



Consulting Engineers Ltd

'optimising development potential'

**Proposed Residential Development for White Farming Limited
Land west of the Havant Crematorium
Bartons Road, Havant**

**Flood Risk Assessment and
Surface Water Drainage Strategy**

Project No. 17-055

December 2018



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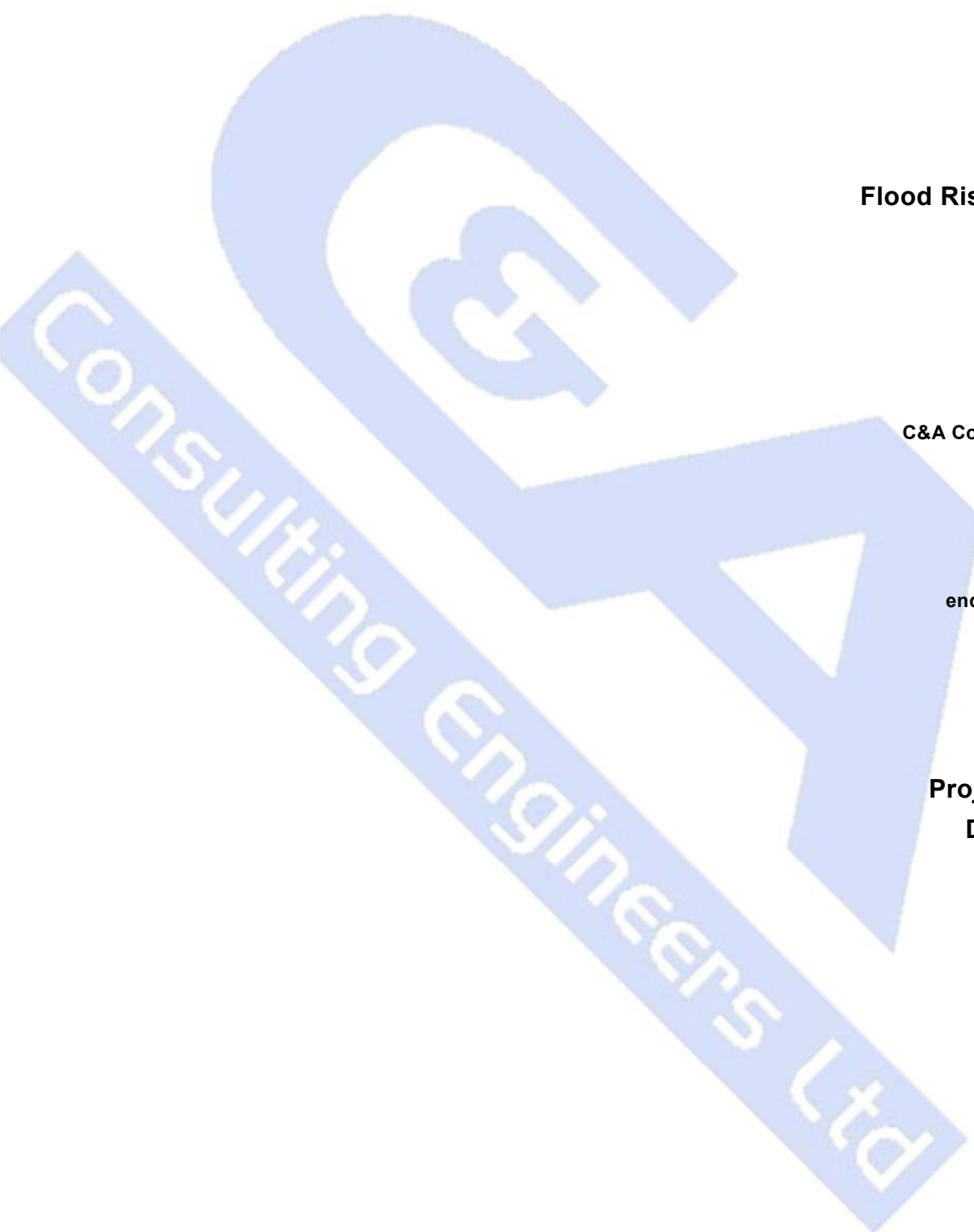
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Land west of the Havant Crematorium
Bartons Road, Havant**

Flood Risk Assessment

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**Project No. 17-055
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1.0 INTRODUCTION

- 1.1 Charles & Associates Consulting Engineers (C&A) have been appointed by White Farming Limited to prepare a Preliminary Flood Risk Assessment for the proposed development of land west of the Havant Crematorium, Bartons Road Havant, within Havant Borough Council (HBC) and Hampshire County Council (HCC), hereafter referred to as 'the site'. The location is shown on **Figure 1**, within this report.

Purpose

- 1.2 The outline application seeks permission for the construction of up to 72 dwellings with open space provision and associated landscaping. With this in mind, this preliminary FRA has been prepared as a means of demonstrating that flooding and drainage issues will not constrain the development of the site. It also confirms that the site will conform to the recently published non-statutory national standards for sustainable drainage (SuDS) and the local requirements as set out by HCC and HBC.
- 1.3 It is noted that the application is outline in nature and, as such, it is expected that a planning condition will be imposed on any approval that requires the principles of this FRA and SuDS scheme to be adhered to and proven at the detailed planning submission and/or the detailed design stage of the site evolution.
- 1.4 In terms of surface water drainage and the potential for flooding, it examines the site's suitability against current planning policy and reviews the physical characteristics of the site in order to develop solutions to deal with surface drainage generated from the development. This will ensure the site is drained in a sustainable manner whilst not impacting the surrounding area.
- 1.5 The provisions of the National Planning Policy Framework (NPPF) (Ref 1) have been considered in preparing this Flood Risk Assessment, together with The Flood & Water Management Act 2010 (Ref 2). In

addition, attention has also been paid to the National Planning Practice Guidance (NPPG) (Ref 3) and policies within the Core Strategy (Ref 4). The surface water drainage strategy (SuDS scheme) will be designed to comply with the Non Statutory Technical Standards for Sustainable Drainage Systems published by DEFRA (Ref 5).

- 1.6 This preliminary FRA also follows the guidance provided by Hampshire County Council, as the Lead Local Flood Authority (LLFA), on the proposed surface water drainage strategies.

Report Limitations

- 1.7 The findings, recommendations and conclusions of this report are based on information obtained from a variety of external sources which are understood to be reputable. However, C&A Consulting Engineers cannot guarantee the authenticity or reliability of any data and/or records provided by third parties.

2.0 SITE LOCATION & DETAILS

- 2.1 The site is located to the northeast of Havant. The site is bounded to the west by Bartons Rise residential development, to the north west by mature woodland and to the north east and east by Havant Crematorium and its access road. The site location is illustrated in **Figure 1**. The entire existing site is open undeveloped land comprising of agricultural land.

Topography & Existing Drainage

- 2.2 Topographic information has been obtained for the site. The high point of the site is located at the north-eastern corner of the site, which was surveyed as approximately 40.50m AOD. Levels generally fall from this point towards the southwest and west. However, there is a crest line running from the north eastern corner towards the southwest which divides the site into 2 major drainage catchments. The low point is located at the north western corner of the site and was surveyed as approximately 28.10m AOD. The topographical survey plan is included as **Figure 2**.
- 2.3 Sewer records were acquired from Southern Water to determine the existing sewer network available to the site. According to the records, a 150mm diameter foul water sewer crosses the site from east to west.
- 2.4 There is a ditch adjacent to the western boundary of the site. The site which is undeveloped can be described as greenfield and as having 'natural' drainage.

Geology

- 2.5 A review of the British Geological Society's records (Ref 6) indicates the eastern part of the site is underlain by superficial Head deposits consisting of Clay and gravel, which is further underlain by bedrock deposits of London Clay formation comprising clay, silt and sand. The western part of the site is underlain by bedrock deposits of London Clay

formation comprising clay, silt and sand (Refer to **Figure 3 & 4** for British Geological Society mapping). This is confirmed by the intrusive site investigation conducted by Ground & Water Limited.

- 2.6 In order to investigate the infiltration potential, soakaway tests were carried out at 9 locations within trial pits and windowless sampling boreholes on site. The test results indicates that the geology underlying the site has low infiltration potential (see soakaway test results contained within **Appendix C**). Due to the low infiltration rates, infiltration drainage techniques are not proposed as the main method of drainage solution for the site. However, as a conservative approach, the lowest infiltration rates achieved within the trial pits (2.81×10^{-5} m/s) will be used for the pervious paving.

Groundwater

- 2.7 A review of the Environment Agency's (EA) records has confirmed that the site is within Zone 1c of the groundwater source protection zone area and is underlain by a 'Secondary A' minor aquifer of intermediate vulnerability. Refer **Figures 5 to 7** and **Figure 10** for EA Groundwater records.
- 2.8 During the intrusive site investigation, groundwater was encountered in trial pit 1 (TP-1) at 2.20mBGL. No groundwater was encountered in any of the other trial pits (see soakaway report in **Appendix C**).
- 2.9 Flood risk from groundwater will be discussed in **Section 7** of this report.

3.0 DEVELOPMENT PROPOSAL

- 3.1 The proposed development is a residential scheme for the construction up to 72 dwellings together with associated amenity and open space provision, landscaping and vehicle access as shown on the preliminary Masterplan in **Appendix A**.
- 3.2 It is intended that the proposed development will be accessed from the existing crematorium access off Bartons Road.
- 3.3 The proposed levels of the dwellings and site circulation roads would generally aim to match the existing ground levels and are considered matters of detailed planning application requirements.
- 3.4 The surface water disposal strategy, proposed for the Development will take the form of a Sustainable Urban Drainage (SUDS) arrangement, this is discussed in **Section 9** of this report.

4.0 NATIONAL POLICY, STRATEGIC FLOOD RISK ASSESSMENT & LOCAL PLANNING POLICY

National Planning Policy

- 4.1 The National Planning Policy Framework (NPPF) and associated guidance (NPPG) sets out a robust approach to the Sequential Test and is intended to provide a rigorous understanding of flood risk. Its aim is to steer new development to areas at the lowest probability of flooding (i.e. Flood Zone 1). The Sequential Test would normally be completed by the Local Planning Authority (LPA) to inform the preparation of the Local Plan (LP).

Sequential and Exception tests

- 4.2 The proposed development is located in Flood Zone 1 (little to no risk of flooding). Therefore, the proposed development passes the Sequential Test and application of the Exception Test is not necessary.
- 4.3 The proposed development is a residential scheme and therefore can be classified as 'More Vulnerable' to risk of flooding. It is consistent with the appropriate uses for Flood Zone 1 as outlined in Table 3 of Planning Practice Guidance (Ref 7).

Strategic Flood Risk Assessment

- 4.4 The Partnership for Urban South Hampshire (PUSH) published their Strategic Flood Risk Assessment for the area December 2007 and February 2016 Update (Ref 8). This includes a web based interactive mapping system of different flood risks and hazards. The primary objective of the SFRA is to determine the variations in flood risk across the Borough and to inform and support the Borough Council's preparation of flooding policies in their Local Plan.

- 4.5 Hampshire as Lead Local Flood Authority (LLFA) for the area have recently published a guidance document for developers setting out the principles of sustainable drainage which should be included in new developments and detailing the level of information they require in support of planning applications.
- 4.6 Both of these documents were referred to during preparation of this report.
- 4.7 The SFRA includes a series of plans assessing flood risk in the Borough. Relevant plans from the SFRA are included in **Appendix B** to this report.

Havant Local Plan

- 4.8 The Havant local plan has 2 key planning documents; 'Core Strategy' adopted in 2011 and 'Site Allocation Plan' adopted in 2014. The core Strategy which sets out planning framework until 2026, has a number of detailed policies which refer to flooding, drainage and the implementation of Sustainable Drainage within new developments. The policies relevant to this development are summarised below.
- 4.9 Policy CS15 on '**Flood and Coastal Erosion Risk**' states that,
- "Development in areas at risk of flooding now and in the future as identified on the latest Environment Agency flood risk maps and Strategic Flood Risk Assessment climate change maps will only be permitted where:*
- It meets the sequential and exception test (where required).*
 - The site is located in a low hazard area as defined in the Strategic Flood Risk Assessment.*
 - A site-specific flood risk assessment demonstrates that the development will be safe, including the access, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

- *The scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the specific requirements of the site.*
- *New site drainage systems are designed taking account of events which exceed the normal design standard.*

All development will be required to ensure that there is no net increase in surface water runoff. Priority should be given to incorporating Sustainable Drainage Systems (SuDS) to manage surface water drainage, unless it is proven that SuDS are not appropriate. Where SuDS are provided arrangements must be put in place for their whole life management and maintenance.”

4.10 Policy DM10 on '**Pollution**' states that,

“ Development that may cause pollution of water, air or soil or pollution through noise, smell, smoke, fumes, gases, steam, dust, vibration, light, heat, electromagnetic radiation and other pollutants will only be permitted where all of the following relevant criteria can be met:

- *The health and safety of existing and future users of the site, or nearby occupiers and residents is not put at risk.*
- *The water environment would not be detrimentally affected.*
- *It would not lead to an unacceptable deterioration in the quality or potential yield of coastal, surface and ground water resources.*

5.0 OTHER CONSULTEES

- 5.1 During the preparation of this assessment the Environment Agency were consulted to obtain details of any potential flooding or drainage impacts of developing the site.
- 5.2 With respect to the flood zones, the EA confirmed that the development site is located within the area classed as 'Flood Zone 1'. Correspondence from the Environment Agency is provided within **Appendix D**.

6.0 DEFINITION OF FLOOD HAZARD

6.1 Flood Zones are defined in Table 1 of the Flood Risk and Coastal Change section of the Planning Practice Guidance which supports NPPF. The Flood Zones refer to the probability of flooding from rivers, the sea and tidal sources. They ignore the presence of existing defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The Environment Agency's online flood map for planning, indicates that the entire site is located in Flood Zone 1.

6.2 Flood Zone 1, as described in Table 1 of the above Practice Guidance (Ref 1), has a low probability of flooding and comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Sources of flooding

6.3 NPPF identifies six potential sources of flooding that require investigation:

- Flooding from rivers or fluvial flooding;
- Flooding from the sea or tidal flooding;
- Flooding from land;
- Flooding from groundwater;
- Flooding from sewers; and
- Flooding from reservoirs, canals, and other artificial sources.

Flooding from rivers (Fluvial Flooding)

6.4 There is a ditch adjacent to the western boundary of the site. During times of severe storm events, water levels within the ditch could rise causing fluvial flooding to occur. The probability of flooding will be discussed in **Section 7.3** below.

Flooding from the Sea or Tidal Flooding

- 6.5 Tidal flooding, in general, happens when there is an exceptionally high tide due to a storm surge. Storm surge is generally associated with increases in water levels due to the changes in atmospheric pressure and wind generated by storm.
- 6.6 The site is remote from the sea and at an elevation between 28.10m AOD (above ordnance datum) and 40.40m AOD. It is significantly above the tidal limit, and therefore, no further detailed assessment is required.

Flooding from Land (Local Surface Water Flooding)

- 6.7 Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. Increased run-off from developed areas consisting of impermeable surfaces can also increase overland flows. If the flow paths of these overland flows are not carefully considered during the detail design and planning of development drainage systems, flooding from overland flows could occur. Probability of surface water flooding will be discussed within **Section 7.4 - section 7.5** below.

Flooding from Sewers

- 6.8 Local urban drainage within sewerage systems should also be considered, as every drainage system has a design capacity, which could be exceeded during extreme rainfall events. Sewer and surface water flooding generally results in localised short term flooding caused by intense rainfall events which overload the capacity of sewers or run off adjacent land as sheet flow. Flooding can also occur as a result of blockage, poor maintenance or from structural failure. Probability of sewer flooding will be discussed within **Section 7.6 - section 7.7** below.

Flooding from Groundwater

- 6.9 Groundwater flooding occurs when water levels in the ground rise above surface elevations. Severe storm events could cause groundwater levels to rise above ground level. Underlying geology is the principal factor which influences groundwater flooding. Groundwater flooding most commonly occurs in low lying areas which are underlain by permeable rocks or aquifers. Probability of groundwater flooding will be discussed within **Section 7.8- 7.11** below.

Flooding from Reservoirs, Canals and other artificial Sources

- 6.10 There are no artificial sources of water (i.e. reservoirs, dams *etc.*) in the vicinity of the site or flood defences and therefore the failure of local infrastructure of perched water sources or flood defences is unlikely to pose a risk of flooding at the site. Therefore, no further detailed assessment is required.

7.0 PROBABILITY OF FLOODING

Flood Zone

- 7.1 Flood maps published by the EA and further information provided by the Agency/Planning Authority indicate that the site lies within 'Flood Zone 1, low probability flood risk area', for fluvial sources, as defined by Table 1 of NPPF. Correspondence from the Environment Agency is provided within **Appendix D** and shown on **Figure 8**.

Vulnerability Classification

- 7.2 With reference to Table 2 of NPPF, the proposed residential dwellings would be considered as a 'More Vulnerable' land use. As previously set out, the site has a Flood Zone 1 classification. The site is therefore considered suitable for residential development and deemed to have passed the Sequential Test as set out in the NPPG guidance.

Flooding from Rivers (Fluvial Flooding)

- 7.3 The site is located within Flood Zone 1 of the EA Flood Zone Map and is therefore at little to no risk of fluvial flooding. There are no historic records of flooding on or adjacent to the site.

Flooding from Land (Surface Water Flooding)

- 7.4 **Figure 2**, which shows the existing site levels, confirms that the site has 2 major drainage catchments, falling towards the south and the northwest. The latest Flood Map for surface water included in **Figure 9** shows no flooding within the site boundary.
- 7.5 The new surface water regime on the development will also ensure that no localised surface water flooding will occur due to the type of SuDS scheme proposed (see **section 9.0**) which will change the existing drainage patterns and intercept run off at source. Therefore, the development proposals

have will have no adverse impact on the surface water flood regime and the risk of surface water flooding at the site is assessed as low.

Sewer Flooding

7.6 Southern Water is responsible for managing the sewer network in and around the proposed development area. As per the historical flood record maps (**Appendix B**) included within the PUSH SFRA (Ref 8), there are no known incidences of sewer flooding in the area it is not considered to be at risk from sewer flooding.

7.7 The development will contain two principal drainage networks, consisting of separate foul water and surface water systems, with the surface water being discharged into the existing ditch located to the west (see **Section 9.0**). All new foul pipe networks will be independent to any surface water drainage and any upgrades required in the local network would be carried out prior to the completion of the development. Therefore, the probability of flooding from a failure in the existing sewers is assessed as low.

Flooding from Groundwater

7.8 The site is within Zone 1c of the groundwater source protection zone area and is underlain by a 'Secondary A' minor aquifer of intermediate vulnerability. Refer **Figures 5 to 8** and **Figure 10** for EA Groundwater records.

7.9 As described in **Section 2.8** above, groundwater was encountered in trial pit 1 (TP1) at 2.20mBGL during the site investigation. However, no groundwater was encountered in any of the other 8 trial pits. Since the groundwater is more than 2.20m below the surface and was encountered only in one trial pit, it is not considered that ground water flooding is a problem on the site.

- 7.10 With respect to groundwater flooding, PUSH SFRA Guidance document for Havant Borough Council (2016 update) states that,

“Within the PUSH region the key areas at risk of groundwater flooding are north of Havant Borough in East Hampshire, Winchester, Eastleigh and Test Valley where highly permeable geology meets lower permeability geology as shown in Flood Mapping: Flooding from Other Sources: Groundwater, which has been verified by inspection of the historical incident records. The key risks to new development in the Havant Borough come from increases in flows in the Lavant Stream as a result of high groundwater levels emerging in East Hampshire District. It is therefore recommended that site specific FRAs for sites located within the Flood Zone of the upper reaches of the Lavant Stream consider the joint effects of high groundwater flows in the Lavant Stream combined with rapid runoff from intense rainfall events”

- 7.11 The site is not located adjacent to any of the above rivers and therefore, it is our opinion that ground water flooding is not a problem on the site. In addition, the historical groundwater flood map for the local area included within the PUSH SFRA (Ref 8), indicates no recorded groundwater flooding incidents on site or in the immediate vicinity of the site. As such, the risk of groundwater flooding is not considered significant and has not been considered further.

