

Your Environment

SURFACE WATER DRAINAGE STRATEGY LAND TO THE NORTH OF FLINT BARN, BARNHAM

For Manorwood Ltd

Your Environment
Head Office, Chilgrove Business Centre, Chilgrove Park Road, Chilgrove, Nr
Chichester, PO18 9HU
[REDACTED]

Report Number: YE4281, Date: June 2018

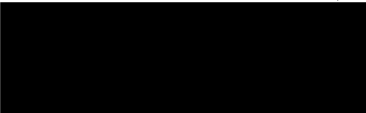
Tristan Le Butt
[REDACTED]

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	Name	Position	Signature	Date
Prepared by:	Paul Timmins	Drainage Consultant		June 2018
Reviewed by:	Tristan Le Butt	Geo Environmental Consultant		June 2018
Approved:	Colin Hiscock	Director		June 2018
For and on behalf of YourEnvironment				

Issue	Date	Description	Prepared	Reviewed	Approved
00	08/06/18	Final Report	PT	TLB	CH
01	11/06/18	Reference to the correct planning application reference added.	PT	TLB	CH

1.0 Executive Summary

YourEnvironment (YE) was instructed by Manorwood Ltd (Quote No: Q4281 Dated: 6th February 2018) to provide a Surface Water Drainage Report to describe the proposed drainage strategy for the proposed development within land to the north of Flint Barn, Barnham. The development of a new dwelling was granted permission by Arun District Council on 1st February 2018 (planning ref. BN/61/16/PL). A revised layout for the development was submitted on 2nd March 2018 and is as yet undecided (planning ref. BN/7/18/PL).

The purpose of this report is to provide a drainage layout plan for the revised development layout. Similar to the previous permission, it is expected that a planning condition relating to surface water drainage will be applied should the application be permitted.

We trust this is sufficient for your requirements and should you have any questions please do not hesitate to contact the undersigned.

For YourEnvironment

Colin Hiscock

Director

2.0 Introduction

YourEnvironment (YE) was instructed by Manorwood Ltd (Quote No: Q4281 Dated: 6th February 2018) to provide a Surface Water Drainage Report to describe the drainage strategy for the proposed development within land to the north of Flint Barn, Barnham.

The development of a new dwelling was granted permission by Arun District Council on 1st February 2018 (planning ref. BN/61/16/PL). A revised layout for the development was submitted on 2nd March 2018 and is as yet undecided (planning ref. BN/7/18/PL).

The location of the site is illustrated on Figure 1 (below).



Figure 1: Location of the development site

The development proposes the removal of existing storage building and erection of a single dwelling on a site of around 0.7ha. The new dwelling is 80m² with space for parking and a storage barn/garage to the north (140m²).

Plans and elevations of the proposed development are provided in Appendix A.

Should the revised application be permitted, it is expected that a planning condition relating to surface water drainage will be applied to the development similar in wording to Condition 3 from the Decision Notice for the initial application. This condition states the following:

Development shall not commence until full details of the proposed surface water drainage scheme have been submitted to and approved in writing by the Local Planning Authority.

The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, the recommendations of the SUDS Manual produced by CIRIA.

Winter groundwater monitoring to establish highest annual ground water levels and Percolation testing to BRE 365, or similar approved, will be required to support the design of any Infiltration drainage.

No building shall be occupied until the complete surface water drainage system serving the property has been implemented in accordance with the agreed details and the details so agreed shall be maintained in good working order in perpetuity.

Reason: To ensure that the proposed development is satisfactorily drained in accordance with policies GEN7 and GEN9 of the Arun District Council Local Plan. This is required to be a pre-commencement condition because it is necessary to implement the surface water drainage system prior to commencing any building works.

3.0 Hierarchy of Preference for Surface Water Disposal

Part H3 of the Building Regulations sets out the hierarchy of preference for the disposal of surface water from new development as follows:

Rainwater Drainage

H3... (3) Rainwater from a system provided pursuant to sub-paragraphs (1) and (2) shall discharge to one of the following, listed in order of priority:

- a) An adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,*
- b) A watercourse, or, where that is not reasonably practicable,*
- c) A sewer.*

Infiltration potential at the site

Investigations to determine whether the underlying soils at the site were suitable for infiltration were carried out in March 2018. These comprised the excavation of two trial pits in order to carry out permeability testing using the BRE365 test procedure.

However, during excavation of the trial pits it was found that the groundwater table was high and prevented the tests from being undertaken.

The trial pit logs and selected photos of the trial pits excavated are provided in [Appendix B](#).

Without permeability test results, it has been concluded that surface water by infiltration means is not possible at the site. Firstly, because of the difficulty of measuring a soil infiltration rate for the underlying soils and secondly because the base of any soakaway structure is likely to be less than 1m above the maximum anticipated groundwater level.

The presence of a watercourse

Inspection of the topographical survey of the site (see [Appendix C](#)) identifies a drainage ditch located to the west of the proposed location of the new dwelling. This drains in a southerly direction towards the watercourse alongside Hill Lane, which eventually feeds into Lidsey Rife and then to Aldborough Rife and out to sea at Bognor Regis¹.

It is proposed that surface water from the site is disposed to the watercourse alongside the development site.

¹ Environment.data.gov.uk. (2018). Environment Agency - Catchment Data Explorer. [online] Available at: <http://environment.data.gov.uk/catchment-planning/WaterBody/GB107041011980> [Accessed 6 Jun. 2018].

4.0 Surface Water runoff disposal

Surface water runoff shall be managed from roofs, external circulation areas close to the new building and the access roads. Runoff from these areas shall be piped to the site's discharge point and then into the watercourse adjacent to the site.

The method of surface water disposal has been developed with the guidance (Supplementary Requirements for Surface Water Drainage Proposals) published by Arun District Council.²

The guidance document recommends that discharge to a watercourse be restricted to the estimated mean greenfield runoff rate (QBar) by means of a controlled outflow (or restricted to existing runoff rates for brownfield sites).

Calculations for QBar have been undertaken using the Rural Runoff Calculator module within Microdrainage using the ReFH2 method. The results are provided in Appendix D (the site-specific point descriptors and rainfall depth data were acquired through the Flood Estimation Handbook Web Service³). As the area to be drained from the site is small (220m²) the calculated values for QBar are very small (0.1l/s). Control of surface water flows at this flow rate is impractical.

As infiltration structures are not feasible due to the high groundwater table and control of runoff impractical due to the low flows, it is proposed that surface water runoff from the parking area, the storage barn and the roof to drain to a planted dry swale which allows some runoff to infiltrate to ground and be disposed by evapotranspiration. The proposed drainage design layout is provided in Appendix E. The calculations below have been used to confirm that the swale is sized adequately.

Design Calculations

The swale is designed to drain the parking area (including the storage Barn) and the roof to the new dwelling. This is a total area of 220m².

The parking area will be surfaced in 10mm pea shingle over a Type 1 sub-base. The layers will be graded to fall towards the swale to allow runoff to be drained away. Direct infiltration of rainfall through the Type 1 layer and into the natural ground is clearly possible, however the design calculations will assume that the underlying soils are saturated causing runoff to drain to the swale directly.

The swale will incorporate a 50mm orifice at its outlet to control flows from the site and the swale will be sized to provide storage for the 1:30 year event of critical duration (assumed to be 15 minutes). The swale will discharge into a narrow ditch which will run southwards along the western boundary to the site discharging into the existing watercourse.

The calculations assume that infiltration to ground from the swale will not occur, however clearly both infiltration and evapo-transpiration will occur but at relatively low rates. The presence of the high groundwater table also limits the use of infiltration for surface water disposal in design terms, but in practical terms it will still occur.

² Arun District Council. (2018). Supplementary Requirements for Surface Water Drainage Proposals. [online] Arun.gov.uk. Available at: <https://www.arun.gov.uk/surfacewater> [Accessed 6 Jun. 2018].

³ Fehweb.ceh.ac.uk. (2018). Home Page - FEH Web Service. [online] Available at: <https://fehweb.ceh.ac.uk/> [Accessed 6 Jun. 2018].

Swale Dimensions

The swale shall be formed using the characteristics shown in Table 1 below

Plan Area of system (17m long x 2.1m wide at crest)	35m ²
Bed width	300mm
Side Slopes	1:3
Longitudinal Slope	1:200
Crest Level	9.30m
Invert Level	9.00m

Table 1: Design parameters for the swale

Hydraulic modelling of the drainage design has been undertaken with the Source Control module of the Microdrainage software suite. The results of the modelling are provided in Appendix F. The results demonstrate that no flooding occurs during a 1 in 30 return period event of critical duration.

Maintenance and Management

The Swale shall be maintained on a regular basis by the landowner. The maintenance actions recommended by the CIRIA SuDS Manual 2015 (Table 17.1) are reproduced below.

