ARDENT CONSULTING ENGINEERS

EAST MALLING TRUST

PROPOSED RESIDENTIAL DEVELOPMENT
DITTON EDGE (SITE B)

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

REPORT REF. 182600-01
PROJECT NO. 182600
DECEMBER 2018

PROPOSED RESIDENTIAL SCHEME: DITTON EDGE (SITE B)

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

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CONTENTS

APPENDICES

DOCUMENT CONTROL SHEET

REV	ISSUE PURPOSE	AUTHOR	CHECKED	APPROVED	DATE
-	DRAFT	NT	PS	DRAFT	NOVEMBER 2018
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1.0 INTRODUCTION

1.1. Ardent Consulting Engineers (hereafter referred to as Ardent) has been appointed by East Malling Trust to undertake a Flood Risk Assessment & Drainage Strategy (FRA) for the proposed development site located to the west of Kiln Barn Road, East Malling, Kent, ME20 6AH (hereafter referred to as 'the site'). The Lead Local Flood Authority (LLFA) is Kent County Council (KCC) and the Local Planning Authority (LPA) is Tonbridge and Malling Borough Council (TMBC).

1.2. The site is 11.58 ha in area and the Environment Agency (EA) Flood Map shows that the site is located within Flood Zone 1 which is considered to have a less than 1 in 1,000 year annual probability of flooding (0.1%). This FRA has been prepared to support the outline planning application for the proposed development of the site which will comprise of up to 300 residential units.

1.3. This FRA has been written with reference to the requirements of National Planning Policy Framework (NPPF) and the Planning Practice Guidance, which superseded the Technical Guidance to the NPPF in March 2014.

Site Location

1.4. The site is located to approximately 5.5km to the north west of Maidstone. The site is bound by Kiln Barn Road to the east, agricultural land to the south, a farm and associated infrastructure to the west and residential properties situated off Cherry Orchard and Brampton Field to the north.

1.5. The site is currently accessed from the east from Kiln Barn Road and from the west via a private access road that links through to Bradbourne Lane to the north.

1.6. The overall site occupies an area of approximately 11.58 ha and is centred on National grid reference 571024mE, 157671mN as shown in Figure 1-1 on the following page.

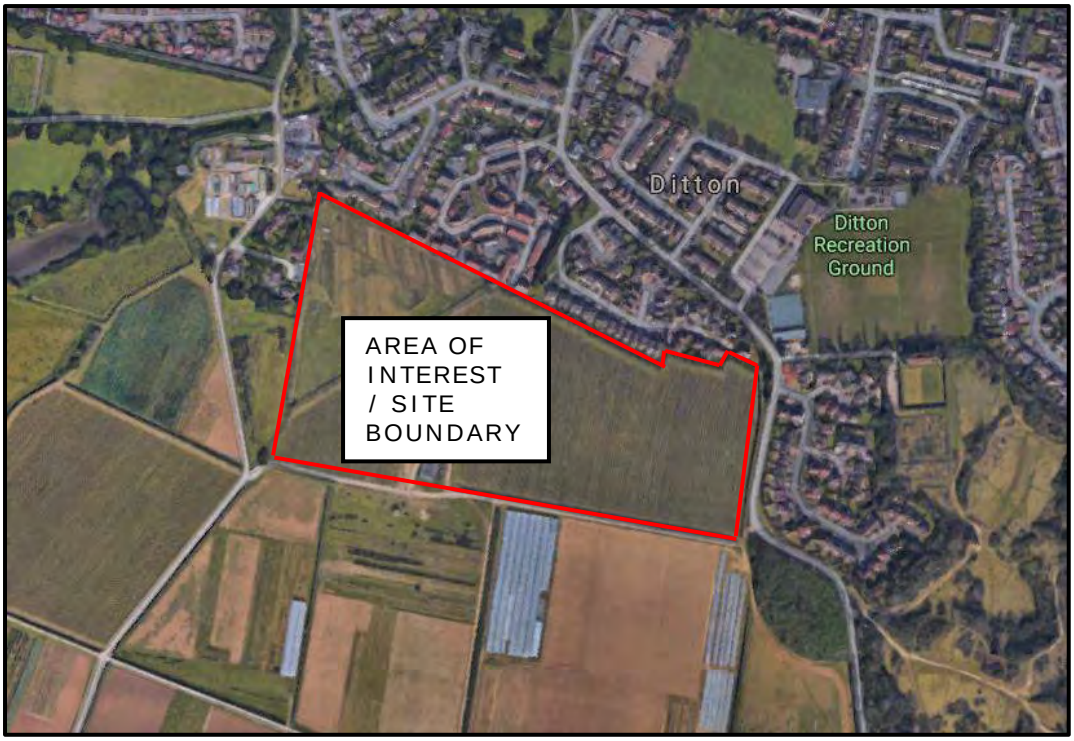

Figure 1-1: Site Location Plan

1.7. The eastern portion of the site slopes from the south west corner to the northern boundary at a level of 23.16m AOD to 18.27m AOD respectively, over a distance of 378m resulting in a gradient of approximately 1 in 77. The western portion of the site slopes from the south east corner from a level of 22.73m AOD to the same point, over a distance of 400m at a gradient of 1 in 84.

1.8. A copy of the Topographical Survey is included in Appendix A.

Development Proposals

1.9. The development proposals comprise a redevelopment of the existing agricultural land into a scheme comprising of up to 300 residential units (Class C3) and associated infrastructure.

1.10. As part of the proposed development, a new access is to be formed off Kiln Barn Road to the east of the site.

1.11. The proposed development layout is included in Appendix B and an excerpt is shown in Figure 1-2 below.

Figure 1-2: Extract of Proposed Site Layout

2.0 POLICY CONTEXT

National Planning Policy Framework (July 2018)

2.1. On the 24th July 2018, the Ministry of Housing and Local Government published their revised National Planning Policy Framework (NPPF) which came into effect immediately. Paragraph 155 to 165 inclusive, establishes the Planning Policy relating to flood risk management. The Technical Guide to the NPPF has been superseded by the Planning Practice Guidance (PPG) in March 2014.

2.2. The main focus of the policy is to direct development towards areas of the lowest practicable flood risk and to ensure that all development is safe, without increasing flood risk elsewhere. The main considerations are:

a) "*applying the sequential test and then, if necessary, the exception test as set out below;*

b) *safeguarding land from development that is required, or is likely to be required, for current of future flood management;*

c) *using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques); and*

d) *where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development including housing, to more sustainable locations."*

2.3. The NPPF states that a Flood Risk Assessment is required "*for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding."*

Planning Practice Guidance Flood Risk and Coastal Change

2.4. The accompanying planning practice guidance to the NPPF provides additional guidance to local planning authorities to ensure the effective implementation of the planning policy set out in the National Planning Policy Framework on development in areas at risk of flooding.

2.5. The PPG provides supporting information on:

- The application of the sequential approach and Sequential and Exception Tests;
- Measures to reduce flood risk to acceptable levels;
- How to manage residual risks; and
- Guidance on how to take climate change into account.

2.6. The March 2015 update to the practice guidance provides additional guidance on SuDS, including:

- The importance of SuDS;
- When SuDS should be considered;
- The SuDS discharge hierarchy;
- Factors a local authority will address when considering SuDS as part of a planning application;
- When SuDS are inappropriate and relevant flood risk consultees;
- Applicability of Defra's Non-statutory Technical Standards for Sustainable Drainage Systems;
- Design and construction cost considerations;
- Operation and maintenance considerations; and
- Where to go for further SuDS advice.