8.0 EFFECT OF CLIMATE CHANGE

Climate Change

- 8.1 Based on the advice on climate change in NPPG, peak rainfall intensity, sea level, peak river flow, offshore wind speed and extreme wave heights are all expected to increase in the future. It is recommended that considerations for future climate change are included in Flood Risk Assessments for proposed developments.
- 8.2 In February 2016, the Environment Agency published new guidance on how to use climate change allowances in flood risk assessments and drainage strategies. It is recommended that the design accommodates the 1 in 100 year storm with a 20% allowance for climate change and an additional analysis undertaken to understand the flooding implication for a greater climate change allowance of 40%.
- 8.3 Mapping within the SFRA and the EA data confirms that all dwellings will remain located in Flood Zone 1, after allowing for climate change and therefore will not be affected by the impact of climate change.
- 8.4 The site is likely to be subject to increases in rainfall intensity of 20% to 40% over the lifetime of the development which will place additional pressure on surface water drainage infrastructure. Therefore, the sustainable drainage system that will serve the proposed development has been designed to cater for the 1 in 100 year plus 20% rainfall event and sensitivity analysis has been carried out for 1 in 100 year plus 40% rainfall event to ensure a suitable drainage strategy through the lifetime of the development.

9.0 SURFACE WATER MANAGEMENT PROPOSAL

Development Proposal

- 9.1 The proposed development is a residential scheme for the construction of up to 72 residential dwellings with vehicular and pedestrian access, public open space, car parking and landscaping as shown on the preliminary Masterplan at **Appendix A**.
- 9.2 The existing site exhibits greenfield run-off rates. Microdrainage software has been used to calculate the Greenfield run-off rates from the proposed development area of the site, where the QBAR has been calculated as 12.50 l/s. The runoff for 1, 30 and 100 year return periods has been calculated as 10.6 l/s, 28.30 l/s and 39.80 l/s respectively. Existing runoff rate calculations are included in **Appendix E**.

Proposed Drainage

- 9.3 A comprehensive sustainable drainage system will be implemented to manage runoff from this development close to source thus not increasing flood risk on the site or to other areas. This will be fully detailed at the detailed drainage design stage of the proposed development, although an indicative strategy to demonstrate that SuDS can be delivered is described below.
- 9.4 There are a number of options available to impose surface water restrictions on proposed developments. These include attenuation ponds, oversized sewers, below ground storage tanks, pervious paving, infiltration systems etc. Approved Building Regulations Document Part H (Ref 9) sets out a hierarchy for surface water disposal, which encourages a sustainable approach.
- An adequate soakaway or some other adequate infiltration system, or where that is not reasonably practicable;
 - A watercourse, or where that is not reasonably practicable;
 - to a surface water sewer, highway drain, or other drainage system;

- to a combined sewer.

9.5 As described in **Section 2.6** above, the result of the soakage test is not favourable for infiltration drainage to be used as the main drainage disposal method for the development site. Therefore, it is considered that the lowest infiltration rates achieved within the trial pits (2.81×10^{-5} m/s) will be utilised only for the proposed pervious paving areas and for highway infiltration swale/trench.

9.6 Considering the above, a mixture of surface water attenuation measures are proposed as the principal method of surface water attenuation for this development. These will potentially include pervious paving, swales and attenuation structures/basins and controlled discharges into the watercourse located to the west of the site. This is described further in the section below.

Proposed SuDS

9.7 The preliminary site layout (**Appendix A**) was reviewed to identify of potential areas for SuDS attenuation. A breakdown of the proposed methods for disposal of surface water run-off from the different elements within the site as part of this illustrative scheme are as follows.

- Water run-off from the roof surfaces of the proposed dwellings located within the site is to be collected using traditional pipes and eventually discharging into the attenuation features.
- As cited in **section 9.5** above, the underlying geology of the site has low infiltration potential, hence only the pervious paving with infiltration into the ground is proposed.
- Runoff from the access/internal road would be attenuated via swales, where technically possible, or piped into local SuDS features. This will then route to the main attenuation SuDS feature. However, as a conservative approach, for this application, road area has been included for the attenuation basin storage calculations.

- Patios and footpaths of private dwellings drain to lawns and soft landscaped areas.
- It is proposed to make full use of the attenuation capacity within the SuDS features for all storm events up to 1 in 100 years +40% climate change.

Microdrainage Storage Calculations

- 9.8 The preliminary site layout in **Appendix A** was used to assess the impermeable areas on the developed site. As this masterplan is further developed through the detailed design process run off calculations will be further refined. For the purpose of modelling and estimating the attenuation requirement for the proposed SuDS areas, a 40% increase in rainfall intensity has been assumed. Overall, this SuDS strategy will ensure that the surface water runoff from the future development will be attenuated within the development area. This will also provide some betterment to the existing condition and it will not increase flood risk from surface water run-off within the site as a result of climate change.
- 9.9 An indicative surface water drainage strategy has been prepared and included in **Appendix F** of the report. This strategy shows open space SuDS basin with controlled discharge into the ditch as the principal method for surface water attenuation. Drawings and calculations are provided in **Appendix F & G** respectively.
- 9.10 Preliminary calculations for the SuDS system in **Appendix G** demonstrate that for the respective critical storm events of up to 1 in 100 year return period plus a 40% allowance for climate change, the drainage system and attenuation of runoff is contained within the storage features. There is also the potential to implement source control SuDS measure such as bio-retention areas, rainwater harvesting in the form of water butts etc. locally to reduce the runoff entering the drainage system and also to provide pollution treatment at source. These will be considered during the detailed design stage.

- 9.11 Provision of a surface water drainage solution for the potential future development within the northern part of the site has also been considered. The drainage proposal for the northern land parcel could include SuDS conveyance swales, basin and attenuation pond which are indicatively shown in the surface water drainage strategy plan (refer to **Appendix F**).
- 9.12 The preliminary SuDS system for the development has been designed to Havant Borough Council and Hampshire County Council guidance. This guidance will need be followed during detailed design of the development should the site gain planning permission.

10.0 POLLUTION CONTROL MEASURES

10.1 Table 4.3 of the SuDS manual (C753), sets out minimum water quality requirements for discharges to receiving surface waters and groundwater. Roof areas of residential dwellings and driveways/low traffic roads have 'very low' and 'low' pollution risks respectively. These will require at least one type of SuDS source/site control component to be implemented on site to provide the required treatment prior to discharge. It is intended that this will be a minimum design parameter for any future detailed design. However, the scheme below sets out treatment trains beyond this.

10.2 A comprehensive SuDS system will be incorporated into the masterplan to provide a 'treatment train' approach to maintain high water quality prior to discharge into the ground via infiltration and/or into the attenuation basin. This will take the form of source and site control features. Typical SuDS components that have been implemented on-site in the preliminary design, to reduce total suspended solids, heavy metals and hydrocarbons from the runoff and to provide the necessary water quality treatment are as follows:

- Roofs – All roof areas will include some pre-treatment to remove leaves and other roof debris at source. All roofs will reach Level 1 on the treatment train as a minimum, with the majority receiving up to 2 levels of treatment or more before discharging into the watercourse.
- Communal car parking Areas – These areas will include source control pre-treatment such as silt traps and porous paving. Two levels of treatment will be included as the minimum.
- Roads – Runoff from highways will be routed to the attenuation infiltration features via catch-pit gullies, grass filter strips and/or swales, where technically possible. This effectively reduces total suspended solids, heavy metals and hydrocarbons from the runoff, providing the necessary water quality treatment. All roads will reach a minimum of three levels of treatments.

10.3 The level of treatment that will be achieved via each SuDS component is summarised below.

- **Interception/Primary treatment (level 1)** – rainwater harvesting, downpipe filters, silt traps for driveways, catch-pit gullies, permeable paving, petrol interceptors
- **Secondary treatment (level 2)** – permeable paving, bio-retention areas
- **Tertiary treatment (level 3)** – Attenuation Basin

11.0 FLOOD RISK MANAGEMENT MEASURES

Flood Risk Management Measures

- 11.1 NPPG requires that the safety of people and the proposed development be considered against each source of flooding identified in **Section 7**.
- 11.2 The residential development will be located within Flood Zone 1 and therefore, even with the potential for climate change, properties will not be at risk of fluvial flooding.
- 11.3 A preliminary drainage strategy incorporating SuDS has been provided to manage the increase in run-off from the site over the lifetime of the development, such that it will not place properties at risk of surface water flooding.
- 11.4 The SuDS system will also be maintained by a suitably qualified Management Company for the lifetime of the development, such that it will not place properties either on the site or elsewhere at an increased risk of surface water flooding. This complies with NPPF guidance and Havant District Council & HCC SuDS guidance & policies.
- 11.5 The flood risk to the proposed development and surrounding area, as a consequence of the development is therefore considered to be low and no specific flood risk management measures will be required.

12.0 OFF SITE IMPACTS

Flood Risk Elsewhere

- 12.1 As the proposed development is located entirely within a Flood Zone 1 designation, it will not have any adverse impact on the flood risk to others by virtue of obstruction to flood flows or the reduction of flood plain storage.

Surface Water Management

- 12.2 NPPG, Paragraph F6 states;
“Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.”
- 12.3 To ensure the run-off from the developed site mimics or is less than that of the undeveloped site, sustainable drainage measures have been fully utilised. The development proposals, with the indicative surface water drainage solutions provided, confirm that the site can be drained in a sustainable manner. The drainage proposals are presented within **Section 9** above.

13.0 RESIDUAL RISKS

Residual Flood Risk

- 13.1 As the site's residential properties will be built in Flood Zone 1 they will not be at significant risk of flooding, during its lifetime even allowing for climate change.
- 13.2 Extreme rainfall events are generally predictable, but by their nature predictions are based on probability and thus subject to uncertainty. Therefore, an unquantifiable residual risk remains that events exceeding those predicted may occur, notably surcharging or blockage of sewers or gullies.
- 13.3 If the drainage system is overwhelmed, either by a storm event with a magnitude greater than that designed for or due to a blockage, the finished site levels will be designed to ensure that there is no risk of floodwaters ponding to a significant depth. In addition, the overland flow path for any such exceedance storm event will be designed to take overland flow to open space areas.

Management

- 13.4 The traditional piped networks of the SuDS system for proposed development will be offered for adoption to Southern Water Ltd under a standard Section 104 agreement of the Water Industry Act. For any additional SuDS element of the scheme, HCC, as required under the FWMA as the lead Local Flood Authority, will approve the scheme in detail however a management Company will be employed to maintain the SuDS element of the system.

14.0 CONCLUSIONS & RECOMMENDATIONS

Background

- 14.1 This report has been commissioned to assess the risk to, and the impact of, a proposed development of the land west of the Havant Crematorium, Bartons Road, Havant, within Havant District Council and Hampshire County Council. It is proposed to provide up to 72 dwellings together with associated amenity and open space provision, landscaping and vehicle access.
- 14.2 The entire site lies in Flood Zone 1 'Low Probability' flood area as defined by Table 1 of NPPG. The proposed residential development is considered as a 'More Vulnerable' when utilising Table 2 of NPPG. It is consistent with the appropriate uses for Flood Zone 1, as outlined in Table 3 of Planning Practice Guidance.

Sequential and Exception tests

- 14.3 The proposed development is located in Flood Zone 1 (little to no risk of flooding). Therefore, the proposed development passes the Sequential Test and application of the Exception Test is not necessary.

Probability of flooding

- 14.4 All potential sources of flood risk at the application site have been assessed, and the risks of flooding occurring at the application site have all been assessed as low. In assessing the flood risk, the impacts of climate change have been considered for the lifetime of the proposed development and considered acceptable.

Flood Risk Management

- 14.5 As the proposed residential development will lie within Flood Zone 1, the risk of flooding from all sources is assessed to be low and the safety of

people is considered acceptable in all foreseeable flooding events. No specific flood management measures beyond that of maintenance are considered to be necessary.

Offsite Impacts

- 14.6 The Preliminary Drainage Strategy set out in this assessment identifies an option for the management of surface water run-off using sustainable drainage techniques, which will provide betterment to the existing situation and consequently, reduce surface water run-off rates from the site, for storm return periods up to the 1 in 100 year event, allowing for the detrimental effects of climate change. The proposed development will therefore not increase the flood risk elsewhere.

Residual Risks

- 14.7 A residual risk remains that an event exceeding the design parameters used for the drainage system may occur, or part of the drainage system may fail due to a blockage. The finished site levels will be designed to ensure that there is no risk of floodwaters ponding to a significant depth and the overland flow path for any such exceedance storm event will be designed to take overland flow to open space areas.
- 13.1 In addition, the employment of a management company for the life of the development to maintain the surface water management train will ensure the scheme will operate at its maximum efficiency at all times.

Recommendations

- 14.8 This Flood Risk assessment concludes that if flood mitigation measures and the drainage strategy as proposed in the report are implemented as part of the development then it will be fully compliant with current national and local flood policy guidelines and there is no reason why the development should not be granted planning permission.

15.0 REFERENCES

1. National Planning Policy Framework, Department for Communities and Local Government, 2012.
2. The Flood & Water Management Act 2010 (TFWMA), DEFRA, April 2010
3. Department for Communities and Local Government, 2014 National Planning Practise Guidance.
4. Havant Borough Draft Local Plan 2036, Havant Borough Council, 2011
5. Non-Statutory Technical Standards for Sustainable Drainage Systems, DEFRA, March 2015
6. British Geological Survey, Geology of Britain viewer, http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html
7. HM Government, Planning Practice Guidance, Flood Zone and Flood Risk Tables, Paragraph: 065 Reference ID: 7-065-20140306, revision date 6 March 2014
8. Strategic Flood Risk Assessment, Partnership for Urban South Hampshire (PUSH), December, 2007 and February 2016 Update
9. Part H of the Building Regulations 2010 - DTLR. The Stationary Office
10. The Sustainable Drainage (SuDS) Manual -C753, CIRIA. 2016

FIGURES



Site Boundary ———

Grid Ref: X-473270, Y-108045

Nearest postcode: PO9 5NB



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01732 448120

Job Title

**Land west of the Havant crematorium
Bartons Road, Havant**

Drawing Title

Site Location

Client

White Farming Limited

Rev	Amendments	Drm	Chk	App	Date
Scale	NTS @A4	Date	Nov 2018	Designed	-
Drawn	DK	Checked	SS	Approved	GAC
Job No	17-055	Figure No	FIGURE 1	Rev	-



NOTES

Rev	Amendments	Dm	Chk	App	Date



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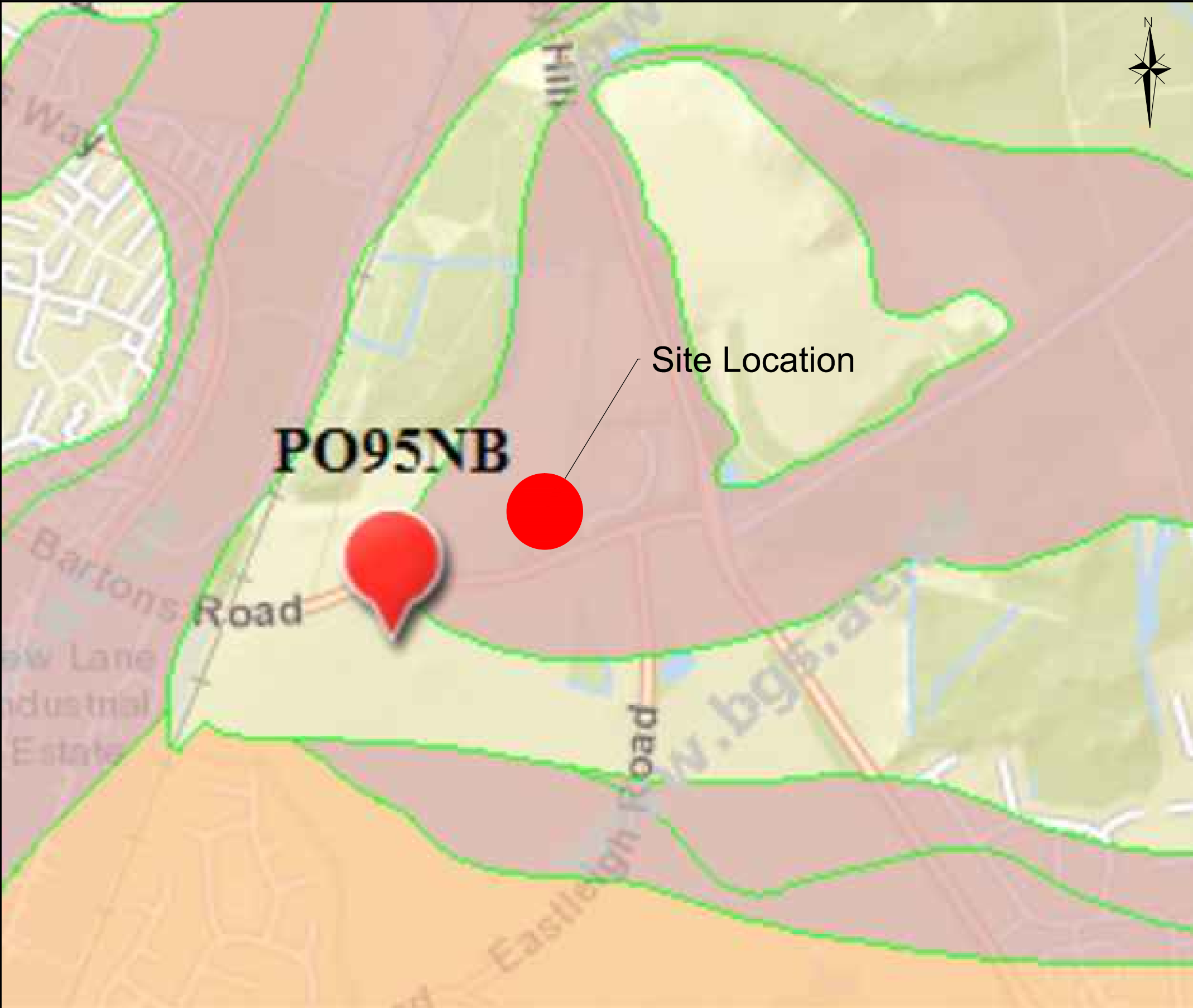
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Job Title
Land west of the Havant crematorium
Bartons Road, Havant

Drawing Title
Topographical Survey
Plan

Client
White Farming Limited

Scale 1:1000 @A2	Date Nov 2018	Designed N/A
Drawn DK	Checked TSH	Approved GAC
Job No 17-055	Figure No FIGURE 2	Rev -



KEY

Superficial deposits	
	ALLUVIUM - CLAY, SILT, SAND AND GRAVEL
	BEACH AND TIDAL FLAT DEPOSITS (UNDIFFERENTIATED) - CLAY, SILT, SAND AND GRAVEL (UNLITHIFIED DEPOSITS)
	HEAD - GRAVEL, CLAYEY
	HEAD - CLAY, SILT, SAND AND GRAVEL
	RAISED BEACH DEPOSITS, 1 - SAND AND GRAVEL
	RAISED MARINE DEPOSITS - SAND AND GRAVEL
	RAISED STORM BEACH DEPOSITS, 2 - GRAVEL
	RIVER TERRACE DEPOSITS (UNDIFFERENTIATED) - SAND, SILT AND CLAY
	CLAY-WITH-FLINTS FORMATION - CLAY, SILT, SAND AND GRAVEL

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Job Title	Land west of the Havant crematorium Bartons Road, Havant
Drawing Title	BGS Map - Superficial Deposits