TABLE 17.1 Operation and maintenance requirements for swales			
	Maintenance schedule	Required action	Typical frequency
Regular maintenance		Remove litter and debris	Monthly, or as required
		Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
		Manage other vegetation and remove nuisance plants	Monthly at start, then as required
		Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
		Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
		Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
		Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance		Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions		Repair erosion or other damage by re-turfing or reseed	As required
		Relevel uneven surfaces and reinstate design levels	As required
		Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
		Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
		Remove and dispose of oils or petrol residues using safe standard practices	As required

5.0 Limitations

YE have prepared this report with all reasonable skill, care and diligence. The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources.

The opinions given in this report have been dictated by the finite data on which are they based and are relevant only to the purpose for which the report was commissioned.

Information reviewed should not be considered exhaustive and has accepted in good faith as providing true and representative data with respect to site conditions. Should additional information become available which may influence the opinion expressed in this report, YE reserves the right to review such information and, if warranted, to alter the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed.

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted industry practices at this time and as such are not a guarantee that the study site is free of hazardous conditions.

This report has been prepared solely for the use of the named client, and may not be relied upon by other parties without written consent from YE. YE disclaim any responsibility to the client and others in respect of any matters outside the agreed scope of the work

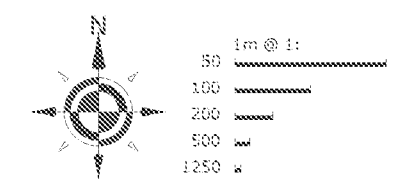
Appendix A -Proposed Development Layout Plans



Notes:

This drawing is the copyright of
Manorwood
Do not scale from this drawing except
for Local Authority planning purposes

All dimensions must be checked on site
prior to commencement of works



Location Plan
1:1250

Revisions



Client
Julie Waite

Job
Land (to the rear of) The Flint Barn
Yapton Road
Barnham

Drawing
Site:

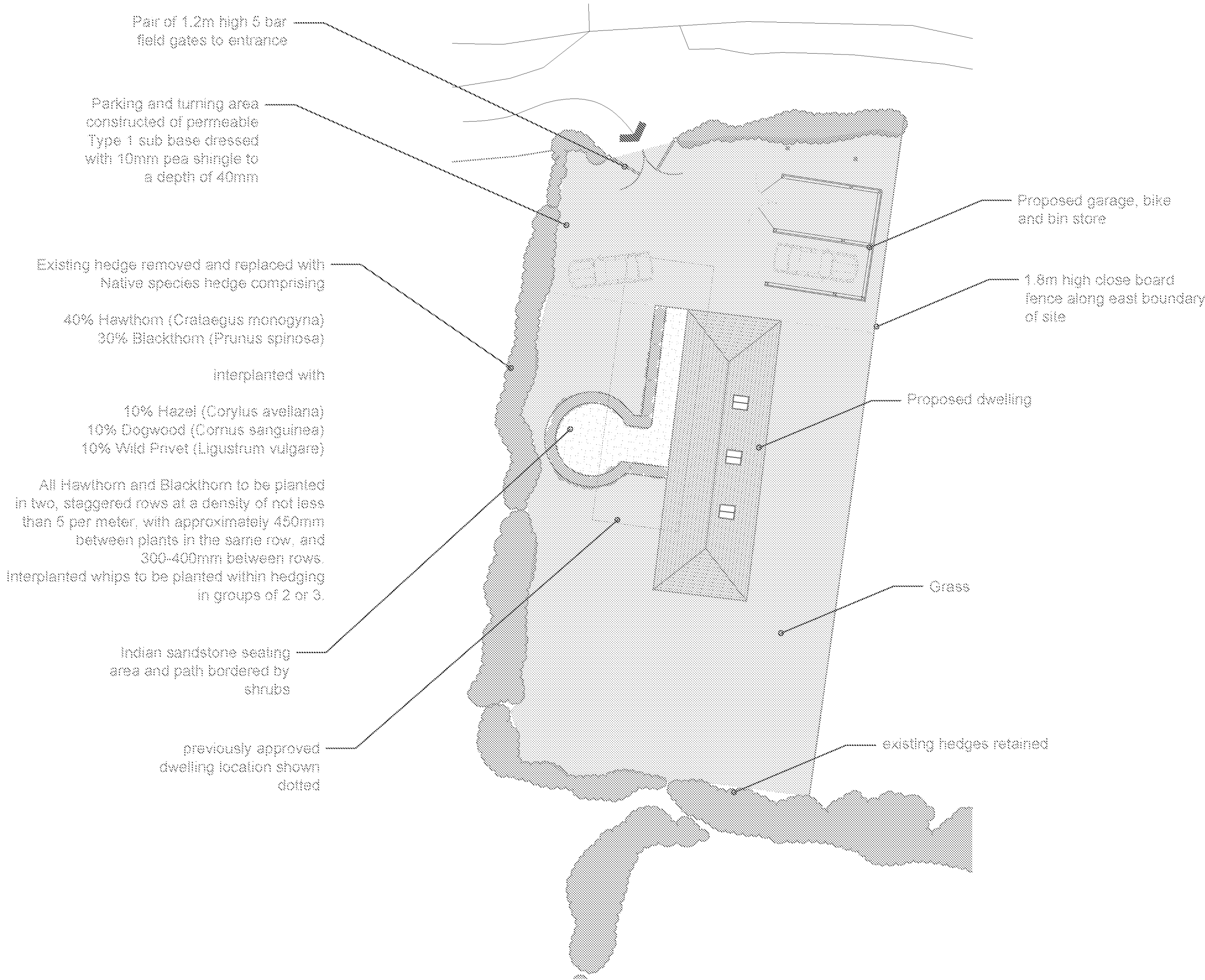
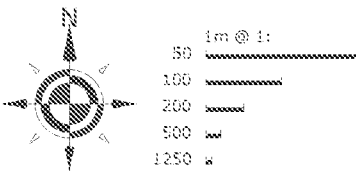
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Status	For comment	

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Block Plan
1:200

Revisions



Client
Julie Waite

Job
Land (to the rear of) The Flint Barn
Yapton Road
Barnham

Drawing
Site:
Block Plan

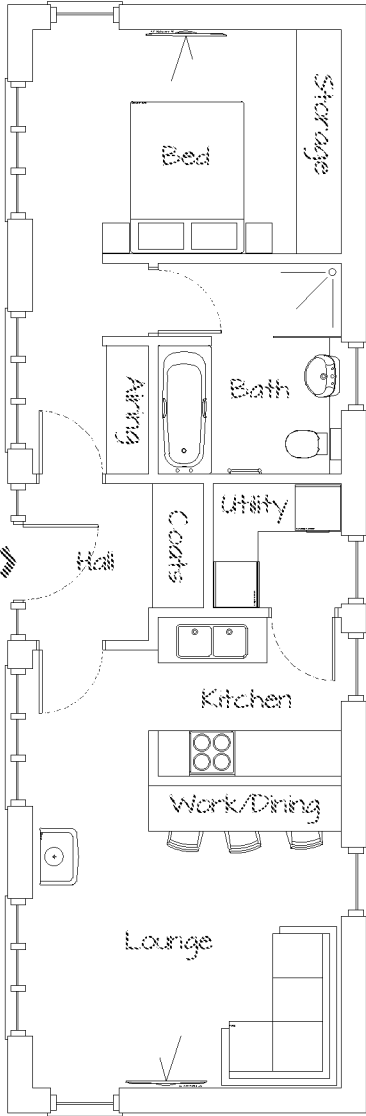
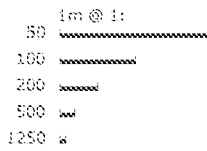
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Status
For comment

