Southern Testing ST Consult

www.southerntesting.co.uk tel:01342 333100 www.stconsult.co.uk tel:01604 500020

Start - End Date	Project ID:	Hole Type:	BH1
25/10/2018	J13838	RO	Sheet 2 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570860E - 157820N	19.08	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 11.4m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
						(6.00)			Light grey LIMESTONE.
					3.6	(1.50)		15.50	Yellowish brown coarse grained SANDSTONE.
					2.1			17.00	End of Borehole at 17.00m

11 12 13 14 15 16 17 18 19 20

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.00	200			25-10-2018	15.50			11.40	10				

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Start - End Date	Project ID:	Hole Type:	BH2
25/10/2018 - 26/10/2018	J13838	RO	Sheet 1 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570763E - 157610N	20.54	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 12.0m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
					20.2	(0.30)		0.30	TOPSOIL
									Dark brown medium to coarse SAND.
					19.0	(1.20)		1.50	Light grey LIMESTONE.
						(3.00)			
					16.0			4.50	Interbedded SANDSTONE and LIMESTONE.
						(10.50)			

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.00	200			26-10-2018	17.00			12.00	10				

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Start - End Date	Project ID:	Hole Type:	BH2
25/10/2018 - 26/10/2018	J13838	RO	Sheet 2 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570763E - 157610N	20.54	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 12.0m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
									Interbedded SANDSTONE and LIMESTONE.
					5.5	(2.00)		15.00	Yellowish brown coarse grained SANDSTONE.
					3.5			17.00	End of Borehole at 17.00m

11 12 13 14 15 16 17 18 19 20

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.00	200			26-10-2018	17.00			12.00	10				

Southern Testing ST Consult

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Start - End Date	Project ID:	Hole Type:	BH3
26/10/2018	J13838	RO	Sheet 1 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570980E - 157784N	18.13	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 10.2m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
					17.8	(0.30)		0.30	TOPSOIL.
									Dark brown medium to coarse SAND.
					17.1	(0.70)		1.00	Interbedded SANDSTONE and LIMESTONE.
						(14.00)			

1 2 3 4 5 6 7 8 9 10

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.50	200			26-10-2018	12.00				0				
				26-10-2018	17.50			10.20	10				

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Start - End Date	Project ID:	Hole Type:	BH3
26/10/2018	J13838	RO	Sheet 2 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570980E - 157784N	18.13	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 10.2m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
									Interbedded SANDSTONE and LIMESTONE.
					3.1	(2.50)		15.00	Yellowish brown coarse grained SANDSTONE.
					0.6			17.50	End of Borehole at 17.50m

11 12 13 14 15 16 17 18 19 20

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.50	200			26-10-2018	12.00				0				
				26-10-2018	17.50			10.20	10				

Appendix L

Preliminary Risk Assessment

ARDENT CONSULTING ENGINEERS

SLOUGH REAL ESTATE LTD

PROPOSED RESIDENTIAL SCHEME: 23-25 MILL STREET, SLOUGH

FLOOD RISK STATEMENT AND DRAINAGE STRATEGY

REPORT REF. 175610-02
PROJECT NO. 175610
SEPTEMBER 2018

PROPOSED RESIDENTIAL DEVELOPMENT: DITTON EDGE (SITE B)

PRELIMINARY RISK ASSESSMENT

Ardent Consulting Engineers
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LONDON
EC3M 5JE
Tel: 020 7680 4088
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REPORT REF NO. 182600-15
PROJECT NO. 182600
DECEMBER 2018

CONTENTS Page

APPENDICES

DOCUMENT CONTROL SHEET

REV	ISSUE PURPOSE	AUTHOR	CHECKED	APPROVED	DATE
-	DRAFT	NT	PS	-	NOVEMBER 2018
A	FINAL, REVISED TO ALTERNATIVE DRAINAGE STRATEGIES.	NT	PS	BC	JANUARY 2019

1.0 INTRODUCTION

3.1. Ardent Consulting Engineers (hereafter referred to as Ardent) has been appointed by East Malling Trust to undertake a Groundwater Preliminary Risk Assessment.

3.2. This assessment has been prepared to be included in the Flood Risk Assessment dated November 2018.

3.3. The aim of this Preliminary Risk Assessment is to confirm the proposed Surface Water Drainage Strategy provides appropriate treatment of surface water runoff prior to discharging to the ground.

3.4. The Environment Agency Position Statements G1 and G9 to G13 included in The Environment Agency's approach to groundwater protection, dated February 2018, Version 1.2, detail the minimum requirements in order to protect groundwater.

2.0 ENVIRONMENTAL SETTING

Geological conditions

2.1 The geological conditions at the survey area have been collated from the British Geological Survey (BGS) online viewer. The indicated geological sequence is outlined in Table 2.1.

Table 2.1: Geology

Stratum	Layer	Description
Superficial Deposits	N/A	N/A
Bedrock	Hythe Formation Sandstone And [subequal/subordinate] Limestone, Interbedded. Sedimentary Bedrock	

Site Conditions

2.2 The ground conditions are described in detail in the logs attached in Appendix A. In summary, the soil conditions at the site are identified in Table 2.2 below.