2.7. As part of the March 2015 update, the PPG provides details on the parties responsible for assessing the suitability of SuDS practices. As per paragraph 084 from the practice guidance:

- The decision on whether a sustainable drainage system would be inappropriate in relation to a particular development proposal is a matter of judgement for the local planning authority. In making this judgement the local planning authority will seek advice from the relevant flood risk management bodies, principally the lead local flood authority, including on what sort of sustainable drainage system they would consider to be reasonably practicable.

Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems March 2015

2.8. The Non-statutory technical standards for sustainable drainage systems were published in March 2015. This document sets out non-statutory technical standards for sustainable drainage systems. They should be used in conjunction with the Planning Practice Guidance. In addition, the Best Practice Guidance for the Planning Practice Guidance was published in July 2015.

2.9. The Local Planning Authority (LPA) may set local requirements for planning permission that have the effect of more stringent requirements than these non-statutory technical standards.

2.10. In addition, SuDS should be designed in accordance with CIRIA C753 SuDS Manual, which represents current best practice.

Regional & Local Planning Policy

2.11. In the preparation of this report, specific reference is made to the following regional and local planning policy pertinent to flood risk:

- Tonbridge and Malling Borough Council Core Strategy (September 2007);
- Kent County Council Preliminary Flood Risk Assessment (PFRA) (September 2011);
- Kent County Council Drainage and Planning Policy Statement (June 2017);

- Tonbridge and Malling Borough Council Strategic Flood Risk Assessment (August 2006);
- Tonbridge and Malling Surface Water Management Plan (October 2013).

2.12. The Tonbridge and Malling Borough Council Core Strategy (TMBCS) sets out the council's vision, aims and objectives which will determine the future pattern of development in the Borough over the period up until 2021. The TMBCS reflects the government's requirements as set out in the NPPF.

2.13. The Preliminary Flood Risk Assessment (PFRA) states that the county of Kent has the highest number of properties at risk of surface water flooding of any LLFA in England according to the Environment Agency's national surface water mapping exercise. Kent also has significant flood risks from groundwater and ordinary watercourses, however, the data available to assess these risks is less quantitative and there is currently no data available regarding our proposed site.

2.14. An email was sent to Kent County Council (KCC), as the Lead Local Flood Authority, on the 29 June 2018 enquiring if they are aware of any reported historic flooding or unreported flood risks on our site. On the 02 July 2018 the LLFA responded and directed us to their Drainage and Planning Policy Statement for details. A copy of the correspondence is included in Appendix C. A copy of their completed Pro-Forma that is to accompany FRAs submitted as part of planning applications submitted in their county is included in Appendix J.

2.15. PFRA mapping is including in Appendix D, amongst the mapping are plans showing the following:

- Groundwater Risk Areas;
- Surface Water Flood Risk to Settlements;
- Length of Ordinary Watercourse in Settlements;
- Recorded Past Flood Events.

2.16. Although the maps are shown at a very high level, they indicate that the area in the flood risk in the vicinity of the site ranges between

high and negligible. It is estimated that the number of properties at risk of groundwater flooding by a 1 in 200 year storm event are between 8 – 50 dwellings. The length of Ordinary Watercourses in settlements is between 0.267 – 1.239 km/km^2. There are few incidences of past flood events recorded in the vicinity of the site, maps showing the above are included in Appendix D.

2.17. Strategic Flood Risk Assessment (SFRA) considers all sources of flooding, including fluvial, pluvial, groundwater, artificial sources and sewer flooding, within the Tonbridge and Malling Borough. The SFRA summary provides a detailed assessment of the flood hazard within the Flood Zones. It also includes detailed mapping of specific areas in the Borough that are prone to groundwater flooding, the site is shown to be in an area that is at 50-75% groundwater risk. A copy of the mapping is included in Appendix E.

Sequential and Exception Test

2.18. According to Table 2 of the Planning Practice Guidance, the proposed residential development for the site is classified as 'More Vulnerable'. The site is situated in Flood Zone 1 and therefore is not required to undergo the Sequential and Exception Tests, the site is deemed appropriate for the development.

3.0 BASELINE DATA

Hydrology

3.1. The nearest surface water body is located to the west of the site, it relates to a Lake within the grounds of Bradbourne House which appears to feed a watercourse that flows to the north and discharges to the River Medway. The River Medway is located approximately 1.5km to the north of the site. Refer to Figure 3-1 below.

3.2. The biggest water feature in the vicinity to the site is also the Lake within the grounds of Bradbourne House.

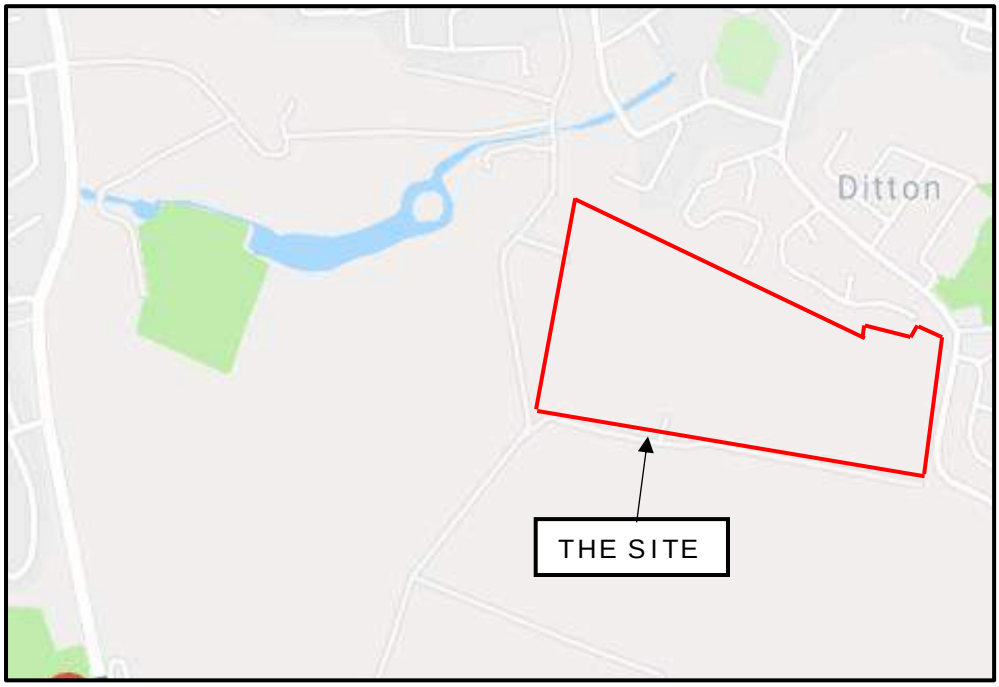

Figure 3-1: Hydrology

Ground Conditions

3.3. According to The British Geological Survey (BGS) online data sets at a scale of 1:50,000 indicates that the majority of the site is underlain by bedrock geology of Hythe Formation, Sandstone and Limestone with no superficial deposits. The north of the site is underlain by

Sandgate Formation, consisting of Sandstone, Siltstone and Mudstone refer to Figure 3-2 below.