Client	White Farming Limited
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Scale NTS @A3	Date May 2018	Designed N/A
Drawn DK	Checked SPS	Approved GAC
Job No 17-055	Figure No Figure 3	Rev -



KEY

Bedrock geology

- WITTERING FORMATION - SAND, SILT AND CLAY
- BOGNOR SAND MEMBER - SAND
- LONDON CLAY FORMATION - CLAY, SILT AND SAND
- LONDON CLAY FORMATION - SAND
- LAMBETH GROUP - CLAY, SILT AND SAND
- LAMBETH GROUP - SAND
- PORTSDOWN CHALK FORMATION - CHALK
- SPETISBURY CHALK MEMBER - CHALK
- TARRANT CHALK MEMBER - CHALK
- NEWHAVEN CHALK FORMATION - CHALK
- LEWES NODULAR CHALK FORMATION, SEAFORD
- CHALK FORMATION, NEWHAVEN CHALK FORMATION, CULVER CHALK FORMATION

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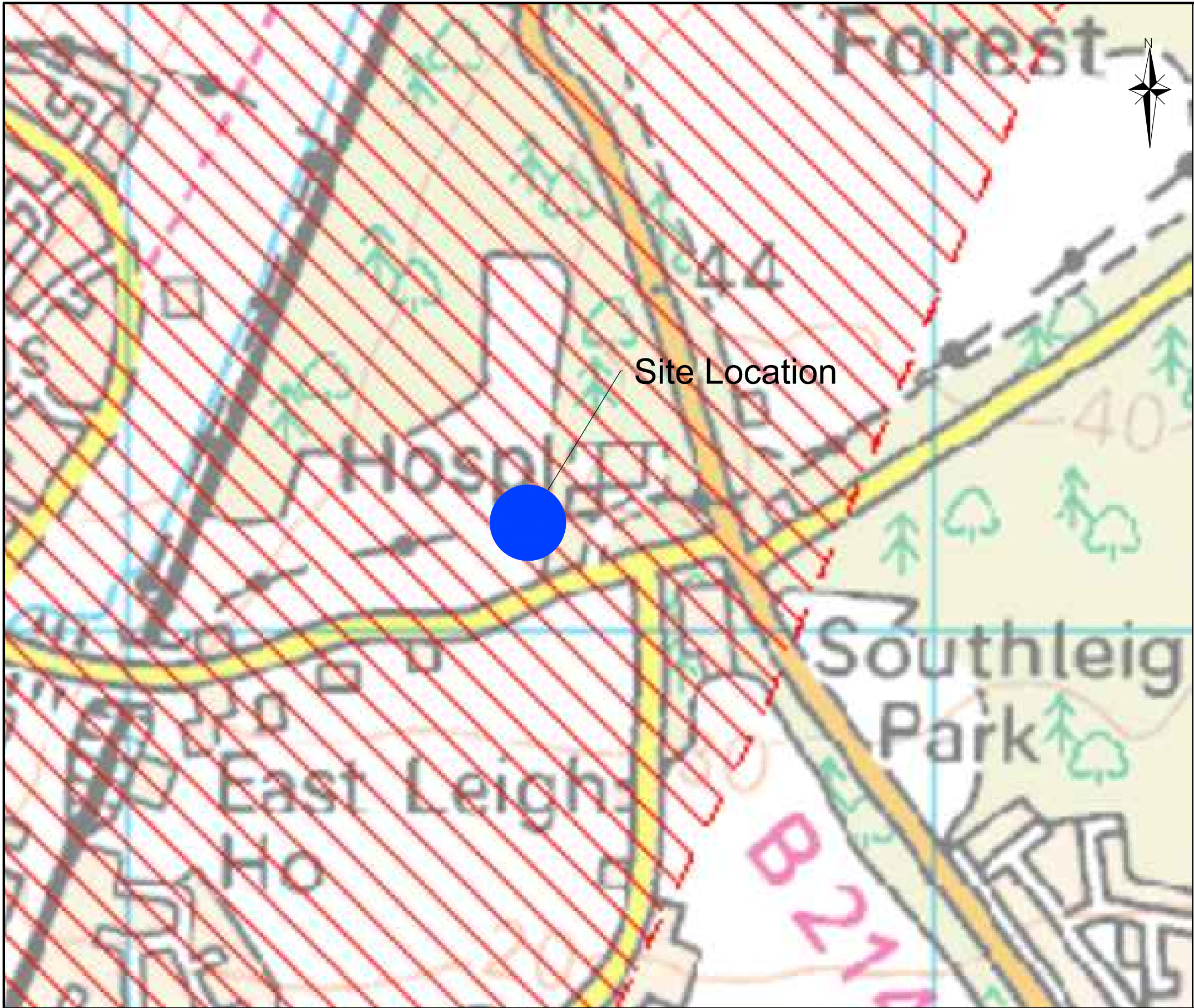
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Job Title	Land west of the Havant crematorium Bartons Road, Havant
Drawing Title	BGS Map - Bedrock Deposits

Client	White Farming Limited
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Scale NTS @A3	Date May 2018	Designed N/A
Drawn DK	Checked SPS	Approved GAC
Job No 17-055	Figure No Figure 4	Rev -

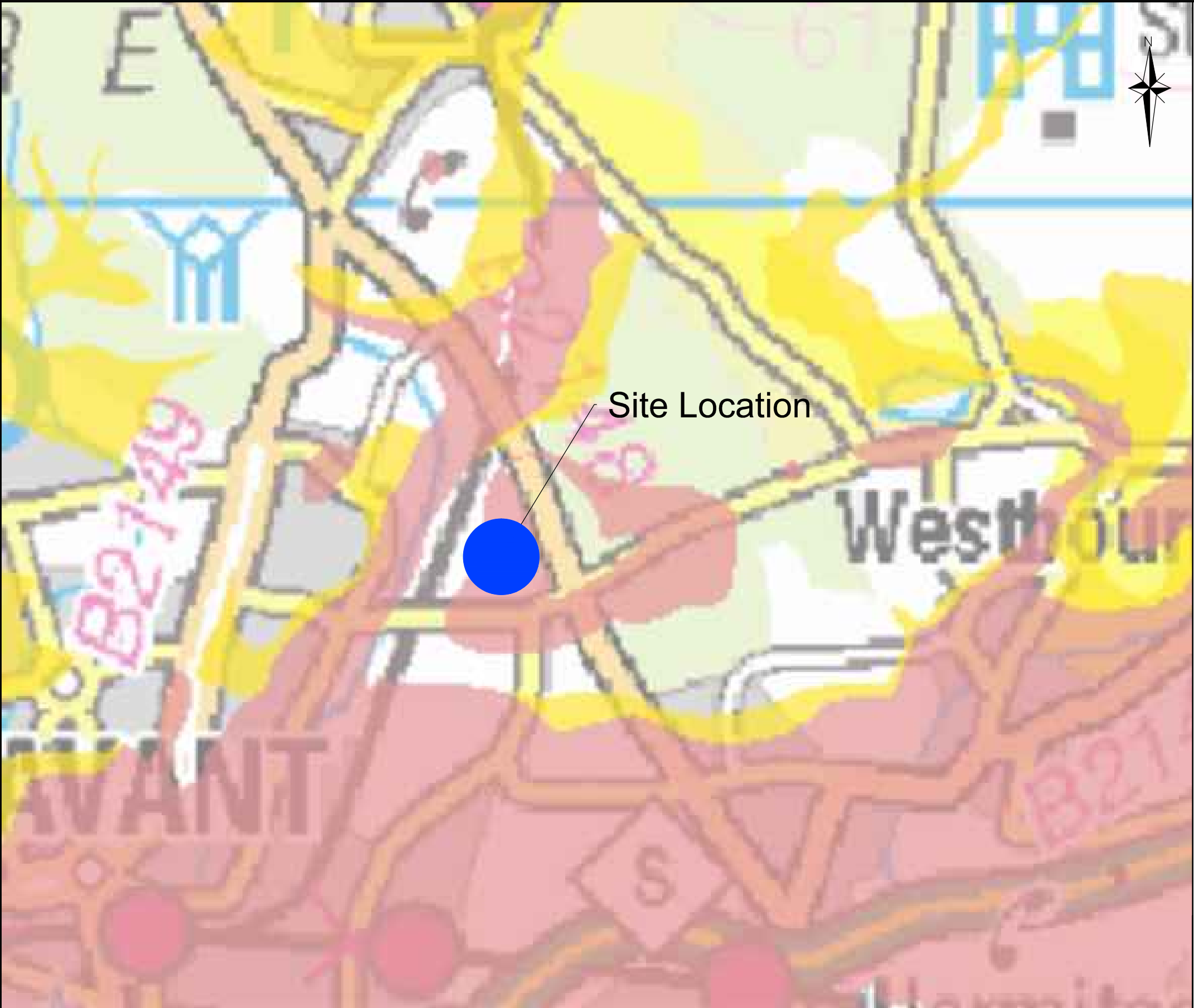


KEY

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

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	☐ Park House, Park Farm East Malling Trust Estate Bradbourne Lane Aylesford, Kent ME20 6SN 01732 448120	Drawing Title GW Source Protection Zones Map		Drawn DK	Checked SPS	Approved GAC
				Job No 17-055	Figure No Figure 5	Rev -



KEY

	Principal
	Secondary A
	Secondary B
	Secondary (undifferentiated)
	Unknown (lakes and landslip)

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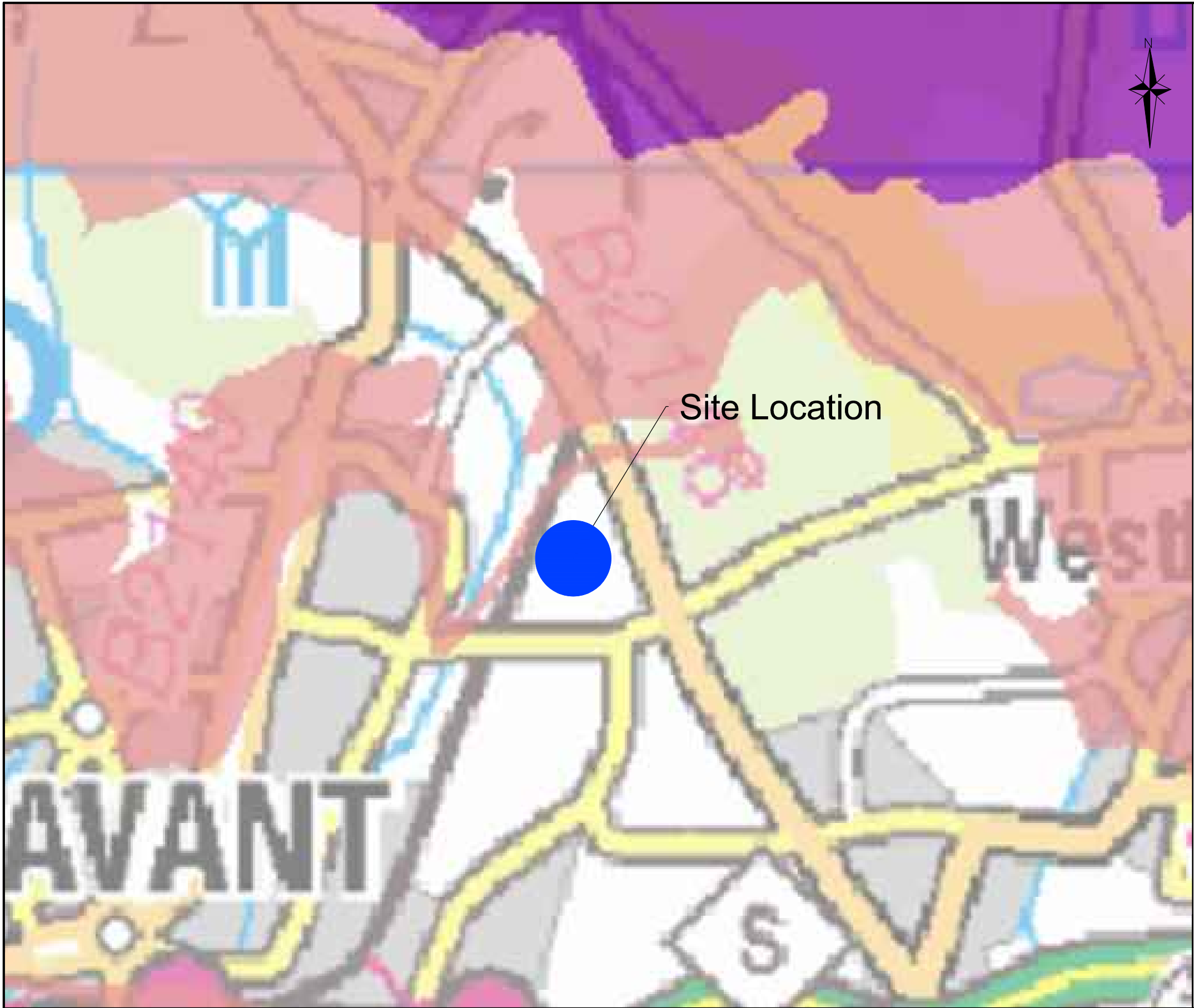
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Job Title	Land west of the Havant crematorium Bartons Road, Havant
Drawing Title	Aquifer Maps - Superficial Deposits

Client	White Farming Limited
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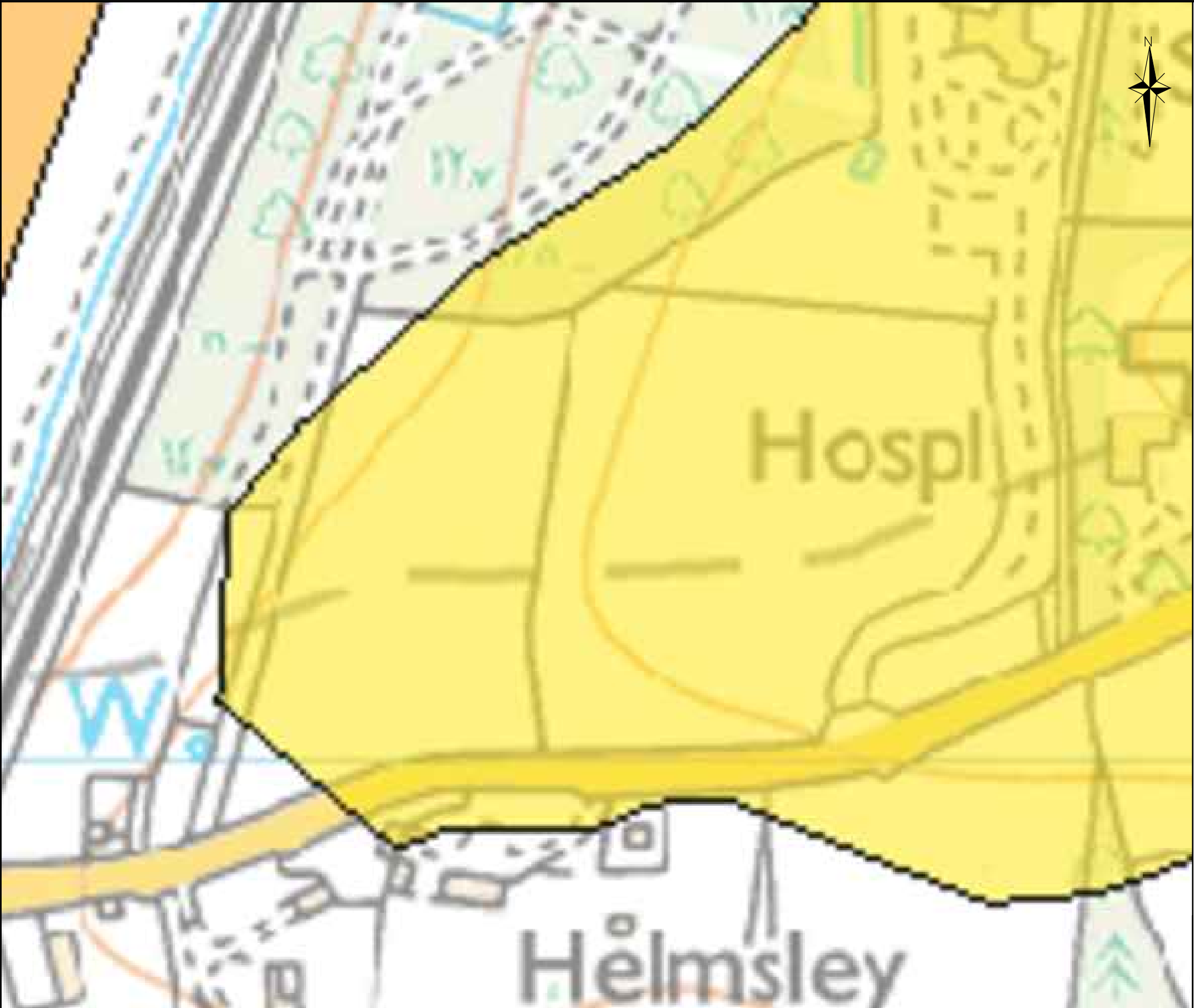
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Drawn DK	Checked SPS	Approved GAC
Job No 17-055	Figure No Figure 6	Rev -



KEY

	Principal
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	Secondary B
	Secondary (undifferentiated)
	Unknown (lakes and landslip)

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	☐ Park House, Park Farm East Malling Trust Estate Bradbourne Lane Aylesford, Kent ME20 6SN 01732 448120	Drawing Title Aquifer Maps - Bedrock Deposits			Drawn DK	Checked SPS	Approved GAC		
					Job No 17-055	Figure No Figure 7	Rev -		



KEY

	Major Aquifer High
	Major Aquifer Intermediate
	Major Aquifer Low
	Minor Aquifer High
	Minor Aquifer Intermediate
	Minor Aquifer Low

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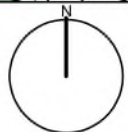
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Job Title	Land west of the Havant crematorium Bartons Road, Havant
Drawing Title	GW Vulnerability Zones Map

Client	White Farming Limited
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Scale 1:2k @A3	Date May 2018	Designed N/A
Drawn DK	Checked SPS	Approved GAC
Job No 17-055	Figure No Figure 10	Rev -

APPENDIX A
OUTLINE ILLUSTRATIVE MASTER PLAN



0 10 20 30m

Do not scale from this drawing. Contractors to confirm all dimensions before commencing work on site or shop drawings. STAINSBYARCHITECT to be notified of any discrepancies.