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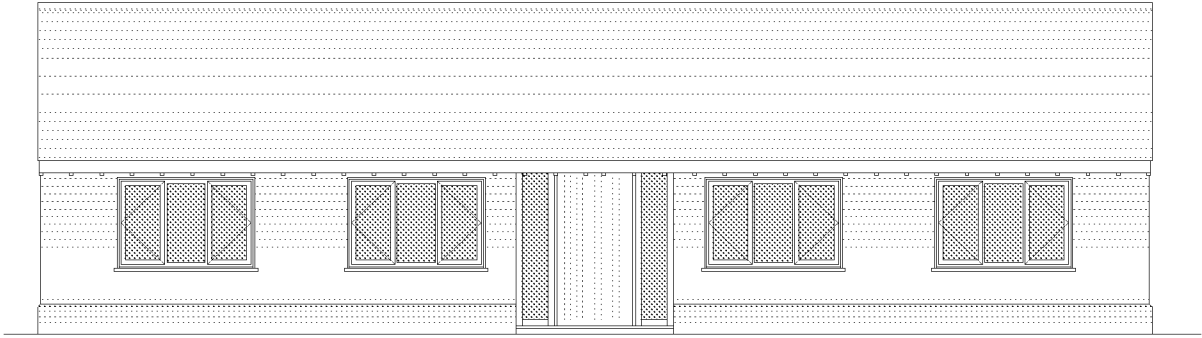
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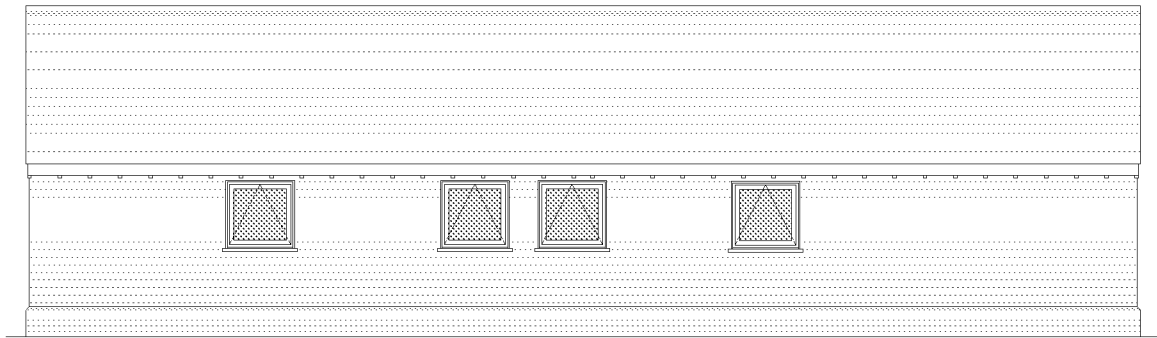
Approved Plan

1:100



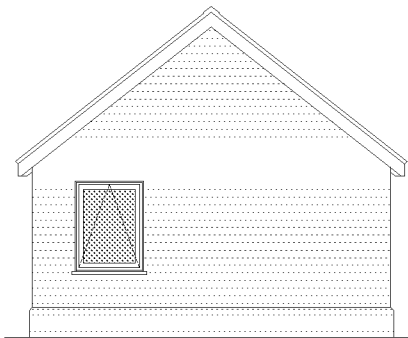
Approved West Elevation

1:100



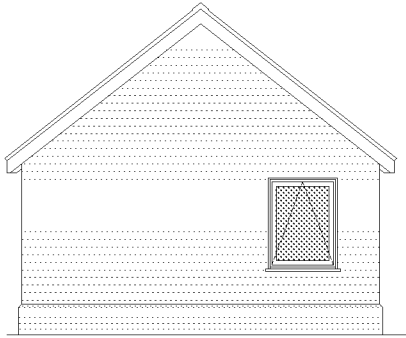
Approved East Elevation

1:100



Approved South Elevation

1:100



Approved North Elevation

1:100

Revisions



Client
Julie Waite

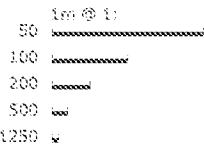
Job
Land (to the rear of) The Flint Barn
Yapton Road
Barnham

Drawing
Approved
Plan
Elevations

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Job No.	Drawing No.	Revision
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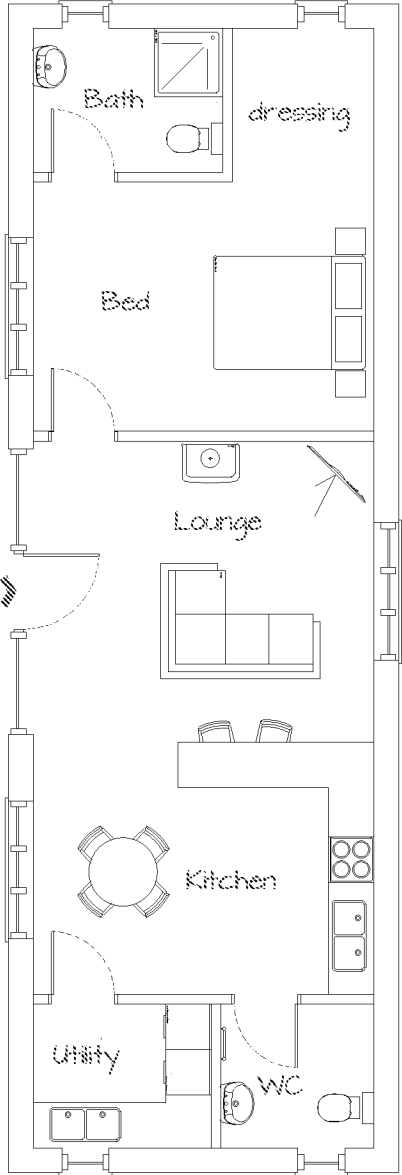
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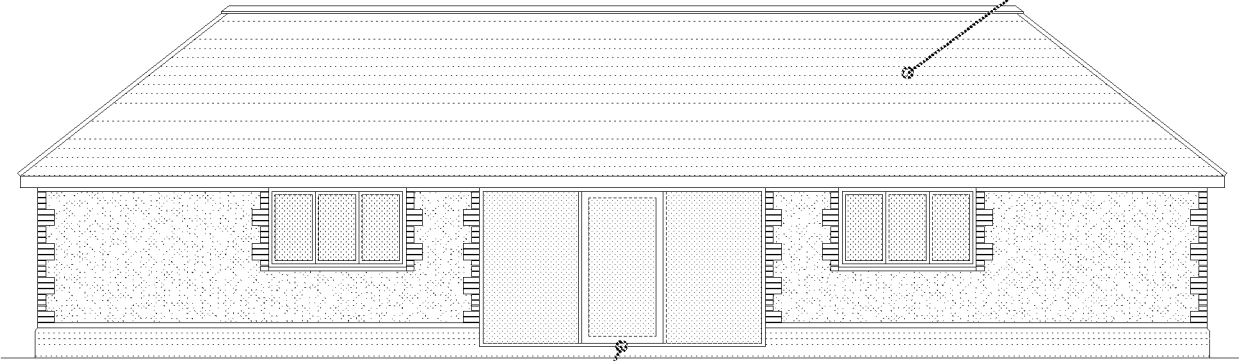


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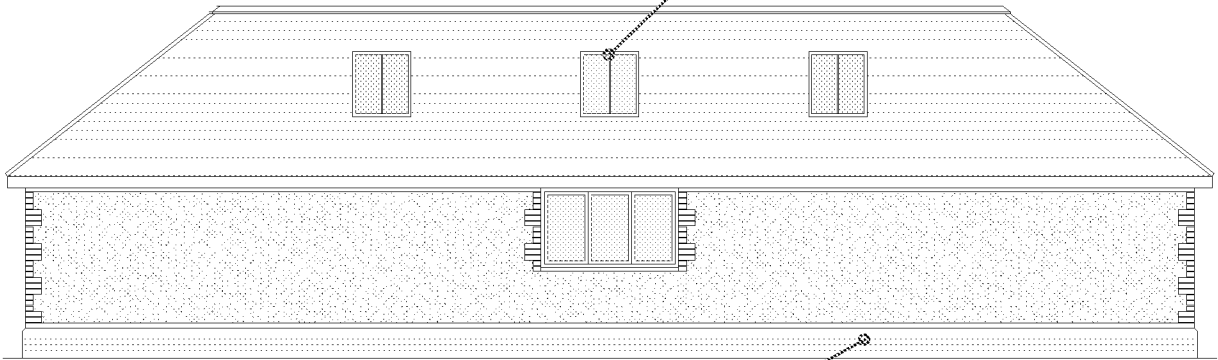