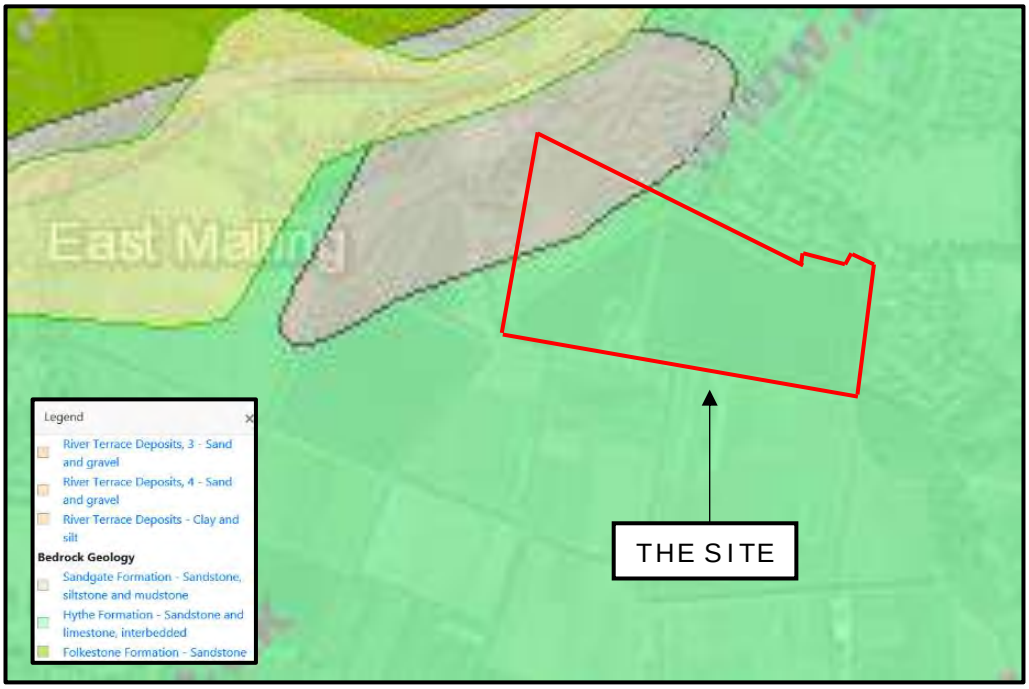

Figure 3-2: BGS Online Bedrock and Superficial Mapping (1:50,000)

3.4. The geology above suggests that there could be the potential for infiltration type drainage.

3.5. The nearest historic borehole log is TQ75NW460 is located directly to the south of the site, in agricultural land. The borehole shows the below ground is firm red/orange brown clayey SILT down to 1.10m, underlain by moderately strong black stained Limestone (Ragstone) down to 1.20m. No groundwater was present during the excavation. The borehole record is contained in Appendix F.

3.6. Borehole and infiltration testing were undertaken in October 2018 and the results are contained within Appendix K of this report. The borehole logs show that Limestone and Sandstone is present below 3.4m below ground level, above the strata varies between sand and clay depending on the location within the Site. The infiltration rates obtained as part of the borehole testing varied between 100 l/min to the south of the site and 400 l/min to the north of the site.

3.7. The site is located within a Zone 2 (Outer Protection Zone) the Groundwater Source Protection Zones (SPZs). These zones help to

monitor risk of contamination from any activities that might cause pollution to the groundwater source. The presence of the protection zone may limit the use of soakaways.

Existing Sewer Infrastructure

3.8. Southern Water Asset Plans, contained within Appendix G, show that there are numerous foul sewers in the residential development to the north of the site, all are shown with 150mm diameters. A 150mm diameter foul sewer is also shown to be located in Kiln Barn Road, the sewer flows from north to south. A pre-development enquiry has been submitted to Southern Water, their response is contained in Appendix G and states there is currently no capacity to serve the foul sewerage from the proposed Site.

3.9. Refer to Figure 3-3 below for an extract of Southern Water asset plan.

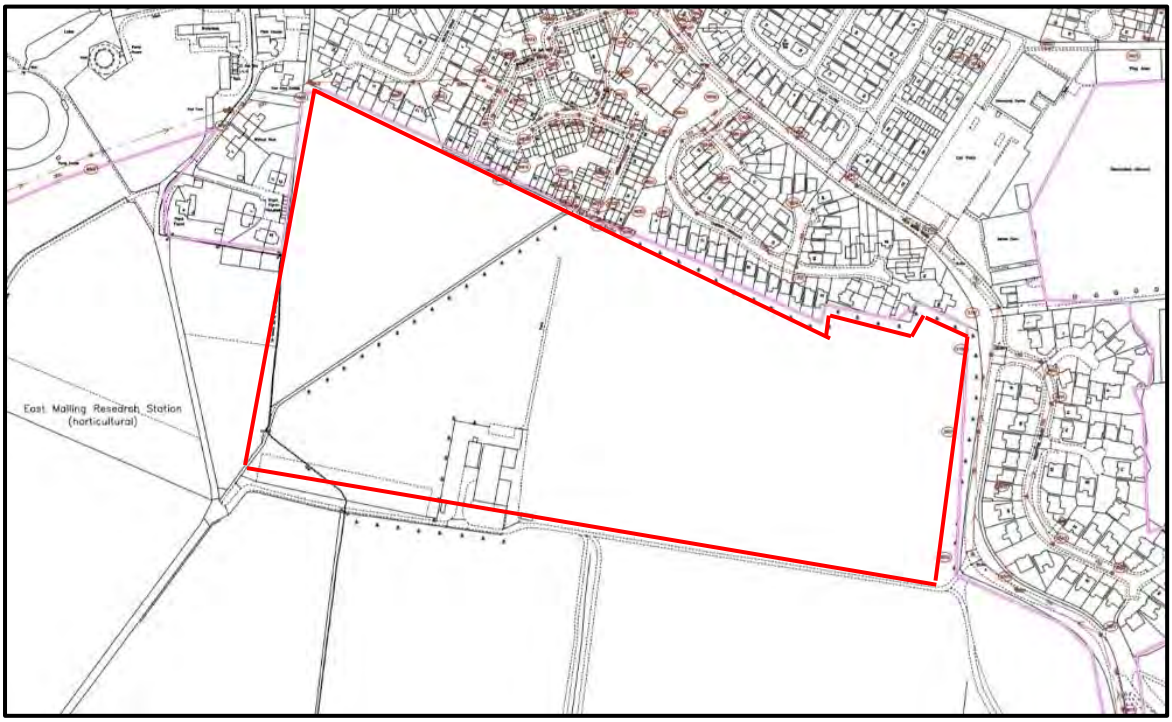

Figure 3-3: Extract of Southern Water Asset Plan

3.10. Southern Water confirmed that no surface water flows (existing or proposed) can be accommodated within the existing foul sewerage system.

4.0 SOURCES OF FLOODING

4.1. The NPPF requires flood risk from the following sources to be assessed, each of which are assessed separately below:

- Tidal sources (flooding from the sea);
- Fluvial sources (river flooding);
- Pluvial sources (flooding resulting from overland flows);
- Groundwater sources;
- Sewer surcharge; and
- Artificial sources, canals, reservoirs etc;
- It also requires the risk from increases in surface water discharge to be assessed (surface water management).

Tidal/Fluvial Flooding

4.2. The EA's online mapping indicates that the site is located within Flood Zone 1 which means that the site has less than a 1 in 1,000 probability of river or sea flooding annually (low probability). Refer to the EA Flood Map in Figure 4-1 below. An area of Flood Zone 3 is located to the North West of the site and is associated with the Lake with the grounds of Bradbourne House.

