Northaw Riding School

Northaw

Hertfordshire

Flood Risk Assessment

May 2015

Heronslea Group

EAS

Document History

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Contents

1 Introduction

1.1 This Flood Risk Assessment has been prepared in support of a planning application by Heronslea Group at Northaw Riding School, on the east edge of the village of Northaw, Welwyn Hatfield Borough, Hertfordshire. A location plan is contained in **Appendix A**.

1.2 The site is currently used for a riding school and stables covering an area of 1.67ha. The existing site layout is contained in **Appendix B**. It is proposed to develop the site to provide 17 dwellings comprising 4no. 3-bed properties and 13no. 4-bed properties. The proposed site layout is contained in **Appendix C**.

1.3 This FRA has been commissioned to identify any sources of flooding and recommend a suitable drainage strategy for the development site.

1.4 The site is located entirely within Flood Zone 1 on the Environment Agency (EA) Flood Zone maps, so is at a low risk of flooding (less than 1 in 1000 year probability of flooding). As the development site is more than 1 hectare in size, the National Planning Policy Framework (NPPF) requires a site specific flood risk assessment, this FRA has been prepared to consider the drainage options for the site and to demonstrate that any additional surface water runoff from the proposed development can be managed sustainably without increasing flood risk to others.

1.5 This report is based on the following data: Welwyn Hatfield Borough Council Strategic Flood Risk Assessment (SFRA), EA Flood Maps, BGS geological information and OS mapping.

1.6 The contents of each section of this document are as follows:

Section 2 sets out the national, regional and local flood risk policies.

Section 3 described the site conditions.

Section 4 describes the potential sources of flooding.

Section 5 discusses the on-site drainage.

Section 6 contains the conclusions of the study.

2 Policy Framework

National Policy

2.1 The contents of this FRA are based on the advice set out in The National Planning Policy Framework (NPPF) and the Technical Guidance to the NPPF, published March 2012 and the Planning Practice Guidance (PPG), published March 2014.

2.2 The Technical Guidance to the NPPF Table 1 defines each Flood Zone along with appropriate land use and FRA requirements. The flood risk zones are defined as follows:

- Flood Zone 1 – This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river flooding (<0.1%).
- Flood Zone 2 – This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding.
- Flood Zone 3a – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), and for tidal flooding at least a 0.5% annual probability of flooding from tidal sources.
- Flood Zone 3b – This zone comprises land where water has to flow or be stored in times of flood.

2.3 A copy of the Environment Agency's Flood Map is included in **Appendix D.** The mapping shows that the site is located entirely within Flood Zone 1 and therefore deemed to be at low risk of fluvial or tidal flooding.

2.4 The NPPF requires that for a development site located within Flood Zone 1 which is larger than one hectare, a FRA must accompany the planning application which demonstrates that the proposals would not be exposed to an unsatisfactory level of flood risk, and would not result in an increase in the existing level of flood risk to the surrounding area.

2.5 The above national policy guidance has been taken into account within this site specific FRA, including a proposed SuDS drainage strategy to offer a reduction in the level of flood risk within the local area.

Local Policy

2.6 Welwyn Hatfield Borough Council is in the process of completing their Local Development Framework and the Core Strategy, to guide development in the borough until 2031. The draft Local Plan Consultation document was reviewed by the Council's Cabinet Housing and Planning Panel in December 2014 and recommendations were made. Public consultation on the document was between January and March 2015. Together with the strategic policies set out in the Emerging Core strategy, this will form the Local Plan for the borough. As the Local Plan has not been finalised yet, the relevant document which outlines the Council's plans for development within the borough is the 'Emerging Core Strategy (2012)'.

2.7 Emerging Core Strategy Policy CS1: *Delivering Sustainable Development* highlight's the requirement for adaption and mitigation principles to be included in the design and construction of new development. This

includes water efficiency measures and the use of sustainable drainage systems (SuDS).

2.8 Policy CS11: *Protection of Critical Assets* notes the importance of the water environment, stating: "The boroughs floodplains will be protected by avoiding development in Flood Zones 2 and 3 unless it is for a compatible use."

2.9 The Welwyn Hatfield Emerging Core Strategy Sustainability Appraisal Report was produced in September 2012 and outlines the sustainability aims of the borough. This document notes that the borough has relatively few areas within the EA medium and high flood risk zones, but the impact of climate change is likely to exacerbate the frequency and severity of flooding events. The long term objective is therefore to avoid locating new development in flood risk areas and avoid development that will increase flood risk elsewhere. It is also stated that the capacity of the surface water drainage systems of new developments should be capable of accommodating more development; therefore use of sustainable drainage systems is necessary where possible.

2.10 Policies CS1, CS11 and the Sustainability Appraisal Report were considered during the preparation of this FRA, and the flood risk mitigation measures discussed within this report will demonstrate that the proposed extension will be consistent with the core strategy aims for the borough.

Welwyn Hatfield Borough Council Strategic Flood Risk Assessment (SFRA)

2.11 The Welwyn Hatfield Borough Level 1 SFRA was published in May 2009, and provides an overview of the flooding issues within the borough.

2.12 The site is not noted in the Level 1 SFRA to be at risk of flooding from any source. Figure 7 of the SFRA does not show any historic flood incidents near to the site or in the local area. The SFRA does however highlight the use of sustainable drainage (SuDS) for future developments within the borough, due to their benefits of reducing flood risk and pollution while also providing landscape and wildlife benefits.

2.13 The SFRA does not identify groundwater and sewer flooding within the vicinity of the site, nor does it specifically note surface water flooding as being an issue in Northaw.

2.14 The surface water drainage strategy outlined in this FRA is consistent with the aims of the Welwyn Hatfield SFRA.

3 Site Description

3.1 The site is located at Northaw Riding School, Northaw Road West, Northaw, Hertfordshire EN6 4NT. Northaw Road West is immediately north east of the site, beyond which is agricultural and farmland. To the northwest is the village of Northaw. The site is bounded to the south and east by agricultural land and farmland. A location plan is contained in **Appendix A**.

3.2 The site covers 1.67 hectares in area and is currently developed with a number of buildings, stables and paddocks associated with Northaw Riding School. The existing site layout is contained in **Appendix B**.