Table 2.2: Summary of the borehole logs (BH1, BH2 and BH3)

Depth From (m)	Depth To (m)	Soil Type	Description
Ground level	0.30	TOPSOIL	TOPSOIL
0.30	1.0 – 1.5	SAND	Dark brown medium to coarse SAND. (BH2 & 3)
0.3	3.4	CLAY	Stiff greyish brown CLAY. (BH1)
1.0 – 3.4	>17.00	LIMESTONE / SANDSTONE	Interbedded SANDSTONE and LIMESTONE,

			yellowish brown coarse grained SANDSTONE, Light grey LIMESTONE.

2.3 Standing water was recorded at depths of between 10.2m and 11.4m below ground level.

2.5 Falling head soakage testing was undertaken within the boreholes. Based on the volume of water lost during filling, estimated infiltration rates of between 100 – 400 litres/minute were recorded within the boreholes.

2.6 Based on the calculated results, it was concluded that the site is suitable for deep borehole soakaways within the Hythe beds. However, additional groundwater monitoring should be undertaken during the winter months to establish highest ground water levels.

Groundwater – Hydrogeology

2.7 Hydrogeological information from the British Geological Survey (BGS) website and site investigation indicate that direction of groundwater flow is from west to east.

2.8 The Magic Website indicates that there is no aquifer designation within the superficial drift deposits. However, the aquifer designation for bedrock indicates that the site is split between being located in a Principal and Secondary A aquifer. Refer to Figures 2.1 and 2.2 below respectively. A Principal Aquifer is rock consisting of layers with high intergranular and/or fracture permeability. These are generally aquifers formerly classified as major aquifers. Secondary A aquifers comprise permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers. Refer to Figure 2.1 below.

Figure 2.1 Aquifer Designation Map (Superficial Drift)

Figure 2.2 Aquifer Designation Map (Bedrock)

2.9 Groundwater vulnerability maps indicate the site is located within a Major Aquifer, with a High leaching potential that has the ability to attenuate diffuse source pollutants or in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer. Refer to Figure 2.3 below.

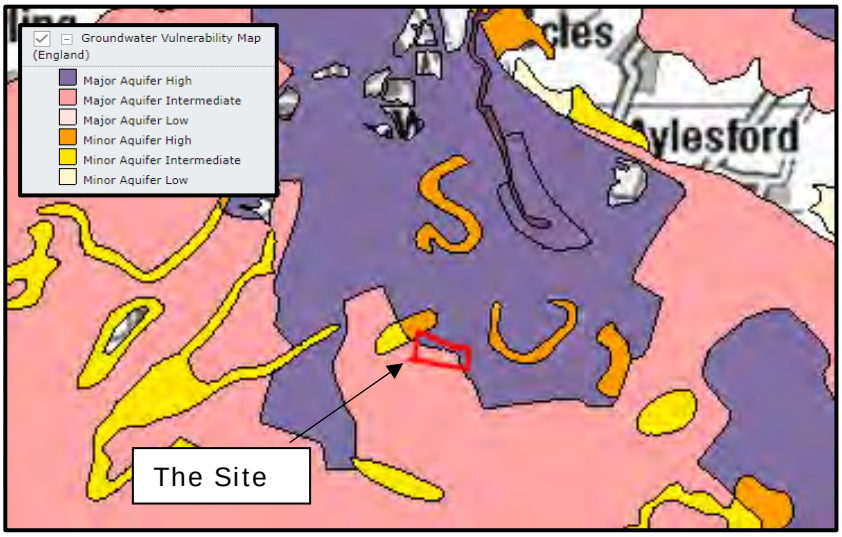

Figure 2.3 Groundwater Vulnerability Map

Groundwater Source Protection Zones

2.10 The site is located within Zone 2 – Outer Protection Zone. Refer to Figure 2.4 below.

Figure 2.4 Groundwater Source Protection Zone

3.0 PRELIMINARY CONCEPTUAL SITE MODEL AND QUALITATIVE RISK CONCEPTUAL SITE MODEL

3.1 For contamination within soil or water to pose a risk, a pollutant linkage must be established. A pollutant linkage consists of three parts:

- A source of contamination in or on the land;
- A pathway by which the contaminant can cause harm (or which presents a significant possibility of such harm being caused); and
- A receptor that is sensitive to impact from the contamination.

3.2 Where all three of these parts are present, a pollutant linkage exists. Current guidance recommends that a Conceptual Site Model (CSM) is formulated based on the information available. As more information becomes available the conceptual model may be updated. The CSM is limited at this stage to the identification and assessment of potential sources, potential receptors, and the anticipated pathways to those receptors identified as result of the documentary research.

Potential sources of ground contamination

3.3 Contamination sources can include neighbouring land uses and historical activities within the survey area and in its surrounding. However, for the purpose of this assessment, potential sources of contamination within the survey area are considered to be from the end use, proposed residential development.