Rev: Amendment

Date:

Planning
STAINSBYARCHITECT

Master Plan
Camp Field, Havant

089 PL 04 H

Scale 1:1000 @ A3 Oct 2018

Tab House, Tilford Road, Hindhead, Surrey, GU26 6RA T 01428 607808 M 07584 574626 www.stainsbyarchitect.com

APPENDIX B

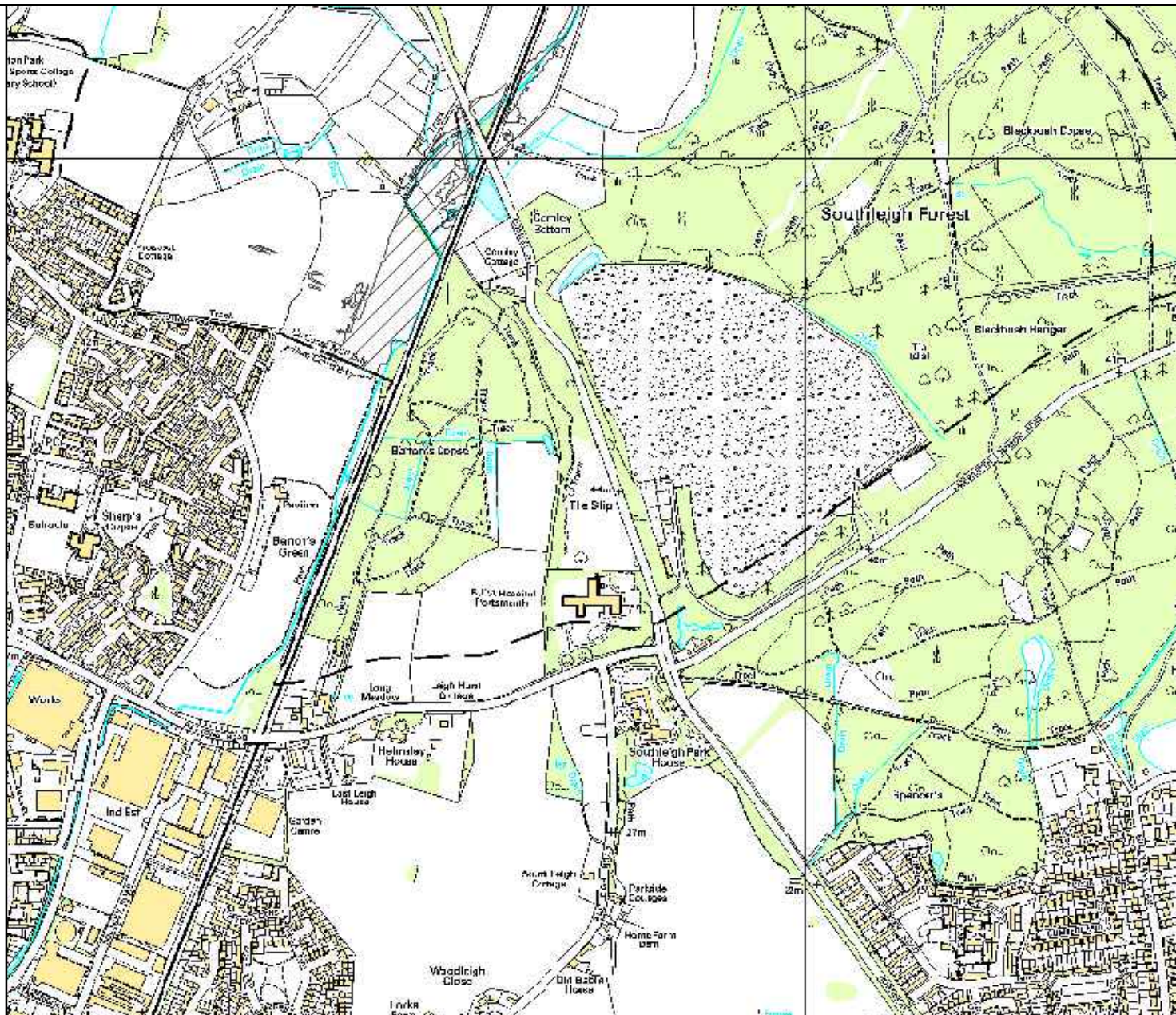
PUSH SFRA HISTORICAL FLOOD MAP AND HANTS SURFACE WATER/SUDS GUIDANCE



LEGEND:

Legend	
☒	Background Mapping
☒	Flood Mapping
	Flood Zone 3
	Flood Zone 2
	Historic Flood Map
	Hazard Map
	Flooding from Other Sources
	Updated Flood Maps for Surface Water
	Updated Flood Maps for Surface Water
	Updated Flood Maps for Surface Water
	Groundwater Flooding
	Impact of Land Use Change
	Potential Sources of Overland Flow
	Southern Water Observed Flooding

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						DK	SS	GAC	
						Job No	Figure No	Rev	
						17-055	FIGURE 11	-	



LEGEND:

	Groundwater Flooding
	1F2_EA_Groundwater_Flood_Incidents



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Job Title
**Land west of the Havant crematorium
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Drawing Title
PUSH SFRA Map_Historical Groundwater Flooding

Client
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Scale	NTS@A4	Date	Nov 2018	Designed	-
Drawn	DK	Checked	SS	Approved	GAC
Job No	17-055	Figure No	FIGURE 12	Rev	-

Flood Risk Overview

Sources of Flood Risk



Havant is the eastern-most Local Authority in the PUSH sub-region. It covers a total area of approximately 55 km² which is split between the mainland and Hayling Island. The council has approximately 56 km of coastal frontage (including 42 km around Hayling Island) and 32 km of main river. At present, approximately 22% of the Borough's land area is designated as within Flood Zones 2 and 3 (see SFRA Map: Flood Mapping Dataset).

The SFRA has shown that the primary source of flood risk to Havant is from the sea. The key parts of the Borough which are currently at risk of flooding from the extreme tides include Brockhampton, Langstone and Emsworth on the mainland and Eastoke, Selsmore and Mengham on Hayling Island. Flooding due to wave overtopping is historically known to occur on Hayling Island, particularly along the southern frontage. Land behind this frontage has suffered significant flooding from wave overtopping even though the land is relatively high and is shown to lie within Flood Zone 1, i.e. the zone of low probability of tidal flooding.

The secondary source of flood risk to Havant Borough is from fluvial sources including the Lavant Stream, the Hermitage Stream and associated tributaries. These watercourses flow through the town centre of Havant and discharge into Langstone Harbour. Additionally, the upper reaches of the Wallington River rise near Waterlooville in Havant Borough. The key parts of the Borough which are currently at risk of fluvial flooding include Havant town centre, Leigh Park, West Leigh and Stockheath.

Historically, Havant has also been susceptible to flooding from other sources including; groundwater, surface water and flooding caused by infrastructure failure. A number of previous groundwater flooding incidents have been observed in the upper parts of the Lavant Stream between Rowlands Castle and Havant in the north of the Borough. The town of Havant has a drainage system which in many places dates back to before the mid-1960s. As such, flooding from surface water drainage systems and sewers has occurred at many locations, including along The Florins, Petersfield Road, Park Lane and Hulbert Road.

Key physical characteristics that may constrain development

Approximately 58% of Havant Borough is currently covered by existing development, suggesting that much future development will need to be concentrated on brownfield sites. A number of environmentally designated areas represent a significant constraint on development in the Borough, covering approximately 24% of its area. As such there may be only limited land upon which development can be permitted following consideration of other planning constraints.

The topography of Havant Borough ranges from sea level to approximately 80 metres above ordnance datum (mAOD). Hayling Island is entirely below approximately 9 mAOD. Further development on the island will likely increase the pressure for further maintenance and improvement to existing flood defences, particularly following predicted rises in sea level in future. The town of Havant itself varies in elevation from 5 mAOD near the coast to 40 mAOD in Leigh Park

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and West Leigh. The majority of the existing development on the mainland in Havant Borough will not therefore face increasing flood risk due to predicted sea level rise over the next 100 years. Waterlooville is situated between 30-50 mAOD while elevations in the Purbrook area rise to approximately 65 mAOD on the approach to Portsdown Hill.

Geologically, Havant Borough is underlain by a mix of low, moderate and highly permeable bedrock formations. The towns of Havant and Waterlooville and the southern part of Hayling Island are underlain by low and moderately permeable bedrock formations, while a highly permeable chalk layer exists between these two areas, resulting in the many springs used by Portsmouth Water. However, moderately permeable superficial deposits overlie the majority of this permeable layer, reducing its permeability in terms of surface water runoff generation. This may make the implementation of Sustainable Drainage Systems (SUDS) difficult, which is of particular importance in the Cowplain and Waterlooville area where deep clay strata result in a lack of positive drainage and more frequent small surface water flooding incidents.

The existing drainage systems in Havant are known to be at or below capacity in key areas and it may therefore be difficult to provide new development in parts of the town without significant investment in drainage infrastructure.

Vulnerability to Climate Change

The SFRA has generated predicted tidal outlines for a number of years up to 2115 (see SFRA Map: *Flood Mapping: Climate Change* Dataset). These outlines account for the most up-to-date predicted rises in sea-level over the coming century due to climate change and they therefore allow the identification of locations that will be most vulnerable to this change due to their topography. In Havant Borough, Hayling Island is the most sensitive area to sea level rise, particularly the southern half of the island. With much of the island low-lying, predicted sea-level rise could result in extreme tidal events inundating more of the island. In addition to this effect of rising sea levels, it is anticipated that climate change will result in an increase in fluvial flood flows. This may put additional pressure on areas in the town of Havant adjacent to the streams.

Existing defence assets and likely future investment

The coastal frontages of Havant Borough are almost entirely defended from either wave overtopping or tidal flooding by some form of coastal defence. Approximately half the coastal defences in Havant Borough have a crest level which is higher than a present day 1 in 200 year tide. Areas where defences are below the minimum standard of protection required for new development are the north eastern coast of Hayling Island south of Northney, the Chichester harbour frontage at Emsworth and the frontage at Langstone.

The coastal defences in Havant Borough are, however, likely to be susceptible to climate change, as 100 years of predicted sea level rise would mean that most man-made defences at their current level would fail to offer protection from a 1 in 20 year tidal flood, with the exception of the southern frontage of Hayling Island. To sustain future development in Havant Borough, particularly on Hayling Island, significant investment in flood defences and flood defence infrastructure will be required. On some frontages where defences can prevent inundation of large areas by tidal flooding, significant

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investment will be required in improving and maintaining existing flood defences (see SFRA Map: Infrastructure Dataset). In order to consider the sustainability of investing in improved defences, the 'danger to people from breaching' index (see SFRA Map: Infrastructure: Danger to Public/ Property Dataset) will provide indications as to where the residual risk due to breaching may remain unfavourably high following improvements to defences to protect from extreme tidal floods.

Sequential and Exception Test

National Planning Policy Framework (NPPF) and The Planning Practice Guidance sets out the Government's objectives for achieving sustainable development through the avoidance and management of flood risk. The NPPF aims to ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas of flood risk. To achieve this aim, the Planning Practice Guidance provides a decision making tool to ensure that sites with a low probability of flooding are developed in preference to areas at higher risk. The Sequential Test is the decision process which Local Authorities must demonstrate when developing their Local Development Frameworks and Local Development Documents. This SFRA has developed a suite of mapping outputs to assist Local Authorities in applying the Sequential Test.

When applying the Sequential Test, The Flood Mapping Dataset of the SFRA will provide all the necessary information required upon which to base decisions regarding the location of future development in relation to flood risk. Within The Flood Mapping Dataset, the key map required for applying the Sequential Test is the Environment Agency's Flood Map for Planning, shown as Flood Zone 2 and Flood Zone 3 in conjunction with the Historic Flood Map.

The Flood Mapping Dataset also contains 4 other Mapsets which provide useful information to support Local Authorities when applying the Sequential Test, these include:

- *Hazard Map* – Undefended Flood Hazard
- *Flooding from Other Sources* – including Surface Water, Groundwater, Sources of Overland Flow
- *Flood Warning Areas*
- *Climate Change* - Outlines for years 2025, 2055, 2085 and 2115

In the original SFRA published in 2007 these guidance documents included specific advice on how to apply the PPS25 Sequential and Exception Tests. This advice has since been updated and incorporated into other guidance notes. For the purpose of efficacy and ensuring this text remains contemporary, it will not be reproduced here and instead signposted from the key guidance below:

- [The National Planning Policy Framework](#)
- [Planning Practice Guidance: Flood Risk and Coastal Change](#)
- [Flood risk assessment for planning applications](#)
- [Flood risk assessment: standing advice](#)

It is requested that if in applying any of this guidance that links are found to be broken or require updating that contact is made with the SFRA helpdesk through contact details on the mapping webpage.



Planning Policy

Paragraph 100 of the National Planning Policy Framework (NPPF) seeks to direct development away from areas at highest risk of flooding. Local Plans should be supported by SFRA and develop policies to manage flood risk from all sources.

Local Plans should apply a sequential, risk based approach to the location of development. Development should not be permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding.

If, following application of the sequential test, it is not possible (consistent with wider sustainability objectives) for the development to be located in zones with lower probability of flooding, the exception test can be applied if appropriate. The exception test should demonstrate that there are wider benefits to the community which outweigh flood risk. It should also demonstrate, through a site specific flood risk assessment, that the development will be safe for its lifetime.

Chapter 10 of the NPPF provides full guidance on climate change, flooding and coastal change.

Guidance Document: Havant Borough Council

SFRA Mapping Outputs

The table below summarises the most relevant mapping outputs and their purpose, for each of the key users of the PUSH SFRA.

Key Users	Relevant SFRA Mapping Dataset	Purpose
Planning Policy	Flood Mapping: NPPF Sequential Test and Relevant Supporting Information	Flood Mapping Dataset provides all the necessary information to help planners apply the Sequential Test and Exception Test when allocating new sites for development. Flood Mapping Dataset also allows planners to identify sites with the lowest probability of flooding and lowest flood hazard / danger and how the extent of flooding is likely to change in the future due to climate change.
Development Control	Flood Mapping: NPPF Sequential Test and Relevant Supporting Information	Flood Mapping Dataset helps Development Control personnel to: o Prepare specifications for site specific FRAs. o Review site specific FRAs for new development sites and check for compliance with NPPF
Risk Management	Flood Mapping: NPPF Sequential Test and Relevant Supporting Information	Flood Mapping Dataset helps Flood Risk Managers to identify variations in flood hazards / dangers to existing development. The data also provides mapping to show how the extent of flooding is likely to increase over time due to climate change.
	Infrastructure: Appropriate Defence Standards and Levels of Investment	Infrastructure Dataset helps Flood Risk Managers to: o Identify shortfalls in existing defences in providing appropriate standards of defence, now and in the future. o Identify indicative levels of investment required to provide the appropriate standards, now and in the future.
Emergency Planning	Flood Mapping: NPPF Sequential Test and Relevant Supporting Information	Flood Mapping Dataset can provide emergency planners with information on the variation of flood probability and hazard across the sub region. Such information can aid in the development of emergency plans and evacuation routes during flood events.
	Infrastructure: Appropriate Defence Standards and Levels of Investment	Infrastructure Dataset can help Emergency Planners to: o Identify indicative standards of defence, now and in the future.

Recommendations for Site Specific Flood Risk Assessments

Whilst the information presented in this SFRA will inform Local Authorities and facilitate their strategic allocation of sites for future development, it should not preclude the need for developers to undertake site specific flood risk assessments (FRAs). A SFRA, by its very nature, is a high level assessment of flood risk at the local authority level. It does not provide sufficiently detailed information to satisfy all of the requirements of a site specific FRA as outlined in the National Planning Policy Framework.

To improve the efficiency of disseminating general guidance, the Environment Agency has produced a suite of standing advice and guidance on producing Flood Risk Assessments.

- Flood Risk Assessment: Guidance for completing flood risk assessment to accompany a planning application
 - o [When you need an assessment](#)
 - o [When you don't need an assessment](#)
 - o [When to follow standing advice](#)
 - o [How to do an assessment](#)
 - o [Get information to complete an assessment](#)
- Flood Risk Assessment: Guidance for planning authorities on review of flood risk assessments submitted as part of planning applications
 - o [Check if you need to consult](#)
 - o [Flood zone 1](#)
 - o [Flood zone 2](#)
 - o [Flood zone 3](#)
 - o [What you need to check in an assessment](#)
 - o [Extra flood resistance and resilience measures](#)

The following sections provide additional specific guidance for assessing flood risk at the site specific level within Havant Borough and indicate how the outputs from the SFRA can inform such assessments.

Tidal Flooding

Flooding from tidal sources is one of the primary sources of flood risk within Havant Borough and the areas at risk are predicted to increase significantly by 2115. The *Flood Mapping* Dataset shows the existing areas at risk of tidal flooding and the associated undefended flood hazard. The index of flood hazard represents a gradation of hazard within the Flood Zones based on a combination of the depth of flood water and the velocity of the water (indicative ranges for which have been assumed based on distance from the coastline). It should also be noted that this dataset was derived during the evolution of the 2007 work package and the mapping has not been updated as part of the 2015 review. For this reason in areas where there have been flood mapping updates since 2007, there may be discrepancies in the data presented. There are notable occurrences of this around the area

Guidance Document: Havant Borough Council

of Havant Town Centre within the Borough. Where this occurs it is recommended that further advice is sought from the SFRA Helpdesk team or local Environment Agency office.

The frontages where existing defences provide the minimum standards required for new development (i.e. 1 in 200 years for tidal flooding), are identified in the *Infrastructure: Overview* Dataset by a purple line. Indicative Areas Benefiting from Defences (ABDs) are also shown in this dataset. The Indicative ABDs have been defined as areas where the crest levels of the existing defences are consistently equal to or higher than the present day 1 in 200 year extreme sea level.

If small lengths of defences have crest levels which fall below the 1 in 200 year extreme sea level (even for a short length), the area behind the defence has not been classed as an Indicative ABD. The frontage of Brockhampton is an example of where this study has not been able to define an Indicative ABD due to small lengths of defence where the crest levels fall below the 1 in 200 year extreme sea level. The gaps in the defence level can also be viewed in more detail using *Infrastructure: Defence Level*. It should be noted that other areas may potentially be classified as ABDs if more detailed modelling assessments of the defences, which is beyond the scope of this SFRA, are carried out.

The *Flood Mapping: Hazard Map* Dataset shows the flood hazard (in terms of danger to people) associated with a hypothetical breach in the defences for the whole of the tidal frontage. The Indicative ABDs shown in *Infrastructure: Overview* define which of the hazard maps is most appropriate for consideration. Hazard Map for Flood Zone 2 is only appropriate for considering present day flood hazards within an ABD. To aid interpretation, the areas where this index is not appropriate for present day analysis are hatched out. The benefit of showing hazard information in the hatched out areas is to allow planners and developers to understand the likely residual risks that would remain if they were to invest in defending an area to a 1 in 200 year standard. The Hazard Map for Flood Zone 2 (Undefended Flood Hazard) should be used to assess the variation of flood hazard within the Flood Zones for all areas outside the Indicative ABDs.

The benefit of both the undefended flood hazard maps and the danger from breaching maps is that the gradation of flood hazard within the Flood Zones can facilitate both planners and developers to ensure that development is steered away from the areas of highest hazard. The hazard mapping presented in *Flood Mapping: Hazard Map*, however, should only be applied when appropriate consideration has been taken of alternative sites at a lower probability of flood risk (i.e. within Flood Zone 1) have been considered.

The flood hazard information, for both the undefended and breach scenario, developed as part of this SFRA, has been undertaken at a strategic level and is therefore at an appropriate level of detail to allow Local Authorities to strategically allocate sites for development. The hazard data has been classified into 4 categories to illustrate the gradation of flood hazard within Flood Zones 2 and 3 in line with best practice guidance as set out in Defra/ EA Guidance FD2320. The hazard data has not been calculated using modelling or other detailed numerical methods and is therefore not appropriate for identifying design parameters as part of site specific FRAs. It is therefore recommended that FRAs for sites located within the flood hazard zones should still include a

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quantitative assessment of flood hazard based on more detailed assessments of defence standards, defence failure scenarios and overland conveyance of flood flow.

The impact of climate change on increasing sea levels has a significant effect on the extents of Flood Zones 2 and 3 by 2115, especially on frontages around Hayling Island. The NPPF expects consideration to be given to both current and future flood zones at the site specific level, taking account of climate change. The climate change flood extents presented should be used when undertaking a site specific FRA to inform the assessment of the long term sustainability of developments currently within Flood Zone 1 and the likely increases in flood risk in Flood Zones 2 and 3.

The defence information provided in the *Infrastructure Dataset* can provide developers undertaking site specific FRAs with an indication of the equivalent tidal return period of the crest level of the existing defences in the present day and an indicative level of investment that may be required to raise defence standards to the minimum required for new development. Such investment could be secured through the development process by Community Infrastructure Levy or Section 106 agreements.

Wave Overtopping

The Wave Energy mapset included within *Flood Mapping: Flooding from Other Sources*, shows how exposure to wave energy varies along the frontage of the study area. Such information can be used to assess, at a high level, the risk of flooding caused by extreme wave overtopping. Historically, Hayling Island has suffered from flooding caused by extreme wave overtopping, most recently in November 2005 and during the winter storms of 2013/14 which caused some highway flooding. During the 2005 event, properties which are classified in Flood Zone 1 were flooded, as indicated on the historical information layer. It is recommended that all applications for development within the vicinity of the southern frontage of Hayling Island include an assessment of extreme wave overtopping, regardless of which Flood Zone the site is in. This will ensure that this risk is always considered for new development in the relevant locations. The assessment of extreme wave overtopping should be appropriate to the scale of risk and may, in some cases, be ruled out as a significant risk quite easily, but should nevertheless be addressed.

