

## Executive Summary

**jnp group** was commissioned by Legal & General Homes to undertake a Flood Risk Assessment (FRA) in support of the proposed development at Hogwood Farm, Finchampstead.

This report assesses existing flood risk issues at the site and proposes mitigation where necessary to ensure that there is a low risk of flooding to occupants' post-development with no increased risk of flooding offsite.

The existing site is mainly large open fields separated by hedgerows and fences. Sections of mature woodland, ditches, and various buildings are present across the site. The site is bounded by Reading Road (A327) to the west, Park Lane to the east, south-east and north-east and Sheerlands Road to the north-west.

The site is 109.824ha and the development proposed consists of the construction of 1,500 dwellings, 6.529ha of general industrial and employment land, a 0.296ha neighbourhood centre, 2.506ha for the construction of a primary school, 1.866ha for use as community allotments, 5.970ha of outdoor sports facilities, 21.539ha of open space (parks etc.) and 29.942ha of Suitable Alternative Natural Greenspace (SANG).

A topographic survey of the site shows multiple valleys which fall from the north, west and east towards the central and south-western areas of the site. The lowest area onsite is located in south-west, this area is also the flattest with a more gradual fall which continues south-westwards (towards Long River approximately 880m away). In the far north-western corner of the site the land also falls northwards, this is because the beyond the site, approximately 1.2km to the north is Barkham Brook. The topographic survey shows that on more localised scales the land falls towards the onsite ditch network which drains the site.

The site is identified in Flood Zone 1 on the Environment Agency's (EA) Flood Map for Planning, meaning the site passes the Sequential Test and Exception Test. Whilst the Flood Map suggests that the site is at low risk of fluvial flooding, two unmodelled watercourses were identified within the onsite ditch network by **jnp group** during a site visit carried out in November 2017. The first flows from the north to the south-western corner of the site where it leaves via culvert, this watercourse shall be referred to as Hogwood Ditch. The second flows from the eastern boundary of the site, south-westwards towards the central area of the site. Where it merges with Hogwood Ditch, this watercourse shall be referred to as Robinson Crusoe Ditch. Past the culvert that leaves the site the watercourse continues to flow south-westwards where it feeds into Long River, approximately 880m away from the site. Long River flows into Blackwater River, which merges with the River Hart before flowing into the River Loddon (which is a tributary of the River Thames).

**jnp group** undertook a detailed hydraulic modelling project of the onsite watercourses in December 2017 to February 2018, to identify any risk to the proposed development. The results of the hydraulic modelling revealed that the existing floodplain of the modelled watercourses is mainly located in the lower-lying south-western areas of the site. This part of the site is proposed to be developed into SANG, so the flooding of this area is not considered a risk to the developable area.

A small area along the northern bank of the Robinson Crusoe ditch was shown to be within the existing floodplain for the 1in1000 year and 1in100 year+70% Climate change events. Although these events are in excess of the 1in100+35% required for assessment and mitigation required by the National Planning Policy Framework, top of bank levelling was applied to centralise these very extreme floodplain extents about the ditch and allow the area to be used for SuDS.

Alterations to the existing watercourses in the form of the removal of all non-essential culverts and the extension of an existing culvert at the upstream end of Robinson Crusoe Ditch downstream approximately 50m are proposed to reduce the fluvial flood risk without causing any increased flooding offsite. The model inflows were also modified to include the decreased runoff rates that will be achieved across the development land through the implementation of SuDS. This proposed alteration was modelled to demonstrate no increase in offsite flooding as a result of these changes. In accordance with the EA's standing advice Finished Floor Levels (FFLs) are to be set a minimum of 600mm above the 1in100 year fluvial flood level plus a 35% allowance for climate change.

The EA's Surface Water Flood Risk Map shows the south-western and central areas of the site to be at high risk, with possible depths of flooding over 900mm and flow velocities of over 0.25m/s. There are also areas of flood risk shown on-site and at the site access locations. However, this does not take the extensive ditch network and culverts on-site which are likely to substantially reduce risks. Nevertheless, the remaining risks on-site are mitigated through avoidance of development in the central and southern areas (designated as SANG) and introduction of a formal surface water drainage design using SuDS to control and attenuate onsite surface water runoff. There remains a residual risk from this source at each of the 3 primary access points. This will be mitigated through retention of existing drainage infrastructure (including diversions and extensions where necessary) and the introduction of formal drainage where needed.

The risk of groundwater flooding to the site is low due to the high clay content of the superficial and underlying geology which is likely to impede groundwater from emerging at surface. However, groundwater was found to be present at shallow depths onsite, although, it was described as a trickle or slow ingress. The Site Investigation did not include groundwater monitoring and the intrusive works were carried out during July which is time of year where groundwater levels are low. Therefore, further groundwater monitoring at the site is proposed to be carried out and will be used to inform detailed design and construction works.

The site is inland and not near to any tidally influenced watercourses. Therefore, the site is at low risk of flooding from this and all other sources including canals and reservoirs.

A Drainage Assessment has been prepared separately (JNP report reference C85672-R003). This proposes a strategy for the discharge of surface water run-off in a manner that will not increase the risk of flooding from this source either on or offsite. This includes an ongoing SuDS maintenance plan to manage any residual risk of flooding from proposed sewers and other drainage infrastructure.

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## 1 INTRODUCTION

### 1.1 Terms of Reference

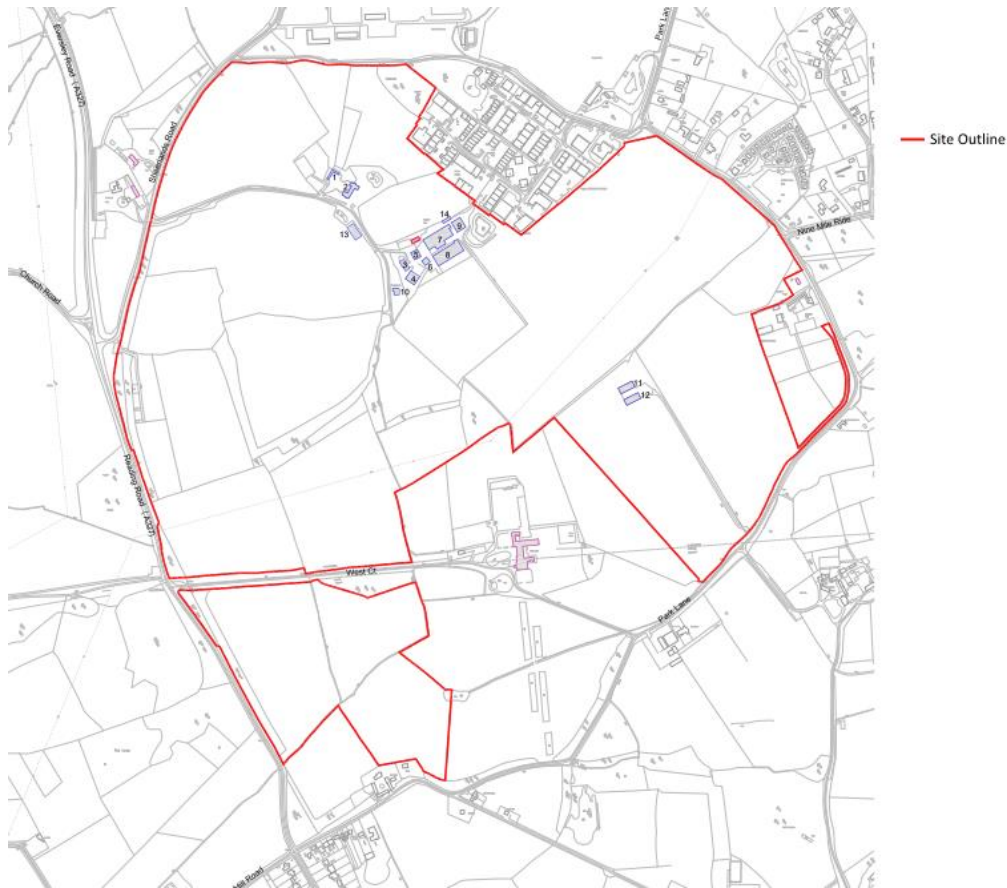
- 1.1.1 **jnp group** was commissioned by Legal & General Homes to undertake a Flood Risk Assessment (FRA) for the proposed development of land at Hogwood Farm, Finchampstead, Wokingham.
- 1.1.2 The development proposals include the construction of 1,500 dwellings, 6.529ha of general industrial and employment land, a 0.296ha neighbourhood centre, 2.506ha for the construction of a primary school, 1.866ha for use as community allotments, 5.970ha of outdoor sports facilities, 21.539ha of open space (parks etc.) and 29.942ha of Suitable Alternative Natural Greenspace (SANG). A copy of the Proposed Development Plan is provided in Appendix A.
- 1.1.3 The National Planning Policy Framework (NPPF) states that when determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where informed by a site-specific flood risk assessment. This assessment is required for:
- “Proposals of 1 hectare or greater in Flood Zone 1, all new development (including minor development and change of use) in Flood Zones 2 and 3 and an area within Flood Zone 1, which has critical drainage problems as notified to the local planning authority by the Environment Agency (EA).”*
- 1.1.4 In accordance with the March 2014 Planning Practice Guidance (PPG), which supports the NPPF, the objectives of this flood risk assessment are to establish:
-  *“Whether a proposed development is likely to be affected by current or future flooding from any source.*
  -  *Whether it will increase flood risk elsewhere.*
  -  *Whether the measures proposed to deal with these effects and risks are appropriate.”*
- 1.1.5 Consultation has been undertaken with the EA to obtain site-specific flood data, as well as Wokingham Borough Council (WBC) who are the acting Lead Local Flood Authority (LLFA).
- 1.1.6 This FRA should be read in conjunction with the Drainage Assessment, which has been prepared separately (**jnp group** report reference C85672-R003).

