

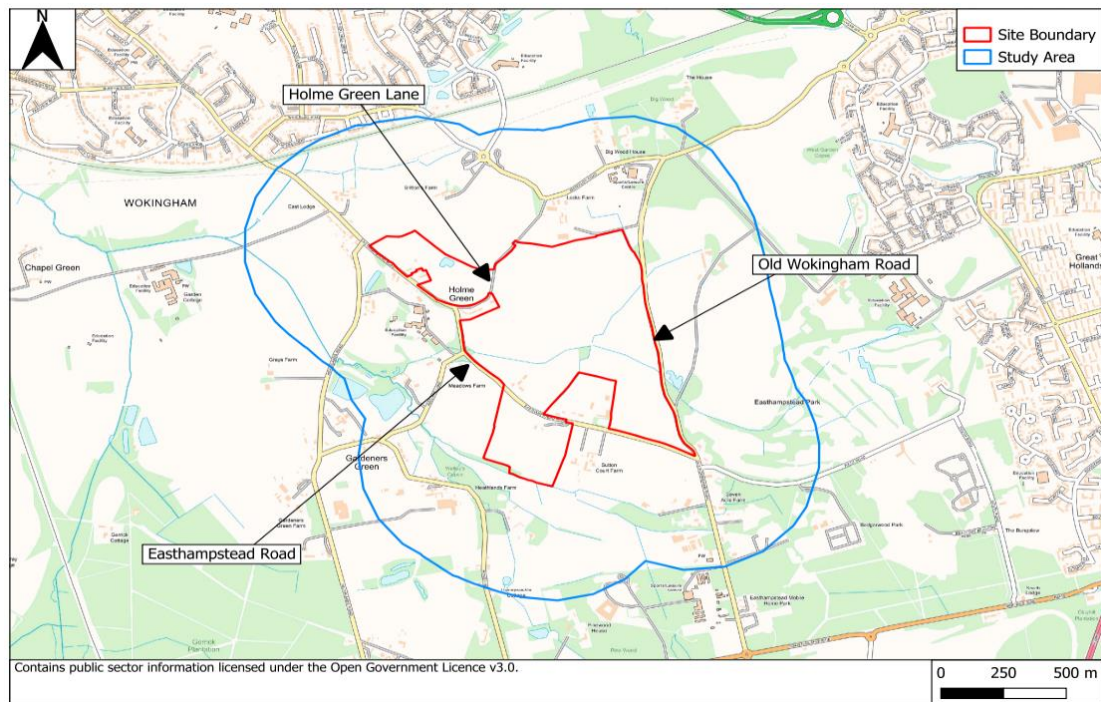
9. HYDROLOGY AND FLOOD RISK

Introduction

- 9.1 This Chapter of the ES assesses the likely effects of the Proposed Development with respect to hydrology and flood risk, particularly the effects on fluvial, pluvial, reservoir breach inundation and surface water drainage, as set out in the scoping opinion. This Chapter also describes the legislative and policy framework; the methods used to assess the effects; the baseline conditions currently existing at the Application Site; the mitigation measures required to prevent, reduce, or offset any significant negative effects; and the likely residual effects after these measures have been adopted.
- 9.2 This Chapter has been prepared by Abley Letchford Partnership (ALP) on behalf of Lightwood Strategic ('Lightwood') and Nicholas King Homes ('NKH'). All staff involved in the preparation of this ES Chapter are members of CIWEM. It has been checked and approved by an ALP Associate Director who is a chartered engineer and a chartered member of CIWEM. All staff involved in the production of this ES Chapter are competent in the appraisal of flooding and drainage.