Fluvial Flooding

The mainland part of Havant Borough is at risk of fluvial flooding from the Lavant Stream, Hermitage Stream and, during extreme events (1 in 1000 years), the upper reaches of the River Wallington. The *Flood Mapping* Dataset shows the fluvial Flood Zones, which show the town centre of Havant to be the key area at risk of fluvial flooding in the Borough.

Across Havant Borough, gaps in available fluvial flood risk data exist. Therefore, for the purposes of this SFRA, Flood Zone 3b (defined by Planning Practice Guidance as the 'functional floodplain') has been defined as the entire extent of Flood Zone 3, as recommended by the Planning Practice Guidance. This is a precautionary approach and should be tested by site specific FRAs, where required.

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Unlike the tidal Flood Zones, flood levels associated with the fluvial Flood Zones have not been identified as part of this SFRA. The variations in previous modelling approaches for the rivers within the PUSH sub-region, coupled with the spatial variation on flood levels along the river valleys, meant that it was not possible to provide a consistent approach to identifying fluvial flood levels without re-modelling a number of rivers. Such detailed assessments were outside the scope of this SFRA.

Developers undertaking a FRA for a site within the fluvial Flood Zones should obtain the most up to date flood risk data from the Environment Agency. If no further information is available then a site specific FRA may need to include a numerical assessment to refine the understanding of fluvial flood risk, and agree the form of this assessment with the Environment Agency.

Undefended flood hazard information, shown in Map Set 1B, has also been developed for the fluvial Flood Zones 2 and 3. This information can provide developers with an indication of the varying degree of flood hazard within the Flood Zones which can facilitate the design and layout of development sites to avoid areas of high hazard. As with the tidal flood hazard data, it is recommended that FRAs for sites located within the flood hazard zones undertake a more detailed quantitative assessment of flood hazard based on an improved understanding of defences and flow routes. As with the tidal flood hazard data, this dataset was derived during the evolution of the 2007 work package and has not been updated as part of the 2015 update. For this reason in areas where there have been flood mapping updates since 2007, there may be discrepancies in the data presented. There are notable occurrences of this around the area of Havant Town Centre within the Borough. Where this occurs it is recommended that further advice is sought from the SFRA Helpdesk team or local Environment Agency office.

It is recommended that FRAs for sites located within the flood hazard zones to undertake a more detailed quantitative assessment of flood hazard based on an improved understanding of defences and flow routes.

Surface Water/Overland Flow Flooding

The dataset *Flood Mapping: Flooding from Other Sources* show both maps for potential surface water flooding and the variation in the potential source of overland flow across the PUSH sub-region. The areas shown in red and orange relate to areas of very high and high potential for generating overland flow. Notably, the urban areas are indicated as red or orange due to the high runoff potential from urban land uses.

Within Havant Borough there are a number of areas which have a high to very high potential for generating overland flow. FRAs for sites that are found to be within or in the vicinity of these areas, especially if the local topography places the site at a lower elevation than the surrounding land and hence downstream of the source, should consider the impacts and management of flooding due to overland flow.

The data shows that new development located on the majority of the Greenfield Land in Havant Borough is likely to have a moderate impact on the surface water runoff regime. Site specific FRAs should therefore carefully consider the impact of development on the local surface water runoff regime and should investigate SUDS options to manage surface water where achievable.

Groundwater Flooding

Within the PUSH region the key areas at risk of groundwater flooding are north of Havant Borough in East Hampshire, Winchester, Eastleigh and Test Valley where highly permeable geology meets lower permeability geology as shown in *Flood Mapping: Flooding from Other Sources: Groundwater*, which has been verified by inspection of the historical incident records. The key risks to new development in the Havant Borough come from increases in flows in the Lavant Stream as a result of high groundwater levels emerging in East Hampshire District. It is therefore recommended that site specific FRAs for sites located within the Flood Zone of the upper reaches of the Lavant Stream consider the joint effects of high groundwater flows in the Lavant Stream combined with rapid runoff from intense rainfall events.

Flooding from Infrastructure

Historically, the mainland part of Havant Borough has recorded the most incidents of flooding caused by problems relating to the drainage infrastructure as shown in Dataset *Flood Mapping: Flooding from Other Sources*. The majority of these incidents have occurred in the vicinity of Havant Town Centre, Purbrook, Cowplain and Emsworth. When undertaking a site specific FRA for a large development site, consultation with Southern Water should always be undertaken to investigate whether the proposed development will have an adverse impact on the local drainage system.

Sustainable Urban Drainage Systems (SUDS)

Conventional surface water drainage systems have traditionally used underground pipe networks to efficiently convey water away from sites. In the past this has led to problems of downstream flooding, reductions in groundwater recharge and waste pollution incidents associated with surface water overwhelming combined sewers. Both 'Making Space for Water' and the 'Water Framework Directive' have highlighted the need for an improved understanding and better management of how our urban environments are drained. The SUDS management train approach is the principle that a range of SUDS which feed into each other can often offer benefits to the delivery of a successful surface water system/strategy.

NPPF states that Local Authorities should prepare and implement planning strategies that help to deliver sustainable development, by using opportunities offered by new development to reduce the causes and impacts of surface water flooding. By implementing policies to encourage developers to incorporate SUDS wherever possible, Local Authorities can help to mitigate the impacts that development has on surface water runoff rates and volumes.

Emergency Planning

As well as informing the development control process, the outputs of the SFRA can also be used by the Local Authority to inform their Emergency Planning Policies. The Flood Mapping Datasets are particularly useful when considering the feasibility and sustainability of key access routes within their administrative boundaries. The benefit of producing such outputs on a sub-regional scale mean that the Local Authority can also consider access to the Borough beyond their administrative boundary where key access routes (e.g. M27) cross a number of Local Authorities.

PUSH Strategic Flood Risk Assessment – 2016 Update

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Additional Guidance

- [Flood risk assessment for planning applications](#); Environment Agency
- [Flood risk assessment: standing advice](#); Environment Agency
- [National Planning Policy Framework](#); DCLG
- [National Planning Policy Framework Quick Guide](#); Environment Agency
- [Planning Practice Guidance – Online web-based resource](#); DCLG
- [Flood and coastal risk guidance: climate change allowances](#); Environment Agency
- [Development and Flood Risk: Guidance for the Construction Industry](#) CIRIA (2004)
- [Flood Risk Assessment Guidance for New Development: FD2320/TR2](#) Environment Agency / DEFRA
- [Susdrain online resource: The community for sustainable drainage](#) CIRIA
- [Havant BC emergency planning flooding – online resource](#)
- [Havant BC Local Plan SFRA evidence – online resource](#)
- [South East Hampshire Catchment Flood Management Plan](#), Environment Agency
- [Local Flood Risk Management Strategy](#), Hampshire County Council

APPENDIX C

EXTRACTS FROM SITE INVESTIGATION REPORT

Soakaway Letter Report

CLIENT	White Farming Ltd c/o C&A Consulting Engineers
SITE ADDRESS	Land to the West of Spire Portsmouth Hospital, Bartons Road, Havant, Hampshire PO9 5NP. A site location plan is provided in Figure 1. A site development area can be seen in figure 2, and an aerial view in figure 3.
REPORT REFERENCE	GWPR2493. Land to the West of Spire Portsmouth Hospital, Bartons Road, Havant, Hampshire PO9 5NP. Conditions and Limitation can be seen in Appendix A.
ENGINEER	James Harvey, Ground and Water Limited
INVESTIGATION LOCATIONS	Please see Figure 2 attached. Si Site works were undertaken on the 23 rd March 2018 and comprised the excavation of 5No. Trial to a depth of between 1.70 – 3.00m bgl. 4No. Soakage Tests were undertaken in TP1 – TP4. Soakage tests were limited to the eastern boundary along the adjacent road. TP5 was not accessible for the road tanker but was excavated to confirm geology. A further site investigation was undertaken on the 8 th May 2018 and comprised the drilling of 5No. Terrier Windowless Sample Boreholes (WS1 – WS5) to a depth of 3.00m bgl located in the western portion of the site. Falling head tests were conducted within WS1 – WS5.

GROUND CONDITIONS ENCOUNTERED

Summary of Strata Encountered (TP1 –TP5 and WS1 – WS5)		
Strata	Depth Encountered (m bgl/blgl)	Thickness (m)
TOPSOIL: (TP1 – TP5 and WS1 – WS5) Dark brown/ brown gravelly sand. Sand was fine to coarse grained. Gravel was occasional to abundant, fine to coarse, sub-angular to sub-rounded flint.	GL	0.20 – 0.40
GRANULAR HEAD DEPOSITS: (TP1 – TP4) Light brown sandy locally clayey gravel. Sand was fine to coarse grained. Gravel was abundant, fine to very coarse sub-angular to sub-rounded flint.	0.20 – 0.40	1.10 – >2.05
COHESIVE HEAD DEPOSITS: (TP2 – TP5 and WS1 – WS5) Brown/ orange locally mottled red and grey sandy gravelly clay. Sand was fine to coarse grained. Gravel was occasional to abundant, fine to very coarse, sub-angular to sub-rounded flint.	0.25 – 1.50	0.20 – 2.70
HEAD DEPOSITS: (TP5) Brown grey mottled slightly gravelly clay. Gravel was rare to occasional, fine to coarse, sub-angular to sub-rounded flint.	2.30	>0.50
LONDON CLAY FORMATION: (WS4 – WS5) Brown orange grey mottled gravelly sandy clay. Sand was fine grained. Gravel was rare, fine to coarse, sub-angular to sub-rounded flint.	1.20 – 1.50	1.50 – 1.80
LONDON CLAY FORMATION: (WS1 & WS3) brown orange locally sandy silty clay. Sand was fine grained.	0.60 – 0.70	>1.50 – >2.40

GROUNDWATER	Groundwater was encountered within TP1 at a depth of 2.30m bgl. rising to 2.20m bgl after 20 minutes. No groundwater was encountered in the remaining trial holes.
ROOTS	Roots were encountered within TP1 – TP5 and WS1 – WS5 to depths of between 0.20m – 1.00m bgl.
INFILTRATION RATE	Soakage Tests were undertaken within TP1 – TP4 at depths of between 1.70 – 3.00m bgl and within WS1 – WS5

from ground level to 3.00m bgl. TP1 was bottomed out in the granular Head Deposits, comprising a light brown sandy locally clayey gravel. The sand was fine to coarse grained and the gravel was abundant, fine to very coarse, sub-angular to sub-rounded flint. TP2 – TP4 bottomed out within the cohesive Head Deposits comprising a brown/orange locally mottled red and grey sandy gravelly clay. The sand was fine to coarse grained and the gravel was occasional to abundant, fine to very coarse, sub-angular to sub-rounded flint. WS1 – WS5 were bottomed out within the London Clay Formation comprising a brown orange grey mottled clay locally gravelly locally sandy clay. The sand was fine grained and the gravel was rare, fine to coarse, sub-angular to sub rounded flint. It was not possible to achieve full BRE 365 compliance within TP2, TP4 and WS1 – WS5 due to slow drainage rates. The recorded infiltration rates within each trial hole can be seen tabulated overleaf.

Soakage Test Results					
Borehole/Depth of trial hole & geology (m bgl)	Test	Initial Water Level (m bgl)	Final Water Level (m bgl)	Time taken (mins)	Infiltration Rate (in accordance with BRE365) (m/s)
TP1/2.30 (Granular Head Deposits)	1	1.35	1.90	65	1.55×10^{-4}
TP1/1.90 (Granular Head Deposits)	2	1.20	1.88	60	2.01×10^{-4}
TP1/1.90 (Granular Head Deposits)	3	1.40	1.80	60	7.81×10^{-5}
TP2/1.70 (Cohesive Head Deposits)	1	1.00	1.70	167	2.81×10^{-5}
TP2/1.60 (Cohesive Head Deposits)	2	0.90	1.60	160	4.27×10^{-5}
TP3/3.00(Cohesive Head Deposits)	1	2.20	3.00	20	2.51×10^{-4}
TP3/3.00(Cohesive Head Deposits)	2	2.00	3.00	20	3.62×10^{-4}
TP3/2.75(Cohesive Head Deposits)	3	2.10	2.75	20	3.16×10^{-4}
TP4/1.70(Cohesive Head Deposits)	1	0.89	1.27	278	2.33×10^{-4}
WS1/3.00(London Clay Formation)	1	0.00	0.560	302	4.03×10^{-7}
WS2/3.00(Cohesive Head Deposits)	1	0.00	0.820	217	9.98×10^{-7}
WS3/3.00(London Clay Formation)	1	0.00	0.315	105	6.58×10^{-7}
WS4/3.00(London Clay Formation)	1	0.00	0.085	342	5.45×10^{-8}
WS5/3.00(London Clay Formation)	1	0.00	0.325	65	1.32×10^{-6}

The slowest infiltration rates from the tests have been highlighted in bold.

As the Head Deposits develop across the east to south-east of the site they become more granular and infiltration rates improve. Across the western/north-west parts of the site the Head Deposits are thinner, more cohesive, with the London Clay Formation, both of which showed poorer infiltration.

The site was located on a **Secondary Undifferentiated aquifer** relating to the superficial deposits of the Head Deposits and was underlain by **Unproductive strata** relating to the Bedrock Deposits of the London Clay Formation.

Examination of Environment Agency records indicated that the site was located within a Groundwater Source Protection Zone 1 (Subsurface Activity) as classified in the Policy and Practice for the Protection of Groundwater.

Consultation with the Environment Agency must be sought regarding any use that may have an impact on groundwater resources.

Please feel free to contact us should you have any queries regarding the information enclosed within this letter report.

Yours sincerely

A handwritten signature in black ink, appearing to read 'J Harvey'.

James Harvey
Geotechnical and Geo-Environmental Engineer

For and on behalf of Ground and Water Limited

The following Appendices complete this report.

Figure 1: Site Location Plan

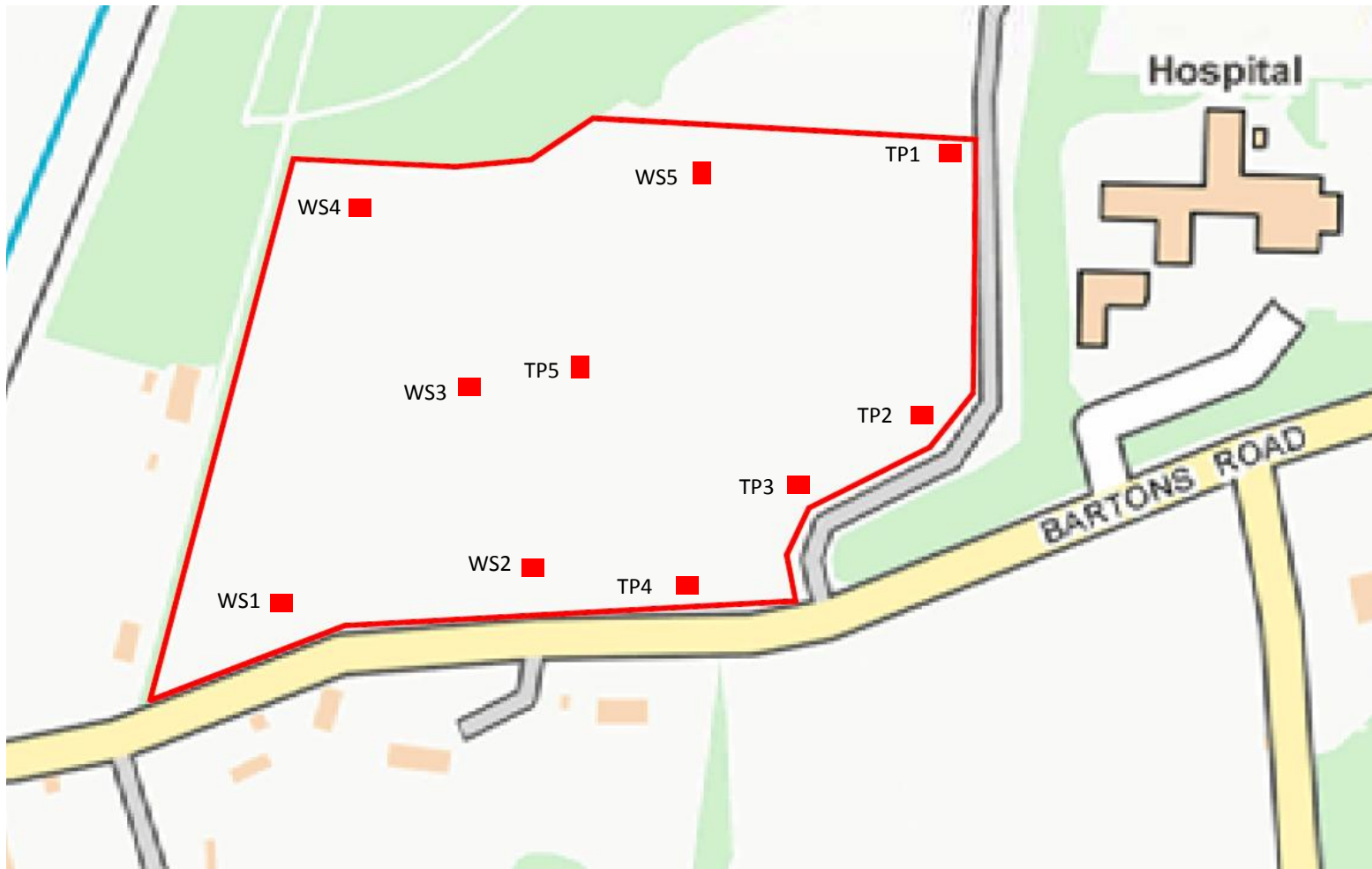
Figure 2: Site Development Area

Figure 3: Aerial View of Site

Figure 4: Trial Pit Location Plan

Appendix A: Conditions and Limitations.