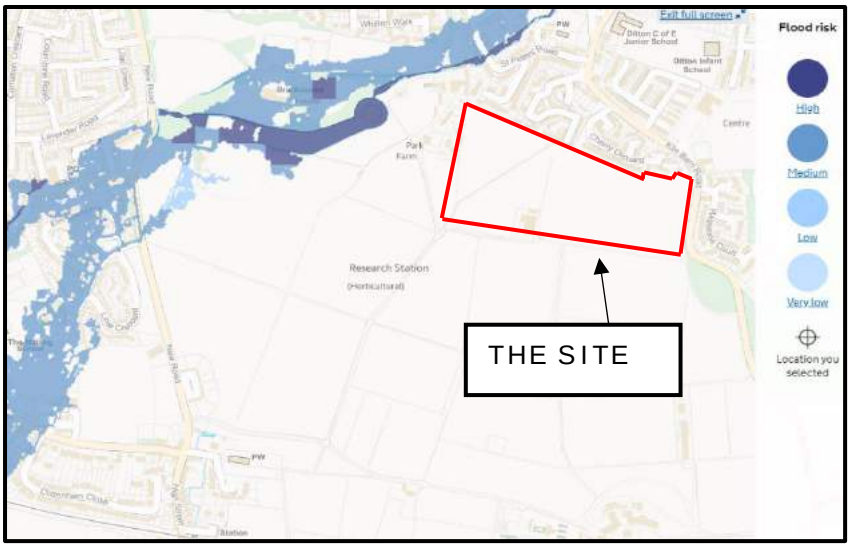

Figure 4-1: Extract of EA Flood Risk from Rivers or Tidal Maps

Pluvial Flooding

4.3. EA flood mapping, shown in Figure 4-2, shows below that the majority of the site is at 'very low risk' of surface water flooding. There are areas of 'low risk' to the west of the site and an area of 'high risk' to the north of the site. It is considered this represents a topographical low point of the site. As. It has been noted that there is existing pluvial flooding in the adjacent roads to the north of the site. It is considered the formalisation of the drainage within the site as part of the proposed development will help reduce the risk of surface water flooding to the residential development located to the north of the site.

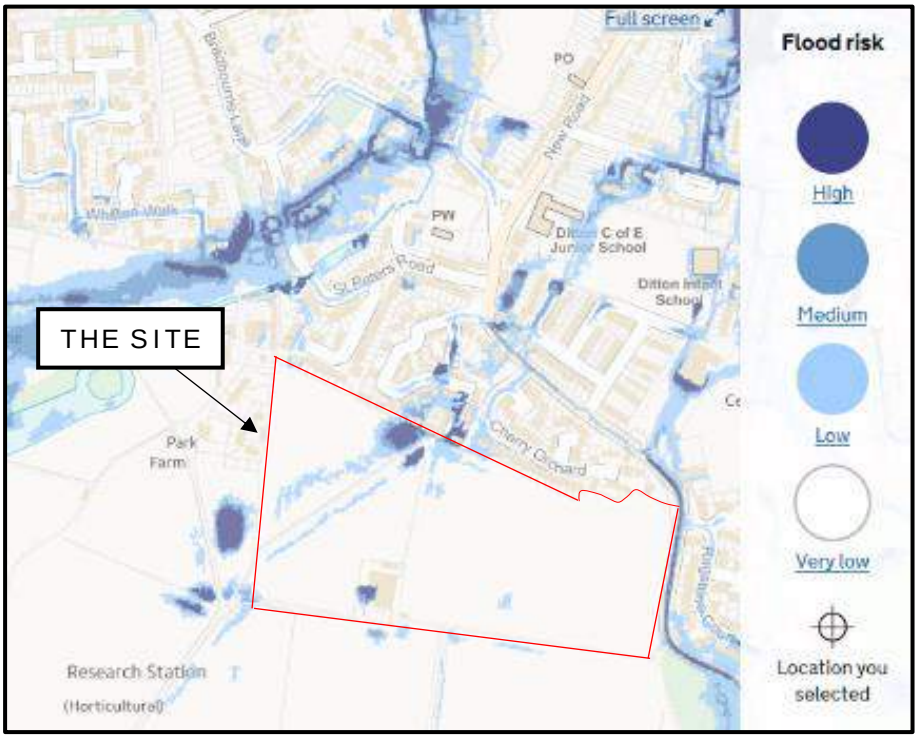

Figure 4-2: Extract of Surface Water Flood Maps for Planning

Groundwater Flooding

4.4. Based on information found on Tonbridge and Malling Borough Council's SFRA Groundwater Flood Maps, the site is located within an area considered to have a risk of between 50 – 75% of groundwater flooding. This shows that groundwater flooding could be a risk to the site. This map is included within Appendix E of this report.

4.5. The EA's groundwater map shows that the Site is located in a Groundwater Source Protection Zone (total catchment protection zone - Zone 2). Refer to Figure 4-3 below.

4.6. The risk of groundwater flooding should be taken into consideration at the detailed design stage to make sure that the foundation strategy does not increase the flood risk from groundwater.

Figure 4-3: EA Groundwater Map

4.7. As part of the infiltration testing ground water was located at depths of between 10 and 12m below ground level and therefore the risk from ground water flooding is considered negligible.

4.8. It is recommended that groundwater monitoring be undertaken pre-construction to assess the variability of groundwater.

Sewer Flooding

4.9. As part of this study, no records of sewer flooding have been located in the vicinity of the site. As there are no surface water or combined sewers in the vicinity of the site, sewer flooding is considered a low risk to the site.

New Road Culvert

4.10. Through review of historical records, discussions with the land owners and local residents it is understood there have been numerous incidents of flooding associated with the culvert that runs along the eastern side of New Road.

4.11. It is understood the flooding is associated with restrictions of flow within the culvert and the potential capacity of the culvert itself. However, the flooding from the culvert is retained within New Road and does enter into the proposed development site. Therefore, the flood risk to the site from the culvert is considered low.

Artificial Sources

4.12. The site is not within any reservoir maximum flood extents and not in the vicinity of any artificial waterbodies including reservoirs or canals. Therefore, the risk of flooding at the site from artificial sources is considered to be very low.

5.0 SURFACE WATER MANAGEMENT

Existing Surface Water Drainage Discharge

5.1. In order to assess the current discharge from the site, the HR Wallingford IH124 ICP SuDS methodology has been used to estimate the current surface water run-off rates from the existing greenfield area, as shown in the calculation sheet contained in Appendix H.

5.2. The greenfield run-off rates calculated using the above method are summarised below:

Table 5-1 Existing Surface Water run-off rates

Site Area (ha)	Surface Water Run-off (l/s)			
	Qbar	1 year	30 year	100 year
8.83	27.8	23.6	63.0	88.7

Proposed Surface Water Management Techniques

5.3. Table 5-The following proposals for the surface water management of the development follow the guidance of the SuDS ICP guidance and Building Regulation Part H with regards to the application of the application of the Drainage Hierarchy.

Infiltration (Localised System)

5.4. Table 5-Based upon the onsite borehole and infiltration testing results detailed within Appendix K the use of localised infiltration techniques could be considered for use on the site. These will be subject to localised testing and optimisation as part of the detailed design works.

5.5. It is intended to seek to use permeable paving within private driveways and parking courtyards. Dependant on in situ testing and achieving suitable strata interface levels these could be applied locally to specific catchment areas for the site. This could be achieved via

the application of house soakaways, boreholes or sump soakaway units.

5.6. Following deep borehole infiltration testing, undertaken by Southern Testing in October 2018, the rate of infiltration found to be present across the site varied from 100 – 400 l/min. As the boreholes are to be located to the north of the site a rate of 400 l/min (1.69m/hr) has been used when determining the required number of boreholes and associated attenuation.

5.7. It is proposed to seek to use borehole soakaways to manage surface water from localised catchment areas. Based upon preliminary calculations it is anticipated that a 0.1Ha catchment area can be drained via a 0.3m borehole, 5m deep, with provision of 100m^3 of storage. The attenuation has been sized to accommodate storm events up to and including the 1 in 100 year event including a 40% allowance for climate change. (Appendix H)

5.8. Further infiltration testing and groundwater monitoring will need to be undertaken prior detailed design of the surface water drainage strategy being prepared.