Proposed Plan
1:100



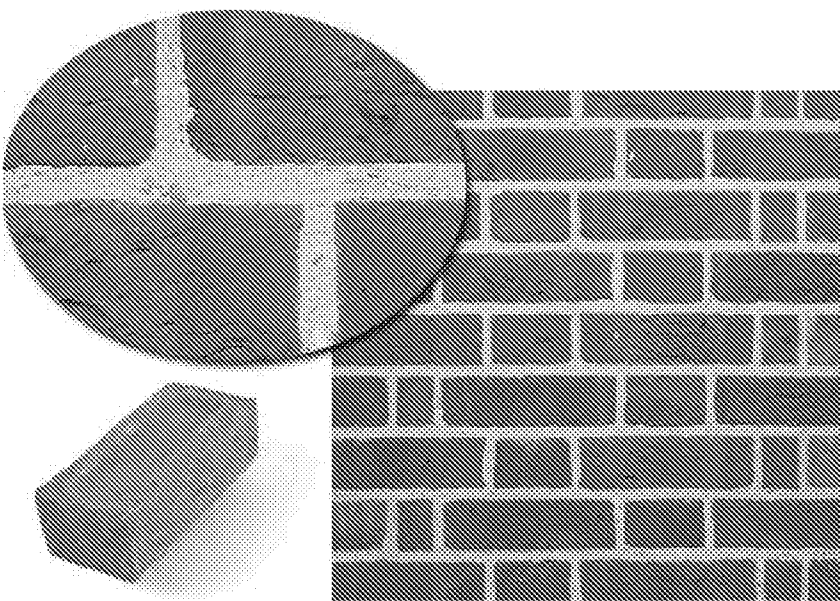
Proposed West Elevation
1:100

Dark stained timber doors and windows

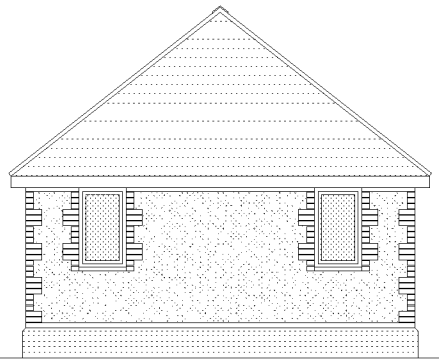


Proposed East Elevation
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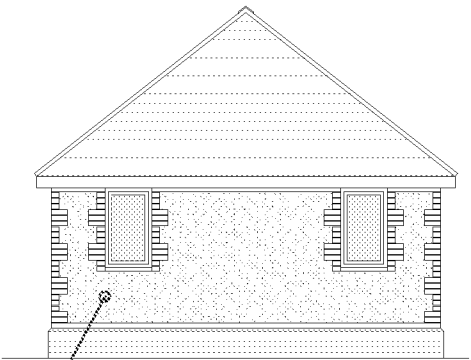
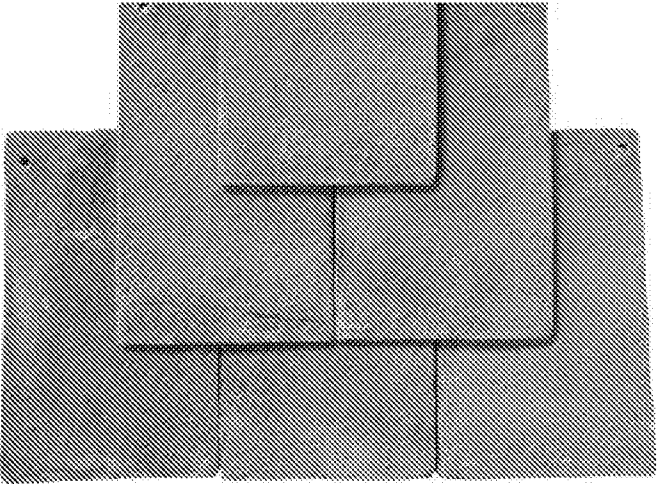
Lambs - Chartwell Medium Multi handmade bricks



Spicer - Medium Antique handmade plain clay tiles

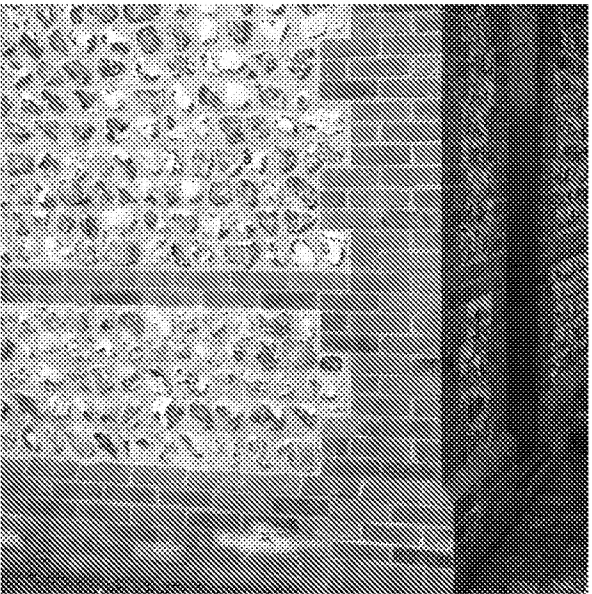


Proposed South Elevation
1:100



Proposed North Elevation
1:100

Flint facing walls to brick quoins and reveals



Revisions



Client
Julie Waite

Job
Land (to the rear of) The Flint Barn
Yapton Road
Barnham

Drawing
Proposed
Plan
Elevations

Drawn	Date	Scale @A3
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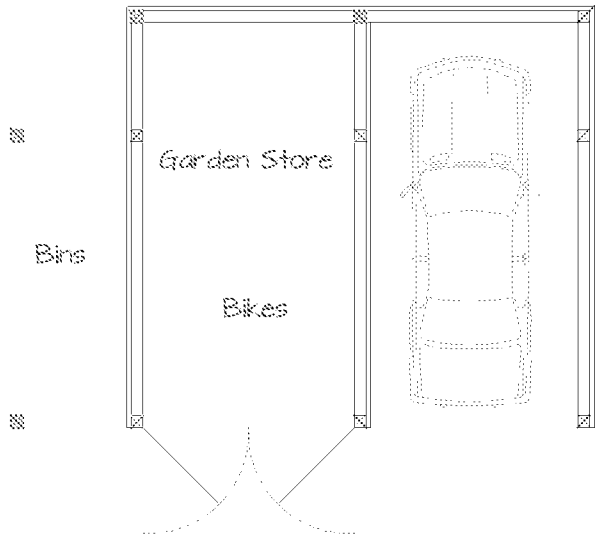
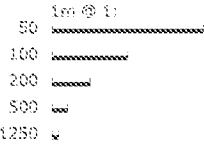
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Status
For comment

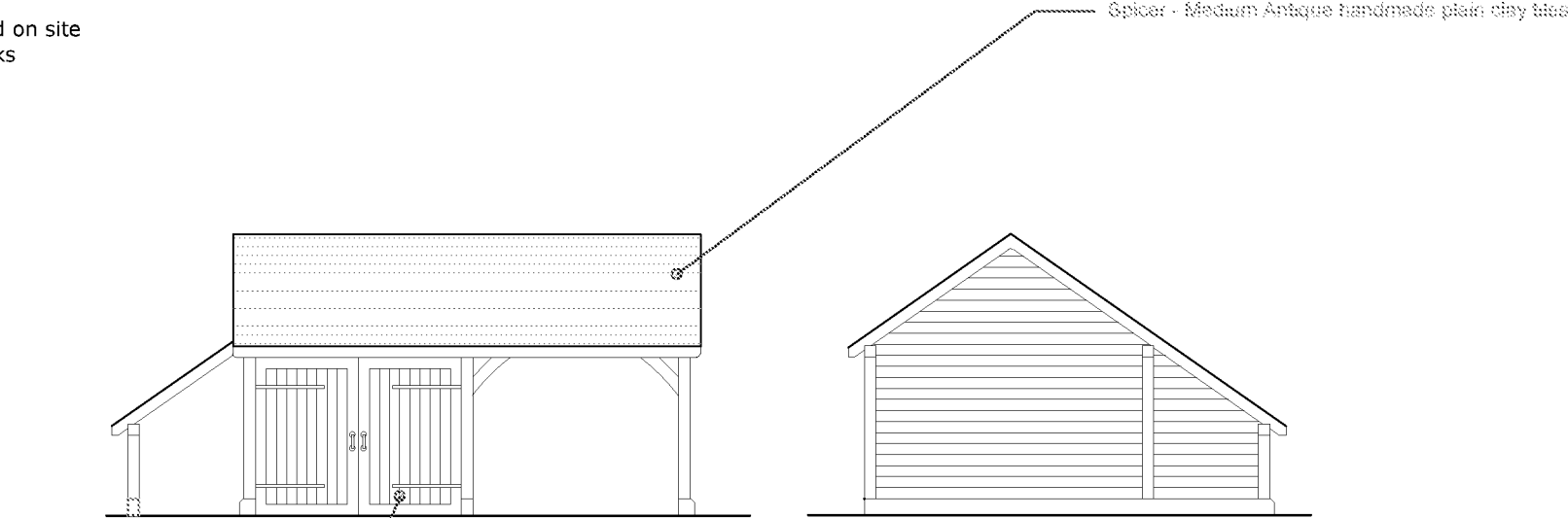
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Proposed Plan
1:100