### 1.2 Site Description

- 1.2.1 The site is approximately 109.824ha in size and is bounded to the west by Reading Road (A327), Park Lane to the east, south-east and north-east and Sheerlands Road to the north-west. Hogwood Lane is present at the sites northern boundary which provides access to pedestrians between Sheerlands Road and Hogwood Industrial Estate. All the sites boundaries are marked by woodland and hedgerows.
- 1.2.2 Adjacent to the sites northern boundary is Hogwood Industrial Estate, located within this area there is a brewery, multiple garages and offices. Just south of Hogwood Industrial Estate there is another smaller industrial estate located onsite. This onsite industrial estate is mainly comprised of garages for car repairs, there is also an irrigation systems supplier based in this area.
- 1.2.3 Cutting through the sites south-western end is West Court, this road connects directly between Reading Road to the west and West Court house, a Grade two listed 17<sup>th</sup> Century former manor house. This road is also known as the Devil's Highway and is part of a former Roman Road network which still exists as

a footpath through the area. As well as cutting through the site, this road is built over onsite ditches, which passes beneath the road via culverts.

- 1.2.4 The site location is shown below in Figure 1. A larger plan of the site is provided in Appendix B.



**Figure 1: Site Location Plan**

- 1.2.5 The land of the site is comprised mainly of large open fields which are used for agricultural purposes and separated by hedgerows and fences. Sections of mature and Ancient Woodland are also present, included in this is the Hogwood Shaw (which is a Wildlife Heritage Site). Various buildings are present across the site, the majority of these buildings are either agricultural (stables etc) or small buildings (garages etc). There are also two houses present; Hogwood Farmhouse and The Lodge. These lie to the north and south of a small private road that leads directly to Hogwood Farm respectively. The development plan for the site specifically excludes the Hogwood Farmhouse which is a Grade II Listed Building, located within the onsite Industrial Estate.

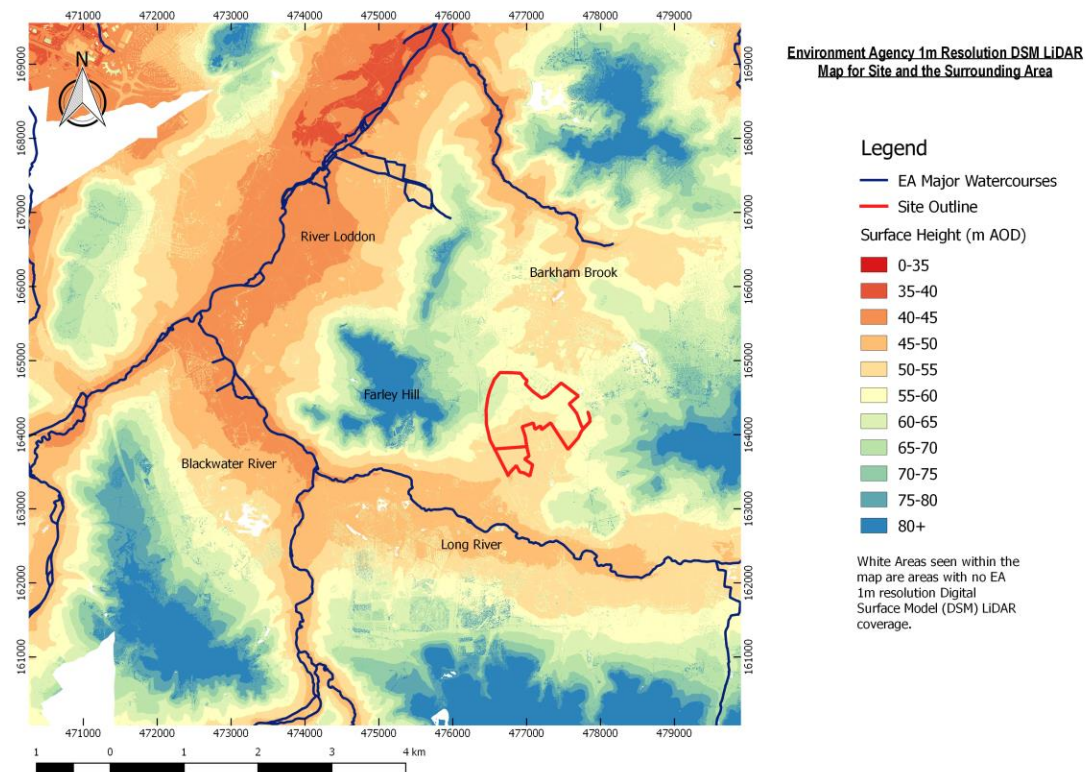
- 1.2.6 The site co-ordinates are:

 N477056  
 E164329  
 RG40 4QY

### 1.3 Topography

#### *Wider Topography*

- 1.3.1 1m resolution Digital Surface Model (DSM) LiDAR data has been provided by the EA; enabling a review of the wider topography around the proposed development site. A map created from this data is provided in Figure 2 below.



**Figure 2: 1m Resolution Environment Agency LiDAR Data for the Wider Area Around the Site**

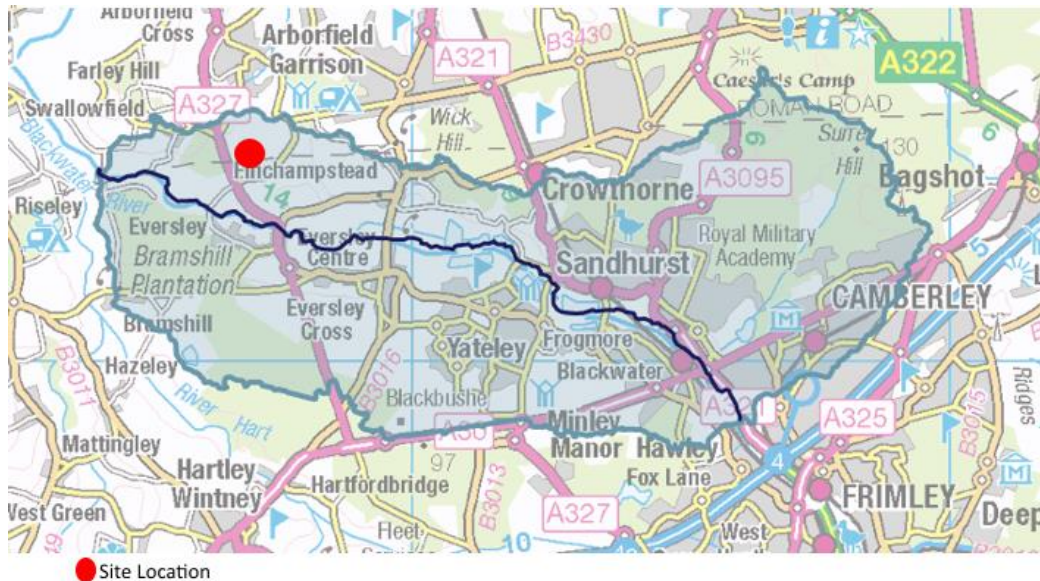
- 1.3.2 The wider area around the site is defined by the River Loddon valley which lies to the west of the site. This in turn is fed by the catchment of Blackwater River to the south-east and Barkham Brook's catchment to the north-west. The majority of the site falls towards the Long River, which flows westwards into the Blackwater River to the south of the site. A tributary of the Long River leaves the site at its south-western corner, forming a valley leading into the wider Long River valley which falls from east to west approximately 0.75km to the south of the site. For ease of reference, this tributary is hereafter called Hogwood Ditch. The wider Barkham Brook valley is located approximately 1.2km north of the site boundary. Part of the sites northern area forms part of the Barkham Brook catchment.
- 1.3.3 Approximately 2km west of the site is Farley Hill, which Figure 2 shows in the LiDAR band of 80+m Above Ordnance Datum (AOD). Approximately 1km east of the site there is another area of high topography in the form of a ridge.
- 1.3.4 The EA's LiDAR information is a useful guide in indicating topographic trends but at a 1m resolution, can be prone to accuracy issues, particularly in areas with extensive waterbodies and trees. Across the site specifically various inaccuracies have been found, especially along the ditch network. This is due to the ditches commonly being surrounded by large hedgerows or woodland. However, the overall general trends for the wider area around the site are considered accurate.