Infiltration (Mass System)

5.9. Based upon the onsite borehole and infiltration testing results detailed within Appendix K the use of a mass infiltration technique could be applied to the site. This will be subject to localised testing and optimisation as part of the detailed design works.

5.10. Provision of a mass infiltration system located within the northern boundary POS area is considered to be the most practicable solution based upon available space, site falls and preliminary infiltration testing.

5.11. Based upon provision baseline hydraulic modelling it is anticipated that a storage system will need to provide 3,200m^3 to a depth of circa 5m to ensure continuity with suitable infiltration strata in line with the preliminary borehole results.

5.12. Given the required storage requirements for the 1 in 100yr design storm of 3,200m^3 and the associated depth for infiltration it is anticipated that this would be provided using geo cellular storage crates which will provide a 95% void capacity (Appendix H).

5.13. It is considered that further optimisation of the storage provisions can be made during the detailed design and hydraulic modelling works based on catchment areas and time to discharge rates to reduce the storage provisions.

5.14. It is currently considered that the proposed on site drainage network will be offered for adoption to the local water authority. It is therefore not likely that the authority will adopt any SuDS infiltration system and this will need to remain private and transferred to a management company with associated rights to discharge being granted. As such provision of a maintainable and unrestricted discharge headwall to the system will need to be provided. It is proposed that a surface water discharge basin should be included to facilitate the discharge and percolation to the cellular storage system below.

5.15. The inclusion of a drainage discharge basin will provide further water quality improvements and flood protection. This basin can also be considered and modelled within the overall drainage model for the extreme storm events this will offer further optimisation of the cellular storage.

5.16. The design of any infiltration system will be subject to detailed ground investigation works including infiltration testing and groundwater monitoring given the local classification of the site.

Restricted Offsite Discharge

5.17. In the event that infiltration options are deemed unviable following detailed site investigation then the use of a restricted off-site discharge can be considered.

5.18. It is known that there are no surface water sewers located in the vicinity of the site therefore discharge would be to the nearest available watercourse.

5.19. Based upon local mapping and Environment Agency plans the nearest water course is located approximately 100m to the north of the site.

5.20. This watercourse is understood to flow in a west to east direction before connecting to the River Medway some 1.5km to the north east of the site.

5.21. It is proposed that onsite attenuation and provision of a flow control device to match the greenfield run off rates (Table 5-1) would be provided.

5.22. Based upon the peak discharge rate of 88.7 l/s (Table 5-1) for the 1 in 100yr + 40% climate change a preliminary sizing of required attenuation suggests that this will be between 2,754m^3 and 3,821m^3 (Appendix H).

5.23. In line with adoptable standards and as part of the detailed design process it is anticipate this would be provided using a discharge attenuation basin and attenuation to adoptable standards as the discharge to the water course would be offered for adoption.

5.24. The detention basin would be expected to accommodate the storm events up to the 1 in 30 year design storm with all further storm events contained within a private offline system which re-discharges to the adoptable sewer network in line with peak discharge rates and Long Term Storage requirements.

5.25. An offsite drainage route would be provided along the farm access track located in the north-western corner of the site onto the private access road within the East Malling Trust estate. It is considered that there are 2no options for the final site discharge point.

5.26. The first offsite drainage route (Fig 5-1) to the watercourse is to the north of the private estate access road. The access road crossed a bridge over the watercourse.

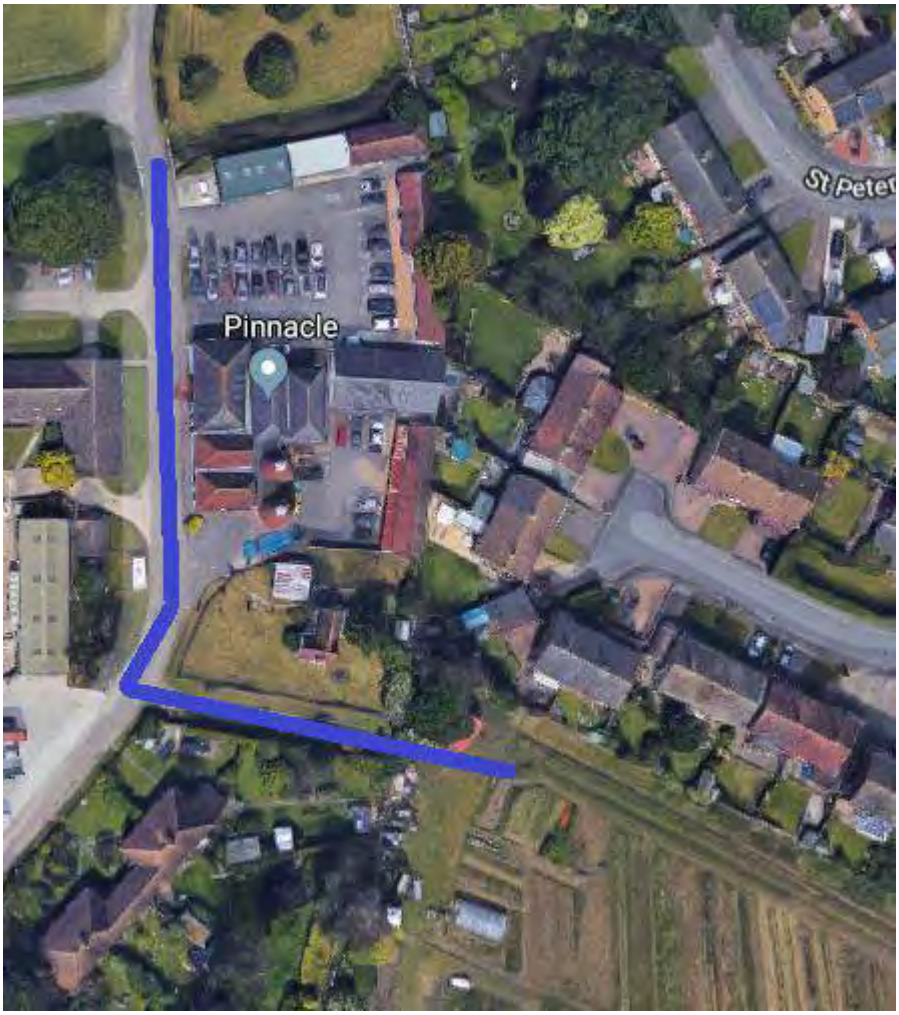

Figure 5-1: Restricted Offsite Discharge (Option 1 – North)

5.27. The second offsite drainage discharge route (Fig 5-2) is to the west of the site past an existing farm building and service yard to the lake to the south of Bradbourne House.

Figure 5-2: Restricted Offsite Discharge (Option 2 – West)

5.28. It is understood that the proposed offsite drainage routes would be contained within the landowner's boundary and therefore would not be subject to any sewer requisition (S98) with Southern Water. This will require verification with the landowner prior to design.

5.29. The final surface water management solution and proposals will be subject to additional ground investigation, topographical works and site layout requirements.

Un-Restricted Offsite Discharge

5.30. In line with current guidance and flood mitigation measures the use of an unrestricted off-site discharge route is not considered suitable.

Proposed Sustainable Drainage Systems (SuDS)

5.31. Table 5-2 appraises the constraints and opportunities for the use of SuDS techniques within the site and it adopts the management train approach outlined in CIRIA C753 'The SuDS Manual'.