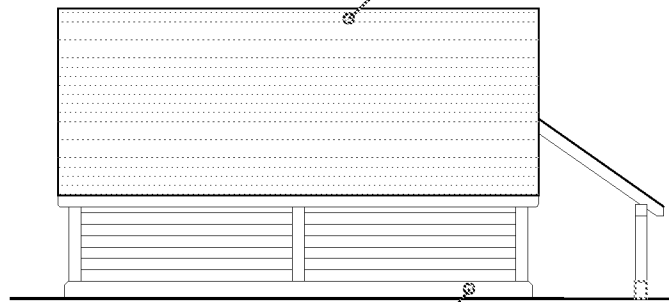


Proposed West Elevation
1:100

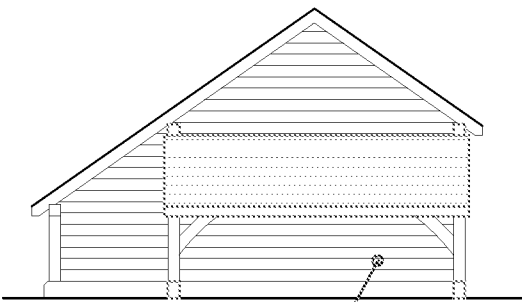
Proposed South Elevation
1:100

Dark stained timber doors

Conservation rooflights

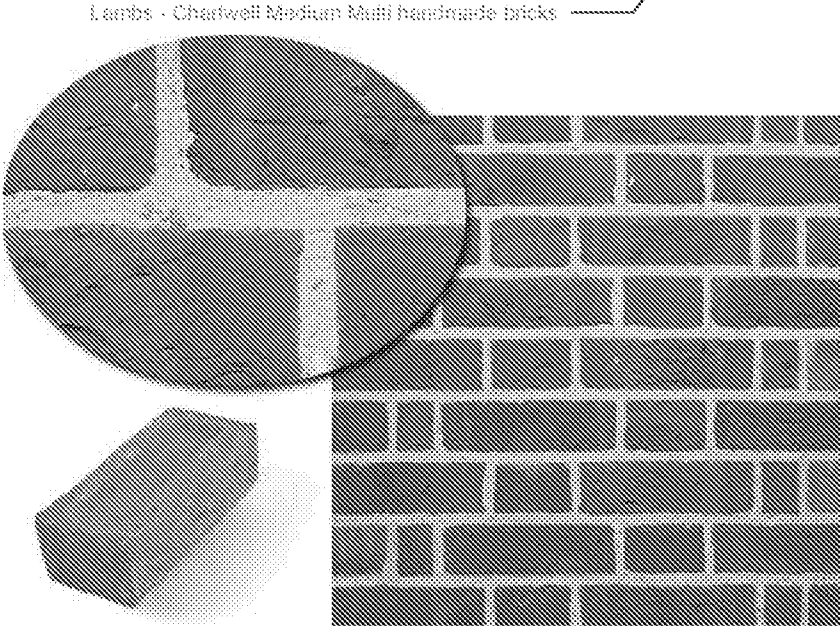


Proposed East Elevation
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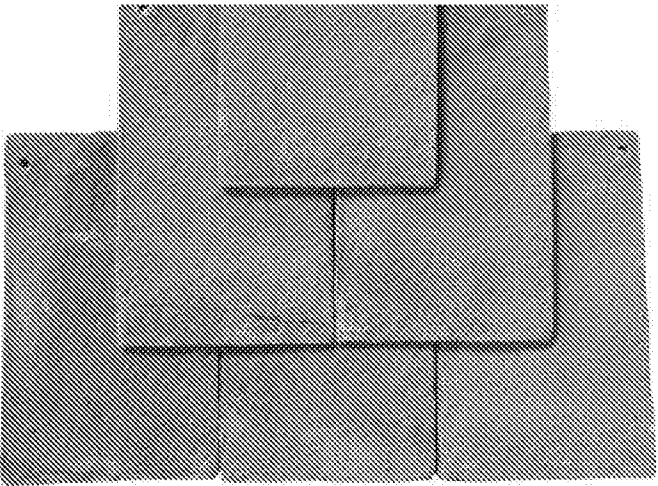


Proposed North Elevation
1:100

unstained oak weatherboard



Lambs - Chartwell Medium Multi handmade bricks



Revisions



Client
Julie Waite

Job
Land (to the rear of) The Flint Barn
Yapton Road
Barnham

Drawing
Proposed garage, bin and bike store
Plan
Elevations

Drawn	Date	Scale @A3
MD	06.07.16	1:100

Job No.	Drawing No.	Revision
1607FL	003	1

Status
For comment

Appendix B - Trial pit logs and photos



Name

ID

YE4281

Client

Engineer

Nick H

Location

Land to rear of Flint Barn, Barnham

Contractor

Tim Splihurst

Date

21.03.2018

Remarks

Trial Pit Information

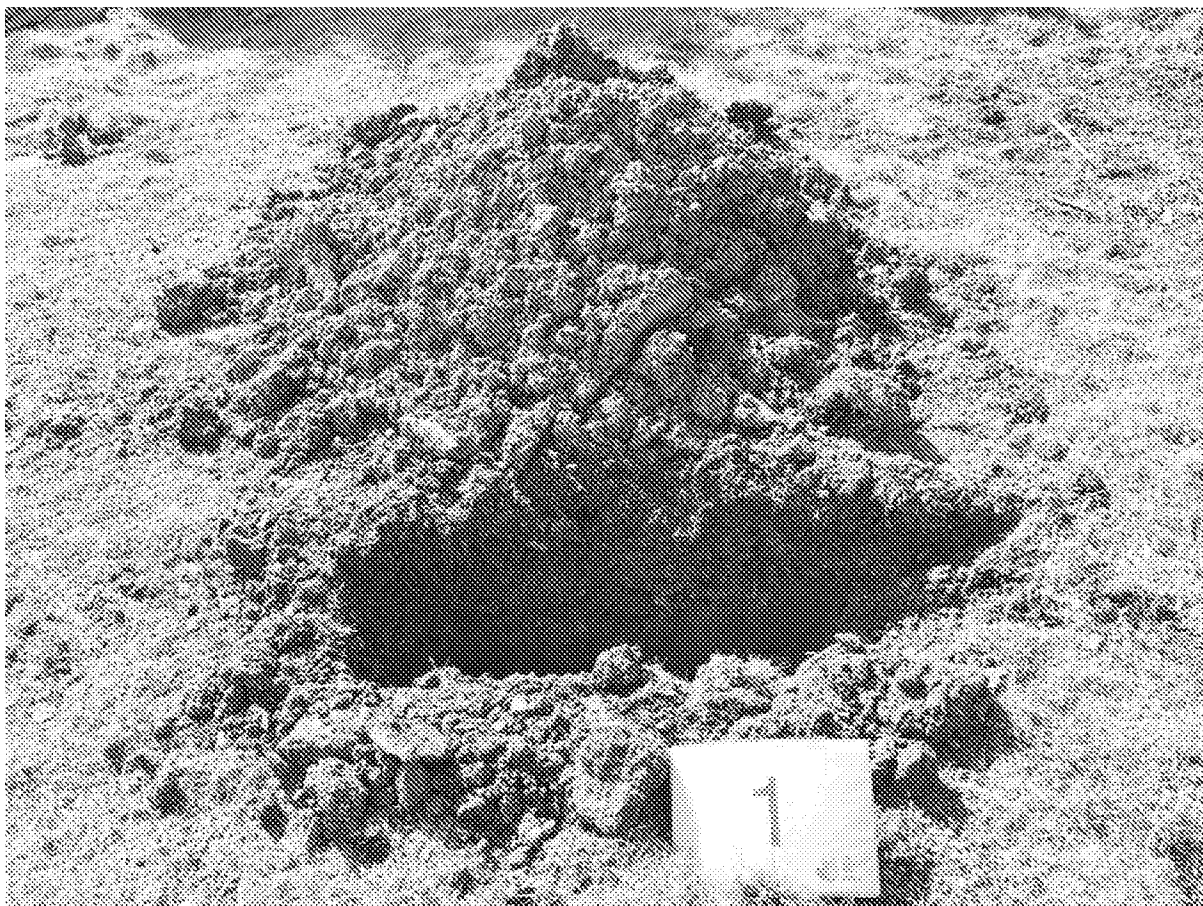
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Geology Information

Hole ID	Geology Code	Legend Code	Top Depth	Base Depth	General Description of Stratum	Stratum Reference
TP1			0.000	0.250	Made ground - soft medium dark grey SILT with rubble and rubbish	
TP1			0.250	0.850	Dark grey very soft medium SILT	
TP1			0.850	1.700	Light brown stiff CLAY	
TP1			1.700	2.000	Light brown medium sand and stiff clay with loose medium GRAVEL	
TP2			0.000	0.450	Made ground - soft medium dark grey SILT with rubble and rubbish	
TP2			0.450	0.850	Dark grey very soft medium SILT	
TP2			0.850	1.050	Light brown stiff CLAY	
TP2			1.050	2.000	Light brown medium sand and stiff clay with loose medium GRAVEL	