Proximity to Watercourses

3.3 The Northaw Brook, classed as a 'Main River' on the EA website, is located approximately 300m south of the site. The Hempshill Brook is approximately 500m to the north, and a tributary of the Hempshill Brook passes around 400m to the north.

Site Levels

3.4 Levels taken from online Ordnance Survey data indicate that the site is located at between 95m AOD and 100m AOD. Land appears to fall steeply to the south of the site to 65m AOD within a distance of approximately 250m.

Underlying Geology

3.5 Reference to the British Geological Survey (BGS) website indicates that the development site has bedrock of London Clay formation – Clay, Sand and Silt. Superficial deposits of Sand and Gravel have also been noted.

Sewer Network

3.6 Sewer records, obtained from Thames Water, show there are no surface water or foul sewers located in the immediate vicinity of the site. There is however a foul water sewer serving the properties to the north of Northaw Road West, which is located in their rear gardens and crosses Park Road to the west. Due to the location of this sewer, which crosses private land, it is unlikely that the properties on the proposed development site would be able to connect to them. The Thames Water sewer records are included in **Appendix E**.

4 Potential Sources of Flooding

Fluvial and Tidal Flooding

4.1 With reference to the online Environment Agency Flood Map, the site is located entirely within Flood Zone 1. This indicates a probability of fluvial and tidal flooding of less than 1 in 1000 years (0.1%AEP).

4.2 The Northaw Brook is located approximately 300m to the south, however the floodplain of the brook does not reach the site due to the steep land to the north of the brook.

4.3 The site is remote from the coast and any tidally influenced rivers, therefore both the tidal and fluvial flood risk are considered to be low.

Surface Water Flooding

4.4 Surface water flooding refers to flooding caused when the intensity of rainfall, particularly in urban areas, can create runoff which temporarily overwhelms the capacity of the local drainage systems or does not infiltrate into the ground. The water ponds on the ground and flows towards low-lying land. This source of flood risk is also known as 'pluvial'.

4.5 The EA online surface water flood maps indicate there to be no areas of surface water flood risk on the site. This is likely due to the steeply sloping land to the south, which would encourage any surface water to flow away from the site in the direction of the Northaw Brook. Although these maps are indicative only and not site-specific, they are useful to provide an overview of surface water flooding.

4.6 The site is not specifically mentioned in the Level 1 SFRA as being at risk of surface water flooding, and there is no record of historic surface water flood risk.

4.7 With reference to the points above, the site is considered to be at low risk of surface water flooding.

Sewer Flooding

4.8 Northaw and the site has not been identified within the SFRA as being at risk of sewer flooding, and is not within the postcode district reported by Thames Water to have been affected by sewer flooding in Figure 14 of the SFRA.

4.9 Reference to the Thames Water sewer maps in **Appendix E** shows there to be no surface water or foul sewers in the vicinity of the site. As such, the risk of sewer flooding is considered to be low.

Groundwater

4.10 The EA online mapping indicates the site is not located in an area underlain by an aquifer, based on either bedrock or superficial deposits. It is therefore unlikely that groundwater would be present in high quantities

which would result in a flood risk.

4.11 The EA online groundwater maps do not show the site to be located within a groundwater source protection zone.

4.12 The Level 1 SFRA indicates there has been a limited number of groundwater flooding incidents within the borough. Figure 11 of the SFRA shows locations of groundwater flooding in the borough. This shows there to be no incidents of groundwater flooding in the vicinity of the site.

4.13 Therefore, the flood risk from groundwater is considered to be low.

Artificial Sources

4.14 Although there are several ponds in the area, the closest being approximately 50m to the east, none of these are classed as reservoirs or considered to be large enough to pose a flood risk to the site. Reference to the EA flood map shows the site is not within an area at risk of flooding from reservoirs.

4.15 There are no other artificial sources of flooding in the vicinity of the site, and the flood risk from these sources is considered to be low.

Mitigation Measures

4.16 The site lies within Flood Zone 1 and even with the advent of climate change will be adequately protected from flooding as it is remote from major rivers and the coast. The risk of flooding of the development from all sources is considered to be low and the safety of people from flooding is considered acceptable in all foreseeable flooding events. Therefore no specific flood management measures are considered to be necessary to protect the development against the sources described in Section 4.

4.17 Surface water flooding is a potential source of flood risk within proposed areas of hard-standing. This will be addressed by ensuring that an effective drainage system will be included as part of the development. The drainage strategy set out in Section 5 indicates how the increased rate and volume of surface water runoff is to be managed such that the risk to the development and others is not increased.

5 Development Drainage

Existing Surface Water Drainage

5.1 No public surface water or foul sewers are located in the vicinity of the site. As such it is likely the existing site is drained using a private drainage system that outfalls to soakaways. It also appears that some rainwater may be collected within a tank on site for use at the riding school.

Pre development Runoff

5.2 Greenfield runoff rates calculations have been carried out using the WinDes MicroDrainage software for a site area of 1 hectare. The ICP SUDS Mean Annual Flood method was used. Greenfield runoff rates have been provided for QBAR, 1 year, 30 year and 100 year events:

- QBAR – 4.4 l/s/ha
- 1 in 100 year – 14.0 l/s/ha
- 1 in 30 year – 10.0 l/s/ha
- 1 in 1 year – 3.7 l/s/ha

5.3 The WinDes MicroDrainage calculation sheet, including the input parameters, is included at **Appendix F**.

Post Development Runoff

5.4 The existing and proposed impermeable areas are shown on the drawings enclosed at **Appendix G**. This shows a reduction in impermeable area of 1262m^2, with the existing hardstandings and roof areas covering 4955m^2 and the proposed development impermeable areas covering 3693m^2.

5.5 The WinDes Micro Drainage Quick Storage Estimate method was used to indicate the volume of runoff attenuation required for the proposed development impermeable area of 0.476 hectares, to that of the existing greenfield site (excluding climate change). This was estimated for the 1 in 100 year (plus 30% climate change) event, attenuated to the 1 in 100 year greenfield runoff rates. Table 1 shows the likely storage volumes required if an attenuation and discharge strategy was used to manage runoff at the proposed development.