Table 5-2: C753 SuDS Management Train Approach

Type:	Infiltration Devices (Source Control)
Constraints:	The site is underlain by Hythe Formation Sandstone, Limestone and also Sandgate Formation to the North which is likely to have an acceptable infiltration rate.
Opportunities:	Although the strata directly beneath ground level is not considered suitable for infiltration type drainage, deep borehole soakaway testing has been undertaken and a good infiltration rate of 400 l/min is known to be present at depth to the north of the Site.
Type:	Lined Permeable Paving (Source Control)
Constraints:	Lined permeable paving cannot be utilised in areas that are proposed to be submitted for adoption by KCC Highways department.
Opportunities:	Permeable paving could be utilised within areas of shared parking courts and some key private drive locations, this will provide an additional method of treatment to surface water discharging from the site.
Type:	Rainwater Harvesting (Source Control)
Constraints:	The benefits of rainwater harvesting on a specific design storm event cannot be quantified, due to the seasonal availability of storage within the structure.
Opportunities:	Rainwater Harvesting has not been considered as part of the surface water management strategy.
Type:	Swales, Detention Basin etc. (Permeable Conveyance)
Constraints:	In order to provide practicable attenuation benefits 1:4 side-slope swales tend to require a significant land requirement.
Opportunities:	Swales with steeper side slopes have been incorporated in the layout to provide additional treatment to surface water discharging from some areas of the highway within the site. A detention basin is to be incorporated in the area of open space to attenuate flows from the site.
Type:	Living Roofs
Constraints:	Green roofs require a level roof and easy access for regular maintenance.
Opportunities:	Green roofs have not been proposed as part of this surface water management strategy.
Type:	Attenuation Tanks
Constraints:	Groundwater flooding.
Opportunities:	Attenuation tanks can be utilised in areas where soakaways are positioned below shared parking areas.

5.32. After consideration of the CIRIA C753 approach, the preferred SuDS option for this site is to be a combination of swales, permeable paving, a discharge detention basin and infiltration soakaways.

5.33. Run-off from the access road / car parking area and the rain water pipes serving the roofs, will drain directly to the piped system terminating in the detention basin via catchpit manholes.

5.34. In some areas of the site additional treatment will be sought by provision of swales running alongside the highway (subject to adoptable standards).

Post Development Impermeable Area

5.35. The planning redline boundary equates to approximately 11.58 ha, of which 8.83 ha is noted as developable area. 60% of this area is considered as impermeable (5.3 ha). Including urban creep, an area of 5.83 ha has been used as part of the drainage calculations.

Finished Floor Levels

5.36. Although the development area is not within tidal, fluvial or pluvial flood extents, it is recommended that the finished floor levels are raised 150mm above the surrounding finished levels. This will protect against localised flooding, groundwater levels and allow adoptable highways to be used as effective exceedance routes.

Storage Requirements

5.37. The Sustainable Design and Construction SPG (Supplementary Planning Guidance) (April 2014) recommended that discharge rates should be restricted to less than the existing greenfield run-off rates.

5.38. The attenuation has been sized to serve up to the 1 in 100 year storm event, with 40% climate change allowance. The total attenuation to be provided as part of the proposed development is 3,200m^3 and is to be split between an attenuation basin and below ground attenuation tanks. Refer to the MicroDrainage calculations provided in Appendix H.

5.39. Within the MicroDrainage calculations contained in Appendix H, the number of boreholes required to serve a 0.1Ha catchment area has been determined by calculating the impermeable area each borehole with 100m^3 of storage can serve.

5.40. During the detailed design stage the extent of the cellular storage and infiltration basin could be optimised based upon localised catchment drainage solutions and inclusion of permeable paving and swale SuDS features within the hydraulic model.

5.41. Drawing No. 181510-001 in Appendix I illustrates the Proposed Drainage Strategy, indicating how the site will be drained.

Urbanisation

5.42. As the development comprises of residential units, a 10% urbanisation factor has been applied in accordance with the LASOO guidance, increasing the impermeable area to 5.83 ha. This figure has been used within the MicroDrainage calculations included in Appendix H.

Long Term Storage

5.43. As the impermeable area would increase as a result of the development, run-off volume generated by the developed area would also increase.

5.44. However, as the flows from the site are discharging via infiltration no provision for Long Term Storage is required.

5.45. Should the ground investigations result in the use of infiltration becoming unviable then a review of provision of long term storage within any off-site discharge option will be considered in line with current guidance.

Exceedance Routes

5.46. As a result of heavy or extreme storm events it is sometimes unavoidable for the capacities of sewers and other drainage systems to be exceeded. Drainage exceedance will occur when the rate of surfaced water run-off exceeds the inlet capacity of the drainage system, when the receiving water body or pipe system becomes overloaded, blocked or when the outfall becomes restricted due to flood levels in the receiving water. Within the development, this has

been mitigated against by raising the finished floor levels to a minimum level of 150mm above proposed ground levels.

5.47. The detention basin has been positioned at the lowest point of the site to allow a gravity drainage solution and provide betterment to the residential properties to the north so they are less likely to suffer flooding from surface water.

5.48. Levels to the north of the Site will be constructed so as to protect the existing development immediately north of the proposed development from exceedance flows. This could be provided in the form of a small bund or cut off ditch.

Future Maintenance

5.49. It is intended that the SuDS components employed throughout the drainage strategy will be maintained by a management company.

The maintenance of all SuDS components will be in accord with the best practices and the CIRIA Manual C753. Excerpt of Recommended operation and Maintenance requirements for the proposed permeable paving and attenuation pond set out in CIRIA Manuel C753 is shown in Tables 5-3 below.

Table 5-3: Maintenance Regime

Inlets, Outlets, Controls and Inspection Chambers	
Regular Maintenance	**Frequency**
Inlets, outlets and surface control structures Inspect surface structures, removing obstructions and silt as necessary. Check there is no physical damage. Strim vegetarian 1m min. Surround to structures and keep hard aprons free from silt and debris.	 Monthly Monthly
Inspection chambers and below-ground control chambers Remove cover and inspect, ensuring that water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt. Undertake inspection after leaf fall in autumn.	 Annually
Occasional Maintenance	
Check topsoil levels are 20mm above edges of baskets and chambers to avoid mower damage.	As necessary
Remedial Work	**Frequency**
Unpack stone in basket features and unblock or repair and repack stone as design detail as necessary.	As required
Repair physical damage if necessary.	As required

Pervious Pavements	
Regular Maintenance	**Frequency**
Cleaning Brush regularly and remove sweepings from all hard surfaces.	Monthly
Occasional Tasks	**Frequency**
Permeable pavements: Brush and vacuum surface once a year to prevent silt blockage and enhance life design.	Annually
Remedial Work	
Monitor effectiveness of permeable pavement, and when water does not infiltrate immediately advise the client of possible need for reinstatement of top layers or specialist cleaning.	As required

Recent experience suggests that jet washing and suction cleaning will substantially pavement to 90% efficiency.	

Detention basins, ponds and wetlands	
Regular Maintenance	**Frequency**
Grass Mow grass access paths and verges surrounding basins, ponds and wetlands areas at 35-50mm minimum and 75mm maximum, or as specifies; to provide a cared-for appearance and allow pedestrian access.	Monthly or as required
Mow rough grass areas for occasional access or habitat reasons at 100mm and maximum 150mm with cutting removed to wildlife piles.	As required, 4-6 times annually
Grass areas not required for access may be managed for wildlife interest and to reduce costs. Two cuts in July and September or one cut annually in September or October as specified, and cuttings removed to wildlife piles.	Annually or as required
Wet woodland management Manage annually, with cuttings left in-situ or removed to wildlife piles.	Annually or as required
Wetland vegetation Cut (strim) at 100mm with cuttings removed to wildlife piles September-October. Or Maintain as a mosaic to be cut 25-30% in any one year at 100mm in September or October with cuttings removed to wildlife piles.	Annually or as required
Occasional tasks	**Frequency**
Where silt accumulates on apron or area in front of inlet or outlet, remove and land apply within design profile of SuDS. Where silt accumulates more than 150mm in base of wetland, undertake a phased removal of silt subject to client approval. Remove silt as instructed, but not more than 30% of the pond or wetland area at any one time and to an agreed depth but not the subsoil layer. Retain as much representative existing vegetation as possible to ensure rapid recolonisation of open areas. Stack excavated material adjacent to wetland to allow de-watering of silt.	Annually or every 3 years, as required

Undertake silt removal during September-October to minimise damaged to protected wildlife and ensure regrowth of aquatic vegetation before winter. Spread excavated material on site above SuDS design profile, e.g. top of banks, in accordance with EA (2010).	