Record Photo of Trial Pit 1



Record Photo of Trial Pit 1



Record Photo of Trial Pit 2



Record Photo of Trial Pit 2

Appendix C - Topographical Survey

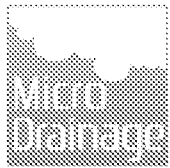




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Appendix D - Microdrainage modelling outputs: QBar calculation



KPT Properties		Page 1
19 Lonsdale Avenue Hutton Essex CM13 1NH		
Date 07/06/2018 09:37 File	Designed by Paul Checked by	
XP Solutions Source Control 2018.1		

ReFH2 Rural Runoff Peak Flows

Input

Return Period (Years)	2
FEH Rainfall Version	2013
Site Location	GB 496538 104129
Data Type	Point
Season	Summer
Country	England/Wales/Northern Ireland
Area (ha)	0.022
SAAR (mm)	757
BFIHOST	0.661
FARL	0.000
SPRHOST	0.000
URBEXT (2000)	0.0000

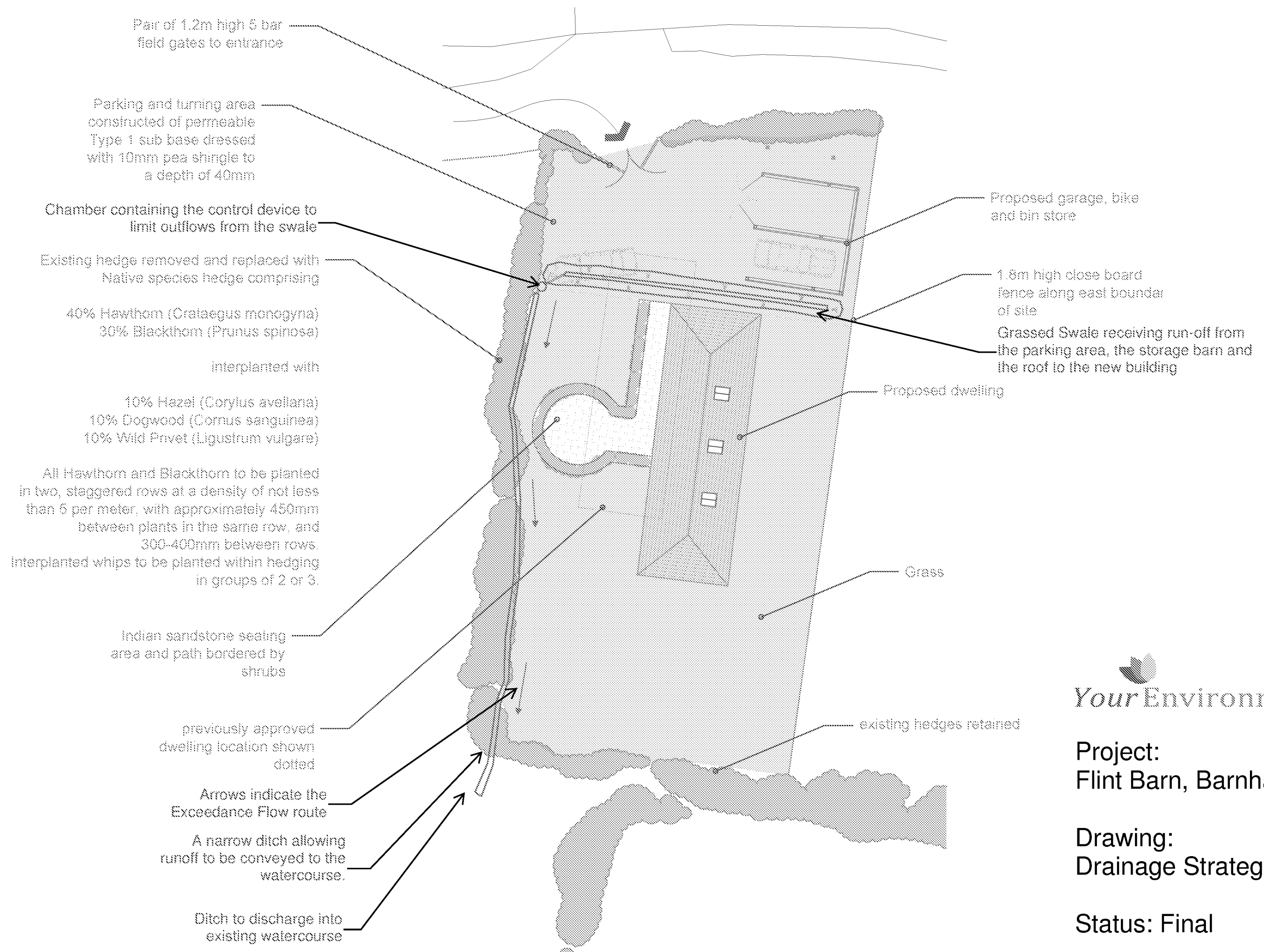
Results

Return Period (Years)	Rural (l/s)	Urban (l/s)
User	0.1	0.1
Q1	0.1	0.1
Q2	0.1	0.1
Q5	0.1	0.1
Q10	0.1	0.1
Q30	0.1	0.1
Q50	0.2	0.2
Q75	0.2	0.2
Q100	0.2	0.2
Q200	0.2	0.2
Q1000	0.3	0.3

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Appendix E - Proposed Drainage Design Layout





Your Environment

Project:
Flint Barn, Barnham

Drawing:
Drainage Strategy

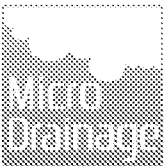
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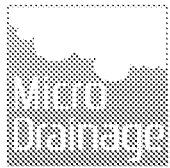
Date: June 2018