Return Period Restricted to…	**Greenfield Runoff Rate for 0.369 ha proposed impermeable area**	**Storage volume required for a 1 in 100 year (+30%) storm**
1 in 100 year	5.166 l/s	156 to 209m^3

Table 1: Greenfield Runoff Rates and Attenuation Volumes

5.6 Reference to the Thames Water sewer records (**Appendix E**) suggests that it may not be possible to drain the proposed development to a nearby sewer as there do not appear to be any surface water sewers in the vicinity.

As such, the viability of infiltration methods should be investigated along with other options of attenuation and discharge. The SUDS selection table (Table 2) shows the likely methods that may be viable at the site.

Relevant SuDS Policy

5.7 The NPPF states within Flood Zone 1, *"developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques (SuDS)".*

5.8 SuDS mimic the natural drainage system and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. In addition to reducing flood risk, these features can improve water quality and provide biodiversity and amenity benefits.

5.9 The SuDS management train incorporates a hierarchy of techniques and considers all three SUDS criteria of flood reduction, pollution reduction, and landscape and wildlife benefit. In decreasing order of preference, the preferred means of disposal of surface water runoff is:

- Discharge to ground.
- Discharge to a surface water body.
- Discharge to a surface water sewer.
- Discharge to a combined sewer.

5.10 The philosophy of SuDS is to replicate as closely as possible the natural drainage from a site pre-development and to treat runoff to remove pollutants, resulting in a reduced impact on the receiving watercourses. The benefits of this approach are as follows:

- Reducing runoff rates, thus reducing the flood risk downstream.
- Reducing pollutant concentrations, thus protecting the quality of the receiving water body.
- Groundwater recharge.
- Contributing to the enhanced amenity and aesthetic value of development areas.
- Providing habitats for wildlife in developed areas, and opportunity for biodiversity enhancement.

Site-Specific SuDS

5.11 The various SuDS methods need to be considered in relation to site-specific constraints. Several SuDS options are available to reduce or temporarily hold back the discharge of surface water runoff. Table 2 outlines the constraints and opportunities to each of the SuDS devices in accordance with the hierarchical approach outlined in The SuDS Manual CIRIA C697i. It also indicates what could and could not be incorporated within the development, based upon site-specific criteria.

Device	Description	Constraints / Comments	Appropriate
Living roofs (source control)	Provide soft landscaping at roof level which reduces surface water runoff.	Not appropriate given the proposed residential development as green roofs are hard to maintain on private residences. Also depends on pitch of roof.	No
Infiltration devices & Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	The underlying bedrock of clay may not have potential for infiltration, although superficial deposits of sand and gravel may make this viable. Soakage tests required to confirm.	Possibly
Pervious surfaces (source control)	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers.	The underlying bedrock of clay may not have potential for infiltration, although superficial deposits of sand and gravel may make this viable. Soakage tests required to confirm.	Possibly
Rainwater harvesting (source control)	Reduces the annual average rate of runoff from the Site by reusing water for non-potable uses e.g. toilet flushing, recycling processes.	Potential to use recycled rainwater for toilet flushing.	Yes
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting).	The underlying bedrock of clay may not have potential for infiltration, although superficial deposits of sand and gravel may make this viable. Soakage tests required to confirm. Also depends on site layout but may be possible if there is space within the site boundary to include swales to convey runoff towards a balancing pond.	Possibly
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (which are designed to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	The underlying bedrock of clay may not have potential for infiltration, although superficial deposits of sand and gravel may make this viable. Soakage tests required to confirm.	Possibly
Filter Strips (permeable conveyance)	Wide gently sloping areas of grass or dense vegetation that remove pollutants from run-off from adjacent areas.	Spatial constraints at the site mean there is unlikely to be room to incorporate filter strips.	No
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration.	The underlying bedrock of clay may not have potential for infiltration, although superficial deposits of sand and gravel may make this viable. Soakage tests required to confirm.	Possibly
Wet ponds & constructed wetlands (end of pipe treatment)	Provide water quality treatment & temporary storage above the permanent water level.	Potential to incorporate this into the site layout in areas of public open space but depends on final scheme.	Yes
Attenuation Underground (end of pipe treatment)	Oversized pipes or geo-cellular tanks designed to store water below ground level.	Used only when the SuDS listed above cannot be installed with sufficient volumes to restrict to the required rate. However, there are no sewers in the vicinity to which the site could be drained, therefore this method would require requisition of a sewer and permission to outfall to a nearby watercourse or land drain.	Possibly

Table 2: Site-Specific Sustainable Drainage Techniques

5.12 It can be seen in the SuDS selection table above that both infiltration and attenuation methods may be viable at the site. It is however advisable to take a conservative approach when selecting the SUDS and assume the whole site is drained through attenuation and discharge rather than infiltration.

5.13 It is recommended that infiltration tests are carried out at the detailed design stage to determine the suitable drainage strategy for the site. This will determine the rate at which runoff soaks into the ground and therefore aid in the sizing of infiltration devices. In the instance that infiltration is not viable, a drainage strategy based upon attenuation and discharge has also been considered.

Outline Drainage Scheme

5.14 As discussed previously, a suitable drainage strategy for the site should be selected after soakage tests and ground investigations are carried out on site.

Option 1 – Infiltration

Soakaways

5.15 Assuming the results of the infiltration tests conclude that this is a viable option for draining the site, the most effective means of infiltration would be through soakaways and permeable paving.

5.16 It is recommended that cellular storage with infiltration (soakaways) are installed in the individual properties gardens to drain surface water runoff from the roof areas. It should be noted that the minimum distance between the soakaway and property must be no less than 5m.

5.17 The soakaways should be sized so that they meet all the three scenarios below, and allow for a 30% increase in peak rainfall intensity (climate change):

(a) To meet CIRIA 156: a 1 in 10 year rainfall event, with a safety factor of 5.

(b) To meet Sewers for Adoption 6th Edition: a 1 in 30 year rainfall event as required if the SuDS device is to be offered for adoption by Thames Water; with a safety factor of 1.5.

(c) To meet guidance within the NPPF: a 1 in 100 year rainfall; again with a safety factor of 1.5.

5.18 Following the infiltration test, the dimensions of the soakaways can be determined based on a worst case scenario, to allow good site drainage for all dwellings with both higher and lower infiltration rates.