### *Site Topography*

- 1.3.5 This section should be read in conjunction with the site specific topographic survey carried out by Brunel Surveys Ltd in November 2017. A copy of this survey is provided in Appendix C.
- 1.3.6 Generally, the site falls from north to south and from the east and west towards the centre of the site, where Hogwood Ditch flows south, before falling towards the south-western corner. However, the onsite topography is undulating, with hills, secondary ditches and smaller valleys all present.
- 1.3.7 63.53m AOD is the peak height found on the site; located adjacent to where the private access road in the north-west joins Sheerlands Road. However, this was observed as a mound of earth during a site visit in November 2017, giving this area an exaggerated height on the survey. Nevertheless, even without the mound, the land surrounding this point does still fall away from this high point, although the fall is not as pronounced as that suggested by the site specific topographic survey.
- 1.3.8 The land falls from the base of the mound to the east at approximately 1:150. This fall continues to the Hogwood Ditch valley in the centre of the site before rising towards the north-eastern boundary with Hogwood Industrial Estate. The land at the boundary with Hogwood Industrial Estate has a peak height of 58.71m AOD and a fall towards the south-west of 1:70.
- 1.3.9 In addition to the general fall towards the central valley, the land also generally falls from north to south. This fall is approximately 1:194 and continues across the site from the north in general to the south-western boundary with Lea Farm. Past this boundary, the land continues to fall towards Long River.
- 1.3.10 The land also drops from the mound towards the northern site boundary of Hogwood Lane with an average 1:100 fall. Levels at this boundary are a minimum of 59.08m AOD.
- 1.3.11 On the eastern side of the site, the land falls from the boundaries of Shepperlands Farm and Park Lane from north towards the south and west at approximately 1:130 before reaching a valley with a tributary of Hogwood Ditch flowing westwards from the north-east site boundary. This tributary is hereafter referred to as Robinson Crusoe Ditch. On the adjacent side of the valley, land rises at approximately 1:50.
- 1.3.12 As identified in the general site trends, levels fall towards the south and west. However, the site is flatter in the south, with a much gentler fall of approximately 1:318 towards Hogwood Ditch, which leaves via a culvert in the south-western corner and flows away into Long River. Levels in the south-eastern corner are approximately 49.80m AOD.

## **1.4 Hydrology**

- 1.4.1 To aid understanding, this section should be read in conjunction with the plan showing the existing ditches and onsite hydrological features created by **jnp group** (reference: C85672-SK-011) provided in Appendix D.
- 1.4.2 The closest major watercourse to the site according to the EA's Rivers and Major Watercourses Map is Long River which is located approximately 880m away to the south-west. Long River flows into Blackwater River approximately 3.5km south-west of the site before merging with the River Hart and flowing into the River Loddon which flows away to the north-west and eventually into the River Thames. Figure 3 below shows the Blackwater River catchment which the site and Long River to the south form a part of.



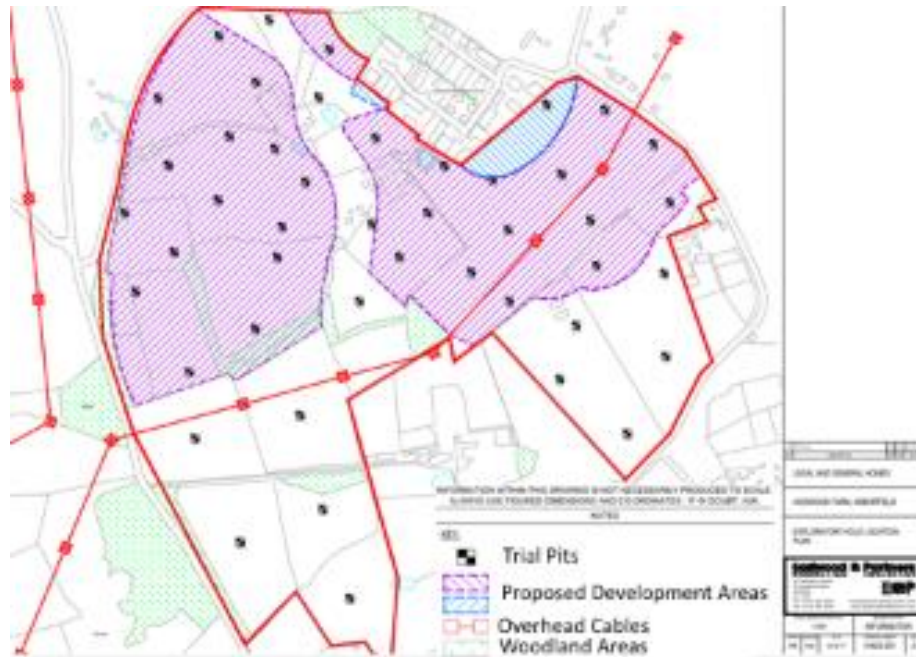
**Figure 3: EA Blackwater River (Hawley to Whitewater confluence at Bramshill) Catchment**

- 1.4.3 While the mapping provided by the EA does show the major watercourses in the area, it does not show the two watercourses present onsite; Hogwood Ditch and its tributary Robinson Crusoe Ditch which joins Hogwood Ditch in the central area of the site. Hogwood Ditch flows across the site towards the south-western corner where it leaves via a culvert. Past the site boundary the watercourse continues to flow towards the south-west where it feeds into Long River.
- 1.4.4 As well as Hogwood Ditch and Robinson Crusoe Ditch, other ditches are present throughout the site. These ditches are key to the sites drainage due to the low permeability of the areas geology, which is outlined in Section 1.5 below. The majority of these ditches form on-site, and it should be noted that a number are not hydrologically effective i.e. they have variable falls, or they have no outfall. The ones that do have outfalls all drain into Hogwood Ditch or Robinson Crusoe Ditch.
- 1.4.5 Ditches have also been identified running along the sites boundary parallel to the roads adjacent to the site. The most prominent of which is the ditch which runs along the sites eastern boundary with Park Lane (hereafter referred to as Park Lane Ditch). These ditches formally drain the roads and convey offsite flows to either the onsite watercourses or away from the site.
- 1.4.6 In addition to the onsite ditch network, a number of ponds are also present on site, these are all hydraulically linked by the local ditch network into either Hogwood Ditch or Robinson Crusoe Ditch. In the north-eastern area of the site there is a large pond which attenuates run-off from the Hogwood Industrial Estate via a surface water sewer (shown on the Asset Location Plan for the site). The controlled outflow to this pond drains directly into Hogwood Ditch.

## 1.5 Existing Geology and Ground Conditions

- 1.5.1 British Geological Survey (BGS) 1:50,000 map shows that the bedrock geology of the site is comprised of London Clay, there is no record of the areas superficial geology on the BGS map. BGS borehole data in the area of Hogwood Industrial Estate shows a layer of top soils that ranges between 0.15 to 0.3 meters in thickness. The BGS boreholes show that this layer is underlain by the London Clay (bedrock layer).

- 1.5.2 A Site Investigation was carried out by Eastwood & Partners Consulting Engineers between 25-27th July 2017 (report reference 41623-002). During the Ground Investigation 45 trial pits were dug across the site, to depths of between 1.2 to 3.2m below ground level (m bgl). The location of each trial pit is displayed on Figure 4 below.