Study Area

- 9.3 The South Wokingham Strategic Development Location (SDL) Extension (the Site) covers an area of approximately 64 hectares with the 'NKH' Site extending to circa 7.5 hectares located in the west and the 'Lightwood' Site extends across the remainder of the Site covering 56.5 hectares, including land to the south of Easthampstead Road. The Site includes the third application Site known as Byway30 which is a road crossing and pedestrian access located between the 'NKH' Site and the 'Lightwood' Site.
- 9.4 The study area will follow the red line boundary of the Site shown in **Figure 9.1** with a 500m buffer around the Site boundary. The buffer has been used to define a wider area to assess the offsite impacts.

Figure 9.1 – Site Location and Study Area

9.5 The western and southern boundaries of the Site are predominantly defined by Easthampstead Road. However, an area of land for SANG is proposed to the south as part of the Proposed Development. To the east the Site predominantly borders the Old Wokingham Road. The majority of the Site lies to the south of the Holme Green Lane, although it also includes an area of land around Pearce's Farmhouse (and adjoining Easthampstead Road) located to the north of this byway.

9.6 The Site primarily comprises arable fields and grazed equine land. There are tree line and hedge lined Site and field boundaries.

Legislative Planning Policy Framework

9.7 The National Planning Policy Framework (NPPF), updated most recently in December 2023 sets out the Government's planning policies for England and how they are expected to be applied. In terms of Water Resources and Flood Risk, the NPPF sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow, with a view to achieving sustainable development.

9.8 To accompany the updated NPPF, the web-based Planning Practice Guidance (PPG) provides additional technical guidance of flood risk and coastal change. The PPG retains key elements of former Planning Policy Statement (PPS) 25 Development and Flood Risk (withdrawn on adoption of the NPPF) as an interim measure, pending a wider review of guidance to support planning policy. The original technical guidance published in 2012 has also been replaced by this web-based

- 9.9 In terms of the general planning approach to Development and Flood Risk, the Flood Risk and Coastal Change PPG sets out the following main steps to be followed.
- Assessment of Flood Risk;
 - Avoid Flood Risk; and
 - Manage and Mitigate Flood Risk.
- 9.10 The guidelines also suggest that in plan - making, local planning authorities apply a sequential approach to Site selection so that development is, as far as reasonably possible, located where the risk of flood (from all sources) is lowest, taking account of climate change and the vulnerability of future uses to flood risk. In plan-making this involves applying the 'Sequential Test' to Local Plans and, if needed, the 'Exception Test' to Local Plans. Guidance on when and how the 'Sequential' and 'Exception' Tests should be applied to planning applications is also provided in the PPG.
- 9.11 Current best practice guidance on the planning for and design of SuDS treatment is provided by C753 The SuDS Manual, The Design Manual for Roads and Bridges (DMRB) HA 103/06 Vegetative Treatment Systems for Highway Runoff, and the DMRB HD 33/06 Surface and Subsurface Drainage Systems for Highways. In the context of the Proposed Development, the assessment guidance described in the C753 The SuDS Manual³⁶ is the most appropriate method of assessment to determine the risk to the water environment and the need for treatment measures.
- 9.12 1Wokingham Borough Council (WBC) Development Plan currently includes the following documents:
- WBC Core Strategy DPD (January 2010);
 - Managing Development Delivery Local Plan (February 2014);
 - South East Plan Policy NRM6 (2010);
 - Emerging Draft Local Plan Update (2021);
 - Adopted Supplementary Planning Documents, including:
 - South Wokingham SDL SPD (October 2011);
 - Infrastructure Delivery and Contributions SPD (October 2011);
 - Sustainable Design and Construction SPD (May 2010) and its Companion to Sustainable Design and Construction SPD document (May 2010);
 - Affordable Housing SPD (July 2013); and
 - Borough Design Guide SPD (May 2012).
- 9.13 WBC Core Strategy (adopted on 29th January 2010) sets the board vision and policies for the Borough, having been informed by the views of the community through consultation, the

vision of WBC and community strategy, together with the nation policy. The Core Strategy sets out where development will occur within the Borough to 2026, taking account of health, wellbeing and quality of life.

9.14 Policy CP1 (Sustainable Development) states that:

'Planning permission will be granted for development proposals that...