Permeable Paving

5.19 It is proposed that the surface water runoff from private driveways is drained directly to the underlying soils via permeable paving as part of a SuDS approach. Permeable paving allows surface water to drain down between the blocks and into the pavement sub-base where it can then either be collected or, as in this case, drained away into the underlying soil, imitating the natural drainage behaviour of a site.

5.20 The following typical construction would be expected based on guidance from Marshalls for the popular Priora Paving system:

(d) 80mm paving course
(e) 50mm laying course (generally a 6mm aggregate)
(f) 80mm layer of perforated Asphalt Concrete (DBM)
(g) A calculated depth of course grade aggregate (generally 250mm of a 30mm aggregate)
(h) An additional sub-base / capping layer if required.

5.21 The depth of the course graded aggregate layer will be designed to meet both structural and attenuation requirements; hence, once CBR values have been measured which will inform the structural design at a detailed design stage. The infiltration rate at the base of the proposed road construction should be determined for a number of locations, in order to check that the specified depth of course grade aggregate provides adequate attenuation for the runoff from the road and footways. However given the 30-40% of voids likely to be available within a sub-base of a course grade aggregate, it is likely that there will be ample storage available within the road structure.

5.22 Unlike other attenuation systems, the pollutants carried within the surface water run-off are filtered out as they pass through the course grade aggregate and sub-base. Once trapped they are then broken down over time; figures from the Construction Industry Research and Information Association have shown that 60-95% of suspended solids and 70-90% of hydrocarbons are removed by permeable pavements; as such no further filtration of pollutants will be required.

Infiltration Basin

5.23 An infiltration basin can be located in the area of public open space located to the west of the development. Surface water runoff from the main carriageway, footways and car parking bays can be directed to this area through gullies. If a second form of filtration is required, an oil/petrol interceptor can be installed prior to runoff reaching the infiltration basin. Runoff will be allowed to infiltrate to the underlying ground in this area.

5.24 Infiltration basins can be very effective at pollutant removal via infiltration through the soils, although it is important that they are correctly maintained and may require pre-treatment (e.g. oil interceptors) to aid efficiency. They are simple and cost-effective to construct and it is easy to observe whether they are performing effectively. It is very important that geotechnical investigations are carried out in this area to confirm the location of an infiltration basin will be suitably located here.

5.25 The indicative SUDS layout is shown on the drawing in **Appendix H**.

Option 2 – Attenuation and Discharge

5.26 Should the infiltration testing concludes that the soakage rate is unacceptable to adequately drain the site, a second option should be considered. Reference to the attenuation volumes set out in Table 1 suggests that up to 270m^3 storage is required to manage runoff for a 1 in 100 year (+30%) event, restricted to greenfield runoff rates.

5.27 In the instance that an attenuation option is required, it is recommended that surface water run-off is directed to a balancing pond to the southeast of the site with outfall to the Northaw Brook via a surface water sewer. Northaw

Brook is located approximately 300m to the south of the site at a much lower elevation. It is therefore proposed that a new surface water sewer is requisitioned through third party land to outfall into the Northaw Brook. This should be undertaken under a Section 98 application to Thames Water and would give the developer a right to requisition the new public sewer within third party land. The new public surface water sewer can either be constructed by Thames Water on the developers behalf, or the developer can construct it under Section 30 of the Water Authority Act 1977. The new sewer can be offered for adoption by Thames Water. Consent would be required from the Environment Agency to allow discharge of surface water into the Northaw Brook, which is classed as a 'Main River'.

5.28 Outfall to Northaw Brook from the balancing pond would be restricted to greenfield run-off rates using a flow control device such as complex control or hydrobrake. It should be noted that rainwater harvesting could also be implemented at each property where possible, to re-use rainwater for non-potable uses such as toilet flushing and washing machines. This will reduce the amount of water discharging to the storage system.

Proposed Surface Water Drainage Strategy Summary

5.29 The proposed strategies outlined above would ensure that the rate of surface water runoff from the site would not increase above that of the existing site as a result of the proposed development. This will ensure that flood risk is not increased to others in line with NPPF and local policies, whilst providing the most sustainable SuDS solutions practical within the site constraints.

Adoption and Maintenance

5.30 Hertfordshire County Council (HCC) is the Lead Local Flood Authority in the area, and is likely to become the SUDS Approval Body (SAB) at some time in the near future. As such the SUDS features within the site may be offered to HCC for adoption once they have taken up the role of a SAB.

5.31 Should HCC not take up the role of the SAB at the appropriate time, Thames Water may be prepared to consider the adoption and maintenance of SUDS features in public open space, such as the proposed infiltration basin/balancing pond, alongside the adoption of the new surface water sewer in the instance that a new sewer is requisitioned to serve the development.

5.32 It is the intention of the developer that all of the SUDS features within the development site will be offered for adoption. It is recommended that regular inspections of the surface water drainage systems are carried out by HCC/Thames Water, to ensure that they continue to work effectively.

Residual Flood Risk

5.33 With respect to Sections 4 and 5, it can be confirmed that the site is not at significant risk of flooding either before or after the development. 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 drainage systems.

6 Summary and Conclusions

6.1 The Environment Agency's Flood Map illustrates that the site at Northaw Riding School is located within Flood Zone 1 and therefore deemed to be at a low risk of fluvial and tidal flooding.

6.2 The proposed development will seek to locate 15 residential units on the site of the Northaw Riding School. The existing site is a horse riding school with a number of buildings and rural land associated with riding. The site area is 1.67 hectares.

6.3 The risk of flooding from groundwater, artificial sources and sewers has been assessed to be low, given the underlying geology and the rural location away from artificial sources and sewers.

6.4 The EA surface water flood maps do not indicate a risk of surface water flooding within the site boundary, and the site has not been specifically identified in the SFRA as being at risk of surface water flooding.

6.5 It is advised that infiltration tests are carried out on site at detailed design stage to determine whether infiltration is a viable option for surface water drainage at the proposed development. If infiltration is viable, it is proposed that soakaways are installed at individual properties to take the roof runoff, and that permeable paving is used for private driveways to filter and dispose of runoff in these areas. Runoff from roads, footways and car parking bays could be directed to an infiltration basin via a petrol interceptor. If infiltration methods are not viable, runoff should be directed to a balancing pond located in the area of public open space. A new sewer from the balancing pond would need to be requisitioned across third party land to the south of the site, to outfall to the Northaw Brook at greenfield runoff rates via a flow control device.