Surface Water Run-off

5.50. In terms of surface water treatment, the integration of the SuDS features outlined in the above sections would make sure that surface water run-off would be of sufficient quality, so as not to cause pollutant-based detriment to the ground below.

5.51. In determining the necessary SuDS treatment methods, reference is made to Table 26.2, Table 26.3 and Table 26.4 of the SuDS Manual (CIRIA C753). The tables outline the 'Simple Index Approach' which sets out the water treatment criteria in relation to land use and SuDS performance evidence. To make sure sufficient treatment is proposed for surface waters, the total pollution mitigation index of the selected SuDS methods must equal or exceed the pollution hazard index for the site. See Table 26.2, 26.3 and 26.4 below.

5.52. In order to satisfy the requirements of CIRIA C753 it is considered that permeable paving could be incorporated into the design where possible. This will enable the surface water discharging from the private hardstanding areas of the site to filtrate through the granular material and as such be treated at source, prior to entering in to the ground.

5.53. Due to the presence of ground water a Preliminary Risk Assessment has also been prepared by Ardent to accompany this report and is included in Appendix L. This report further demonstrates the proposed drainage strategy does not pose a risk of pollution to the ground water beneath the site.

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) i.e. < 300 traffic movements/day.	Low	0.5	0.4	0.4
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 &	High	0.8[2]	0.8	0.9

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.				

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.		

Table 26.4 Indicative SuDS mitigation indices for discharge to groundwater

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	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 (where a suitable depth of filtration material is included that provides treatment, i.e. graded gravel with sufficient smaller particles but not single size coarse aggregate	0.4	0.4	0.4

such as 20mm gravel) underlain by a soil with good contaminant attenuation potential of at least 300mm in depth.			
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with 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[4]	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.		

5.54. 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.

5.55. The Preliminary Risk Assessment for Groundwater (included in Appendix L) 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, the 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.

6.0 FOUL WATER MANAGEMENT

6.1. Southern Water Asset Plans, contained within Appendix G, show that there are numerous foul sewers in the residential development to the north of the site, all are shown with 150mm diameters. A 300mm diameter adoptable foul sewer is shown to the north western edge of the site. A 150mm diameter foul sewer is also shown to be located in Kiln Barn Road, the sewer flows from north to south.

6.2. A pre-development enquiry has been sent to Southern Water and they have confirmed that no capacity is available in the sewers to the north of the site. The alternative proposed by Southern Water, is to discharge to the Ditton WWTW. This is not considered a viable solution and therefore discussions with Southern Water are continuing, in order to determine a suitable alternative for the discharge of the proposed rate of 13.89 l/s to their existing network.

6.3. Refer to Appendix G for copies of Southern Water record plans and the Pre-Development Enquiry response. The proposed Foul Water Drainage Strategy is shown on Drawing No. 182600-001 in Appendix I.

6.4. It is considered that there are 2no options for the discharge of the Foul Water from the site subject to further networks modelling and network upgrade works.

6.5. Firstly, it is considered the foul sewerage will drain via gravity to anon site adoptable foul water pumping station (location to be confirmed subject to levels and easement provisions) before discharging to the sewer in Kiln Barn Road via a rising main.

6.6. Secondly the system, subject to detailed design and critical levels, could drain by gravity to the 300mm sewer located to the north west of the site.

6.7. It is considered that further liaison with Southern Water to verify scope of upgrading works and approved connection/discharge location and rates will need to be undertaken as part of the detailed design process.

7.0 CONCLUSIONS

7.1. This Flood Risk Assessment has been prepared by Ardent to accompany a proposed development of up to 300 residential units.

7.2. According to the EA's flood zone mapping, the site is situated in Flood Zone 1 considered to have a less than 1 in 1,000 year annual probability of flooding (0.1%).

7.3. As the Site is located in Flood Zone 1 it will not have to undergo the sequential or exception tests.

7.4. The underlying geology of the site varies between clay and sand directly beneath the topsoil with Sandstone and Limestone at depth.

7.5. EA surface flood mapping shows that the majority of the site is at very low risk of surface water flooding. There is a very small area of low risk of flooding to the west of the site and a small area, at a low point to the north of the site, shown to be at high risk of flooding. It is considered by formalising the drainage on the site this will reduce the risk of pluvial flooding to north of the site and the adjacent residential properties directly to the north of the site.

7.6. It is recommended that the finished floor levels are raised 150mm above the existing ground level to minimise the risk of surface water run-off into the building.

7.7. Surface water from the site will follow the drainage hierarchy and solutions.

7.8. In the first instance this will seek to use infiltration via localised catchment areas or a mass system which is likely to incorporate the use of a detention basin for discharge and water quality management benefits.

7.9. Localised discharge will either be via house soakaways, boreholes or sump soakaway units to suit ground strata.

7.10. The attenuation required for storm events up to and including the 1 in 100 year storm event plus a 40% allowance for climate change will be provided in the form of below ground attenuation tanks and an attenuation basin. Permeable paving, catchpits and swales will be

incorporated into the layout to provide sufficient treatment to the surface water, before infiltrating into the ground.

7.11. Should infiltration be deemed not suitable or viable then the surface water will be restricted to match greenfield run off rates with provision of a flow control device and discharge offsite to the local watercourse.

7.12. Provision of attenuation to accommodate all storm events will be required along with consideration of Long Term Storage and discharge rate measures.

7.13. Foul sewerage from the proposed development will discharge via a new connection into the Southern Water sewer, the proposed outfall location of the foul sewerage from the site is to be agreed with Southern Water subject to network capacity modelling and upgrading works.

7.14. In conclusion, this Flood Risk Assessment demonstrates that the proposals are consistent with the aims of national and local policy. The site will not be at significant risk of flooding or increase flood risk to the site or others.

Appendix A

Topographical Survey

Station Information:

Station	Easting (m)	Northing (m)	Level (m)
GH1	570199.882	157743.366	19.574
GH2	570190.670	157818.298	18.725
GH3	570180.351	157839.471	19.279
GH4	570149.179	157842.023	19.766
GH5	570138.833	157859.881	20.879
GH6	570113.297	157871.619	20.887
GH7	570063.709	157738.390	20.393
GH8	570080.813	157585.896	21.979
GH9	570118.211	157458.801	24.639
GH10	570167.471	157252.501	29.531
GH11	570188.634	157161.096	30.358
GH12	570224.372	157168.630	29.397
GH13	570253.415	157160.032	29.240
GH14	570353.879	157476.447	22.055
GH15	570570.150	157393.665	24.271
GH16	570725.053	157600.648	20.870
GH17	570934.162	157576.195	21.184
GH18	571244.304	157532.905	23.478
GH19	571254.068	157553.488	22.677
GH20	571259.024	157566.089	22.147
GH21	571280.489	157724.786	19.985

All station points are PK nails.