**Figure 4: Trial Pit locations**

- 1.5.3 Figure 4 above shows, at least one trial pit was dug in every field across the site.
- 1.5.4 A summary of the findings from the Site Investigation is provided below:
-  Topsoil was found at thicknesses of between 0.2 to 0.4m. This layer was mainly composed of silty clay and occasional pockets of gravel with flints.
  -  At the eastern side of the site Bagshot formation was found between the topsoil and London Clay layers. This formation was found between 0.3 to 0.5m bgl. This layer was described as being orange/brown in colour, medium to fine in grain size and medium density. Varying amounts of medium to coarse grained gravel and silt were also found within the Bagshot formation.
  -  The site is underlain by London Clay at between 0.25 to 0.6m bgl. The depth of the London Clay was not proven during the Site Investigation. This layer was described as orange, brown and grey/blue in colour. The clay is commonly described in the logs as stiff with varying amounts of sand and gravel present across the site.
- 1.5.5 Due to the impermeable clay present across the site, groundwater was rarely encountered during the Site Investigation. Only 13% of the trial pits encountered any groundwater, it was recorded as ingress and described as a slow trickle or seepage at depths between 1.2 and 2.4m bgl. No groundwater monitoring was carried out and the Site Investigation intrusive works were carried out in July which is a dry period where ground water levels and concentrations are less.
- 1.5.6 The EA's aquifer classification system designates London Clay as an unproductive strata, meaning that it has low permeability and little effect on the areas water supply. However, the eastern end of the site has deposits of Bagshot Formation which the EA classifies as a Secondary A aquifer. This means that

the aquifer is not highly permeable or has a high level of storage potential and is only capable of supporting water supplies at a localized scale.

- 1.5.7 The site is not within a groundwater Source Protection Zone as defined by the EA.

## 2 FLOOD RISK ASSESSMENT (FRA)

### 2.1 Flood Risk Guidance

2.1.1 The following resources have been reviewed to assist with the preparation of the FRA and assess the existing flood risk at the site:

-  **Strategic Flood Risk Assessment (SFRA):** A review of the SFRA has been carried out to establish the potential sources of flooding in the area. The SFRA was prepared for Wokingham Borough Council (WBC) in February 2012.
-  **S19 Flood Investigation:** A flood investigation of the winter 2013/2014 flood event which affected large areas of Wokingham Borough was carried out by Parsons Brinckerhoff in January 2016. This report was prepared for and published by WBC.
-  **Local Flood Risk Management Strategy (LFRMS):** A review of the LFRMS has been carried out to further establish the potential sources of flooding in the area. The LFRMS was prepared for WBC in April 2015.
-  **Preliminary Flood Risk Assessment (PFRA):** The PFRA was produced in June 2011 for WBC by Halcrow Group Limited (Doc No. 4 Rev:0). The PFRA includes a high-level overview of the risk of flooding from all sources.

### 2.2 National Planning Policy

2.2.1 The PPG, which supports NPPF, defines three Flood Zones in relation to river flooding. These are defined as:

-  Flood Zone 1 (Low Probability): This zone comprises land assessed as having less than a 1in1000 annual probability of river flooding;
-  Flood Zone 2 (Medium Probability): This zone comprises land assessed as having between a 1in100 and 1in1000 annual probability of river flooding; and
-  Flood Zone 3 (High Probability): This zone comprises land assessed as having greater than a 1in100 annual probability of river flooding.

2.2.2 The EA's Flood Map for Planning shows that the site is located in Flood Zone 1.

### 2.3 Climate Change

2.3.1 In accordance with the PPG, a site-specific flood risk assessment must consider the following question:

*"How is flood risk at the site likely to be affected by climate change?"*

2.3.2 The EA in February 2016 provided guidance on the predicted impacts of climate change on peak river flow and rainfall intensity over the next 100 years. The site is located in the Thames River Basin District, where peak river flow is predicted to increase by 35-70% by 2115. Peak rainfall intensity is predicted to increase by up to 40% by 2115.

2.3.3 Residential development has an expected minimum lifetime of 100 years, so to ensure that the development is safe from the effects of flood risk through this lifetime, climate change must be

considered. The below assessment takes account of the forecasted effects of climate change on all possible sources of flood risk (fluvial, tidal and surface water drainage).

## **2.4 Sequential Test and Exception Test**

### **2.4.1 In accordance with the NPPF:**

*“The aim of the sequential Test is to steer new developments to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding.”*

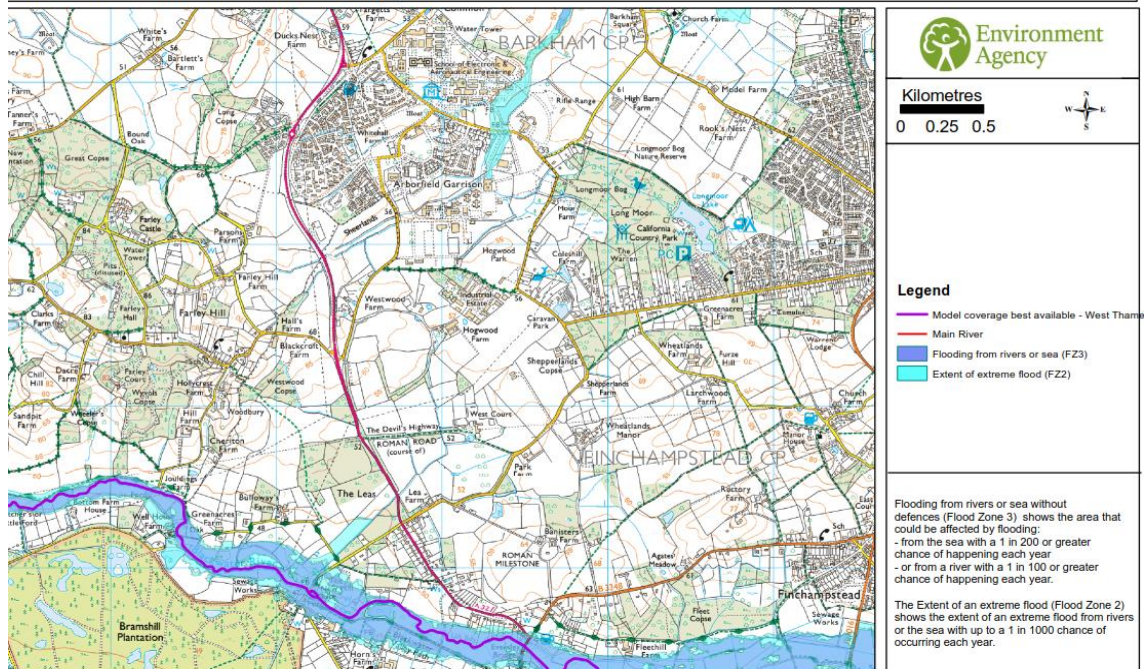
### **2.4.2 Where areas of lower risk are not available, the Exception Test, as set out in paragraph 102 of the NPPF can be applied, to ensure flood risk management for people and property meets the required level of standard.**

### **2.4.3 As the site is located in its entirety in Flood Zone 1, it passes the Sequential Test and Exception Test.**

## **2.5 Flood Risk from Rivers (Fluvial)**

### **2.5.1 The proposed development is located entirely in the EA's Flood Zone 1. This indicates that the area has a low risk of flooding from fluvial sources with an annual probability of 0.1% (1in1000 year). An extract of the EA's Flood Map for Planning highlighting the sites location relative to the Flood Zones is provided in Figure 5 below.**

**Flood Map for Planning centred on Hogwoods Farm, Wokingham**  
**Created 20/11/2017 - REF: THM\_65726**



**Figure 5: Environment Agency Flood Map for Planning**

- 2.5.2 The Flood Map for Planning is based on a combination of hydraulic flood modelling and historical flood records. However, in many parts of the country, including the proposed development site, a number of watercourses have not been modelled or have not been modelled in sufficient detail to confirm the risk to a site. Onsite watercourses convey flows from the local catchment down and away to the south-west into Long River approximately 880m from the site boundary. However, the risk of fluvial flooding from these watercourses is unknown. The lack of recorded historical events does not confirm whether or not flooding has happened, but rather whether or not it has been reported.
- 2.5.3 The EA has confirmed that they do not have any detailed flood modelling for the onsite watercourses of Hogwood Ditch and Robinson Crusoe Ditch. Therefore, the risk of fluvial flooding from the onsite watercourses is unknown.
- 2.5.4 **jnp group** has carried out a detailed hydraulic modelling study of the onsite watercourses. The modelling process is detailed in full within **jnp group** report C85672-R002 provided in Appendix E.
- 2.5.5 The modelling approach follows the best practice guidance contained within the EA's 2009 'Requirements for completing computer river modelling for Flood Risk Assessments – Guidance for developers' document.
- 2.5.6 The detailed hydraulic modelling has shown that large areas of the central and south-west of the site are within the onsite watercourses floodplain. However, these areas are to remain undeveloped i.e. the proposed SANG meaning they do not pose a risk to the development itself.
- 2.5.7 Whilst the majority of the development is outside of the fluvial floodplain, there are small areas of the floodplain within the proposed eastern and central parcels of development, as shown on C85672-SK-021A in Appendix F. In these areas, maximum flood depths are shown to be no greater than 225mm in

all storms up to and including the most extreme modelled event (1in1000year event). Suitable mitigation measures are detailed in Section 3 to demonstrate that flood risk is managed for all development users.