6.6 By disposing of surface water in a sustainable manner, either through infiltration or attenuation and discharge, the development proposals will not increase flood risk to others.

6.7 **We believe that the development proposals comply with the guidance provided in the NPPF, and with the recommendations of the Welwyn Hatfield Borough Council, and that no reason exists to object to the proposals in terms of flood risk or drainage.**

Appendices

Appendix: A Location Plan

Appendix: B EA Flood Map

Appendix: C Proposed Site Plans

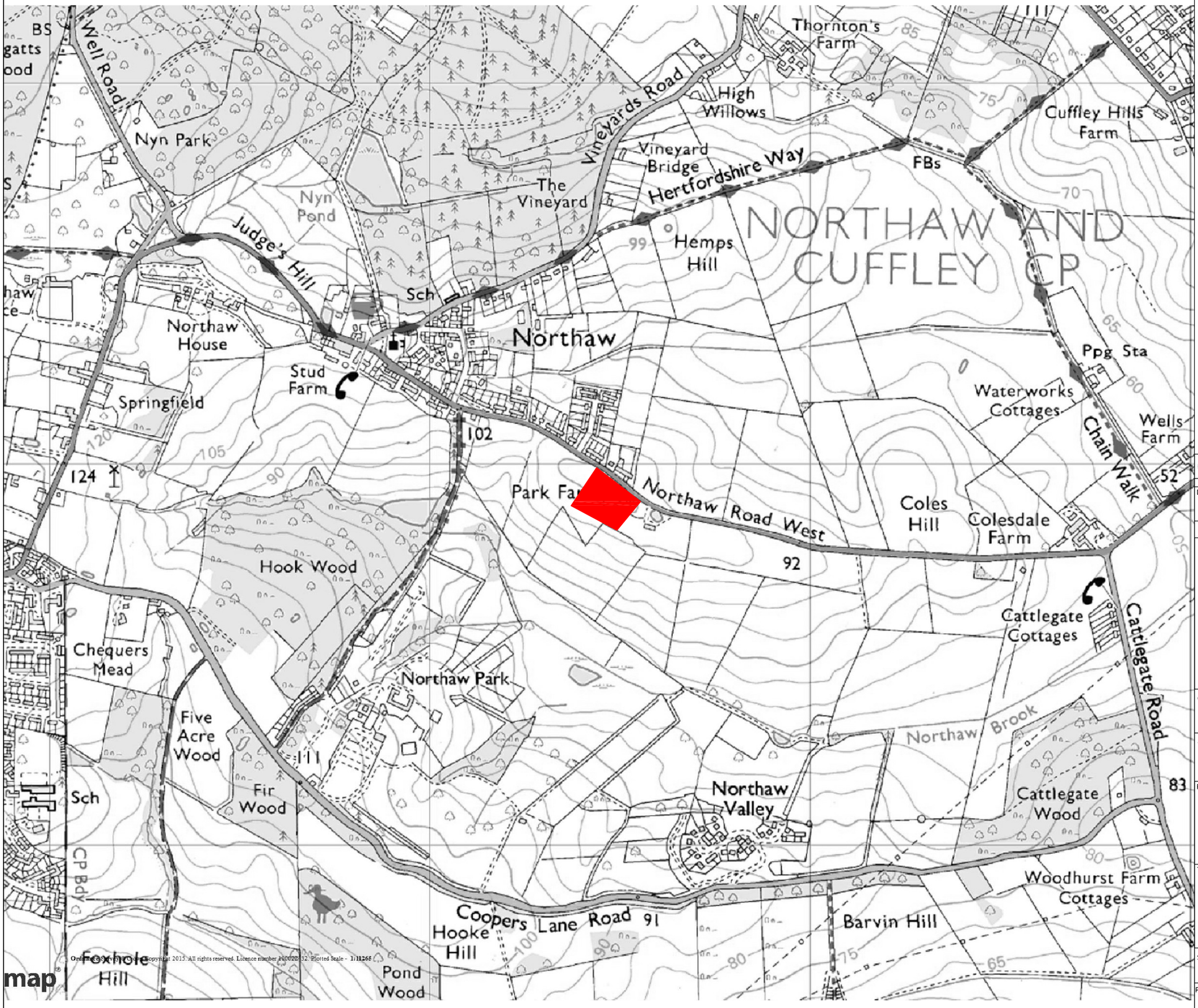
Appendix: D Thames Water Sewer Records

Appendix: E WinDes Greenfield Run-off Rates Calcs and Quick Storage Estimates

Appendix: F Existing and Proposed Impermeable Areas

Appendix: G Surface Water Drainage Layout Option 1

Appendix: A LOCATION PLAN



SITE LOCATION

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS:

EAS

Unit 108, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
Tel: 01920 871777

www.eastp.co.uk

CLIENT:

ARCHITECT:

PROJECT:

NORTHAW RIDING SCHOOL
HERTS

TITLE:

LOATION PLAN

SCALE @ A3:	DESIGN–DRAWN:	DATE:
1:10000	PL	17/04/2015

PROJECT No:	DRAWING No:
730	FIGURE 02

Appendix: B EXISTING SITE LAYOUT

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS:

FOR INFORMATION

EAS

Unit 108, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
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CLIENT:

HERONSLEA

ARCHITECT:

HERONSLEA

PROJECT:

NORTHAW RIDING SCHOOL,
NORTHAW, HERTFORDSHIRE

TITLE:

EXISTING
SITE
LAYOUT

SCALE @ A3:	DESIGN-DRAWN:	DATE:
1:1000	MD	28.05.2015

PROJECT No:	DRAWING No:
730	SK01

Appendix: C PROPOSED SITE LAYOUT

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS:
FOR INFORMATION

EAS

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CLIENT:
HERONSLEA

ARCHITECT:
HERONSLEA

PROJECT:
NORTHAW RIDING SCHOOL,
NORTHAW, HERTFORDSHIRE

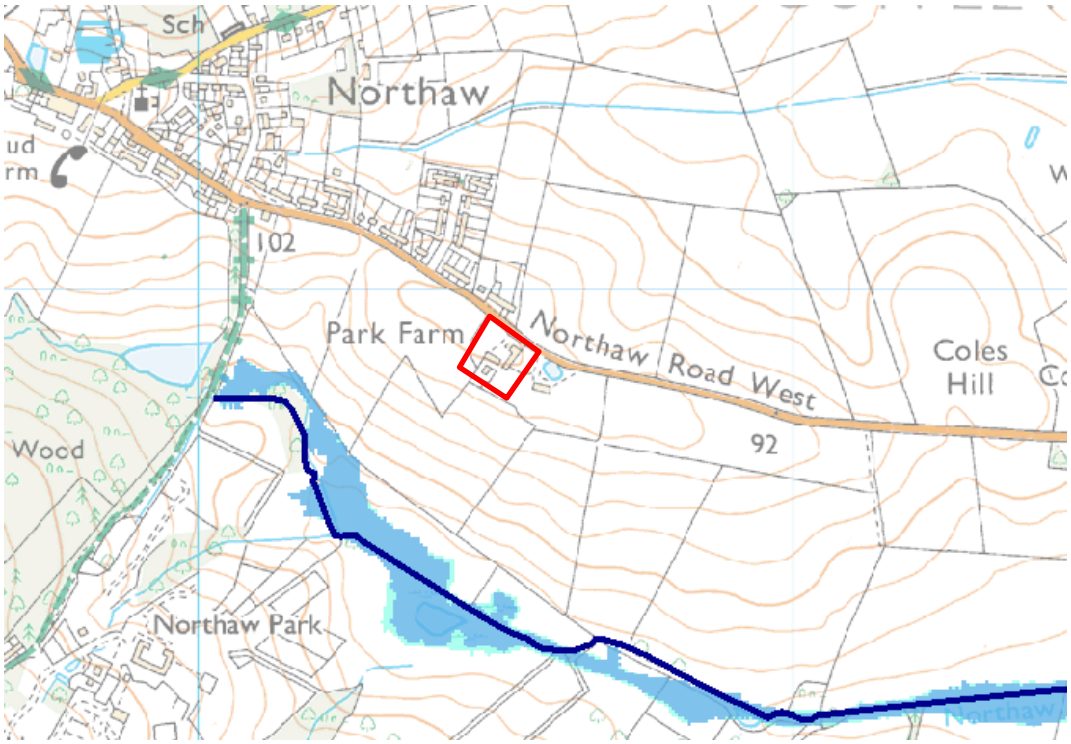
TITLE:
PROPOSED
SITE
LAYOUT

SCALE @ A3:	DESIGN-DRAWN:	DATE:
1:1000	MD	28.05.2015

PROJECT No:	DRAWING No:
730	SK02

Appendix: D EA FLOOD MAPPING

Environment Agency Flood Map – Northaw Riding School, Northaw Road West, Northaw, Hertfordshire EN6 4NT



Key

- Site Location
- Flood Zone 3, High Risk of flooding from rivers or the sea, without the presence of defences
- Flood Zone 2, Medium Risk of flooding from rivers or the sea, without the presence of defences
- Flood Zone 1, Low Risk of flooding from rivers or the sea
- Flood defences
- Areas benefiting from flood defences
- Main River

Source: Environment Agency (www.environment-agency.gov.uk)

Appendix: E

THAMES WATER SEWER RECORDS

Asset Location Search Sewer Map - ALS/ALS Standard/2015_3019438

The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 528459,201894

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

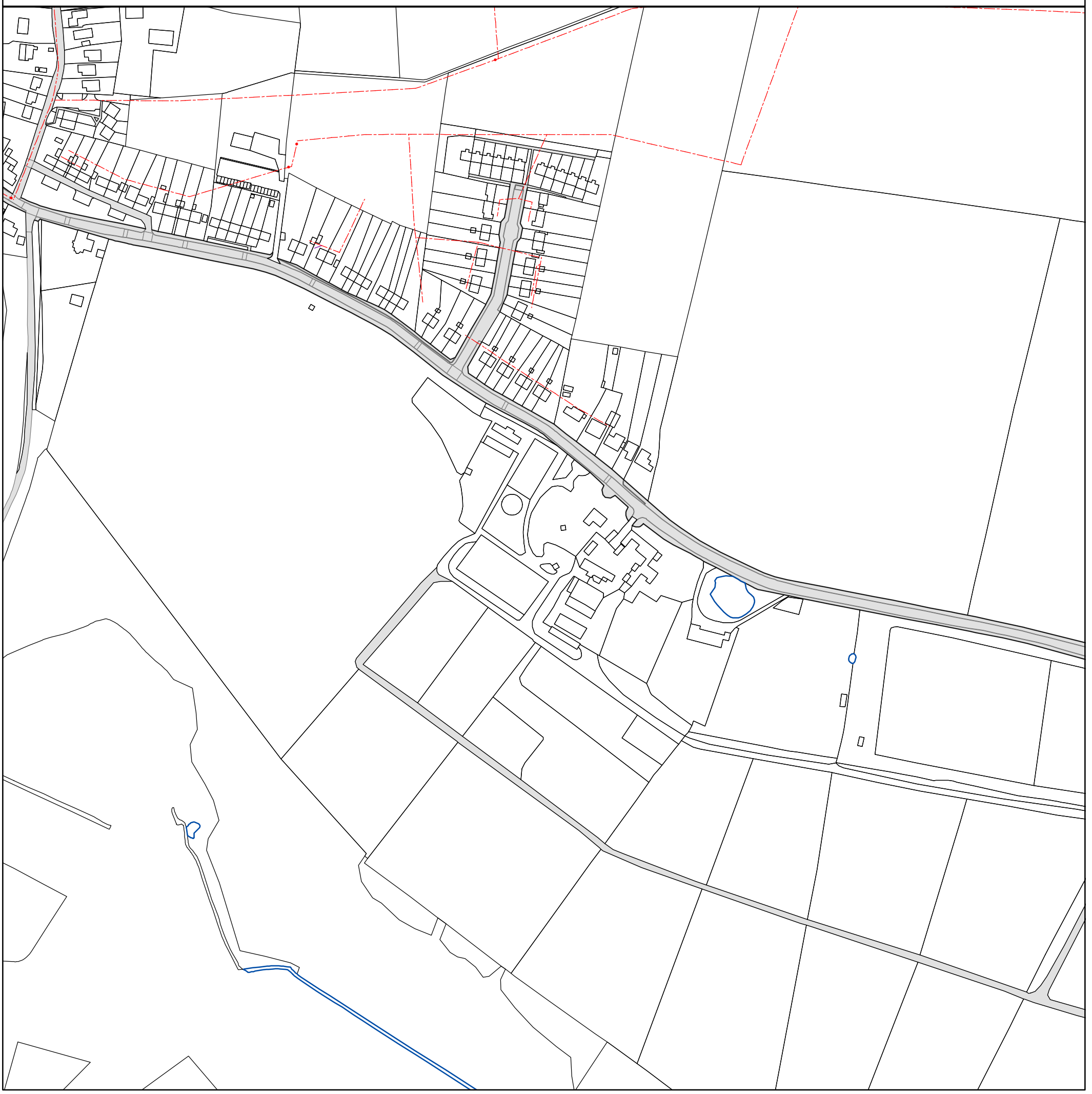
NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
401C	n/a	n/a
4106	83.93	82.78
401B	n/a	n/a
4001	93.34	92.3
401A	n/a	n/a
411A	n/a	n/a
4108	n/a	n/a
591A	n/a	n/a
211A	n/a	n/a
211B	n/a	n/a
311A	n/a	n/a
3103	n/a	n/a
3104	n/a	n/a
3002	97.31	96.25
4002	93.48	92.51
4107	88.48	85.63
401E	n/a	n/a
4102	85.03	83.66
401D	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2015_3019438