OS Note:

Some services may have been omitted due to parked vehicles. The Ordnance Survey tile is to be used as a guide only.

OS Buildings *Surveyed Buildings*

This survey has been orientated to the Ordnance Survey (O.S) National Grid OSGB36(15) via Global Navigation Satellite Systems (GNSS) and the O.S. Active Network (OS Net).

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN15GB & OSGM15GB transformation models.

The survey has been correlated to this point and a further one or more OSGB36 (15) points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid and datum.

Legend:

Buildings
Wall
Kerb line
Line marking
Drop kerb
Centre line
Top of bank
Overhead Cable
Concrete edge
Tarmac edge
Grass verge
Canopy/Overhang
Verge
Bottom of bank
1 100.000 Station and Name / Station Level
Tree / Bush / Sapling
Area of Undergrowth
Woodland
R: Ridge Level
E: Eaves Level
F: Flat Roof Level
Gate

Fence types:
I\W Interwoven
I\R Iron Railings
W\M Wire Mesh
P\R Post & Rail
P\W Post & Wire
C\L Chain Link
W\P Wooden Panels
C\B Close Boarded
S\P Steel Palisade

IC	Inspection chamber	Bo	Bollard
PInv	Pipe invert	IB	Illuminated bollard
Gy	Gully	Bin	Rubbish bin
Bg	Back gully	Vp	Vent pipe
Dp	Down pipe	Grl	Ground light
Pipe	Pipe above ground	Lbox	Letter box
MH	Manhole	Stmp	Tree Stump
WL	Water level	Sty	Stile
Fl	Flood light	IFL	Internal floor level
Lp	Lamp post	THL	Threshold level
Tp	Telegraph post	Sp	Sign post
Ep	Electricity post	TH	Trialhole
Tl	Traffic light	BH	Borehole
Bus	Bus stop	ELC	Electric
Sv	Stop valve	BT	British Telecom
St	Stop tap	C'box	Control box
Er	Earth rod	TT	Tactile
Wm	Water meter	BP	Brick paved
Gas	Gas valve	CPS	Concrete paving slabs
Av	Air valve	CVR	Cover
ICU	Unidentified inspection	R/wall	Retaining wall
Wo	Wash out	BS	Bus Shelter
Re	Rodding eye	TCL	Tree canopy level
BB	Belisha beacon	G:	Girth
CTV	Cable tv	MG	Multi girth
Mkr	Marker post	IC	Inspection chamber
Gmkr	Gas marker post	CL:	Cover level
So	Soffit	IL:	Invert level
Fh	Fire hydrant	UTL	Unable to lift

Rev	Date	Description	Drawn	Q. Ref.

greenhatch group

- Topographical Surveys
- Site Engineering
- Utility / CCTV Surveys
- Measured Building Surveys
- 3D Laser Scanning
- Revit & BIM Models

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CLIENT

Ardent Consulting Engineers

PROJECT

Kiln Barn Road (Site B), Ditton, Kent ME20 6AJ

TITLE

Topographical Survey

SCALE	DATE
A1@ 1: 1000	10.08.18
DRAWN	QUALITY REF
SS\JS	GH3443

Level datum	See note
Grid orientation	See note
Job number	31057

Drawing No.	Rev.
31057_T	0

Comments

This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.

All dimensions should be checked on site prior to design and construction.

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

Appendix B

Proposed Layout Plans

REV	DATE	INITIAL

Site B Red Line Boundary
(11.58 Ha)

Public Right of Way to be Retained

N

0 50m 100m
SCALE 1:2500

Project Name
East Malling Trust

Drawing Title
Site B: Red Line Boundary
(Illustrative Masterplan)

Job no. MSBL377057
Dwg no. EMT - B - 02
Rev. A
Drawn by. M.L.
Date. 05.12.2018
Scale. 1:2,500 @A3
Checked by. A.D.

URBAN DESIGN STUDIO
Southampton:London:Oxford
Cambridge:Birmingham
Savills.com/urbandesign

Appendix C

Kent County Council Correspondence

Mail

RE: 182600 East Malling Site B - Surface Water Drainage [Filed 16 Oct 2018 14:12]

A

Alex.Brauninger@kent.gov.uk <Alex.Brauninger@kent.gov.uk>
16/10/2018 13:14

To: Peter Sparham; SUDS@kent.gov.uk Cc: Naomi Thamba; Simon Hall; Andrew Braun

Hi Peter

Our general position is that we would expect to see infiltration testing (and viable zones of permeable strata demonstrated) at the initial planning stage where infiltration would be the only option to manage surface water from the development.

Where an alternative outfall exists within or adjacent to the site boundary (i.e. a watercourse or public surface water sewer), then may recommend approval without ground investigations. This is because it mitigates the risks of being unable to deliver a workable drainage strategy.

Even where alternatives exist, it would always be preferable to have some preliminary ground investigations at the earliest possible stage whenever there is an opportunity for infiltration drainage to be used.

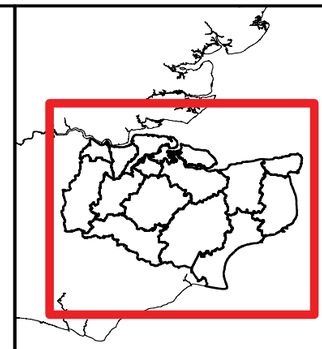
Regards

Alex Brauninger | Senior Flood Risk Project Officer | Invicta House, Maidstone | Phone: 03000 413 878

Appendix D

Preliminary Flood Risk Assessment Mapping

N



Legend

- Recorded Flood Events
- Sewer flooding incident postcode area

Note:
The size of the sewer flooding incident areas represents the size of the postcode area the incident occurred in not the scale of the flood event.

Drawing Title:

Recorded Past Flood Events

Drawing Number:

Figure 4

0 2.5 5 10

Kilometers

Kent County Council

N

Legend

Dwellings predicted to be flooded by 1 in 200 year rain storm event

Flooded dwellings per sq. km

- 0 - 4
- 5 - 7
- 8 - 21
- 22 - 50
- 51 - 83
- 84 - 210

Drawing Title:

Surface Water Flood Risk to Settlements

Drawing Number:

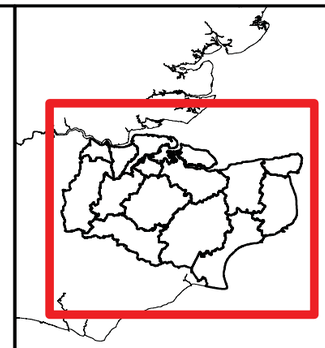
Figure 5

0 2.5 5 10

Kilometers

Kent County Council

N



Legend

Griound water Risk Areas

- Negligible
- Low
- Medium
- High

Drawing Title:

Groundwater Risk Areas

Drawing Number:

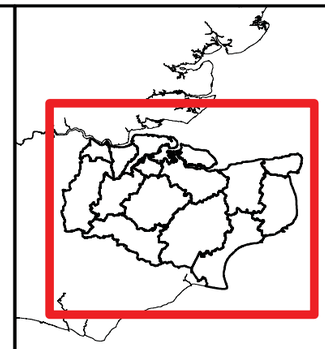
Figure 6

0 2.5 5 10

Kilometers

Kent County Council

N



Legend

OW Risk to Settlements

Length per unit area km/km²

- 0.000 - 0.266
- 0.267 - 0.703
- 0.704 - 1.239
- 1.240 - 1.720
- 1.721 - 2.198
- 2.199 - 2.950

Drawing Title:

Length of Ordinary Watercourse in Settlements

Drawing Number:

Figure 7

0 2.5 5 10

Kilometers

Kent County Council