Limit any adverse effects on water quality (including groundwater).

Ensure the provision of adequate drainage...

Incorporate facilities for recycling of water...

Avoid increasing (and where possible reduce) risks of or from all forms of flooding (including from groundwater) ...'

9.15 Policy CC09 (Development and Flood Risk) states:

'All sources of flood risk should be considered during the planning application process. Proposals must be consistent with the guidance in the NPPF and the accompanying NPPF Technical Guidance and should demonstrate how the Strategic Flood Risk Assessment (SFRA) has been used to determine the suitability of the proposal.

Development should be guided towards the areas of the lowest flood risks by applying the sequential approach. Development proposals within Flood Zones 2 or 3 must ensure that flood risk is not increased due to the Project and must take into account the vulnerability of the Proposed Development.

Development will only be considered in areas of flood risk if it can be considered that: the development provides wider sustainability benefits to the community which outweighs flood risk; the development will be safe for its lifetime taking into account the vulnerability of its users and the development will not increase flood risk, and where possible, will reduce flood risk overall.'

9.16 Policy CC10 (Sustainable Drainage) states:

'Surface water arising from the Proposed Development must be managed in a suitable manner, taking into account the effects of climate change.

Where practically possible, development proposals should incorporate SuDS, which must be designed to meet the long-term needs of the development. If a development discharges surface water into a public sewer, adverse impacts to the public sewerage network serving the development should not be experienced.'

9.17 A small area of land to the north is located within Bracknell Forest Council. The BFC Development Plan comprises the Bracknell Local Plan (March 2024) and South East Plan Policy NRM6: Thames Basin Heaths Special Protection Area.

9.18 The relevant policies include but are not limited to the legislation below:

- The Water Resource Act (1991)
- Land Drainage Act (1994)
- The Environment Act (1995)
- Anti-Pollution Works Regulations (1999)
- Water Framework Directive
- The Water Act (2014)
- The Environmental Permitting Regulations (2019)

Assessment Methodology

9.19 This section details the methodology used to assess the impact of the Proposed Development in respect to hydrology and flood risk, specifically pluvial, fluvial, reservoirs and surface water drainage flood risk. The methodology for assessing these is outlined below.

9.20 A site-specific Flood Risk Assessment (FRA) has been undertaken for the 'NKH' Site, the 'Lightwood' Site and the Byway 30 Site in accordance with the Ministry of Housing, Communities and Local Government (MHCLG's) (updated 2020) PPG: Flood Risk and Coastal Change. A copy of these FRAs which have been prepared in accordance with the NPPF PPG have been included within the Appendix. The ES Chapter has been prepared in accordance with the relevant national and local guidance.

9.21 The flood risk and drainage assessment involved the following methodology.

- Consultation with the relevant statutory and non-statutory bodies.
- Desk study to established baseline conditions including the determination of the sensitivity of these conditions.
- Evaluation of potential effects of the Proposed Development.
- Evaluation of the significance of these effects through the magnitude and significance matrix.
- Identification of possible mitigation measures against and adverse effects
- Identification of residual effects.

Table 9.1 – List of Consultees

Organisation	Individuals	Form of Consultation/ Meeting and Date	Summary of Discussions/ Outcomes
Wokingham Borough Council	-	In person meetings and emails	Structure and scope for which the FRA's have been produced.
Thames Water	James Hern	Various Emails	Ongoing discussions on TW assets and capacity.
Environment Agency	-	Email request for datasets	Product 4, 5, 6 and 7 Flood Risk datasets received from the EA.

9.22 In order to assess the significance of any potential impacts, a matrix approach has been adopted to map the potential impacts to the vulnerability of potential receptors. We have adopted the vulnerability categories for flood risk as set out in the PPG below.