Appendix B: Fieldwork Logs



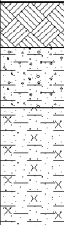
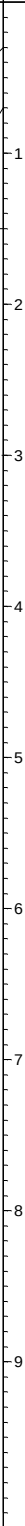
APPROXIMATE SITE BOUNDARY

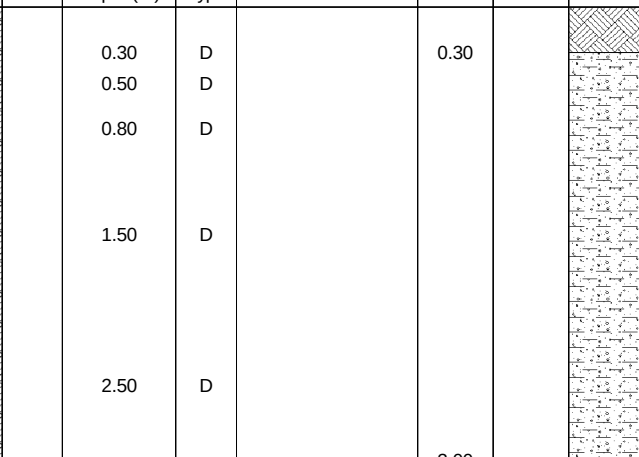
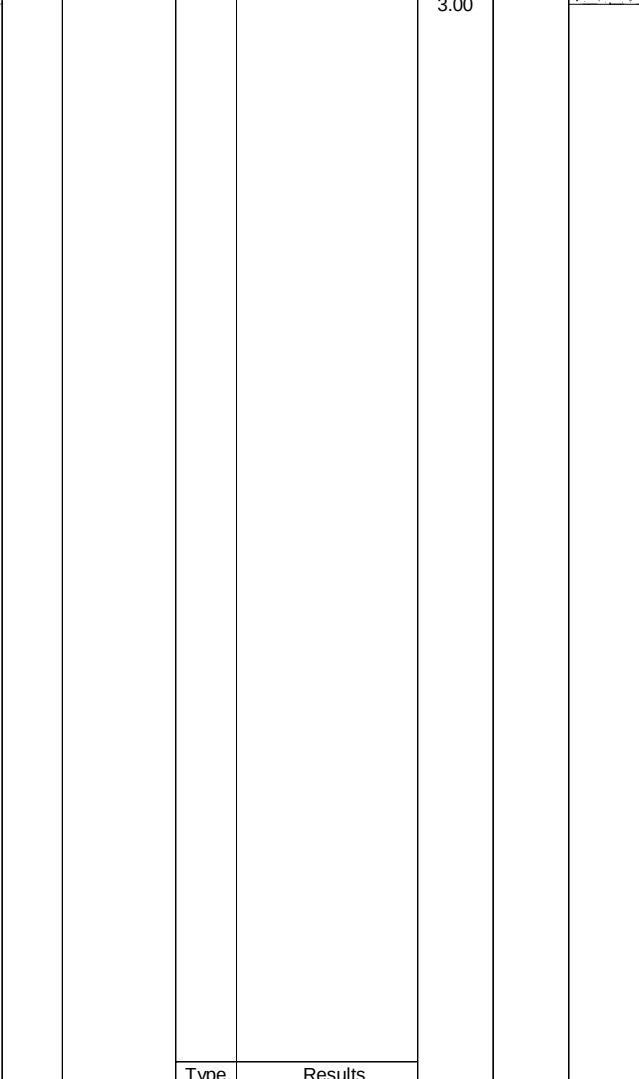
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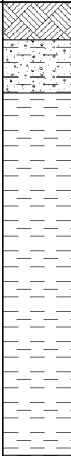
Project: Land to the west of Spire Portsmouth Hospital, Bartons Road, Havant, Hampshire PO9 5NP		Figure 4 ground&water
Client: White Farming Ltd c/o C&A Consulting Engineers	Date: June 2018	
Trial Hole Location Plan	Ref: GWPR2493	

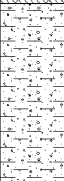
APPENDIX B

Fieldwork Logs

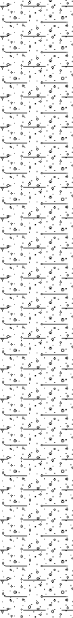
Ground and Water Ltd							Borehole No WS1 Sheet 1 of 1			
Project Name Land W/SW Spire Portsmouth Hospital				Project No. GWPR2493		Co-ords: -		Hole Type WLS		
Location: Bartons Road, Havant, PO9 5NP						Level: -		Scale 1:50		
Client: White Farming Limited						Dates: 08/05/2018		Logged By JH		
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.30	D		0.30			TOPSOIL: Brown gravelly sand. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint.		
		0.50	D		0.70					HEAD DEPOSITS: Brown/orange sandy gravelly CLAY. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint.
		0.80	D							LONDON CLAY FORMATION: Brown/orange sandy silty CLAY. Sand is fine grained.
		1.50	D							LONDON CLAY FORMATION: Brown orange grey mottled CLAY.
		2.50	D							
					3.00			End of Borehole at 3.00 m		
		Type	Results							
Remarks: No groundwater encountered. Roots noted to 1.00m bgl.										

Ground and Water Ltd								Borehole No WS2 Sheet 1 of 1	
Project Name Land W/SW Spire Portsmouth Hospital				Project No. GWPR2493		Co-ords: -		Hole Type WLS	
Location: Bartons Road, Havant, PO9 5NP						Level: -		Scale 1:50	
Client: White Farming Limited						Dates: 08/05/2018		Logged By JH	
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	D		0.30		TOPSOIL: Brown gravelly sand. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint. HEAD DEPOSITS: Brown/orange sandy gravelly CLAY. Sand is fine to coarse grained. Gravel is very abundant, fine to coarse, sub-angular to sub-rounded flint.		
		0.50	D						
		0.80	D						
		1.50	D						
		2.50	D						
					3.00		End of Borehole at 3.00 m		
Remarks: No groundwater encountered. Roots noted to 0.30m bgl.									

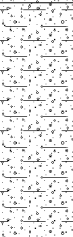
Ground and Water Ltd								Borehole No WS3 Sheet 1 of 1	
Project Name Land W/SW Spire Portsmouth Hospital				Project No. GWPR2493		Co-ords: -		Hole Type WLS	
Location: Bartons Road, Havant, PO9 5NP						Level: -		Scale 1:50	
Client: White Farming Limited						Dates: 08/05/2018		Logged By JH	
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	D		0.25			TOPSOIL: Brown gravelly sand. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint. HEAD DEPOSITS: Brown/orange sandy gravelly CLAY. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint. LONDON CLAY FORMATION: Brown orange grey mottled CLAY.	
		0.50	D		0.60				
		0.80	D						
		1.50	D						
		2.50	D						
					3.00		End of Borehole at 3.00 m		
	</								

Ground and Water Ltd							Borehole No WS4 Sheet 1 of 1		
Project Name Land W/SW Spire Portsmouth Hospital				Project No. GWPR2493		Co-ords: -		Hole Type WLS	
Location: Bartons Road, Havant, PO9 5NP						Level: -		Scale 1:50	
Client: White Farming Limited						Dates: 08/05/2018		Logged By JH	
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	D		0.30			TOPSOIL: Brown gravelly sand. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint.	1
		0.50	D						
		0.80	D						
		1.30	D						
		1.80	D						
		2.30	D						
		2.80	D						
					1.50			HEAD DEPOSITS: Brown/orange sandy gravelly CLAY. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint.	2
									
Remarks: No groundwater encountered. Roots noted to 0.30m bgl.									

Ground and Water Ltd								Borehole No WS5 Sheet 1 of 1	
Project Name Land W/SW Spire Portsmouth Hospital				Project No. GWPR2493		Co-ords: -		Hole Type WLS	
Location: Bartons Road, Havant, PO9 5NP						Level: -		Scale 1:50	
Client: White Farming Limited						Dates: 08/05/2018		Logged By JH	
Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	D		0.30			TOPSOIL: Brown gravelly sand. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint.	
		0.50	D						
		0.80	D						
		1.30	D						
		1.50	D						
		1.80	D						
		2.30	D						
		2.80	D		3.00		HEAD DEPOSITS: Brown/orange sandy gravelly CLAY. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint.		
								LONDON CLAY FORMATION: Brown orange/grey mottled gravelly sandy CLAY. Sand is fine grained. Gravel is rare, fine to coarse, sub-angular to sub-rounded flint.	
End of Borehole at 3.00 m								1	
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Ground and Water Ltd							Trialpit No TP1 Sheet 1 of 1		
Project Name Land W/SW Spire Portsmouth Hospital				Project No. GWPR2493		Co-ords: - Level: -		Date 23/03/2018	
Location: Bartons Road, Havant, PO9 5NP						Dimensions: -		Scale 1:25	
Client: White Farming Limited						Depth 2.30m		Logged By JH	
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description			
Depth (m)	Type	Results							
0.05	D		0.25			TOPSOIL: Brown gravelly sand. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint.			
0.30	D					HEAD DEPOSITS: Light brown sandy clayey GRAVEL. Sand is fine to coarse grained. Gravel is abundant, fine to very coarse, sub-angular to sub-rounded flint.			
0.50	D								
0.80	D								
1.00	D								
1.50	D		2.30		Trialpit Complete at 2.30 m				
2.00	D								
2.30	D								
Remarks: Roots noted to 0.30m bgl.									
Groundwater: Groundwater strike at 2.30m bgl rising to 2.20m bgl after 20 minutes.									

Ground and Water Ltd							Trialpit No TP2 Sheet 1 of 1	
Project Name Land W/SW Spire Portsmouth Hospital			Project No. GWPR2493		Co-ords: - Level: -		Date 23/03/2018	
Location: Bartons Road, Havant, PO9 5NP					Dimensions: -		Scale 1:25	
Client: White Farming Limited					Depth 1.70m		Logged By JH	
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description		
Depth (m)	Type	Results						
0.30	D		0.30			TOPSOIL: Brown gravelly sand. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint.		
0.50	D					HEAD DEPOSITS: Gravelly SAND. Sand is fine to coarse grained. Gravel is abundant, fine to medium, sub-angular to sub-rounded flint.		
0.80	D							
1.00	D							
1.50	D		1.50			HEAD DEPOSITS: Brown/orange sandy gravelly CLAY. Sand is fine to coarse grained. Gravel is abundant, fine to very coarse, sub-angular to sub-rounded flint.		
1.70	D		1.70			Trialpit Complete at 1.70 m		
							1	
							2	
							3	
							4	
Remarks: Roots noted to 0.30m bgl.								
Groundwater: No groundwater encountered.								

Ground and Water Ltd							Trialpit No TP4 Sheet 1 of 1	
Project Name Land W/SW Spire Portsmouth Hospital			Project No. GWPR2493		Co-ords: - Level: -		Date 23/03/2018	
Location: Bartons Road, Havant, PO9 5NP					Dimensions: -		Scale 1:25	
Client: White Farming Limited					Depth 1.70m		Logged By JH	
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description		
Depth (m)	Type	Results						
0.30	D		0.40			TOPSOIL: Dark brown gravelly sand. Sand is fine to coarse grained. Gravel is occasional to abundant, fine to medium, sub-angular to sub-rounded flint.		
0.50	D					HEAD DEPOSITS: Brown sandy GRAVEL. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, sub-angular to sub-rounded flint.		
0.80	D					HEAD DEPOSITS: Light brown/orange sandy clayey GRAVEL. Sand is fine to coarse grained. Gravel is abundant, fine to very coarse, sub-angular to sub-rounded flint. Becoming more clayey at 1.00m bgl.		
1.00	D		1.50			HEAD DEPOSITS: Red/orange gravelly CLAY. Gravel is occasional to abundant, fine to coarse, sub-angular to sub-rounded flint.		
1.50	D							
1.70	D							
						Trialpit Complete at 1.70 m		
1 2 3 4								
Remarks: Roots noted to 0.40m bgl.								
Groundwater: No groundwater encountered.								

Ground and Water Ltd							Trialpit No TP5 Sheet 1 of 1	
Project Name Land W/SW Spire Portsmouth Hospital			Project No. GWPR2493		Co-ords: - Level: -		Date 23/03/2018	
Location: Bartons Road, Havant, PO9 5NP					Dimensions: - Depth 2.80m		Scale 1:25	
Client: White Farming Limited							Logged By JH	
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description		
Depth (m)	Type	Results						
0.30	D		0.20			TOPSOIL: Dark brown gravelly sand. Sand is fine to coarse grained. Gravel is occasional to abundant, fine to medium, sub-angular to sub-rounded flint.		
0.50	D					HEAD DEPOSITS: Brown gravelly CLAY. Gravel is abundant, fine to very coarse, sub-angular to sub-rounded flint.		
0.80	D		0.80			HEAD DEPOSITS: Orange/grey very gravelly CLAY. Gravel is abundant, fine to very coarse, sub-angular to sub-rounded flint.		1
1.00	D							
1.50	D							
2.00	D							
2.50	D		2.30			LONDON CLAY FORMATION: Brown mottled grey slightly gravelly CLAY. Gravel is rare to occasional, fine to coarse, sub-angular to sub-rounded flint.		2
2.80	D		2.80					3
						Trialpit Complete at 2.80 m		
								4
Remarks: Roots noted to 1.00m bgl.								
Groundwater: No groundwater encountered.								

APPENDIX D

EA FLOOD DATA AND PRE- APPLICATION CORRESPONDENCE

Dan Kimani

From: SSD Enquiries <SSDEnquiries@environment-agency.gov.uk>
Sent: 05 February 2018 11:24
To: Dan Kimani
Subject: 180205: SSD74599 Prod 4 Camp Field Bartons Road, PO9 5NB

Dear Mr Kimani

Thank you for your request of 29 January 2018 to use Environment Agency Product 4 data, for the Camp Field, Bartons Road, PO9 5NB.

The Environment Agency's records indicate that the above site is located in Flood Zone 1 (land assessed as having less than 0.1% (1 in 1,000) chance of flooding in any given year from rivers or the sea). Therefore the likelihood of flooding in this area is estimated as 'very low'.

The above site is approximately 100 metres away from Flood Zone 3.

We are therefore unable to provide data from our detailed fluvial or tidal models which is relevant to your site. However, I have attached a surface water flood map for your information.

Please be aware that in February 2016 the Environment Agency updated its guidance on climate change allowances. The standard allowance of adding 20% to peak flows – as per previous guidance in the National Planning Policy Framework, may not be applicable for the purposes of informing development proposals. It is possible that our current modelling has under estimated flood risk when taking climate change into consideration. This does not however have an effect on Flood Zone 2 or 3. For further information please visit:

<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

Further details about the Environment Agency information supplied can be found on the GOV.UK website:

<https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather>

If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of Environment Agency Information for Flood Risk Assessments

<https://www.gov.uk/planning-applications-assessing-flood-risk>

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

I hope this information is useful to you.

Yours sincerely

Matthew Murphy
Customers and Engagement
Environment Agency | Chichester Office, Oving Road, Chichester, West Sussex, PO20 2AG

Matthew.Murphy@environment-agency.gov.uk

Working days: Monday to Friday



Creating a better place
for people and wildlife



From: Dan Kimani [<mailto:dkimani@c-a.uk.com>]
Sent: 29 January 2018 12:33
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Cc: Saman Seekkubadu <Saman.S@c-a.uk.com>
Subject: 17-055 - Camp Field Bartons Road (Nearest postcode: PO9 5NB)

Dear Sirs,

We are in the process of producing a Flood Risk Assessment for a proposed development site at above address, I attach a site location plan your reference.
It would be really appreciated if you could provide us the updated data at your earliest convenience which we need EA **product 4** data and the following data:

1. Flooding from Rivers for all return period events within your possession including modelling data produced with new climate change allowance.
2. Ground Water Flooding and or monitoring details on or near the site;
3. Classification of aquifers and depth to for the site, if any;
4. Bedrock and superficial ground conditions and aquifers;
5. Ground water source protection zones if any;
6. River basin catchment policy for the main river adjacent to the site;
7. Protection zones or standoff distances/easements for the River.

Kind Regards

Dan Kimani
BEng (Hons) Civil and Environmental Engineering
Graduate Design Engineer

Finalist...

**Excellence in Planning for
the Natural Environment**



C & A Consulting Engineers

Landmark House
Station Road
Hook
Hampshire
RG27 9HA
T: 01256 630420

Also at:

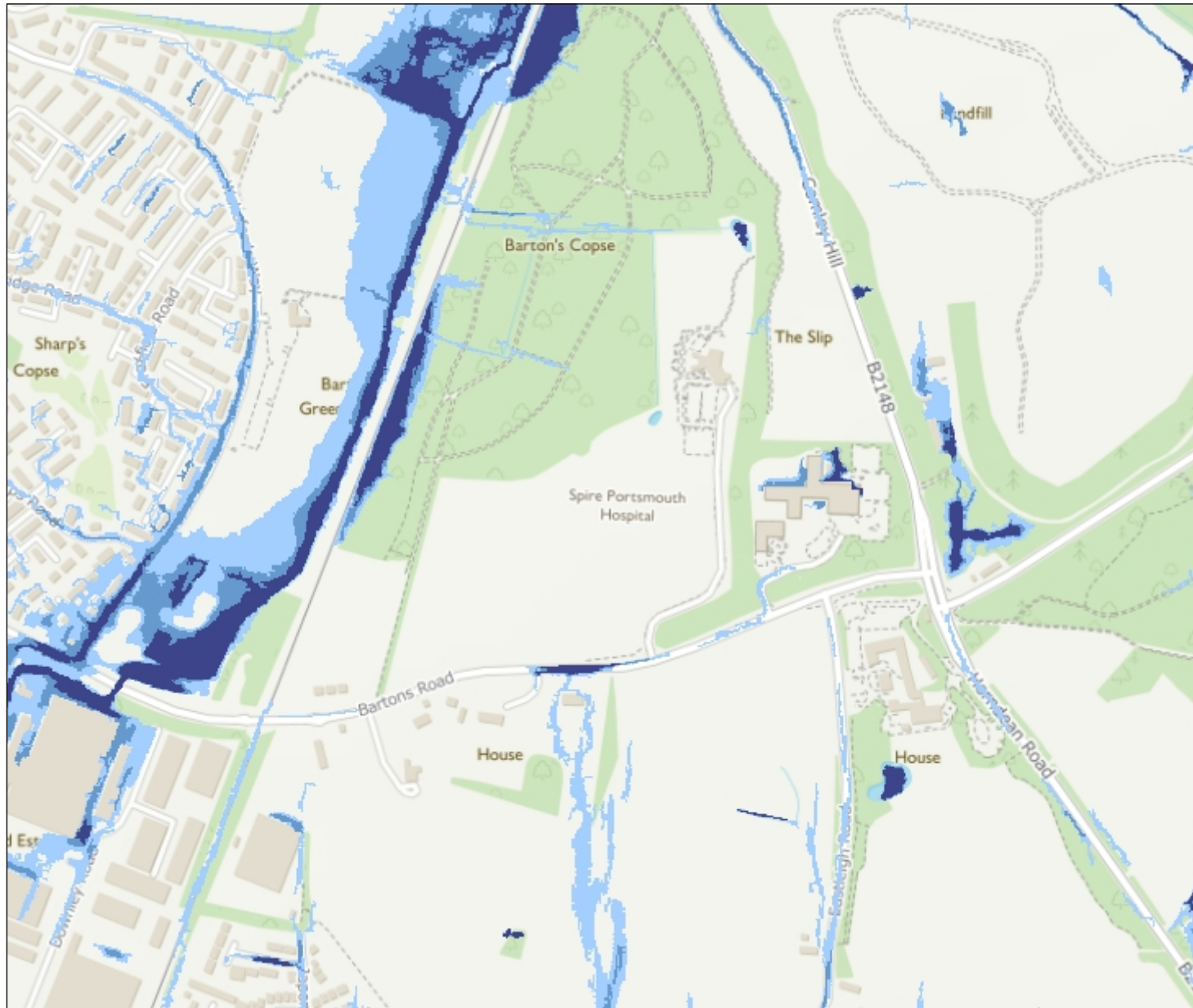
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Registered in England No. 08136641. Registered office: Park House, Park Farm, East Mallings Trust Estate, Bradbourne Lane, Aylesford, Kent, ME20 6SN

Risk of flooding from Surface Water centered on Camp Field Bartons Rd, PO9 5NB - created 02/02/2018



Scale 1:6,828



Likelihood of flooding from Surface Water

- High ($\geq 3.3\%$)
- Medium (3.3% - 1%)
- Low (1% - 0.1%)
- Very Low

Likelihood of flooding from Surface Water

- High: Greater than or equal to 3.3% (1 in 30) chance in any given year
- Medium: Less than 3.3% (1 in 30) but greater than or equal to 1% (1 in 100) chance in any given year
- Low: Less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1,000) chance in any given year
- Very Low: Less than 0.1% (1 in 1,000) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on our website.