Appendix F - Microdrainage modelling outputs: Swale



KPT Properties							Page 1																																																																																																																																																																																																																																																																																	
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<u>Summary of Results for 2 year Return Period</u> Half Drain Time : 6 minutes. <table><thead><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max E Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr></thead><tbody><tr><td>15 min Summer</td><td>9.120</td><td>0.120</td><td>0.0</td><td>1.6</td><td>1.6</td><td>0.7</td><td>Flood Risk</td></tr><tr><td>30 min Summer</td><td>9.120</td><td>0.120</td><td>0.0</td><td>1.6</td><td>1.6</td><td>0.7</td><td>Flood Risk</td></tr><tr><td>60 min Summer</td><td>9.108</td><td>0.108</td><td>0.0</td><td>1.5</td><td>1.5</td><td>0.6</td><td>Flood Risk</td></tr><tr><td>120 min Summer</td><td>9.093</td><td>0.093</td><td>0.0</td><td>1.4</td><td>1.4</td><td>0.4</td><td>Flood Risk</td></tr><tr><td>180 min Summer</td><td>9.080</td><td>0.080</td><td>0.0</td><td>1.2</td><td>1.2</td><td>0.3</td><td>Flood Risk</td></tr><tr><td>240 min Summer</td><td>9.071</td><td>0.071</td><td>0.0</td><td>1.1</td><td>1.1</td><td>0.2</td><td>Flood Risk</td></tr><tr><td>360 min Summer</td><td>9.060</td><td>0.060</td><td>0.0</td><td>0.9</td><td>0.9</td><td>0.2</td><td>Flood Risk</td></tr><tr><td>480 min Summer</td><td>9.053</td><td>0.053</td><td>0.0</td><td>0.7</td><td>0.7</td><td>0.1</td><td>Flood Risk</td></tr><tr><td>600 min Summer</td><td>9.048</td><td>0.048</td><td>0.0</td><td>0.6</td><td>0.6</td><td>0.1</td><td>Flood Risk</td></tr><tr><td>720 min Summer</td><td>9.044</td><td>0.044</td><td>0.0</td><td>0.5</td><td>0.5</td><td>0.1</td><td>Flood Risk</td></tr><tr><td>960 min Summer</td><td>9.038</td><td>0.038</td><td>0.0</td><td>0.4</td><td>0.4</td><td>0.1</td><td>Flood Risk</td></tr><tr><td>1440 min Summer</td><td>9.031</td><td>0.031</td><td>0.0</td><td>0.3</td><td>0.3</td><td>0.0</td><td>Flood Risk</td></tr><tr><td>2160 min Summer</td><td>9.026</td><td>0.026</td><td>0.0</td><td>0.2</td><td>0.2</td><td>0.0</td><td>Flood Risk</td></tr><tr><td>2880 min Summer</td><td>9.024</td><td>0.024</td><td>0.0</td><td>0.2</td><td>0.2</td><td>0.0</td><td>Flood Risk</td></tr><tr><td>4320 min Summer</td><td>9.021</td><td>0.021</td><td>0.0</td><td>0.1</td><td>0.1</td><td>0.0</td><td>Flood Risk</td></tr><tr><td>5760 min Summer</td><td>9.019</td><td>0.019</td><td>0.0</td><td>0.1</td><td>0.1</td><td>0.0</td><td>Flood Risk</td></tr><tr><td>7200 min Summer</td><td>9.018</td><td>0.018</td><td>0.0</td><td>0.1</td><td>0.1</td><td>0.0</td><td>Flood Risk</td></tr><tr><td>8640 min Summer</td><td>9.017</td><td>0.017</td><td>0.0</td><td>0.1</td><td>0.1</td><td>0.0</td><td>Flood Risk</td></tr><tr><td>10080 min Summer</td><td>9.017</td><td>0.017</td><td>0.0</td><td>0.1</td><td>0.1</td><td>0.0</td><td>Flood Risk</td></tr><tr><td>15 min Winter</td><td>9.128</td><td>0.128</td><td>0.0</td><td>1.7</td><td>1.7</td><td>0.8</td><td>Flood Risk</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>37.891</td><td>0.0</td><td>1.6</td><td>12</td></tr><tr><td>30 min Summer</td><td>24.772</td><td>0.0</td><td>2.0</td><td>21</td></tr><tr><td>60 min Summer</td><td>15.619</td><td>0.0</td><td>2.6</td><td>36</td></tr><tr><td>120 min Summer</td><td>10.546</td><td>0.0</td><td>3.5</td><td>68</td></tr><tr><td>180 min Summer</td><td>8.171</td><td>0.0</td><td>4.0</td><td>96</td></tr><tr><td>240 min Summer</td><td>6.740</td><td>0.0</td><td>4.4</td><td>126</td></tr><tr><td>360 min Summer</td><td>5.048</td><td>0.0</td><td>5.0</td><td>186</td></tr><tr><td>480 min Summer</td><td>4.070</td><td>0.0</td><td>5.4</td><td>246</td></tr><tr><td>600 min Summer</td><td>3.431</td><td>0.0</td><td>5.7</td><td>306</td></tr><tr><td>720 min Summer</td><td>2.979</td><td>0.0</td><td>5.9</td><td>366</td></tr><tr><td>960 min Summer</td><td>2.377</td><td>0.0</td><td>6.3</td><td>482</td></tr><tr><td>1440 min Summer</td><td>1.733</td><td>0.0</td><td>6.9</td><td>732</td></tr><tr><td>2160 min Summer</td><td>1.274</td><td>0.0</td><td>7.6</td><td>1084</td></tr><tr><td>2880 min Summer</td><td>1.033</td><td>0.0</td><td>8.2</td><td>1436</td></tr><tr><td>4320 min Summer</td><td>0.788</td><td>0.0</td><td>9.4</td><td>2132</td></tr><tr><td>5760 min Summer</td><td>0.661</td><td>0.0</td><td>10.5</td><td>2936</td></tr><tr><td>7200 min Summer</td><td>0.583</td><td>0.0</td><td>11.6</td><td>3584</td></tr><tr><td>8640 min Summer</td><td>0.531</td><td>0.0</td><td>12.6</td><td>4280</td></tr><tr><td>10080 min Summer</td><td>0.493</td><td>0.0</td><td>13.7</td><td>5000</td></tr><tr><td>15 min Winter</td><td>37.891</td><td>0.0</td><td>1.8</td><td>13</td></tr></tbody></table>								Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	9.120	0.120	0.0	1.6	1.6	0.7	Flood Risk	30 min Summer	9.120	0.120	0.0	1.6	1.6	0.7	Flood Risk	60 min Summer	9.108	0.108	0.0	1.5	1.5	0.6	Flood Risk	120 min Summer	9.093	0.093	0.0	1.4	1.4	0.4	Flood Risk	180 min Summer	9.080	0.080	0.0	1.2	1.2	0.3	Flood Risk	240 min Summer	9.071	0.071	0.0	1.1	1.1	0.2	Flood Risk	360 min Summer	9.060	0.060	0.0	0.9	0.9	0.2	Flood Risk	480 min Summer	9.053	0.053	0.0	0.7	0.7	0.1	Flood Risk	600 min Summer	9.048	0.048	0.0	0.6	0.6	0.1	Flood Risk	720 min Summer	9.044	0.044	0.0	0.5	0.5	0.1	Flood Risk	960 min Summer	9.038	0.038	0.0	0.4	0.4	0.1	Flood Risk	1440 min Summer	9.031	0.031	0.0	0.3	0.3	0.0	Flood Risk	2160 min Summer	9.026	0.026	0.0	0.2	0.2	0.0	Flood Risk	2880 min Summer	9.024	0.024	0.0	0.2	0.2	0.0	Flood Risk	4320 min Summer	9.021	0.021	0.0	0.1	0.1	0.0	Flood Risk	5760 min Summer	9.019	0.019	0.0	0.1	0.1	0.0	Flood Risk	7200 min Summer	9.018	0.018	0.0	0.1	0.1	0.0	Flood Risk	8640 min Summer	9.017	0.017	0.0	0.1	0.1	0.0	Flood Risk	10080 min Summer	9.017	0.017	0.0	0.1	0.1	0.0	Flood Risk	15 min Winter	9.128	0.128	0.0	1.7	1.7	0.8	Flood Risk	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	37.891	0.0	1.6	12	30 min Summer	24.772	0.0	2.0	21	60 min Summer	15.619	0.0	2.6	36	120 min Summer	10.546	0.0	3.5	68	180 min Summer	8.171	0.0	4.0	96	240 min Summer	6.740	0.0	4.4	126	360 min Summer	5.048	0.0	5.0	186	480 min Summer	4.070	0.0	5.4	246	600 min Summer	3.431	0.0	5.7	306	720 min Summer	2.979	0.0	5.9	366	960 min Summer	2.377	0.0	6.3	482	1440 min Summer	1.733	0.0	6.9	732	2160 min Summer	1.274	0.0	7.6	1084	2880 min Summer	1.033	0.0	8.2	1436	4320 min Summer	0.788	0.0	9.4	2132	5760 min Summer	0.661	0.0	10.5	2936	7200 min Summer	0.583	0.0	11.6	3584	8640 min Summer	0.531	0.0	12.6	4280	10080 min Summer	0.493	0.0	13.7	5000	15 min Winter	37.891	0.0	1.8	13
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																																	
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1440 min Summer	9.031	0.031	0.0	0.3	0.3	0.0	Flood Risk																																																																																																																																																																																																																																																																																	
2160 min Summer	9.026	0.026	0.0	0.2	0.2	0.0	Flood Risk																																																																																																																																																																																																																																																																																	
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KPT Properties						Page 2	
19 Lonsdale Avenue Hutton Essex CM13 1NH							
Date 08/06/2018 12:12			Designed by Paul				
File swale_50%.SRCX			Checked by				
XP Solutions			Source Control 2018.1				
<u>Summary of Results for 2 year Return Period</u>							
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	9.123	0.123	0.0	1.6	1.6	0.8	Flood Risk
60 min Winter	9.103	0.103	0.0	1.5	1.5	0.5	Flood Risk
120 min Winter	9.081	0.081	0.0	1.2	1.2	0.3	Flood Risk
180 min Winter	9.067	0.067	0.0	1.0	1.0	0.2	Flood Risk
240 min Winter	9.059	0.059	0.0	0.9	0.9	0.1	Flood Risk
360 min Winter	9.050	0.050	0.0	0.7	0.7	0.1	Flood Risk
480 min Winter	9.044	0.044	0.0	0.5	0.5	0.1	Flood Risk
600 min Winter	9.040	0.040	0.0	0.4	0.4	0.1	Flood Risk
720 min Winter	9.036	0.036	0.0	0.4	0.4	0.0	Flood Risk
960 min Winter	9.031	0.031	0.0	0.3	0.3	0.0	Flood Risk
1440 min Winter	9.026	0.026	0.0	0.2	0.2	0.0	Flood Risk
2160 min Winter	9.023	0.023	0.0	0.2	0.2	0.0	Flood Risk
2880 min Winter	9.020	0.020	0.0	0.1	0.1	0.0	Flood Risk
4320 min Winter	9.018	0.018	0.0	0.1	0.1	0.0	Flood Risk
5760 min Winter	9.016	0.016	0.0	0.1	0.1	0.0	Flood Risk
7200 min Winter	9.015	0.015	0.0	0.1	0.1	0.0	Flood Risk
8640 min Winter	9.015	0.015	0.0	0.1	0.1	0.0	Flood Risk
10080 min Winter	9.014	0.014	0.0	0.1	0.1	0.0	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	24.772	0.0	2.3	22			
60 min Winter	15.619	0.0	2.9	38			
120 min Winter	10.546	0.0	3.9	68			
180 min Winter	8.171	0.0	4.5	96			
240 min Winter	6.740	0.0	5.0	126			
360 min Winter	5.048	0.0	5.6	188			
480 min Winter	4.070	0.0	6.0	244			
600 min Winter	3.431	0.0	6.3	304			
720 min Winter	2.979	0.0	6.6	366			
960 min Winter	2.377	0.0	7.0	482			
1440 min Winter	1.733	0.0	7.7	732			
2160 min Winter	1.274	0.0	8.5	1072			
2880 min Winter	1.033	0.0	9.2	1456			
4320 min Winter	0.788	0.0	10.5	2120			
5760 min Winter	0.661	0.0	11.7	2856			
7200 min Winter	0.583	0.0	12.9	3568			
8640 min Winter	0.531	0.0	14.1	4472			
10080 min Winter	0.493	0.0	15.3	5216			
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KPT Properties		Page 4
19 Lonsdale Avenue Hutton Essex CM13 1NH		
Date 08/06/2018 12:12 File swale_50%.SRCX	Designed by Paul Checked by	
XP Solutions Source Control 2018.1		