9.23 The assessment methodology stages can be outlined as follows:

Table 9.2 – Sensitivity of Receptor

Receptor Value/ Sensitivity	Description of Criteria	Example of Receptors
Very High	Nationally significant attribute of high importance	Surface Water: Watercourse having Water Framework Directive (WFD) classification shown in a River Basin Management Plan (RBMP) and Q95 $\geq 1.0\text{m}^3/\text{s}$. Site protected/ designated under EC or UK legislation (SAC, SPA, SSSI, Ramsar site, salmonoid water) or species protected by EC legislation LA 108. Groundwater: Principal aquifer providing a regionally important resource and/or supporting a site protected under EC and UK legislation LA 108. Groundwater supports groundwater terrestrial ecosystem (GWDTE). SPZ1. Flood Risk: More Vulnerable development
High	Locally significant attribute of high importance	Surface Water: Watercourse having a WFD classification shown in RBMP and Q95 $<1.0\text{m}^3/\text{s}$. Groundwater supports GWDTE. Groundwater: Principal aquifer providing locally important resources or supporting a river ecosystem. SPZ2. Flood Risk: More Vulnerable development.

Receptor Value/ Sensitivity	Description of Criteria	Example of Receptors
Medium	Of moderate quality and rarity	Surface Water: Watercourse not having a WFD classification shown in RBMP and Q95 >0.001m ³ /s. Groundwater: Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ3. Flood Risk: Less Vulnerable Development.
Low	Lower quality	Surface Water: Watercourse not having a WFD classification shown in RBMP and Q95 ≤0.001m ³ /s. Groundwater: Unproductive strata. Flood Risk: Water compatible development.

- 9.24 The magnitude of impact is based on an assessment of two factors. Firstly, how flood levels might change because of the impact on the fluvial flood plain and secondly, qualitatively how surface water flows might be increased because of the Proposed Development strategy.

Table 9.3 – Magnitude of Change

Change	Magnitude
Major adverse	Result in loss of attribute and/or quality and integrity of the attribute. Surface Water: Loss or extensive change to a fishery. Loss or pollution of a regionally important water supply. Loss or extensive change to a nature conservation site. Reduction in a water body's WFD classification. Groundwater: Loss of, or extensive change to, an aquifer. Loss of a regionally important water supply. Loss of, or extensive change to GWDTE or baseflow contribution to protected surface water bodies. Reduction in water body WFD classification. Loss of, or significant damage to major structures through subsidence or similar effects. Flood Risk: Increase in peak flood level >100mm. Loss of flood storage.
Moderate adverse	Result in effect on integrity or attribute or partial loss of the attribute. Surface Water: Partial loss in productivity of a fishery. Degradation of regionally important water supply or loss of a major commercial, industrial or agricultural supplies. Contribution to reduction in water body WFD classification. Groundwater: Partial loss or change to an aquifer. Degradation of a regionally important public water supply or loss of significant commercial, industrial or agricultural supplies. Partial loss of the integrity of GWDTW, Contribution to reduction in water body WFD classification. Damage to major structures through subsidence or similar effects or loss of minor structures. Flood Risk: Increase in peak flood level >50mm.
Minor adverse	Results in some measurable change in attributes, quality or vulnerability. Surface Water: Minor adverse effects on water supplies.

Change	Magnitude
	Groundwater: Minor adverse effects on an aquifer and/or groundwater. Flood Risk: Increase in peak flood level >10mm.
Negligible	Results in effect on attribute, but of insignificant magnitude to affect the use or integrity. Surface Water: No significant loss in quality, fishery productivity or biodiversity. Groundwater: No measurable impact on an aquifer and/or groundwater. Flood Risk: Negligible change to the peak flood level $\leq \pm 10\text{mm}$.
Minor beneficial	Results in some beneficial effect on attribute or a reduced risk of a negative effect occurring. Surface Water: Minor beneficial effects on water supplies or quality. Groundwater: Reduction in waterlogging and/or groundwater flooding. Flood Risk: Creation of flood storage and/or decrease in peak flood level of >10mm.
Moderate beneficial	Results in moderate improvement of attribute quality. Surface Water: Contribution to improvement in the water body WFD classification. Enhanced productivity of a fishery. Reduced effluent to the receiving river. Groundwater: Contribution to improvement in water body WFD classification. Improvement in water body catchment abstraction strategy (CAMS) (or equivalent) classification. Support to significant improvements in damaged GWDTE. Flood Risk: Creation of flood storage and/ or decrease in peak flood level of >50mm.
Major beneficial	Results in major improvement of attribute quality. Surface Water: Removal of existing pollution discharge or removing likelihood of polluting discharge occurring to a watercourse. Improvement in water body WFD classification. Groundwater: Removal of existing polluting discharge to an aquifer or removing the likelihood of pollution discharges occurring. Recharge of an aquifer. Improving a water body WFD classification. Flood Risk: Creation of flood storage and/or decrease in peak flood level (>100mm).