## **2.6 Coastal and Tidal Flood Risk**

- 2.6.1 The site is located inland and is not near any tidally influenced watercourses; therefore, there is a low risk of flooding from this source.

## **2.7 Groundwater Flood Risk**

- 2.7.1 Groundwater flooding occurs when the water table rises and emerges onto the surface. This is most likely to occur in low-lying, partially permeable/permeable areas underlain by a permeable strata (aquifers).
- 2.7.2 The Site Investigation identified that the site is primarily underlain by largely impermeable London Clay, with deposits of Bagshot formation in the eastern area. The Site Investigation encountered groundwater which was described as slow seepage or trickling water in the eastern and southern areas of the site. The groundwater was found at depths of 1.2 to 2.4m bgl during the intrusive works which were carried out in July 2017. The trial pit logs state that the groundwater ingress source was commonly sandy sediment which was situated above the London Clay layer.
- 2.7.3 During a site visit carried out in November 2017 by **jnp group**, it was noted that the surface layer of ground was saturated due to recent rainfall, however no groundwater flooding was observed, and it was also noted that the ground was mainly clay across the site.
- 2.7.4 Both the 2012 SFRA and April 2015 LFMS state that historical incidents of groundwater flooding are sparse. The 2012 SFRA historic flood map shows there are no records of groundwater flooding at or near the site.
- 2.7.5 In summary, groundwater related flooding poses a low risk to the site post-development, due to the impermeable nature of the geology and that groundwater was rarely encountered during the Site Investigation. The south-western area of the site is more susceptible to groundwater flooding due to it being the lowest area topographically. This area is proposed to be developed into SANG and therefore there is no risk to the development if this area experienced groundwater flooding.
- 2.7.6 Groundwater flooding may pose a risk to the site during the construction phase of works. Where the slow ingress and trickling water could lead to ground instabilities. Therefore, mitigation methods to reduce the risk of groundwater to the construction works are discussed in Section 3.

## **2.8 Surface Water Flood Risk (Overland Flows)**

- 2.8.1 Surface water flooding occurs when rainwater does not drain away through the normal drainage system or infiltrate into the ground, but instead lies on or flows over the ground.
- 2.8.2 The EA produced a Risk of Flooding from Surface Water Map in December 2013. The maps were produced using 'direct rainfall' modelling. Although they take into account local drainage capacity, non-surface water influences such as rivers, seas or groundwater are not considered. The map is based on LiDAR topographic data which is not suitable for site specific assessment and therefore, where available,

site specific topographic survey data should be used to provide a more accurate understanding of potential flow paths.

- 2.8.3 The EA surface water flood risk map shows the entire country within four different risk categories, defined below in Table 1.

Table 1: EA Surface Water Flood Risk Categories

| Risk Category | Definition                                                                         |
|---------------|------------------------------------------------------------------------------------|
| High          | Each year, there is a chance of flooding of greater than 1in30 (3.3%)              |
| Medium        | Each year, there is a chance of flooding of between 1in30 (3.3%) and 1in100 (1%)   |
| Low           | Each year, there is a chance of flooding of between 1in100 (1%) and 1in1000 (0.1%) |
| Very Low      | Each year, there is a chance of flooding of less than 1in1000 (0.1%)               |

- 2.8.4 Surface water flooding poses varying degrees of risk to the site, according to the EA surface water flood risk map. An extract of which is provided in Figure 6 below.

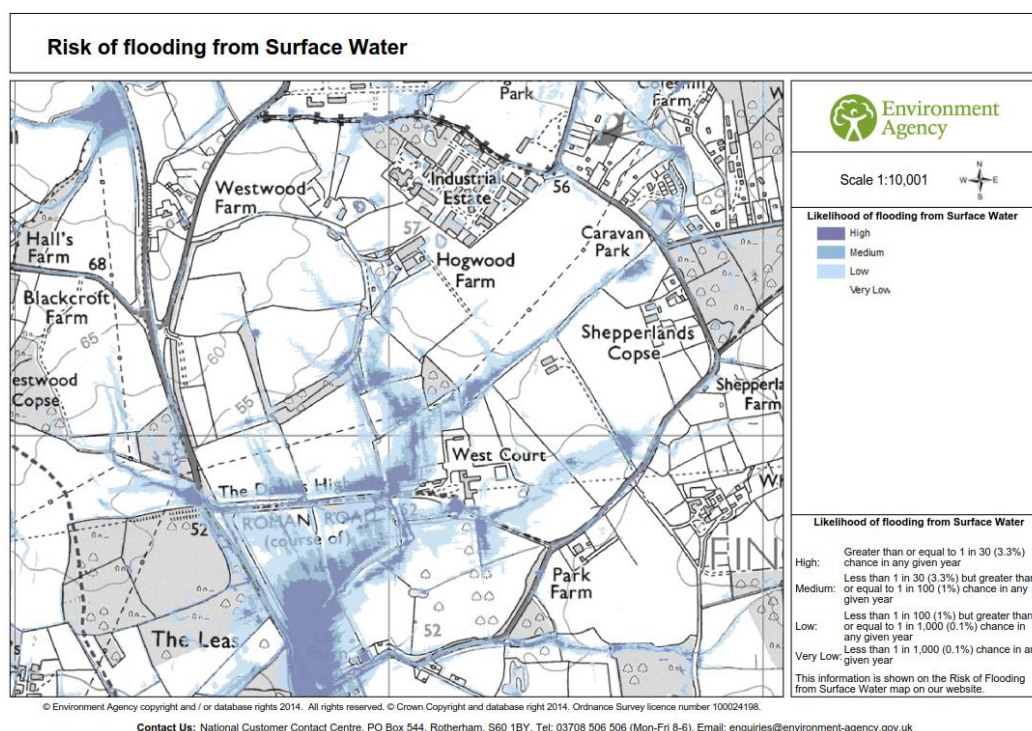


Figure 6: Extract of the Environment Agency Surface Water Flood Risk Map

- 2.8.5 The south-western and central areas of the site are shown to be at high risk with possible depths over 900mm and velocities over 0.25m/s. From a review of the site topographic survey carried out by Brunel Surveys Ltd (provided in Appendix B), these areas are set at the bottom of local valley features, in low-lying areas and also in relatively flat areas (compared to the rest of the site which is mostly falling towards these low spots). As the site is underlain by clay rich soils, it is considered likely that surface water run-off would naturally pond in these areas and as such, the EA's map does identify accurate trends for overland flow paths. However, it should be noted that the EA's mapping is simplistic in nature and doesn't take account of the presence of culverts. This is a material consideration as there are two culverts present in the areas of highest risk (as shown on Figure 6); one leading under The Devils Highway and

one underneath the entrance to West Court. Given this, it is likely that the risk shown is conservative and depths and extents are likely to therefore be diminished. In any case, the areas shown at high risk of surface water flooding are outside of development areas and consequently pose a low risk to end users.

- 2.8.6 Aside from the south-western and central areas of the site, other areas are shown to have bands of low-medium risk from this source. These are all actually ditches onsite, and so the flood risk shown is primarily fluvial in nature and would actually be conveyed through the ditch network and away from development areas rather than building up to any appreciable depth within development areas.
- 2.8.7 The 2012 SFRA shows no records of historic flooding from surface water flooding at or near the site. This further indicates that the risk shown is overly conservative, as considered above.
- 2.8.8 Figure 6 shows that the area where Nine Mile Ride and Park Lane intersect just east of the site boundary is at high risk of surface water flooding. This is also the case in the area where Park Lane and Hogwood Lane intersect, just past the north-eastern corner of the site, and along the bridleway to the east of the industrial estate, at the northern boundary of the site. These are the 3 proposed primary site access locations, as shown on Appendix A
- 2.8.9 The site topographic survey shows that these 3 locations are localised low spots, meaning that surface water run-off from connecting roads and the surrounding area could flow and pool at these locations. However, there are gulleys, drainage ditches and culverts in and alongside these roads which are not taken into account on the EA surface water flood risk map, meaning that the risk of surface water flooding to these points may be lower in reality than that shown. However, the areas of high risk give an indicative idea that there is a risk of flooding in these areas possibly from another source of flooding.
- 2.8.10 The surface water flood risk at the Nine Mile Ride and Park Lane junction is a locally known issue. During a Public Exhibition for the development held on 28<sup>th</sup> March 2018, local parish councillors noted that the area has a history of flooding and that there has been run-off observed flowing from the site towards Robinson Crusoe Park lake. Contamination has also been found within the lake, although given the local topography and greenfield nature of the site in this area, an initial conclusion is that this is likely to originate from highway drainage to Park Lane.
- 2.8.11 The observations of runoff from the site flowing towards Robinson Crusoe Park Lake contradicts the topographic survey and LiDAR data, which show general falls heading south-west. A site visit is proposed to further investigate the flow paths between the site and Robinson Crusoe Park lake and will be carried out once access to Robinson Crusoe Park is agreed with the manager (Richard Wheeler) and local parish councillors.
- 2.8.12 In summary, most of the areas that are at high risk from surface water flooding are located outside of the development parcels or within the existing ditch network. These are consequently not going to pose a risk to people and property.
- 2.8.13 Areas of high risk at site access points have been identified and are addressed in Section 3.
- 2.8.14 Small areas of proposed development land are identified at low to medium risk of surface water flooding and this is considered to be a potentially accurate identification based on site topography and underlying clayey soils. Appropriate measures to mitigate the risk of surface water flooding to these areas and the proposed accesses will be outlined in Section 3.