Potential pathway

3.4 This will be the proposed drainage strategy which for one of the options is looking to infiltrate all surface water runoff from the proposed residential development into soakaways. This would provide a route to the groundwater table (receptor).

Identified receptors

3.6 Based on the current and proposed use of the site, it is considered that the likely receptors will be:

- Deep groundwater (Secondary A aquifer) is present. It might be affected by direct disturbance or leaching and groundwater migration;
- Surface freshwater bodies (various rivers, streams, ditches, ponds, lakes and a canal) through leaching of any soil borne contaminants, inflow of contaminated groundwater or direct entry by runoff; and
- The Environmentally Sensitive Areas.

4. PRELIMINARY CONCEPTUAL SITE MODEL AND QUALITITATIVE RISK ASSESSMENT – RISK SCREENING

4.1. The Groundwater Risk Screening has been carried out in accordance with Tables 26.5 and 26.6 of The SuDS Manual CIRIA C753, to determine whether the Simple Index Approach or a Detailed Risk Assessment is required. Refer to Table 4.1 of this report for the Risk Screening results.

4.2. The risk scores awarded for each element range from 1 (low risk) to 3 (high risk) and are based on qualifying criteria outlined in CIRIA C753.

4.3. A copy of the borehole test results is included in Appendix A.

Table 4.1 – Risk Screening Results

Risk Element	Evidence	Risk Score	Weighting Factor	Total
Pollution hazard Traffic density	Risk score is low for all standard urban land use types (excluding high hazard and trunk roads/motorways) – refer to Table 26.5 of CIRIA C753.	1 (low)	15	15
Standard Average Annual Rainfall (SAAR) depth	SAAR = 672mm (Refer to extract of Flood Estimation Handbook). Risk score is low if SAAR <740mm – refer to Table 26.5 of CIRIA C753.	1 (low)	15	15
Type of SuDS	Proposed SuDS include deep bored soakaway, Assumed worst-case high risk score.	3 (high)	15	45
Unsaturated zone depth	The invert levels of deep bored soakaways are proposed to be approx. 20m below ground level (bgl) and at points discharge directly to groundwater.	3 (high)	20	60

Risk Element	Evidence	Risk Score	Weighting Factor	Total
Predominant flow type through soils between infiltration surface and groundwater	The proposed boreholes within the site discharge directly to groundwater within some areas of the site.	3 (high)	20	60
Unsaturated zone material: clay content	The proposed boreholes within the site discharge directly to groundwater within some areas of the site, therefore, a conservative category 3 has been used.	3 (high)	5	15
Unsaturated zone organic carbon content: soil organic matter (SOM) content	The proposed boreholes within the site discharge directly to groundwater within some areas of the site. However, category 2 has been used as a conservative estimate.	2 (med)	5	10
Unsaturated zone material: soil pH	The proposed boreholes within the site discharge directly to groundwater within some areas of the site. However, category 2 has been used as a conservative estimate.	2 (med)	5	10
		230 Total risk score Between 180 - 250		

4.4. The groundwater screening test demonstrates the risk to groundwater is high and an initial Simple Index and risk assessment approach will need to be undertaken prior to construction. Furthermore, liaison with the Environment Agency should be undertaken at an early stage to obtain pre-permitting advice to determine whether an environmental license is required.

5.0 SIMPLE INDEX APPROACH

5.1. The Simple Index Approach has been carried out in accordance with Tables 26.2 to 26.4 of "The SuDS Manual" CIRIA C753. Reference should be made to these tables when reviewing the below.

5.2. Sections 5 of the FRA provides details of the Proposed Development, the drainage strategy is included in Appendix B.

Summary of Development Surface Water Drainage Strategy

5.3. With knowledge of the local strata and advice from the Lead Local Flood Authority it was considered that the infiltration rate of the below ground strata at shallow depths was not suitable to serve the proposed development.

5.4. Permeable paving was also initially considered for use within the main spine roads of the proposed development. However, as these may be offered for adoption to Kent County Council (KCC), this would not meet KCC Adoptable Highways Standards and therefore has been discounted, other than for private areas.

5.5. It is currently proposed to include an under-drained swale in the verge of parts of the access road. The carriageway and associated footways will be designed to fall towards the swale, which will be used primarily for capture of runoff and treatment. The swale will be vegetated and captured runoff will permeate through the base of the swale, to be conveyed by the filter drain.

5.6. The roof water will drain via sealed pipes to make sure no contaminants from other sources do not pollute the runoff before flowing into the detention basins or storage tanks.

5.7. The private drives will drain via lined permeable paving before flowing into the detention basin.

5.8. Access roads within the catchments will drain via gullies with catchpits and a piped network before flowing into the detention basin and into the deep bore soakaways, where swales are not present adjacent to the highway.

5.9. Highway soakaways will be located at the north of the site and will accommodate flows from the site. The soakaways will be designed based on the infiltration rates observed on site. Storage will be provided in the proposed detention

basins and attenuation tanks. The surface water runoff from the development will have been treated by the upstream SuDS features to remove pollutants. It is proposed to locate any deep bore soakaways a minimum of 2m from the edge of the carriageway following guidance provided by the KCC Highways Team and 15m from any dwelling.