Model Details

Storage is Online Cover Level (m) 9.300

Swale Structure

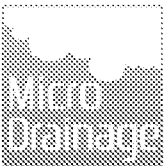
Infiltration Coefficient Base (m/hr) 0.00000	Length (m) 17.0
Infiltration Coefficient Side (m/hr) 0.00000	Side Slope (1:X) 3.0
Safety Factor 2.0	Slope (1:X) 200.0
Porosity 1.00	Cap Volume Depth (m) 0.000
Invert Level (m) 9.000	Cap Infiltration Depth (m) 0.000
Base Width (m) 0.3	

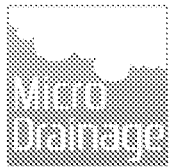
Orifice Outflow Control

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 9.000

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KPT Properties						Page 1	
19 Lonsdale Avenue Hutton Essex CM13 1NH							
Date 08/06/2018 12:10		Designed by Paul					
File swale_3.3%.SRCX		Checked by					
XP Solutions				Source Control 2018.1			
<u>Summary of Results for 30 year Return Period</u> Half Drain Time : 10 minutes.							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m³)	Status
15 min Summer	9.196	0.196	0.0	2.2	2.2	2.0	Flood Risk
30 min Summer	9.204	0.204	0.0	2.2	2.2	2.2	Flood Risk
60 min Summer	9.196	0.196	0.0	2.2	2.2	2.0	Flood Risk
120 min Summer	9.169	0.169	0.0	2.0	2.0	1.5	Flood Risk
180 min Summer	9.145	0.145	0.0	1.8	1.8	1.1	Flood Risk
240 min Summer	9.125	0.125	0.0	1.6	1.6	0.8	Flood Risk
360 min Summer	9.095	0.095	0.0	1.4	1.4	0.4	Flood Risk
480 min Summer	9.077	0.077	0.0	1.2	1.2	0.3	Flood Risk
600 min Summer	9.067	0.067	0.0	1.0	1.0	0.2	Flood Risk
720 min Summer	9.061	0.061	0.0	0.9	0.9	0.2	Flood Risk
960 min Summer	9.052	0.052	0.0	0.7	0.7	0.1	Flood Risk
1440 min Summer	9.043	0.043	0.0	0.5	0.5	0.1	Flood Risk
2160 min Summer	9.034	0.034	0.0	0.4	0.4	0.0	Flood Risk
2880 min Summer	9.030	0.030	0.0	0.3	0.3	0.0	Flood Risk
4320 min Summer	9.026	0.026	0.0	0.2	0.2	0.0	Flood Risk
5760 min Summer	9.024	0.024	0.0	0.2	0.2	0.0	Flood Risk
7200 min Summer	9.022	0.022	0.0	0.2	0.2	0.0	Flood Risk
8640 min Summer	9.021	0.021	0.0	0.1	0.1	0.0	Flood Risk
10080 min Summer	9.020	0.020	0.0	0.1	0.1	0.0	Flood Risk
15 min Winter	9.210	0.210	0.0	2.2	2.2	2.3	Flood Risk
Storm Event			Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer			80.362	0.0	3.3	14	
30 min Summer			53.611	0.0	4.4	22	
60 min Summer			34.116	0.0	5.6	40	
120 min Summer			20.615	0.0	6.8	70	
180 min Summer			15.218	0.0	7.5	102	
240 min Summer			12.208	0.0	8.1	132	
360 min Summer			8.870	0.0	8.8	190	
480 min Summer			7.026	0.0	9.3	248	
600 min Summer			5.851	0.0	9.7	306	
720 min Summer			5.033	0.0	10.0	368	
960 min Summer			3.963	0.0	10.5	488	
1440 min Summer			2.832	0.0	11.2	730	
2160 min Summer			2.040	0.0	12.1	1068	
2880 min Summer			1.630	0.0	12.9	1464	
4320 min Summer			1.210	0.0	14.4	2128	
5760 min Summer			0.993	0.0	15.7	2936	
7200 min Summer			0.862	0.0	17.1	3608	
8640 min Summer			0.774	0.0	18.4	4256	
10080 min Summer			0.710	0.0	19.7	4984	
15 min Winter			80.362	0.0	3.7	14	
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XP Solutions			Source Control 2018.1				
<u>Summary of Results for 30 year Return Period</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	9.216	0.216	0.0	2.3	2.3	2.5	Flood Risk
60 min Winter	9.202	0.202	0.0	2.2	2.2	2.1	Flood Risk
120 min Winter	9.161	0.161	0.0	1.9	1.9	1.3	Flood Risk
180 min Winter	9.127	0.127	0.0	1.7	1.7	0.8	Flood Risk
240 min Winter	9.102	0.102	0.0	1.5	1.5	0.5	Flood Risk
360 min Winter	9.072	0.072	0.0	1.1	1.1	0.2	Flood Risk
480 min Winter	9.061	0.061	0.0	0.9	0.9	0.2	Flood Risk
600 min Winter	9.055	0.055	0.0	0.8	0.8	0.1	Flood Risk
720 min Winter	9.050	0.050	0.0	0.7	0.7	0.1	Flood Risk
960 min Winter	9.043	0.043	0.0	0.5	0.5	0.1	Flood Risk
1440 min Winter	9.035	0.035	0.0	0.4	0.4	0.0	Flood Risk
2160 min Winter	9.028	0.028	0.0	0.3	0.3	0.0	Flood Risk
2880 min Winter	9.026	0.026	0.0	0.2	0.2	0.0	Flood Risk
4320 min Winter	9.022	0.022	0.0	0.2	0.2	0.0	Flood Risk
5760 min Winter	9.020	0.020	0.0	0.1	0.1	0.0	Flood Risk
7200 min Winter	9.019	0.019	0.0	0.1	0.1	0.0	Flood Risk
8640 min Winter	9.018	0.018	0.0	0.1	0.1	0.0	Flood Risk
10080 min Winter	9.017	0.017	0.0	0.1	0.1	0.0	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	53.611	0.0	5.0	24			
60 min Winter	34.116	0.0	6.3	42			
120 min Winter	20.615	0.0	7.6	74			
180 min Winter	15.218	0.0	8.4	104			
240 min Winter	12.208	0.0	9.0	132			
360 min Winter	8.870	0.0	9.8	188			
480 min Winter	7.026	0.0	10.4	248			
600 min Winter	5.851	0.0	10.8	306			
720 min Winter	5.033	0.0	11.2	366			
960 min Winter	3.963	0.0	11.7	484			
1440 min Winter	2.832	0.0	12.6	728			
2160 min Winter	2.040	0.0	13.6	1100			
2880 min Winter	1.630	0.0	14.5	1464			
4320 min Winter	1.210	0.0	16.1	2164			
5760 min Winter	0.993	0.0	17.6	2792			
7200 min Winter	0.862	0.0	19.1	3592			
8640 min Winter	0.774	0.0	20.6	4304			
10080 min Winter	0.710	0.0	22.0	5096			
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Model Details

Storage is Online Cover Level (m) 9.300

Swale Structure

Infiltration Coefficient Base (m/hr) 0.00000	Length (m) 17.0
Infiltration Coefficient Side (m/hr) 0.00000	Side Slope (1:X) 3.0
Safety Factor 2.0	Slope (1:X) 200.0
Porosity 1.00	Cap Volume Depth (m) 0.000
Invert Level (m) 9.000	Cap Infiltration Depth (m) 0.000
Base Width (m) 0.3	

Orifice Outflow Control

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 9.000

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