## **2.9 Sewer/Drainage Flood Risk**

- 2.9.1 Sewer flooding occurs when excess surface water run-off enters the drainage network and the surface/foul water network is insufficient to deal with the influx of water. Sewer flooding can also occur due to 'one off' events such as blockages in the network.
- 2.9.2 The 2012 SFRA states that most sewers in the area are public and owned by Thames Water. The DG5 register shows there have been 2 floods between 2002 and 2012 due to sewer overload, in the postcode area of the site. It is also important to note that Thames Water do carry out frequent improvement works to sewer systems after a flood is reported to reduce the risk of re-occurrence.
- 2.9.3 The historic flood map in the 2012 SFRA shows no records of sewer flooding on site. However just south of the site there are 5 records of house and garage flooding on Park Lane in the area surrounding Lea Farm occurring in 2007. The 2012 SFRA states that the probable source of this flooding is from blocked or backed-up sewer/drains. However, this was not definitively confirmed in the 2012 SFRA.
- 2.9.4 There is one Thames Water public sewer located onsite, it is a surface water sewer which drains from the industrial estate just north of the sites boundary into a pond located onsite. The proposed development will remove the pond, realign the sewers to a new onsite attenuation basin and controlled outfall, to avoid any offsite flooding or flooding of the proposed development areas of the site. The proposals for the sewer realignment can be found in the Drainage Assessment by **jnp group** (report reference C85672-R003).
- 2.9.5 There is a foul sewer which runs parallel to the sites eastern boundary under Park Lane, however this sewer does not have any connections onto the site.
- 2.9.6 Given the lack of sewerage infrastructure on site and lack of historical flooding from this source, it is considered that the risk of flooding to this site is low.

## **2.10 Reservoir Flood Risk**

- 2.10.1 The EA's Reservoir Flood Map shows no risk to the proposed development site.

## **2.11 Canal Flood Risk**

- 2.11.1 The site is not located near to any canals. Consequently, there is no risk of flooding from this source.

### 3 FLOOD RISK MITIGATION

#### 3.1 Introduction

- 3.1.1 Section 2 demonstrates that the risk from tidal, groundwater, sewer and reservoir flooding is low. This chapter, sets out how the identified risk of surface water and fluvial risk from the onsite watercourses in the proposed development areas will be mitigated to ensure that post-development, there is a low risk to residents onsite without increasing the risk of flooding offsite.

#### 3.2 Fluvial Flooding

- 3.2.1 The detailed hydraulic modelling shows that small areas of the proposed residential development are within the existing watercourses floodplain in the modelled 1in1000 year and 1in100+70% Climate Change event (see **jnp group** report C85672-R002 provided in Appendix E and Existing Flood Map in Appendix F). The proposed SANG experiences flooding in all modelled events, as the modelled storm events increase with intensity the area of SANG that is flooded increase (See Appendix F).
- 3.2.2 The existing model was updated to include the following alterations to the watercourses (A number of these changes have been agreed in principle with WBC, see correspondence in Appendix G):
-  Removal of all culverts excluding the one located under Reading Road (A327) at the downstream end of the onsite watercourses and the culverts which pass underneath the Devil's Highway.
  -  Lowering small stretches of the southern bank of Robinson Crusoe Ditch, upstream of the SANG, to enable the floodplain to be more centralised about the channel, removing the developable area from the floodplain.
  -  Moving the inflow location to represent the extension of the existing culvert at the upstream end of Robinson Crusoe Ditch downstream approximately 50m, to allow construction of the new section of Nine Mile Road into the site.
  -  Modifying the modelled watercourses inflows to represent the decreased runoff rates from the site post development due to the implementation of SuDS across the site.
- 3.2.3 The results of the proposed model to the watercourses floodplain show that the proposed areas of residential development that were previously within the 1in1000 year and 1in100+70% Climate Change floodplains are now outside of the floodplain. The proposed development areas do not flood in all modelled events.
- 3.2.4 A plan showing the proposed changes to the watercourses and all fluvial flood extents using the proposed model is shown in Appendix H. Further details on the proposed culvert extension will be developed later in the project, as agreed with WBC.
- 3.2.5 In accordance with PPG and NPPF, it must be demonstrated that the development will be safe for its lifetime taking into account the vulnerability of its users, without increasing flood risk elsewhere, whilst also reducing flood risk overall, where possible.
- 3.2.6 The NPPF and government guidance on flood risk requires that flood risk be assessed against the 35% and 70% within the Thames River Basin, however to demonstrate no increase in the risk of flooding offsite as a result of the proposals, the peak in channel flood level and flow was extracted for the most extreme modelled flood event (1in1000 year) at the downstream boundary of the model. These are provided below in Table 2.

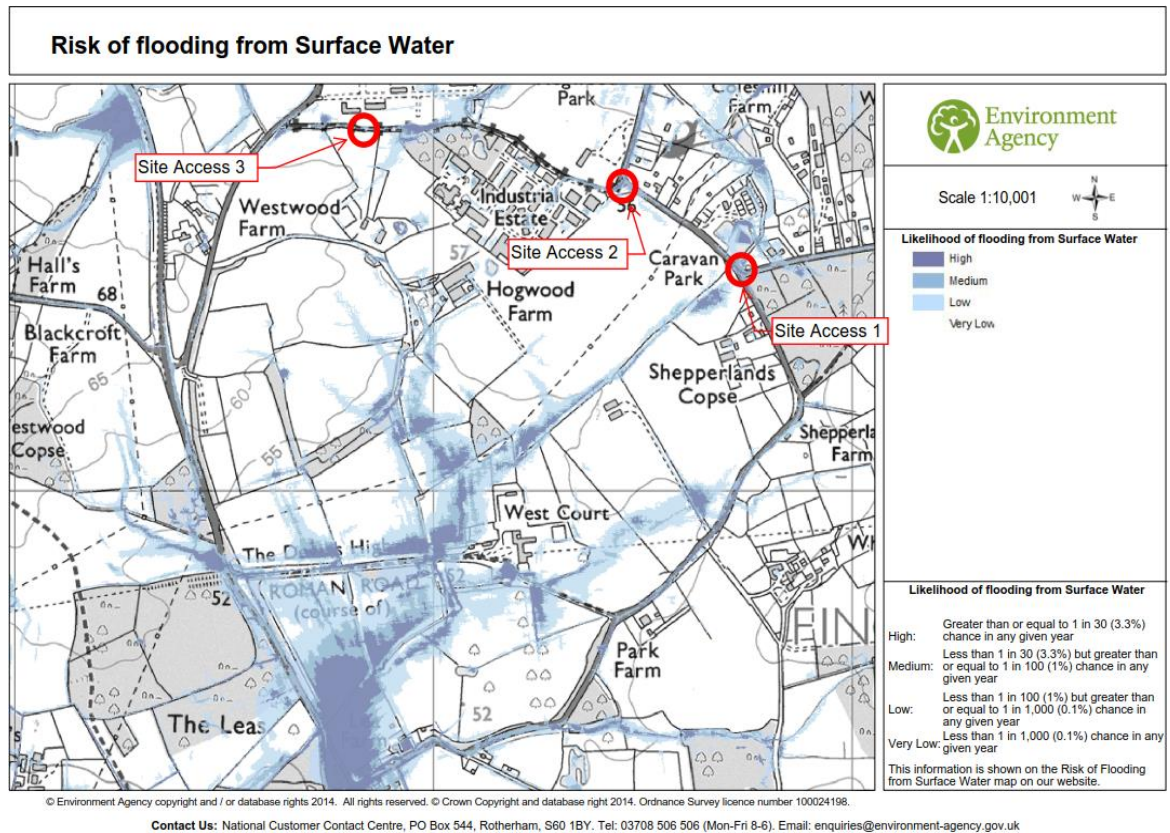
Table 2: Comparison of the Modelled Existing and Proposed 1in1000 year Fluvial Flood Event

|                             | Existing 1in1000 year event | Proposed 1in1000 year event | Difference Between Models |
|-----------------------------|-----------------------------|-----------------------------|---------------------------|
| Maximum Water Level (m AOD) | 49.25                       | 49.22                       | -0.03                     |
| Peak Flow (m/s)             | 1.83                        | 1.75                        | -0.08                     |