Assumed Infiltration Rate

5.10. A detailed Source Control model has been prepared using MicroDrainage, for the 1 in 1, 30 and 100 year plus an allowance for climate change, critical duration storms. The model uses infiltration rates identified during the borehole infiltration testing (400 l/min), based on the Southern testing infiltration test results undertaken in October 2018, from boreholes 1 and 3 located to the north of the site.

Pollution Hazard Indices

5.11. The land use shaded grey is applicable to this development and is based on Table 26.2 of CIRIA C753.

Table 26.2 Pollution hazard indices for different land use classifications

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/industrial roofs).	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices)	Low	0.5	0.4	0.4

i.e. < 300 traffic movements/day.				
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail) all roads except low traffic roads and trunk roads/motorways.	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates & waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, sorted, used or manufactured; industrial sites; trunk roads and motorways.	High	0.8[2]	0.8	0.9

SuDS Mitigation Indices

5.12. The land use shaded grey is applicable to this development and is based on Table 26.3 of CIRIA C753.

Table 26.3 Indicative SuDS mitigation indices for discharges to surface waters			
	Mitigation indices		
Types of SuDS Component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bio-retention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8

Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.

SuDS Mitigation Indices for Discharges to Groundwater

5.13. The land use shaded grey is applicable to this development and is based on Table 26.4 of CIRIA C753.

Table 26.4 SuDS Mitigation Indices for Discharges to Ground

	Mitigation indices		
Characteristic of the material overlying the proposed infiltration surface, through which the runoff percolates	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential of at least 300mm in depth	0.6	0.5	0.6
A soil with good contaminant attenuation potential of at least 300mm in depth	0.4	0.3	0.3
Infiltration trench underlain by a soil with good contaminant attenuation potential of at least 300mm in depth	0.4	0.4	0.4
Constructed permeable paving underlain by a soil with a good contaminant attenuation potential of at least 300mm in depth	0.7	0.6	0.7
Bio retention underlain by a soil with good contaminant attenuation potential of at least 300mm in depth	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

5.14. Based on the above criteria and proposed drainage strategy, a series of tables have been produced to replicate different scenarios within the sites drainage strategy which highlights the pollution source and proposed mitigation to address the risk of pollution to the receptor. Tables 5.1, 5.2 and 5.3 on the following page identify the source of pollution together with the proposed mitigation measures with their associated indices.

Table 5.1: Highways Total SuDS Mitigation Index

Source	TSS	Metals	Hydrocarbons
Highways (low)	0.50	0.40	0.40
Source			
Detention Basin	0.50	0.50	0.60
Check	+0.00	+0.10	+0.20

Table 5.2: Private Drive Total SuDS Mitigation Index

Source	TSS	Metals	Hydrocarbons
Private Drives (low) (worst case)	0.50	0.40	0.40
Source			
Detention Basin	0.50	0.50	0.60
Check	+0.00	+0.10	+0.20

Table 5.3: Residential Roofs Total SuDS Mitigation Index

Source	TSS	Metals	Hydrocarbons
Residential roofs (low) (worse case)	0.20	0.20	0.05
Source			
Detention Basin	0.50	0.50	0.60
Check	+0.30	+0.30	+0.55

Highway Drainage: Further Mitigation

5.15. Further SuDS mitigation will be incorporated within parts of the Highway Drainage Network, which are outlined below. In order to consider the worst-case scenario, these have not been included within the Simple Index Approach above.

- Runoff from the first 5mm of a rainfall event will be captured and retained within under-drained swale with a filter drain base (i.e. Interception). This will ensure that the first-flush is treated wholly within the swale, removing the majority of pollutants before any runoff is discharged to the detention basin and finally the soakaways. Referring to Section 24.8 of CIRIA C753, interception will effectively be delivered where SuDS are designed to infiltrate more than 5mm of rainfall, as with this development;
- The Highway Drainage Network of swales, filter drains and

soakaways will be offered to KCC for adoption, to ensure that they are inspected and maintained regularly. Any drainage aspects not adopted will be maintained by a Management Company instead; and

- A catchpit prior to the soakaway chambers will further remove sediment and pollutants prior to infiltration occurring within the borehole, extending the life of the soakaway and allowing for easy removal of the accumulated sediment.

6. UNCERTAINTIES IN THE CONCEPTUAL SITE MODEL

6.1 At this stage in the process there are a number of uncertainties associated with the preliminary conceptual site model, specifically associated with defining the potential sources, the respective pathways and location of receptor which are summarised below:

- Source from residential areas, but likely to be controlled;
- The pathway to be along the final drainage network which is to be confirmed at detail design; and
- The location of the groundwater table over the winter months to be confirmed by reviewing historical data and ongoing monitoring so as to finalise detail design.