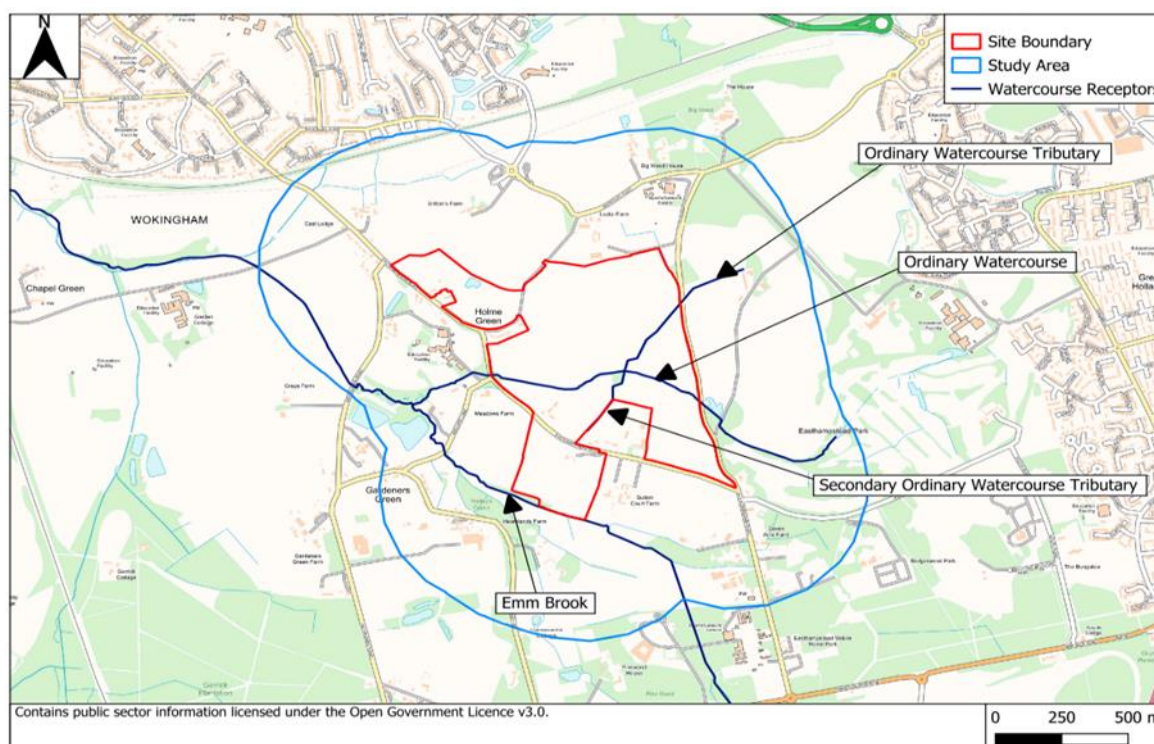
- 9.25 The predicted level of effect is based on the consideration of the magnitude of impact, the sensitivity of the receptor and the degree of professional judgement of how important the effect is.