- 3.2.7 As can be seen in Table 2 above the proposed model shows a net decrease in both maximum in-channel water level and peak flow. This means that the proposed alterations to the watercourses will be a betterment on the existing situation meaning that the flood risk to areas further downstream from the site will be reduced as a result of the changes proposed in the modelling.
- 3.2.8 The proposed flood model removes all development areas from the fluvial floodplain. However, it is a requirement of planning policy that Finished Floor Levels (FFL) of all properties are raised by a minimum of 0.6m above the 1in100 year fluvial flood level (plus an appropriate allowance for climate change). The proposed fluvial flood extents (provided in Appendix H) displays the peak in-channel fluvial flood levels along the development area for the proposed 1in100year plus 35% allowance for climate change scenario.
- 3.2.9 All other areas of floodplain will remain as undeveloped land with no changes to ground levels. Therefore, no mitigation is needed to reduce flooding in these areas as it does not pose a risk to people or property and may have detrimental impacts on the ecological value of these areas.
- 3.2.10 Additional planting is proposed within the SANG which will help reduce overland flood flow and flood risk by catching runoff and allowing it to infiltrate and increasing the rate of take-up of moisture by soil, plants and trees via evapotranspiration.

### 3.3 Surface Water

- 3.3.1 Whilst areas of the site are shown to be at risk of surface water flooding, the majority are proposed to become SANG or amenity greenspace (southern and central areas of the site). These areas consequently do not pose a risk to people or site access/egress and so the risk shown in these areas is acceptable.
- 3.3.2 Within development areas, the primary band of risk is shown along Robinson Crusoe Ditch. This is not actually a surface water risk and the risk from the ditch itself has been modelled as part of the fluvial hydraulic modelling study carried out by **jnp group**. The results of this study showed that there is no risk to development areas from this source, post-development.
- 3.3.3 All remaining areas of risk within development areas are from run-off entirely generated onsite. The proposed surface water drainage strategy will formally convey run-off generated on parcel and will store this in areas which will not put people at risk before discharging at controlled rates, matching the QBar greenfield runoff rate for all post development storm events up to and including the 1in100 year + 40% climate change event, in accordance with NPPF and WBC requirements. Consequently, the surface water drainage strategy fully mitigates the direct risk to the site.
- 3.3.4 There does remain an indicated risk of surface water flooding at all 3 of the proposed primary site accesses as labelled on the plan provided below in Figure 7.



**Figure 7: The EA Surface Water Flood Risk Map with Proposed Site Access Points**

### Site Access 1

- 3.3.5 Site Access 1 on Figure 7 where the new Nine Mile Ride extension connects to the existing Nine Mile Ride, has a considerable area of high risk. The proposed mitigation strategy is to divert the ditch which runs between the site boundary and Park Lane (onwards referred to as Park Lane Ditch) to join into the onsite watercourse of Robinson Crusoe Ditch. Park Lane Ditch is already part of the on-site Robinson Crusoe Ditch catchment area and therefore, the proposed diversion will not increase the inflow to Robinson Crusoe Ditch.
- 3.3.6 The levels of Park Lane Ditch will be altered no more than 0.3m for the diversion and the fall to Robinson Crusoe Ditch will be 1:100. By diverting surface water flows from the highways to this new ditch, it is likely that highway runoff (and thus potentially contaminated runoff) entering Robinson Crusoe lake will be reduced.
- 3.3.7 The culvert located at the upstream end of Robinson Crusoe Ditch is proposed to be extended downstream by approximately 50m to allow for the new Nine Mile Ride site access construction. A plan detailing the proposed mitigation strategy for access 1 is provided in Appendix I.
- 3.3.8 It is considered likely that the risk shown on the EA mapping is highly overestimated as there is an extensive lake upstream of the culvert set at least 0.5m below the local road levels which would act as attenuation for any surface water flooding around the culvert. Therefore, it is considered that the above works will suitably mitigate surface water flood risk in this area. It has also been agreed with WBC that the proposed impact the proposed culvert and culvert extension will have on Robinson Crusoe Park lake will be investigated further at the detailed design stage of works.

### Site Access 2

- 3.3.9 The area of high risk at Site Access 2 where the north-eastern spur of the Nine Mile Extension connects to the existing Park Lane, as labelled on Figure 7, has been identified as a localised low spot where water may pond. However, the topographic survey also shows that there are storm water drains located on either side of Hogwood Lane and Park Lane and an existing ditch between the site boundary and Park Lane. This confirms that this area is already formally drained, which is not accounted for on the EA Surface Water Flood Risk Map, although the final outfall of this ditch is not confirmed on the topographic survey.
- 3.3.10 This means that the area of high risk at Access Point 2 on the EA surface water flood risk map is not representative of the existing situation and the drainage infrastructure in-place should be appropriate to manage this risk. It is proposed that the storm drains and existing ditch are retained in order to continue the formal drainage of the road. This will be reviewed further at detailed design stage.

### Site Access 3

- 3.3.11 Site Access 3, where the western end of the Nine Mile Extension connects onto the existing off-site section of Nine Mile Ride in the northern portion of the Strategic Development Location (SDL) as shown on Figure 7 is also shown to be at risk from surface water flooding. Where the road crosses the existing bridleway, the bridleway is shown to be a low spot in the topographic survey.
- 3.3.12 This area will be raised by up to 0.3m for the new road to join onto the existing road. By slightly raising the levels in this area the surface water run-off will flow onto the site and into the sites road drainage system as laid out in the Drainage Assessment by **jnp group** (report reference C85672-R003). The proposed drainage strategy for Site Access 3, is for the road to be formally drained by swales and gullies. The formal drainage of the road at Site Access 3 will suitable mitigate the risk of surface water flooding. This will be reviewed further at detailed design stage.

## 3.4 Groundwater

- 3.4.1 Although it has been found that there is a very low direct risk of groundwater flooding onsite due to the largely impermeable soils and the catchment for runoff and groundwater being mostly within the site, which is to be formally drained, further groundwater monitoring should be carried out due to the Site Investigation being carried out during July which is a dry period. This monitoring will be carried out monthly across the seasonal wet period and used to inform detailed design and temporary works design.
- 3.4.2 If groundwater is found within areas of underground structures or detention basins, the detailed design will incorporate measures to waterproof these structures and provide below ground flow paths to route any flows away.
- 3.4.3 There is a potential risk to the excavations during the construction phase of works, due to potential shallow groundwater and high clay content of the soil (clay can become unstable when it is saturated). Therefore, groundwater control methods may be required to provide the workable, stable conditions needed to develop the site. These methods could include any of the following:
-  Localised dewatering
  -  Exclusion techniques (i.e. temporary cut-off walls)
  -  Pumping
  -  Minimising construction during winter months

### **3.5 Watercourse Enhancements**

- 3.5.1 As well as the forms of flood risk mitigation outlined in the sections above, key opportunities for enhancing the watercourses have been identified across the site, creating improved and diverse habitats by local ditch reshaping, clearing of overly shaded areas and new planting. These areas of opportunity are displayed on plan in Appendix J (The plan was provided by **jnp group**, reference: C85672-SK-024A).
- 3.5.2 This plan should be viewed in conjunction with the watercourse enhancements technical note by **jnp group** (reference: C85672-TN-009) provided in Appendix K. The watercourse enhancements technical note outlines the various opportunities for watercourse enhancement that may be utilised and the safeguards for each method that need to be considered.
- 3.5.3 It is important to note that all of the opportunities identified for enhancing the onsite watercourses will not impact their hydraulic properties as the ditch cross sectional area will not be reduced. Therefore, they will have no impact on flood risk.