7. CONCLUSIONS

7.1. The Preliminary Risk Assessment for Groundwater demonstrates that the preliminary conceptual site model and qualitative risk assessment based on the simple Index Approach to Water Quality Risk Management is appropriate for this development.

7.2. The Simple Index Approach demonstrates that the proposed SuDS provides the adequate treatment stages to surface water runoff emanating from the site, and that discharge to ground via deep bored soakaways will not cause pollution to groundwater.

7.3. The Preliminary Risk Assessment for Groundwater has been undertaken in accord with the requirements of Contaminated Land Report 11 and Environment Agency guidance "Protect groundwater and prevent groundwater pollution, Groundwater protection technical guidance and Groundwater activity exclusions from environmental permits". In addition this risk assessment has also complied with the requirements of "The Environment Agency's approach to groundwater protection" and position statements G1 and G9 to G13.

Appendix A

Borehole Log

Our Ref: JNR/TRL/AM/J13838

Southern Testing
Environmental & Geotechnical

Southern Testing Laboratories Ltd
Keeble House, Stuart Way
East Grinstead, West Sussex RH19 4QA

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1st November 2018

Ardent Consulting Engineers
Office 3
The Garage Studios
41-43 St. Mary's Gate
The Lace Market
Nottingham
NG1 1PU

For the attention of Peter Sparham
(By email: psparham@ardent-ce.co.uk)

Dear Peter,

Re: Borehole Soakaway Installation at: East Malling Site B, Ditton, Aylesford, Kent, ME20 6QA
National Grid Reference: TQ 71010 57676
Geology: Hythe Formation

1 Authority

Our authority for carrying out this work is contained in a Project Order form completed by Peter Sparham of Ardent Consulting Engineers, dated 19th October 2018. The form refers to our quotation ref. Q18-20117(a).

2 Background and Objectives

The object of the investigation was to drill boreholes to test for infiltration within the Hythe Formation. The borehole locations were specified to us by the Client. The site location is shown on the attached Figure 1.

3 Scope

This letter report presents our findings and test results. As with any site there may be differences in ground conditions between exploratory hole positions.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

Contamination issues are not considered in this report.

The findings and opinions conveyed via this Site Investigation Report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Limited believes are reliable. Nevertheless, Southern Testing Laboratories Limited cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Ardent Consulting Engineers and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Limited. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

Recommendations contained in this report may not be appropriate to alternative development schemes.

4 Borehole Logs, Groundwater, and Soakage Test Results

Three 200mm diameter down-the-hole-hammer boreholes were drilled in the locations specified to us by the Client. The borehole locations are shown on the attached plan (Figure 2).

The materials encountered comprised a covering of sandy clays / clayey sands, overlying interbedded limestone and sandstone. The depth to the top of the limestone/sandstone was variable, and was found to be between 1.0 and 4.5m bgl. The intended depth of the boreholes was 25m bgl. However, the boreholes were terminated early at between 17.0 and 17.5m bgl due to the presence of groundwater. It is our understanding that the Environment Agency would require an unsaturated zone beneath the base of any working borehole soakaway.

Groundwater was encountered in the boreholes as follows:

		Depth of groundwater strike		Rest level of groundwater	
BH ref	BH ground level (mAOD)	mBGL	mAOD	mBGL	mAOD
BH1	19.08	15.50	+3.58	11.40	+7.68
BH2	20.54	17.00	+3.54	12.00	+8.54
BH3	18.13	17.50	+0.63	10.20	+7.93

Table 1: Groundwater observations.

The depth of the groundwater strike can be masked by the drilling methods, and so may not represent the actual level of groundwater beneath the site. However, the rest level of the groundwater before and after the soakage tests appear to be consistent between the three boreholes, and it would appear that the groundwater is at a level of about +8.00m AOD. This will need to be considered in the design of any borehole soakaways on this site.

A soakage test was undertaken in each borehole. The results of the testing are shown in the table below:

BH ref	Approximate soakage rate (litres/minute)	Water level during test (m bgl)
BH1	400	4.50
BH2	100	3.00
BH3	400	3.00

Table 2: Constant head borehole soakage results

After each test the water level receded down to the rest water levels shown in Table 1.

A suitable factor of safety should be applied for the design soakage rate.

If you have any queries or we can be of further assistance, please do not hesitate to contact us.

Yours faithfully,

Thomas Lees MSci MSc CGeol FGS UK RoGEP Professional
For and on behalf of
Southern Testing Laboratories Limited
DDI: 01342 333 136
Email: tlees@southerntesting.co.uk