APPENDIX E
EXISTING SITE RUNOFF RATES

C & A Consulting Engineers Ltd		Page 1																								
Landmark House Station Road, Hook Hampshire RG27 9HA	Land west of the Havant crematorium Greenfield Runoff Calcs																									
Date 05/11/2018 File PERVIOUS PAVING.SRCX	Designed by SPS Checked by TSH																									
Innovyze Source Control 2018.1.1																										
<u>ICP SUDS Mean Annual Flood</u> Input <table><tr><td>Return Period (years)</td><td>100</td><td>Soil</td><td>0.450</td></tr><tr><td>Area (ha)</td><td>2.430</td><td>Urban</td><td>0.000</td></tr><tr><td>SAAR (mm)</td><td>800</td><td>Region Number</td><td>Region 7</td></tr></table> Results 1/s <table><tr><td>QBAR Rural</td><td>12.5</td></tr><tr><td>QBAR Urban</td><td>12.5</td></tr><tr><td>Q100 years</td><td>39.8</td></tr><tr><td>Q1 year</td><td>10.6</td></tr><tr><td>Q30 years</td><td>28.3</td></tr><tr><td>Q100 years</td><td>39.8</td></tr></table>			Return Period (years)	100	Soil	0.450	Area (ha)	2.430	Urban	0.000	SAAR (mm)	800	Region Number	Region 7	QBAR Rural	12.5	QBAR Urban	12.5	Q100 years	39.8	Q1 year	10.6	Q30 years	28.3	Q100 years	39.8
Return Period (years)	100	Soil	0.450																							
Area (ha)	2.430	Urban	0.000																							
SAAR (mm)	800	Region Number	Region 7																							
QBAR Rural	12.5																									
QBAR Urban	12.5																									
Q100 years	39.8																									
Q1 year	10.6																									
Q30 years	28.3																									
Q100 years	39.8																									
©1982-2018 Innovyze																										

APPENDIX F
OUTLINE DEVELOPMENT SURFACE WATER DRAINAGE DRAWING



NOTES

- Do not scale from this drawing.
- All dimensions are in meters unless stated otherwise.
- Preliminary surface water drainage strategy based on topographical survey provided by others. C&A Consulting cannot accept responsibility for any inaccuracies.
- The surface water drainage strategy depicted on this drawing is preliminary only and indicates design intent.
- Infiltration drainage is proposed only for the proposed pervious paving areas where the lowest infiltration rates achieved during the site investigation (2.81x10-5 m/s) has been utilised (refer to Appendix B of the Flood Risk Assessment).
- The surface water drainage system has been designed to attenuate storm events up to 1 in 100years +40% climate change.
- Stated cover levels & invert levels are for hydraulic assessment and should not be relied upon.
- Outflow from the basin will be routed to the watercourse via a shallow-wide swale. Other erosion control measures would also be considered at the detailed design stage.

LEGEND

- Proposed Development Area
- Future Development Area
- Surface Water Pipe/Manhole
- Attenuation Basin
- Extent of Top/Bottom embankment
- Proposed Attenuation Tank
- Proposed Pervious Paving
- Existing Ditch
- Swale
- Highway Infiltration Trench
- Concept SuDS Pond for future Development Area
- Concept SuDS Swale for future Development Area

A	Revised to add concept SuDS for northern side	DK	SS	SC	Nov 18
Rev	Amendments	Dm	Chk	App	Date

C&A
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Job Title
**Land west of the Havant crematorium
Bartons Road, Havant**

Drawing Title
**Indicative Surface Water
Drainage Strategy**

Client
White Farming Limited

Scale 1:500 @A1	Date Nov 18	Designed SPS
Drawn DK	Checked SPS	Approved GAC
Job No 17-055	Drawing No 17-055-031	Rev A

APPENDIX G
OUTLINE DEVELOPMENT SURFACE WATER DRAINAGE CALCULATIONS

Development Surface Water Drainage Calculations:

This set of calculations contains

- Model Details and Details of all surface water storage features
- Summary of critical results for the return period of;
 - 1 in 30 year
 - 1 in 100 year + 20% climate change
 - 1 in 100 year + 40% climate change
- Summary of critical results for the highway infiltration trench/swale

Micro-Drainage Network Details

STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	19.600	Add Flow / Climate Change (%)	0
Ratio R	0.340	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Network Design Table for Storm

Network Results Table

C & A Consulting Engineers Ltd				Page 1			
Landmark House Station Road, Hook Hampshire RG27 9HA		17-055 Bartons Rd Surface Water Drainage lin100 Yr +40%CC					
Date 10/11/2018 File 1IN100YEAR +40%CC.MDX		Designed by SPS Checked by GAC					
Innovyze		Network 2018.1.1					
Summary of Critical Results by Maximum Level (Rank 1) for Storm							
Simulation Criteria							
Areal Reduction Factor 1.000		Additional Flow - % of Total Flow 0.000					
Hot Start (mins) 0		MADD Factor * 10m³/ha Storage 2.000					
Hot Start Level (mm) 0		Inlet Coeffiecient 0.800					
Manhole Headloss Coeff (Global) 0.500		Flow per Person per Day (l/per/day) 0.000					
Foul Sewage per hectare (l/s) 0.000							
Number of Input Hydrographs 0		Number of Storage Structures 11					
Number of Online Controls 19		Number of Time/Area Diagrams 0					
Number of Offline Controls 1		Number of Real Time Controls 0					
Synthetic Rainfall Details							
Rainfall Model		FSR		Ratio R 0.343			
Region England and Wales		Cv (Summer)		0.750			
M5-60 (mm)		19.700 Cv (Winter)		0.840			
Margin for Flood Risk Warning (mm) 240.0		DVD Status OFF					
Analysis Timestep		Fine Inertia Status OFF					
DTS Status		ON					
Profile(s)		Summer and Winter					
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440							
Return Period(s) (years)		100					
Climate Change (%)		40					
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	S1	15 Winter	100	+40%	100/15 Summer	100/15 Summer	
S1.001	S2	15 Winter	100	+40%	100/15 Summer	100/15 Summer	
S1.002	S3	15 Winter	100	+40%	100/15 Summer		
S2.000	S4	15 Winter	100	+40%	100/15 Summer	100/15 Winter	
S2.001	S5	30 Winter	100	+40%	100/15 Summer		
S1.003	S6	15 Winter	100	+40%	100/15 Summer	100/15 Summer	
S1.004	S7	15 Winter	100	+40%	100/15 Summer		
S1.005	S8	15 Winter	100	+40%	100/15 Summer		
S3.000	S9	15 Winter	100	+40%	100/15 Summer		
S3.001	S10	30 Winter	100	+40%	100/15 Summer		
S1.006	S11	15 Winter	100	+40%	100/15 Summer		
S4.000	S12	240 Winter	100	+40%	100/15 Summer		
S4.001	S13	240 Winter	100	+40%	100/15 Summer		
S1.007	S14	240 Winter	100	+40%	100/15 Summer		100/15 Summer
S5.000	S15	15 Winter	100	+40%	100/15 Summer	100/15 Summer	
S5.001	S16	30 Winter	100	+40%	100/15 Summer		
S1.008	S17	15 Winter	100	+40%			
S1.009	S18	15 Winter	100	+40%	100/15 Summer		
S1.010	S19	15 Winter	100	+40%			
S6.000	S20	60 Winter	100	+40%			
S6.001	S20	120 Winter	100	+40%			
S1.011	S21	360 Winter	100	+40%	100/240 Winter		
S7.000	S22	15 Winter	100	+40%	100/15 Summer		
S7.001	S23	30 Winter	100	+40%	100/15 Summer		
S7.002	S24	120 Winter	100	+40%	100/15 Summer		
S7.003	S25	240 Winter	100	+40%			

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Surface Water Drainage
1in100 Yr +40%CC

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Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	11
Number of Online Controls	19	Number of Time/Area Diagrams	0
Number of Offline Controls	1	Number of Real Time Controls	0

Return Period (years)	Rainfall Model	FSR	Profile Type	Summer
		2	Cv (Summer)	0.750
	Region	England and Wales	Cv (Winter)	0.840
	M5-60 (mm)	19.600	Storm Duration (mins)	30
	Ratio R	0.340		

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Online Controls for Storm

Weir Manhole: S3, DS/PN: S1.002, Volume (m³): 2.2

Discharge Coef 0.544 Width (m) 1.200 Invert Level (m) 37.100

Hydro-Brake® Optimum Manhole: S5, DS/PN: S2.001, Volume (m³): 0.9

Unit Reference	MD-SHE-0062-2000-1400-2000
Design Head (m)	1.400
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	62
Invert Level (m)	37.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	2.0
Flush-Flo™	0.272	1.6
Kick-Flo®	0.553	1.3
Mean Flow over Head Range	-	1.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.4	1.200	1.9	3.000	2.8	7.000	4.2
0.200	1.6	1.400	2.0	3.500	3.0	7.500	4.4
0.300	1.6	1.600	2.1	4.000	3.2	8.000	4.5
0.400	1.6	1.800	2.2	4.500	3.4	8.500	4.6
0.500	1.5	2.000	2.4	5.000	3.6	9.000	4.7
0.600	1.4	2.200	2.5	5.500	3.8	9.500	4.9
0.800	1.6	2.400	2.6	6.000	3.9		
1.000	1.7	2.600	2.7	6.500	4.1		

Hydro-Brake® Optimum Manhole: S10, DS/PN: S3.001, Volume (m³): 1.9

Unit Reference	MD-SHE-0113-5000-0500-5000
Design Head (m)	0.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	113
Invert Level (m)	36.100
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0

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Hydro-Brake® Optimum Manhole: S10, DS/PN: S3.001, Volume (m³): 1.9

Control Points	Head (m)	Flow (l/s)
Flush-Flo™	0.179	5.0
Kick-Flo®	0.372	4.4
Mean Flow over Head Range	-	4.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	7.5	3.000	11.6	7.000	17.4
0.200	5.0	1.400	8.1	3.500	12.5	7.500	18.1
0.300	4.8	1.600	8.6	4.000	13.3	8.000	18.7
0.400	4.5	1.800	9.1	4.500	14.1	8.500	19.2
0.500	5.0	2.000	9.6	5.000	14.8	9.000	19.8
0.600	5.4	2.200	10.0	5.500	15.4	9.500	20.3
0.800	6.2	2.400	10.4	6.000	16.1		
1.000	6.9	2.600	10.8	6.500	16.8		

Non Return Valve Manhole: S13, DS/PN: S4.001, Volume (m³): 2.0

Hydro-Brake® Optimum Manhole: S14, DS/PN: S1.007, Volume (m³): 3.9

Unit Reference	MD-SHE-0112-7000-1800-7000
Design Head (m)	1.800
Design Flow (l/s)	7.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	112
Invert Level (m)	34.805
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	7.0
Flush-Flo™	0.487	6.7
Kick-Flo®	0.996	5.3
Mean Flow over Head Range	-	6.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	0.800	6.3	2.000	7.3	4.000	10.2
0.200	5.9	1.000	5.3	2.200	7.7	4.500	10.8
0.300	6.4	1.200	5.8	2.400	8.0	5.000	11.3
0.400	6.6	1.400	6.2	2.600	8.3	5.500	11.9
0.500	6.7	1.600	6.6	3.000	8.9	6.000	12.4
0.600	6.6	1.800	7.0	3.500	9.6	6.500	12.8

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Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.000	13.3	8.000	14.2	9.000	15.0		
7.500	13.7	8.500	14.6	9.500	15.4		

Unit Reference	MD-SHE-0113-5000-0500-5000
Design Head (m)	0.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	113
Invert Level (m)	35.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	7.5	3.000	11.6	7.000	17.4
0.200	5.0	1.400	8.1	3.500	12.5	7.500	18.1
0.300	4.8	1.600	8.6	4.000	13.3	8.000	18.7
0.400	4.5	1.800	9.1	4.500	14.1	8.500	19.2
0.500	5.0	2.000	9.6	5.000	14.8	9.000	19.8
0.600	5.4	2.200	10.0	5.500	15.4	9.500	20.3
0.800	6.2	2.400	10.4	6.000	16.1		
1.000	6.9	2.600	10.8	6.500	16.8		

Unit Reference	MD-SCL-0281-5700-1400-5700
Design Head (m)	1.400
Design Flow (l/s)	57.0
Flush-Flo™	Calculated
Objective	Minimise blockage risk
Application	Surface
Sump Available	Yes
Diameter (mm)	281
Invert Level (m)	33.700
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

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Hydro-Brake® Optimum Manhole: S18, DS/PN: S1.009, Volume (m³): 6.7

Control Points		Head (m)	Flow (l/s)
Flush-Flo™		0.380	56.8
Kick-Flo®		0.883	45.6
Mean Flow over Head Range		-	46.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.7	1.200	52.8	3.000	82.2	7.000	124.1
0.200	32.0	1.400	56.9	3.500	88.6	7.500	128.4
0.300	52.3	1.600	60.7	4.000	94.5	8.000	132.5
0.400	56.8	1.800	64.2	4.500	100.1	8.500	136.4
0.500	55.9	2.000	67.6	5.000	105.4	9.000	140.3
0.600	54.3	2.200	70.8	5.500	110.4	9.500	144.1
0.800	49.5	2.400	73.8	6.000	115.1		
1.000	48.4	2.600	76.7	6.500	119.7		

Hydro-Brake® Optimum Manhole: S20, DS/PN: S6.001, Volume (m³): 0.7

Unit Reference MD-SFP-0145-1000-0500-1000	
Design Head (m)	0.500
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Future Proof
Application	Surface
Sump Available	Yes
Diameter (mm)	145
Invert Level (m)	32.750
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points		Head (m)	Flow (l/s)
Design Point (Calculated)		0.500	10.0
Flush-Flo™		0.199	10.0
Kick-Flo®		0.375	8.7
Mean Flow over Head Range		-	7.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.5	1.200	15.1	3.000	23.4	7.000	35.2
0.200	10.0	1.400	16.3	3.500	25.2	7.500	36.5
0.300	9.6	1.600	17.3	4.000	26.9	8.000	37.7
0.400	9.0	1.800	18.3	4.500	28.4	8.500	38.8
0.500	10.0	2.000	19.3	5.000	29.9	9.000	40.0
0.600	10.9	2.200	20.2	5.500	31.2	9.500	41.1
0.800	12.5	2.400	21.0	6.000	32.6		
1.000	13.9	2.600	21.8	6.500	33.9		

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Innovyze	Network 2018.1.1																																																																																																							
<u>Hydro-Brake® Optimum Manhole: S23, DS/PN: S7.001, Volume (m³): 1.2</u> Unit Reference MD-SHE-0151-1000-0550-1000 Design Head (m) 0.550 Design Flow (l/s) 10.0 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 151 Invert Level (m) 35.700 Minimum Outlet Pipe Diameter (mm) 225 Suggested Manhole Diameter (mm) 1200 <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>0.550</td><td>10.0</td></tr><tr><td>Flush-Flo™</td><td>0.232</td><td>10.0</td></tr><tr><td>Kick-Flo®</td><td>0.427</td><td>8.9</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>8.1</td></tr></table> The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>5.5</td><td>1.200</td><td>14.4</td><td>3.000</td><td>22.4</td><td>7.000</td><td>33.6</td></tr><tr><td>0.200</td><td>10.0</td><td>1.400</td><td>15.5</td><td>3.500</td><td>24.1</td><td>7.500</td><td>34.8</td></tr><tr><td>0.300</td><td>9.9</td><td>1.600</td><td>16.6</td><td>4.000</td><td>25.7</td><td>8.000</td><td>36.0</td></tr><tr><td>0.400</td><td>9.3</td><td>1.800</td><td>17.5</td><td>4.500</td><td>27.2</td><td>8.500</td><td>37.1</td></tr><tr><td>0.500</td><td>9.6</td><td>2.000</td><td>18.4</td><td>5.000</td><td>28.6</td><td>9.000</td><td>38.2</td></tr><tr><td>0.600</td><td>10.4</td><td>2.200</td><td>19.3</td><td>5.500</td><td>30.0</td><td>9.500</td><td>39.2</td></tr><tr><td>0.800</td><td>11.9</td><td>2.400</td><td>20.1</td><td>6.000</td><td>31.1</td><td></td><td></td></tr><tr><td>1.000</td><td>13.2</td><td>2.600</td><td>20.9</td><td>6.500</td><td>32.4</td><td></td><td></td></tr></table> <u>Hydro-Brake® Optimum Manhole: S24, DS/PN: S7.002, Volume (m³): 1.1</u> Unit Reference MD-SHE-0096-3500-0500-3500 Design Head (m) 0.500 Design Flow (l/s) 3.5 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 96 Invert Level (m) 35.500 Minimum Outlet Pipe Diameter (mm) 150 Suggested Manhole Diameter (mm) 1200 <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>0.500</td><td>3.5</td></tr><tr><td>Flush-Flo™</td><td>0.162</td><td>3.5</td></tr><tr><td>Kick-Flo®</td><td>0.359</td><td>3.0</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>2.9</td></tr></table> The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be			Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	0.550	10.0	Flush-Flo™	0.232	10.0	Kick-Flo®	0.427	8.9	Mean Flow over Head Range	-	8.1	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	5.5	1.200	14.4	3.000	22.4	7.000	33.6	0.200	10.0	1.400	15.5	3.500	24.1	7.500	34.8	0.300	9.9	1.600	16.6	4.000	25.7	8.000	36.0	0.400	9.3	1.800	17.5	4.500	27.2	8.500	37.1	0.500	9.6	2.000	18.4	5.000	28.6	9.000	38.2	0.600	10.4	2.200	19.3	5.500	30.0	9.500	39.2	0.800	11.9	2.400	20.1	6.000	31.1			1.000	13.2	2.600	20.9	6.500	32.4			Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	0.500	3.5	Flush-Flo™	0.162	3.5	Kick-Flo®	0.359	3.0	Mean Flow over Head Range	-	2.9
Control Points	Head (m)	Flow (l/s)																																																																																																						
Design Point (Calculated)	0.550	10.0																																																																																																						
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Mean Flow over Head Range	-	8.1																																																																																																						
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																																																	
0.100	5.5	1.200	14.4	3.000	22.4	7.000	33.6																																																																																																	
0.200	10.0	1.400	15.5	3.500	24.1	7.500	34.8																																																																																																	
0.300	9.9	1.600	16.6	4.000	25.7	8.000	36.0																																																																																																	
0.400	9.3	1.800	17.5	4.500	27.2	8.500	37.1																																																																																																	
0.500	9.6	2.000	18.4	5.000	28.6	9.000	38.2																																																																																																	
0.600	10.4	2.200	19.3	5.500	30.0	9.500	39.2																																																																																																	
0.800	11.9	2.400	20.1	6.000	31.1																																																																																																			
1.000	13.2	2.600	20.9	6.500	32.4																																																																																																			
Control Points	Head (m)	Flow (l/s)																																																																																																						
Design Point (Calculated)	0.500	3.5																																																																																																						
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V-Notch Weir Manhole: S30, DS/PN: S7.006, Volume (m³): 23.3

Angle of V in Degrees 45.000 Discharge Coefficient 0.590 Invert Level (m) 35.500

V-Notch Weir Manhole: S31, DS/PN: S7.007, Volume (m³): 22.1

Angle of V in Degrees 45.000 Discharge Coefficient 0.590 Invert Level (m) 35.200

V-Notch Weir Manhole: S32, DS/PN: S7.008, Volume (m³): 10.2

Angle of V in Degrees 45.000 Discharge Coefficient 0.590 Invert Level (m) 35.000

Orifice Manhole: S33, DS/PN: S7.009, Volume (m³): 21.8

Diameter (m) 0.060 Discharge Coefficient 0.600 Invert Level (m) 33.350

Hydro-Brake® Optimum Manhole: S36, DS/PN: S9.001, Volume (m³): 6.9

Unit Reference	MD-SFP-0145-1000-0500-1000
Design Head (m)	0.500
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Future Proof
Application	Surface
Sump Available	Yes
Diameter (mm)	145
Invert Level (m)	32.850
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	10.0
Flush-Flo™	0.199	10.0
Kick-Flo®	0.375	8.7
Mean Flow over Head Range	-	7.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.5	1.200	15.1	3.000	23.4	7.000	35.2
0.200	10.0	1.400	16.3	3.500	25.2	7.500	36.5
0.300	9.6	1.600	17.3	4.000	26.9	8.000	37.7
0.400	9.0	1.800	18.3	4.500	28.4	8.500	38.8
0.500	10.0	2.000	19.3	5.000	29.9	9.000	40.0
0.600	10.9	2.200	20.2	5.500	31.2	9.500	41.1
0.800	12.5	2.400	21.0	6.000	32.6		
1.000	13.9	2.600	21.8	6.500	33.9		