## 4 CONCLUSIONS AND RECOMMENDATIONS

- 4.1.1 This Flood Risk Assessment has been prepared in accordance with the National Planning Policy Framework and the associated Planning Practice Guidance, which reviews aspects of flood risk to the site.
- 4.1.2 The existing site is mainly large open fields which are used for agricultural purposes and separated by hedgerows and fences. Sections of mature woodland, ditches, and various buildings are present across the site. The site is bounded by Reading Road (A327) to the west, Park Lane to the east, south-east and north-east and Sheerlands Road to the north-west.
- 4.1.3 The site is 109.824ha and the development proposed consists of the construction of 1,500 dwellings, 6.529ha of general industrial and employment land, a 0.296ha neighbourhood centre, 2.506ha for the construction of a primary school, 1.866ha for use as community allotments. 5.970ha of outdoor sports facilities, 21.539ha of open space (parks etc.) and 29.942ha of Suitable Alternative Natural Greenspace (SANG).
- 4.1.4 In accordance with the EA Flood Map for Planning, the site is located entirely within Flood Zone 1; at low risk from fluvial flooding. However, the EA's mapping does not include any assessment of the risk posed by the onsite watercourse network.
- 4.1.5 A hydraulic modelling study carried out by **jnp group** has identified the risk of fluvial flooding from the two primary onsite ditches; Hogwood Ditch and Robinson Crusoe Ditch, a number of culverts have been removed across the site and bank levels balanced in a select area on Robinson Crusoe Ditch upstream of the SANG to centralise the extreme floodplain about the channel. These proposed changes to the watercourses have been modelled with the post-development inflows (taking the sites SuDS strategy impacts into account) to confirm that there is no fluvial flood risk to development areas for the range of storm events up to and including the 1in1000 year event. In accordance with the EAs standing guidance, Finished Floor Levels are to be set a minimum of 600mm above the 1in100 year fluvial flood level plus a 35% allowance for climate change.
- 4.1.6 Surface water flooding is identified in areas of the site as low to high risk to the site on the EA's publicly available mapping. However, this does not take the extensive ditch network and culverts on-site which are likely to substantially reduce risks. Nevertheless, the remaining risks on-site are mitigated through avoidance of development in the central and southern areas (designated as SANG) and introduction of a formal surface water drainage design using SuDS to control and attenuate onsite surface water runoff. There remains a residual risk from this source at the 3 primary access points. This will be mitigated through retention of existing drainage infrastructure (including diversions and extensions where necessary) and introduction of further formal drainage where needed.
- 4.1.7 The risk of groundwater flooding to the site is low due to the high clay content of the superficial and underlying geology which is likely to impede groundwater from emerging at surface. However, groundwater was found to be present at shallow depths onsite, although, it was described as a trickle or slow ingress. It is recommended that groundwater monitoring is carried out across the site and this information used within detailed design. During the construction phase, a number of options to manage this risk have been detailed.
- 4.1.8 There is a low risk of flooding from all other assessed sources, including: tidal, sewer and reservoir.
- 4.1.9 In conclusion, the proposed development has an acceptable flood risk within the terms and requirements of the NPPF.
- 4.1.10 The comments stated above are based on information received from other consultees. The flood risk classification of this site has been based on the above observations and the recommendations stated.

This report is intended for the use of the developer of the site in support of their proposed development for this site only.

## Appendix A: Proposed Concept Masterplan



# CONCEPT MASTERPLAN



## KEY

- SITE ACCESS
- PEDESTRIAN ACCESS
- EXISTING OIL PIPELINE (3m/6m EASEMENT)
- PROPOSED DIVERTED OVERHEAD CABLE (6m EASEMENT)
- PRIMARY SCHOOL
- EMPLOYMENT
- RETAIL (500sqm)
- ALLOTMENTS
- FOCAL SPACE
- SPORTS FACILITIES
- SUITABLE ALTERNATIVE NATURAL GREENSPACE
- PUBLIC OPEN SPACE
- NINE MILE RIDE EXTENSION
- GREEN WAY
- PROPOSED BRIDLEWAY

Scale @ A0  
0 10 20 30 40 50 60 70 80 90 100  
Scale 1:2000

Rev Date Drawn Checked

06.04.18

Drawn by: KD  
Checked by: BB  
Dwg No: Rev: E

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Project: HOGWOOD GARDEN VILLAGE  
FINCHAMPTON

Title: CONCEPT MASTERPLAN

Client: Legal & General



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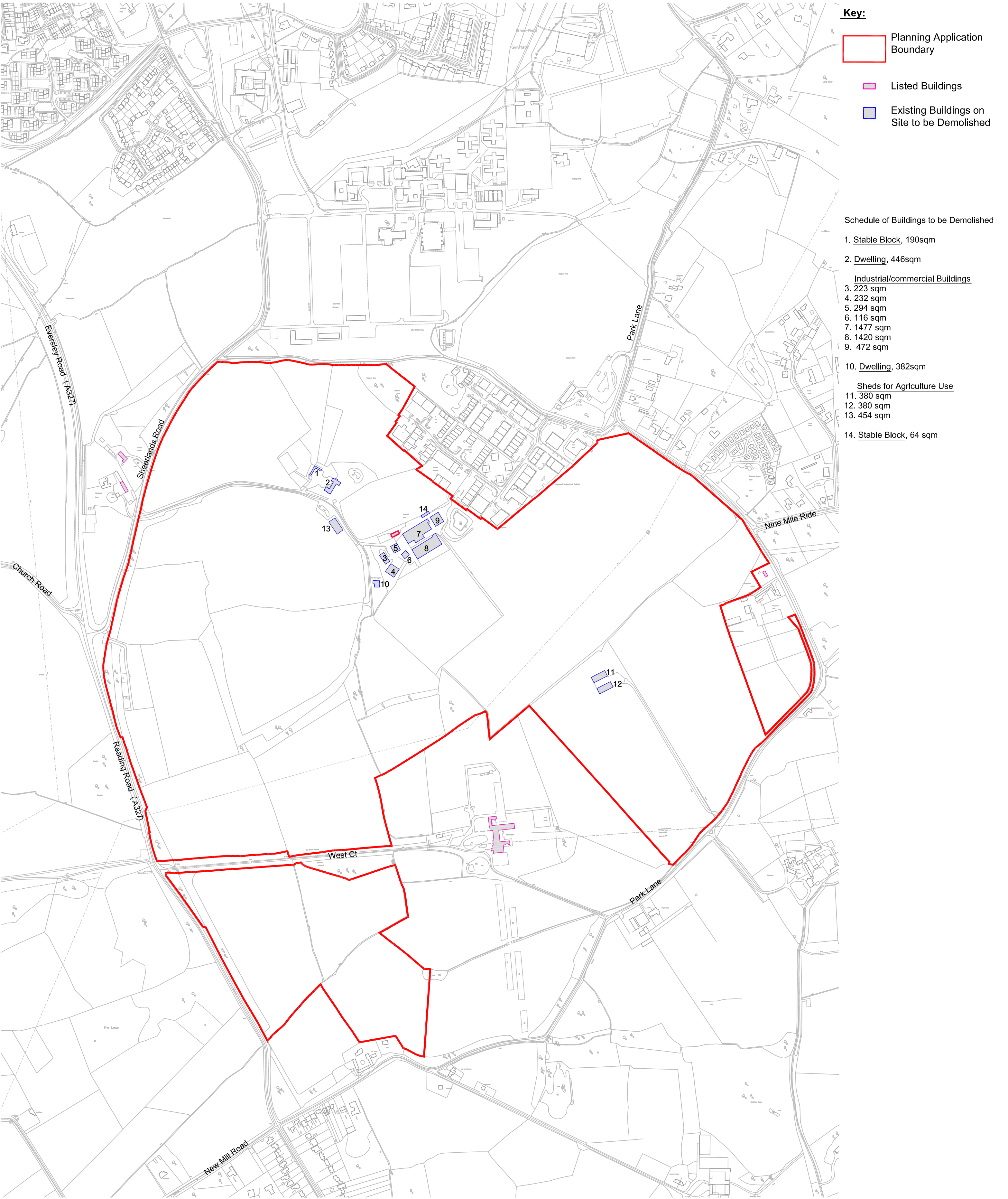
## Appendix B: Site Location Plan



# Hogwood Garden Village

## Part of the Arborfield Garrison Strategic Development Location, Wokingham

### Existing Buildings on Site to be Demolished



Marino Family

WEI YANG PARTNERS

DELIVERING INTEGRATED MASTER PLANS

Hogwood Garden Village

Part of the Arborfield Garrison Strategic Development Location, Wokingham

Existing Buildings on Site to be Demolished

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## Appendix C: Topographic Survey Plan