encs

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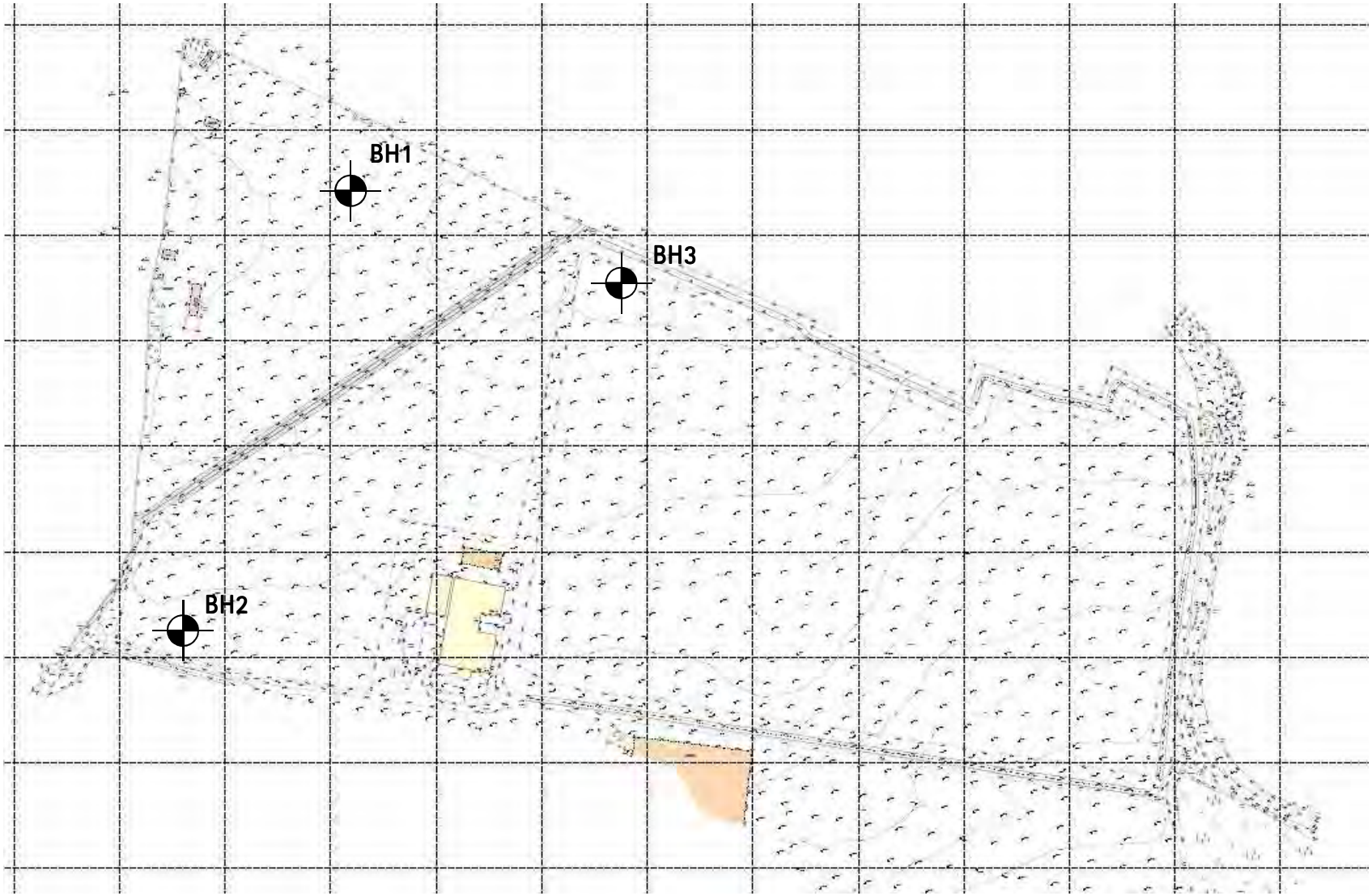
Site:	East Malling Site B	STL: J13838	Fig No: 1
Date:	1 November 2018	Site Location Plan	

Southern Testing

Southern Testing: Keeble House, Stuart Way, East Grinstead, West Sussex RH19 4QA
ST Consult: Twigden Barns, Brixworth Road, Creaton, Northampton NN6 8NN

ST Consult



NB: Positions of Boreholes are only indicative unless dimensioned

Site: East Malling Site B	STL: J13838	Fig No: 2
Date: 1 November 2018	Borehole Location Plan	

Southern Testing

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ST Consult

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Start - End Date	Project ID:	Hole Type:	BH1
25/10/2018	J13838	RO	Sheet 1 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570860E - 157820N	19.08	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 11.4m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
					18.8	(0.30)		0.30	TOPSOIL
									Stiff greyish brown CLAY.
						(3.10)			
					15.7			3.40	Dark brown fine SAND.
						(1.10)			
					14.6			4.50	Light grey LIMESTONE.
						(3.50)			
					11.1			8.00	Yellowish brown coarse grained SANDSTONE.
						(1.50)			
					9.6			9.50	Light grey LIMESTONE.