Hydro-Brake® Optimum Manhole: S39, DS/PN: S1.012, Volume (m³): 5.4

Unit Reference	MD-SCL-0150-1250-1000-1250
Design Head (m)	1.000
Design Flow (l/s)	12.5
Flush-Flo™	Calculated
Objective	Minimise blockage risk
Application	Surface
Sump Available	Yes

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C & A Consulting Engineers Ltd		Page 12
Landmark House Station Road, Hook Hampshire RG27 9HA	17-055 Bartons Rd Surface Water Drainage 1in100 Yr +40%CC	
Date 10/11/2018 File 1IN100YEAR +40%CC.MDX	Designed by SPS Checked by GAC	
Innovyze Network 2018.1.1		

Hydro-Brake® Optimum Manhole: S39, DS/PN: S1.012, Volume (m³): 5.4

Diameter (mm)	150
Invert Level (m)	31.500
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	12.5
Flush-Flo™	0.237	12.4
Kick-Flo®	0.600	9.9
Mean Flow over Head Range	-	10.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.9	1.200	13.6	3.000	21.0	7.000	31.6
0.200	12.4	1.400	14.7	3.500	22.6	7.500	32.6
0.300	12.3	1.600	15.6	4.000	24.1	8.000	33.7
0.400	11.8	1.800	16.5	4.500	25.5	8.500	34.7
0.500	11.2	2.000	17.3	5.000	26.9	9.000	35.6
0.600	9.9	2.200	18.1	5.500	28.1	9.500	36.6
0.800	11.3	2.400	18.9	6.000	29.3		
1.000	12.5	2.600	19.6	6.500	30.5		

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C & A Consulting Engineers Ltd		Page 13																
Landmark House Station Road, Hook Hampshire RG27 9HA	17-055 Bartons Rd Surface Water Drainage lin100 Yr +40%CC																	
Date 10/11/2018	Designed by SPS																	
File 1IN100YEAR +40%CC.MDX	Checked by GAC																	
Innovyze	Network 2018.1.1																	
<u>Offline Controls for Storm</u> <u>Pipe Manhole: S14, DS/PN: S1.007, Loop to PN: S4.001</u> <table><tr><td>Diameter (m)</td><td>0.300</td><td>Roughness k (mm)</td><td>0.600</td></tr><tr><td>Section Type</td><td>Pipe/Conduit</td><td>Entry Loss Coefficient</td><td>0.500</td></tr><tr><td>Slope (1:X)</td><td>20.0</td><td>Coefficient of Contraction</td><td>0.600</td></tr><tr><td>Length (m)</td><td>10.540</td><td>Upstream Invert Level (m)</td><td>35.700</td></tr></table>			Diameter (m)	0.300	Roughness k (mm)	0.600	Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500	Slope (1:X)	20.0	Coefficient of Contraction	0.600	Length (m)	10.540	Upstream Invert Level (m)	35.700
Diameter (m)	0.300	Roughness k (mm)	0.600															
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500															
Slope (1:X)	20.0	Coefficient of Contraction	0.600															
Length (m)	10.540	Upstream Invert Level (m)	35.700															
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C & A Consulting Engineers Ltd		Page 14	
Landmark House Station Road, Hook Hampshire RG27 9HA	17-055 Bartons Rd Surface Water Drainage lin100 Yr +40%CC		
Date 10/11/2018 File 1IN100YEAR +40%CC.MDX	Designed by SPS Checked by GAC		
Innovyze	Network 2018.1.1		

Storage Structures for Storm

Porous Car Park Manhole: S5, DS/PN: S2.001

Infiltration Coefficient Base (m/hr)	0.10116	Width (m)	13.0
Membrane Percolation (mm/hr)	1000	Length (m)	26.0
Max Percolation (l/s)	93.9	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	37.000	Membrane Depth (mm)	0

Porous Car Park Manhole: S10, DS/PN: S3.001

Infiltration Coefficient Base (m/hr)	0.10116	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	33.0
Max Percolation (l/s)	73.3	Slope (1:X)	330.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	36.100	Membrane Depth (mm)	0

Tank or Pond Manhole: S13, DS/PN: S4.001

Invert Level (m) 35.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	240.0	0.800	240.0	0.801	0.0

Porous Car Park Manhole: S16, DS/PN: S5.001

Infiltration Coefficient Base (m/hr)	0.10116	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	35.0
Max Percolation (l/s)	77.8	Slope (1:X)	300.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	35.700	Membrane Depth (mm)	0

Porous Car Park Manhole: S20, DS/PN: S6.001

Infiltration Coefficient Base (m/hr)	0.10116	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	35.0
Max Percolation (l/s)	48.6	Slope (1:X)	40.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	31.750	Membrane Depth (mm)	0

Porous Car Park Manhole: S23, DS/PN: S7.001

Infiltration Coefficient Base (m/hr)	0.10116	Width (m)	17.0
Membrane Percolation (mm/hr)	1000	Length (m)	17.0
Max Percolation (l/s)	80.3	Slope (1:X)	55.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	35.700	Membrane Depth (mm)	0

Porous Car Park Manhole: S24, DS/PN: S7.002

Infiltration Coefficient Base (m/hr)	0.10116	Invert Level (m)	35.500
Membrane Percolation (mm/hr)	1000	Width (m)	16.0
Max Percolation (l/s)	75.6	Length (m)	17.0
Safety Factor	2.0	Slope (1:X)	55.0
Porosity	0.30	Depression Storage (mm)	5

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C & A Consulting Engineers Ltd		Page 15
Landmark House Station Road, Hook Hampshire RG27 9HA	17-055 Bartons Rd Surface Water Drainage lin100 Yr +40%CC	
Date 10/11/2018 File 1IN100YEAR +40%CC.MDX	Designed by SPS Checked by GAC	
Innovyze	Network 2018.1.1	

Porous Car Park Manhole: S24, DS/PN: S7.002

Evaporation (mm/day) 3 Membrane Depth (mm) 0

Porous Car Park Pipe: S8.000

Manning's N	0.075	Width (m)	10.0
Infiltration Coefficient Base (m/hr)	0.10116	Length (m)	13.8
Membrane Percolation (mm/hr)	1000	Slope (1:X)	138.1
Max Percolation (l/s)	38.4	Depression Storage (mm)	5
Safety Factor	2.0	Evaporation (mm/day)	3
Porosity	0.30	Membrane Depth (mm)	300
Invert Level (m)	35.500		

Porous Car Park Pipe: S9.000

Manning's N	0.075	Width (m)	7.7
Infiltration Coefficient Base (m/hr)	0.10116	Length (m)	12.9
Membrane Percolation (mm/hr)	1000	Slope (1:X)	257.9
Max Percolation (l/s)	27.6	Depression Storage (mm)	5
Safety Factor	2.0	Evaporation (mm/day)	3
Porosity	0.30	Membrane Depth (mm)	300
Invert Level (m)	33.300		

Porous Car Park Manhole: S38, DS/PN: S7.012

Infiltration Coefficient Base (m/hr)	0.10116	Width (m)	15.0
Membrane Percolation (mm/hr)	1000	Length (m)	16.0
Max Percolation (l/s)	66.7	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	32.650	Membrane Depth (mm)	0

Tank or Pond Manhole: S39, DS/PN: S1.012

Invert Level (m) 31.500

Depth (m) Area (m²)		Depth (m) Area (m²)	
0.000	215.0	1.000	583.0

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1 in 30 year Results

17-055 Bartons Rd
Surface Water Drainage
1 in 30 Year

Designed by SPS
Checked by GAC

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Network 2018.1.1
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Summary of Critical Results by Maximum Level (Rank 1) for Storm									
PN	US/MH Name	Water	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)			Flow (l/s)		
S1.000	S1	37.683	0.383	0.000	0.69		17.5	SURCHARGED	
S1.001	S2	37.255	0.855	0.000	0.97		32.1	SURCHARGED	
S1.002	S3	37.180	0.855	0.000	0.75		36.0	SURCHARGED	
S2.000	S4	37.433	0.083	0.000	1.18		18.7	SURCHARGED	
S2.001	S5	37.128	-0.022	0.000	0.04		1.5	OK	
S1.003	S6	36.450	0.425	0.000	1.05		45.7	SURCHARGED	
S1.004	S7	36.228	0.403	0.000	0.91		52.6	SURCHARGED	
S1.005	S8	36.143	0.419	0.000	0.64		67.5	SURCHARGED	
S3.000	S9	36.392	-0.033	0.000	0.98		26.0	OK	
S3.001	S10	36.244	-0.081	0.000	0.05		4.9	OK	
S1.006	S11	36.001	0.601	0.000	0.83		86.5	SURCHARGED	
S4.000	S12	35.447	0.147	0.000	-0.06		-0.2	SURCHARGED	
S4.001	S13	35.447	0.197	0.000	0.66		8.5	SURCHARGED	
S1.007	S14	35.844	0.664	0.000	0.07	84.5	6.7	SURCHARGED	
S5.000	S15	35.855	0.130	0.000	0.86		22.9	FLOOD RISK	
S5.001	S16	35.812	0.187	0.000	0.12		5.0	SURCHARGED	
S1.008	S17	34.817	-0.297	0.000	0.10		27.3	OK	
S1.009	S18	33.974	-0.101	0.000	0.17		47.6	OK	
S1.010	S19	33.238	-0.262	0.000	0.20		70.2	OK	
S6.000	S20	33.900	-0.150	0.000	0.00		0.0	OK	
S6.001	S20	32.267	-0.633	0.000	0.00		0.0	OK	
S1.011	S21	32.010	-0.213	0.000	0.38		86.7	OK	
S7.000	S22	36.133	-0.092	0.000	0.64		39.7	OK	
S7.001	S23	35.968	0.043	0.000	0.16		9.9	SURCHARGED	
S7.002	S24	35.739	0.014	0.000	0.11		3.3	SURCHARGED	
S7.003	S25	35.665	-0.135	0.000	0.01		2.3	FLOOD RISK	

1 in 100 year (+20%climate change) Results

								Water	
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
S7.004	S26	240 Winter	100	+20%					35.699
S7.005	S27	360 Winter	100	+20%					35.589
S8.000	S28	120 Winter	100	+20%	100/120 Winter				35.701
S8.001	S29	120 Winter	100	+20%	100/30 Summer				35.703
S7.006	S30	120 Winter	100	+20%					35.604
S7.007	S31	120 Winter	100	+20%					35.271
S7.008	S32	120 Winter	100	+20%					35.058
S7.009	S33	120 Winter	100	+20%					33.386
S7.010	S34	120 Winter	100	+20%					33.304
S9.000	S35	15 Winter	100	+20%					33.469
S9.001	S36	15 Winter	100	+20%	100/15 Summer				33.455
S7.011	S37	15 Winter	100	+20%					32.834
S7.012	S38	15 Winter	100	+20%					32.382
S1.012	S39	360 Winter	100	+20%	100/15 Summer				32.166

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1 in 100 year (+40%climate change) Results

C & A Consulting Engineers Ltd			Page 16				
Landmark House Station Road, Hook Hampshire RG27 9HA		17-055 Bartons Rd Surface Water Drainage lin100 Yr +40%CC					
Date 10/11/2018 File 1IN100YEAR +40%CC.MDX		Designed by SPS Checked by GAC					
Innovyze		Network 2018.1.1					
Summary of Critical Results by Maximum Level (Rank 1) for Storm							
Simulation Criteria							
Areal Reduction Factor 1.000		Additional Flow - % of Total Flow 0.000					
Hot Start (mins) 0		MADD Factor * 10m³/ha Storage 2.000					
Hot Start Level (mm) 0		Inlet Coeffiecient 0.800					
Manhole Headloss Coeff (Global) 0.500		Flow per Person per Day (l/per/day) 0.000					
Foul Sewage per hectare (l/s) 0.000							
Number of Input Hydrographs 0 Number of Storage Structures 11							
Number of Online Controls 19 Number of Time/Area Diagrams 0							
Number of Offline Controls 1 Number of Real Time Controls 0							
Synthetic Rainfall Details							
Rainfall Model		FSR Ratio R 0.343					
Region England and Wales Cv (Summer) 0.750							
M5-60 (mm)		19.700 Cv (Winter) 0.840					
Margin for Flood Risk Warning (mm) 240.0 DVD Status OFF							
Analysis Timestep Fine Inertia Status OFF							
DTS Status ON							
Profile(s) Summer and Winter							
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440							
Return Period(s) (years) 100							
Climate Change (%) 40							
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow
S1.000	S1	15 Winter	100	+40%	100/15 Summer	100/15 Summer	
S1.001	S2	15 Winter	100	+40%	100/15 Summer	100/15 Summer	
S1.002	S3	15 Winter	100	+40%	100/15 Summer		
S2.000	S4	15 Winter	100	+40%	100/15 Summer	100/15 Winter	
S2.001	S5	30 Winter	100	+40%	100/15 Summer		
S1.003	S6	15 Winter	100	+40%	100/15 Summer	100/15 Summer	
S1.004	S7	15 Winter	100	+40%	100/15 Summer		
S1.005	S8	15 Winter	100	+40%	100/15 Summer		
S3.000	S9	15 Winter	100	+40%	100/15 Summer		
S3.001	S10	30 Winter	100	+40%	100/15 Summer		
S1.006	S11	15 Winter	100	+40%	100/15 Summer		
S4.000	S12	240 Winter	100	+40%	100/15 Summer		
S4.001	S13	240 Winter	100	+40%	100/15 Summer		
S1.007	S14	240 Winter	100	+40%	100/15 Summer		100/15 Summer
S5.000	S15	15 Winter	100	+40%	100/15 Summer	100/15 Summer	
S5.001	S16	30 Winter	100	+40%	100/15 Summer		
S1.008	S17	15 Winter	100	+40%			
S1.009	S18	15 Winter	100	+40%	100/15 Summer		
S1.010	S19	15 Winter	100	+40%			
S6.000	S20	60 Winter	100	+40%			
S6.001	S20	120 Winter	100	+40%			
S1.011	S21	360 Winter	100	+40%	100/240 Winter		
S7.000	S22	15 Winter	100	+40%	100/15 Summer		
S7.001	S23	30 Winter	100	+40%	100/15 Summer		
S7.002	S24	120 Winter	100	+40%	100/15 Summer		
S7.003	S25	240 Winter	100	+40%			

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Summary of critical results for the
highway infiltration trench/swale

C & A Consulting Engineers Ltd				Page 1	
Landmark House Station Road, Hook Hampshire RG27 9HA		Land west of the Havant cremat Bartons Road, Havant Access Road - swale			
Date 02/11/2018 File Access road swale.SRCX		Designed by SPS Checked by			
Innovyze		Source Control 2018.1.1			
Summary of Results for 10 year Return Period					
Half Drain Time : 38 minutes.					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	35.776	0.776	1.4	4.4	O K
30 min Summer	35.834	0.834	1.8	5.3	Flood Risk
60 min Summer	35.860	0.860	2.0	5.8	Flood Risk
120 min Summer	35.863	0.863	2.0	5.8	Flood Risk
180 min Summer	35.853	0.853	1.9	5.6	Flood Risk
240 min Summer	35.839	0.839	1.8	5.4	Flood Risk
360 min Summer	35.813	0.813	1.6	4.9	Flood Risk
480 min Summer	35.791	0.791	1.5	4.6	O K
600 min Summer	35.772	0.772	1.3	4.4	O K
720 min Summer	35.756	0.756	1.2	4.2	O K
960 min Summer	35.733	0.733	0.9	3.9	O K
1440 min Summer	35.647	0.647	0.7	3.1	O K
2160 min Summer	35.554	0.554	0.6	2.3	O K
2880 min Summer	35.492	0.492	0.5	1.8	O K
4320 min Summer	35.409	0.409	0.4	1.3	O K
5760 min Summer	35.354	0.354	0.3	0.9	O K
7200 min Summer	35.314	0.314	0.3	0.7	O K
8640 min Summer	35.283	0.283	0.3	0.6	O K
10080 min Summer	35.258	0.258	0.2	0.5	O K
15 min Winter	35.810	0.810	1.6	4.9	Flood Risk
30 min Winter	35.866	0.866	2.0	5.9	Flood Risk
60 min Winter	35.887	0.887	2.2	6.3	Flood Risk
120 min Winter	35.880	0.880	2.2	6.2	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
15 min Summer	56.044	0.0	22		
30 min Summer	37.026	0.0	31		
60 min Summer	23.519	0.0	48		
120 min Summer	14.573	0.0	80		
180 min Summer	10.923	0.0	114		
240 min Summer	8.875	0.0	146		
360 min Summer	6.617	0.0	208		
480 min Summer	5.368	0.0	270		
600 min Summer	4.561	0.0	332		
720 min Summer	3.992	0.0	394		
960 min Summer	3.233	0.0	528		
1440 min Summer	2.400	0.0	782		
2160 min Summer	1.780	0.0	1136		
2880 min Summer	1.440	0.0	1500		
4320 min Summer	1.067	0.0	2212		
5760 min Summer	0.862	0.0	2944		
7200 min Summer	0.730	0.0	3672		
8640 min Summer	0.638	0.0	4408		
10080 min Summer	0.569	0.0	5136		
15 min Winter	56.044	0.0	22		
30 min Winter	37.026	0.0	32		
60 min Winter	23.519	0.0	50		
120 min Winter	14.573	0.0	86		
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C & A Consulting Engineers Ltd				Page 2	
Landmark House Station Road, Hook Hampshire RG27 9HA		Land west of the Havant cremat Bartons Road, Havant Access Road - swale			
Date 02/11/2018		Designed by SPS			
File Access road swale.SRCX		Checked by			
Innovyze		Source Control 2018.1.1			
Summary of Results for 10 year Return Period					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
180 min Winter	35.861	0.861	2.0	5.8	Flood Risk
240 min Winter	35.840	0.840	1.9	5.4	Flood Risk
360 min Winter	35.804	0.804	1.6	4.8	Flood Risk
480 min Winter	35.776	0.776	1.4	4.4	O K
600 min Winter	35.755	0.755	1.2	4.2	O K
720 min Winter	35.741	0.741	1.0	4.0	O K
960 min Winter	35.696	0.696	0.8	3.6	O K
1440 min Winter	35.575	0.575	0.6	2.5	O K
2160 min Winter	35.476	0.476	0.5	1.7	O K
2880 min Winter	35.411	0.411	0.4	1.3	O K
4320 min Winter	35.328	0.328	0.3	0.8	O K
5760 min Winter	35.278	0.278	0.3	0.6	O K
7200 min Winter	35.243	0.243	0.2	0.4	O K
8640 min Winter	35.217	0.217	0.2	0.4	O K
10080 min Winter	35.197	0.197	0.2	0.3	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
180 min Winter	10.923	0.0	118		
240 min Winter	8.875	0.0	150		
360 min Winter	6.617	0.0	214		
480 min Winter	5.368	0.0	276		
600 min Winter	4.561	0.0	338		
720 min Winter	3.992	0.0	408		
960 min Winter	3.233	0.0	562		
1440 min Winter	2.400	0.0	796		
2160 min Winter	1.780	0.0	1152		
2880 min Winter	1.440	0.0	1508		
4320 min Winter	1.067	0.0	2216		
5760 min Winter	0.862	0.0	2944		
7200 min Winter	0.730	0.0	3672		
8640 min Winter	0.638	0.0	4400		
10080 min Winter	0.569	0.0	5120		
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C & A Consulting Engineers Ltd		Page 3																																										
Landmark House Station Road, Hook Hampshire RG27 9HA	Land west of the Havant cremat Bartons Road, Havant Access Road - swale																																											
Date 02/11/2018 File Access road swale.SRCX	Designed by SPS Checked by																																											
Innovyze																																												
Source Control 2018.1.1																																												
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Date 02/11/2018 File Access road swale.SRCX	Designed by SPS Checked by																																													
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