Scale:	1:2863
Width:	800m
Printed By:	nmuniyas
Print Date:	17/04/2015
Map Centre:	528458,201894
Grid Reference:	TL2801NW

Comments:

ALS/ALS Standard/2015_3019438

NB: Level quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no Survey information is available.

REFERENCE	COVER LEVEL	INVERT LEVEL
401C		
401B		
4104	83.32	82.45
411A		
4101	80.73	79.51
5201	74.41	72.91
0102	101.99	99.93
0202	96.15	94.9
111A		
1103		
1201	88.76	87.19
2102	89.7	87.71
2201	83.78	82.64
211B		
3102	82.46	81.08
3201	79.58	77.51
3002	97.31	96.25
4107	88.48	85.63
4102	85.03	83.66
4103	84.04	83.08

REFERENCE	COVER LEVEL	INVERT LEVEL
4106	83.93	82.78
4001	93.34	92.3
401A		
4108		
591A		
6101	78.64	77.19
0203	95.6	93.83
0201	97.06	95.52
111C		
1102		
1101	97.32	95.7
2101	86.49	84.59
211A		
311A		
3103		
3104		
4002	93.48	92.51
401E		
4201	77.52	75.06
401D		

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Appendix: F

WinDes Greenfield Run-off Rates Calcs and Quick Storage Estimates

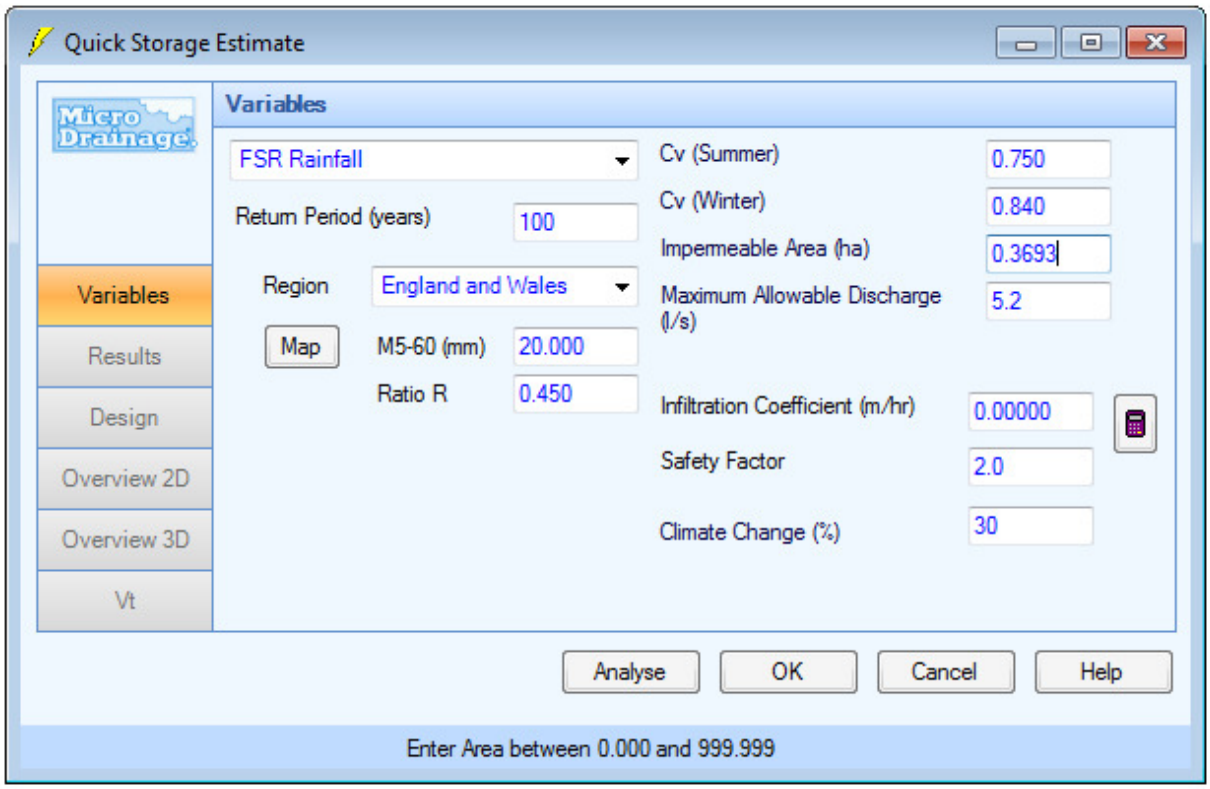
ICP SUDS Mean Annual Flood

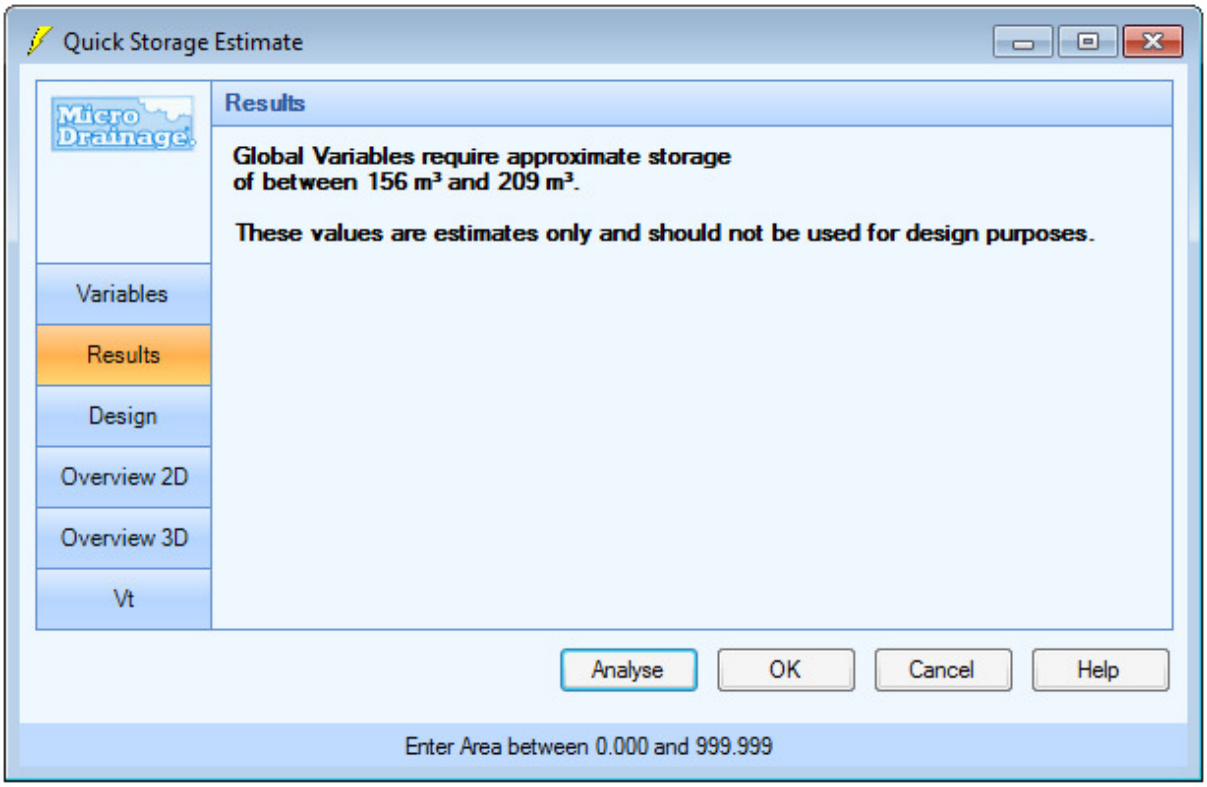
Input

Return Period (years)	100	Soil	0.450
Area (ha)	1.000	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results l/s

QBAR Rural	4.4
QBAR Urban	4.4
Q100 years	14.0
Q1 year	3.7
Q30 years	10.0
Q100 years	14.0


Quick Storage Estimate
Micro Drainage
Variables
FSR Rainfall
Return Period (years) 100
Region England and Wales
Map
M5-60 (mm) 20.000
Ratio R 0.450
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 0.3693
Maximum Allowable Discharge (l/s) 5.2
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 30
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Area between 0.000 and 999.999


Quick Storage Estimate
Micro Drainage
Results