1 2 3 4 5 6 7 8 9 10

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.00	200			25-10-2018	15.50			11.40	10				

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Start - End Date	Project ID:	Hole Type:	BH1
25/10/2018	J13838	RO	Sheet 2 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570860E - 157820N	19.08	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 11.4m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
						(6.00)			Light grey LIMESTONE.
					3.6	(1.50)		15.50	Yellowish brown coarse grained SANDSTONE.
					2.1			17.00	End of Borehole at 17.00m

11 12 13 14 15 16 17 18 19 20

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.00	200			25-10-2018	15.50			11.40	10				

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Start - End Date	Project ID:	Hole Type:	BH2
25/10/2018 - 26/10/2018	J13838	RO	Sheet 1 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570763E - 157610N	20.54	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 12.0m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
					20.2	(0.30)		0.30	TOPSOIL
									Dark brown medium to coarse SAND.
					19.0	(1.20)		1.50	Light grey LIMESTONE.
						(3.00)			
					16.0			4.50	Interbedded SANDSTONE and LIMESTONE.
						(10.50)			

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.00	200			26-10-2018	17.00			12.00	10				

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Start - End Date	Project ID:	Hole Type:	BH2
25/10/2018 - 26/10/2018	J13838	RO	Sheet 2 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570763E - 157610N	20.54	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 12.0m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
									Interbedded SANDSTONE and LIMESTONE.
					5.5	(2.00)		15.00	Yellowish brown coarse grained SANDSTONE.
					3.5			17.00	End of Borehole at 17.00m

11 12 13 14 15 16 17 18 19 20

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.00	200			26-10-2018	17.00			12.00	10				

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Start - End Date	Project ID:	Hole Type:	BH3
26/10/2018	J13838	RO	Sheet 1 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570980E - 157784N	18.13	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 10.2m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
					17.8	(0.30)		0.30	TOPSOIL.
									Dark brown medium to coarse SAND.
					17.1	(0.70)		1.00	Interbedded SANDSTONE and LIMESTONE.
						(14.00)			

1 2 3 4 5 6 7 8 9 10

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.50	200			26-10-2018	12.00				0				
				26-10-2018	17.50			10.20	10				

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Start - End Date	Project ID:	Hole Type:	BH3
26/10/2018	J13838	RO	Sheet 2 of 2

Project Name:	East Malling Site B	Remarks:	Co-ordinates:	Level:	Logger:
			570980E - 157784N	18.13	TJ
Location:	Kiln Barn Road, East Malling, ME20 6QS	Down-the-hole-hammer. Rest groundwater level at 10.2m bgl. Driller's descriptions only.			
Client:	Ardent Consulting Engineers				

Well	Water Strikes	Samples and Insitu Testing: Depth (m bgl)	Type	Results	Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description
									Interbedded SANDSTONE and LIMESTONE.
					3.1	(2.50)		15.00	Yellowish brown coarse grained SANDSTONE.
					0.6			17.50	End of Borehole at 17.50m

11 12 13 14 15 16 17 18 19 20

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
17.50	200			26-10-2018	12.00				0				
				26-10-2018	17.50			10.20	10				

Appendix B

Proposed Drainage Strategy

NOTE : ALL OFFSITE WORKS SUBJECT TO ACCESS RIGHTS REVIEW AND VERIFICATION. PROVISION OF EASEMENT PROVISIONS FOR CONSTRUCTION AND FUTURE MAINTENANCE TO BE CONSIDERED DURING DETAILED DESIGN WORKS.

OPTION 3A (NORTH) - PROPOSED RESTRICTED OFFSITE DISCHARGE TO WATERCOURSE.

CONNECTION TO WATERCOURSE SUBJECT TO FURTHER TOPOGRAPICHAL SURVEY AND VERIFICATION OF CRITICAL DRAINAGE DESIGN. CONSULTATION WITH ENVIRONMENT AGENCY REGARDING DISCHARGE HEADWALL PROPOSALS WILL BE REQUIRED.

OPTION 2 - PROPOSED FOUL GRAVITY DISCHARGE TO EXISTING ADOPTED FOUL NETWORK

CONNECTION SUBJECT TO APPROVAL WITH SOUTHERN WATER AND NETWORK CAPACITY UPGRADE WORKS

OPTION 3B (WEST) - PROPOSED RESTRICTED OFFSITE DISCHARGE TO WATERCOURSE/LAKE.

CONNECTION TO WATERCOURSE/LAKE SUBJECT TO FURTHER TOPOGRAPHICAL SURVEY AND VERIFICATION OF CRITICAL DRAINAGE DESIGN. CONSULTATION WITH ENVIRONMENT AGENCY REGARDING DISCHARGE HEADWALL PROPOSALS WILL BE REQUIRED.

OPTION 2 - INFILTRATION (MASS SYSTEM) ATTENUATION DISCHARGE BASIN & BELOW GROUND TANK

DISCHARGE BASIN BASE AREA 2,091 M²
DISCHARGE BASIN 1.5M DEEP WITH 300MM FREEBOARD ALLOWANCE FOR 1 IN 100 YR DESIGN STORM, INCLUDING CLIMATE CHANGE.
1 IN 4 SIDE SLOPES

TANK 50M x 20M = 1,000 M²
TANK DEPTH SUBJECT TO DETAILED DESIGN AND INFILTRATION STRATA AND TESTING RESULTS

NOTE : PROVISION OF CELLULAR STORAGE FOR INFILTRATION ONLY REQUIRES CIRCA 3.2M DEPTH OF STORAGE.

