999 E (1km) 0.293
Site Location GB 453800 204400 SP 53800 04400 F (1km) 2.464
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.351 Cv (Winter) 0.840
D2 (1km) 0.306

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

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 (%) 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)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	2	480 Winter	100	+40%	30/15 Summer				74.417	0.717	0.000	0.27
1.001	2	480 Winter	100	+40%	30/15 Summer				74.409	0.922	0.000	0.20
2.000	3	480 Winter	100	+40%	100/15 Summer				74.407	0.187	0.000	0.19
2.001	4	480 Winter	100	+40%	100/15 Summer				74.407	0.194	0.000	0.21
3.000	5	480 Winter	100	+40%	30/480 Summer				74.408	0.508	0.000	0.19
3.001	6	480 Winter	100	+40%	30/480 Summer				74.407	0.514	0.000	0.14
1.002	3	480 Winter	100	+40%	30/15 Summer				74.407	0.977	0.000	0.12
1.003	4	480 Winter	100	+40%	30/15 Summer				74.400	1.069	0.000	0.08

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	2		192	3.7	FLOOD RISK	
1.001	2		200	6.6	FLOOD RISK	
2.000	3			0.7	SURCHARGED	
2.001	4		192	2.2	FLOOD RISK	
3.000	5			0.7	FLOOD RISK	
3.001	6		224	2.6	FLOOD RISK	
1.002	3			8.5	FLOOD RISK	
1.003	4		160	6.0	FLOOD RISK	

Appendix F Flood Exceedance Plan

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTS AND SPECIFICATIONS. ANY DISCREPANCIES BETWEEN THIS DRAWING AND ANY OTHER RELEVANT ENGINEERING DRAWING SHOULD BE REPORTED TO THE DESIGN ENGINEER IMMEDIATELY.
2. DO NOT SCALE FROM THIS DRAWING.
3. ALL DIMENSIONS ARE IN m UNLESS OTHERWISE STATED.
4. ALL LEVELS ARE IN m AOD.
5. THIS DRAWING HAS BEEN PRODUCED IN COLOUR AND SHOULD BE REPRODUCED IN COLOUR.
6. TOPOGRAPHICAL INFORMATION TAKEN FROM GLANVILLE DRAWING NUMBER 8190128/4101 DATED JANUARY 2019.
7. LANDSCAPE PLAN TAKEN FROM ADAMS HABERMEHL DRAWING NUMBER 0763.1.2 REV B DATED OCTOBER 2019.

KEY:

SITE BOUNDARY

FLOOD EXCEEDANCE ROUTE

Mark	Revision	Date	Drawn	Chkd	Appd
A	ARCHITECT LAYOUT UPDATED	08.02.21	VT	JS	SH

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Drawing Issue Status

PRELIMINARY

COWLEY CONSERVATIVE CLUB

FLOOD EXCEEDANCE ROUTES

Client

CANTAY ESTATES

Date of 1st Issue	Designed	Drawn
03.12.2019	-	GM
A1 Scale	Checked	Approved
1:200	GR	SH

Drawing Number: 46381/2001/003

Revision: A

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