Global Variables require approximate storage of between 156 m³ and 209 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Area between 0.000 and 999.999

Appendix: G

EXISTING AND PROPOSED IMPERMEABLE AREAS

IMPERMEABLE AREA
ROOF AND HARDSTANDINGS
4,955m²

PERMEABLE AREA
GRASS, UNMADE AND LANDSCAPING
11,777m²

TOTAL SITE AREA
16,732m²

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS:
FOR INFORMATION

EAS

Unit 108, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
Tel: 01920 871777

www.eastp.co.uk

CLIENT:
HERONSLEA

ARCHITECT:
HERONSLEA

PROJECT:
NORTHAW RIDING SCHOOL,
NORTHAW, HERTFORDSHIRE

TITLE:
EXISTING
PERMEABLE AND IMPERMEABLE
AREAS

SCALE @ A1:	DESIGN-DRAWN:	DATE:
1:500	MD	27.05.2015

PROJECT No:	DRAWING No:
730	SK05

IMPERMEABLE AREA
ROOF AND HARDSTANDINGS
3,693m²

PERMEABLE AREA
LANDSCAPING, PERMEABLE PAVING
13,039m²

TOTAL SITE AREA
16,732m²

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS:
FOR INFORMATION

EAS

Unit 108, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
Tel: 01920 871777

www.eastp.co.uk

CLIENT:
HERONSLEA

ARCHITECT:
HERONSLEA

PROJECT:
NORTHAW RIDING SCHOOL,
NORTHAW, HERTFORDSHIRE

TITLE:
PROPOSED
PERMEABLE AND IMPERMEABLE
AREAS

SCALE @ A1:	DESIGN–DRAWN:	DATE:
1:500	MD	27.05.2015

PROJECT No:	DRAWING No:
730	SK06–A

Appendix: H

SURFACE WATER DRAINAGE LAYOUT OPTION 1

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS:
FOR INFORMATION

EAS

Unit 108, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
Tel: 01920 871777

www.eastp.co.uk

CLIENT:
HERONSLEA

ARCHITECT:
HERONSLEA

PROJECT:
NORTHAW RIDING SCHOOL,
NORTHAW, HERTFORDSHIRE

TITLE:
PROPOSED
SURFACE WATER DRAINAGE
LAYOUT

SCALE @ A1:	DESIGN-DRAWN:	DATE:
1:500	MD	28.05.2015

PROJECT No:	DRAWING No:
730	SK07-A