COMBINATION OF DISCHARGE BASIN AND CRATES IS RECOMMENDED FOR ADOPTABILITY AND OPTIMISATION OF STORAGE VOLUMES.

REFER TO FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY DOCUMENT 182600-01 FOR SURFACE WATER COMBINATIONS AND OPTIONS

OPTION 3 - RESTRICTED OFFSITE DISCHARGE ATTENUATION BASIN

DISCHARGE BASIN BASE AREA 2,091 M²
DISCHARGE BASIN 1.5M DEEP WITH 300MM FREEBOARD ALLOWANCE FOR 1 IN 100 YR DESIGN STORM, INCLUDING CLIMATE CHANGE.
1 IN 4 SIDE SLOPES

REFER TO FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY DOCUMENT 182600-01 FOR SURFACE WATER COMBINATIONS AND OPTIONS

OPTION 3 - RESTRICTED OFFSITE DISCHARGE FLOW CONTROL DEVICE
PROPOSED FLOW CONTROL DEVICE AND CHAMBER BASED UPON GREENFIELD RUN OFF RATES (TABLE 5-1)

1 IN 1 = 23.6l/s
1 IN 30 = 63.0l/s
1 IN 100 = 88.7l/s

DISCHARGE HEADWALL TO DISCHARGE BASIN

TO SECURE THE ADOPTABILITY OF THE ONSITE DRAINAGE NETWORK IT IS PROPOSED TO PROVIDE A DISCHARE HEADWALL WHICH WILL BE PROVIDED ABOVE THE 1 IN 30 YEAR DESIGN STORM PEAK WATER LEVEL.

OPTION 1 - INFILTRATION (LOCALISED) SYSTEMS
BOREHOLE/SOAKAWAY & ATTENUATION
CELLULAR ATTENUATION = 100 M³
INFILTRATION RATE 400 L/MIN (1.69m/hr)
15m EXCLUSION ZONE TO BOREHOLE

NOTE : FURTHER PARKING COURTYARDS COULD PROVIDE INFILTRATION USING ALTERNATIVE SOAKAWAY METHODS WITH REDUCTION IN EXCLUSION ZONE. SUBJECT TO LOCALISED TESTING.

OPTION 1 - PROPOSED FOUL PUMPING STATION WITH 15m STAND OFF

LOCATION TO FWPS SUBJECT TO REVIEW BASED UPON SITE LEVELS AND CRITICAL DRAINAGE FALLS

NOTES:
SITE AREA = 11.58HA
DEVELOPABLE AREA = 8.83HA
IMPERMEABLE AREA (60%) =5.3HA
URBAN CREEP (10%) = 0.53HA
TOTAL IMPERMEABLE AREA INCLUDING URBAN CREEP = 5.83HA

THE SURFACE WATER DESIGN IS SUBJECT TO DETAILED DESIGN AND LLFA & SOUTHERN WATER APPROVAL

OPTION 1 - FOUL WATER PUMPING STATION RISING MAIN DISCHARGE CONNECTION TO EX2601.

CONNECTION SUBJECT TO APPROVAL WITH SOUTHERN WATER AND NETWORK CAPACITY UPGRADE WORKS

The Application Site

KILN BARN ROAD

CHERRY ORCHARD

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION, INC. RISK ASSESSMENTS (SEE CDM NOTES) AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
2. DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY.
3. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES UNLESS OTHERWISE STATED.
4. ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.
5. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
6. ANY WORKS OUTSIDE RED SITE BOUNDARY ARE FOR INFORMATION PURPOSES ONLY. UNLESS SPECIFICALLY NOTED, ALL WORKS OUTSIDE THE SITE BOUNDARY WILL BE UNDERTAKEN BY OTHERS UNDER A SEPARATE CONTRACT.

KEY:

- PROPOSED BOUNDARY
- ATTENUATION BASIN
- EX.2501 EXISTING SOUTHERN WATER SEWERS
- PROPOSED BELOW GROUND TANK
- PROPOSED FOUL RISING MAIN
- BOREHOLES WITH 15m OFFSET OF BUILDINGS
- PROPOSED SURFACE WATER NETWORK

FOR PLANNING ONLY

Rev	Description	Drn	Chk	App	Date
B	DRAINAGE STRATEGY UPDATED	DP	DP	BC	18.01.18
A	DRAINAGE STRATEGY UPDATED	GHB	PS	-	05.12.18

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Client: EAST MALLING TRUST

Project Title: DITTON EDGE (SITE B)

Drawing Title: PROPOSED DRAINAGE STRATEGY

A1 Scale	Date	Designed by
1:1000	21/08/2018	NT
Drawn by	Checked by	Approved by
NT	PS	-

Drawing Number: 182600/001 Rev B

File Location: \\ardenth5\projects\ardent projects\182600 - east malling trust sites b & c, ditton\technical\acad\drawings\182600 001 rev b proposed drainage strategy site b.dwg