Table 9.4 – Significance Matrix

Significance		Sensitivity of Receptor		
Impact Magnitude	Major	Major	Major	Moderate
	Moderate	Major	Moderate	Minor
	Minor	Moderate	Minor	Minor
	Negligible	Negligible	Negligible	Negligible

Receptors

- 9.26 Key receptors include the following:
- Ordinary Watercourse and tributaries;
 - Emm Brook;
 - London Clay Formation bedrock geology;
 - Site workers;
 - Site residents, visitors and residents downstream; and
 - Property within the Site and downstream of the Site.
- 9.27 **Figure 9.2** shows the location of the watercourse receptors.

Figure 9.2 – Watercourse Receptors

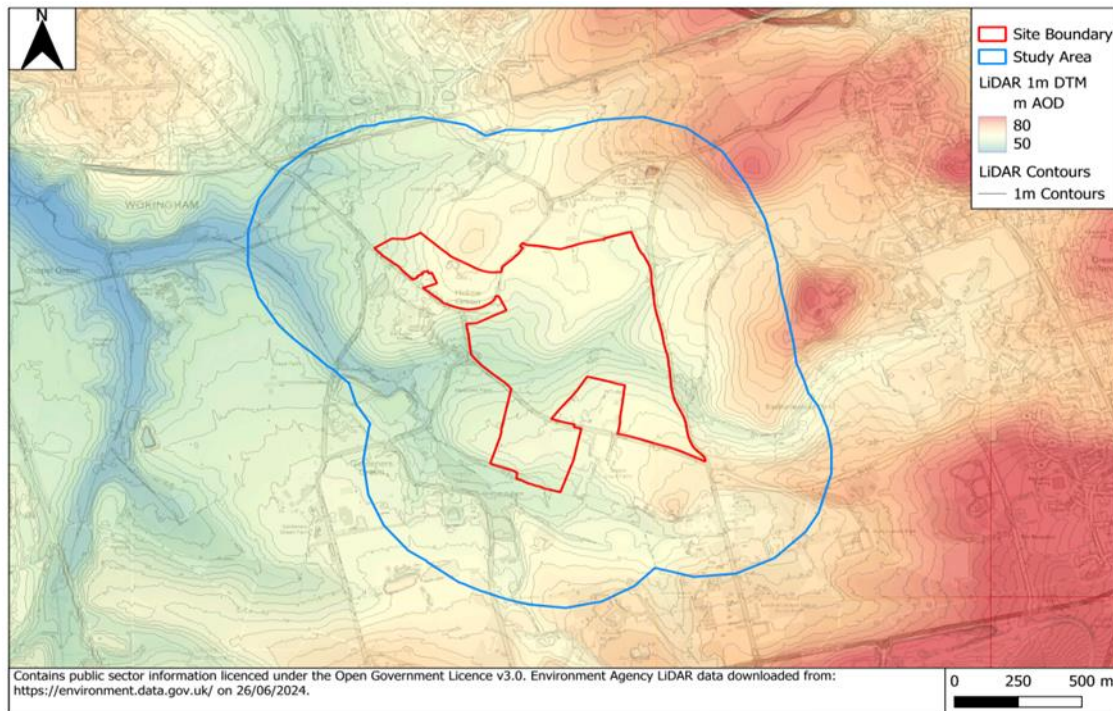
Baseline Conditions

Site Location

- 9.28 The Site is a greenfield site that comprises of farmland with established hedges and tree lined boundaries. The Site is primarily greenfield in nature, essentially subject to a natural regime of pluvial runoff, with some infiltration potential and drainage.

Topography

- 9.29 Ground levels across the Site are shown by LiDAR data in **Figure 9.3**.

Figure 9.3 – LiDAR Elevations

- 9.30 LiDAR data indicates that the topography of the 'Lightwood' Site generally slopes downwards from the north and south towards the Ordinary Watercourse. The elevations across the 'Lightwood' Site are between 56.7m AOD and 67.1m AOD. The highest elevation along the northern boundary of the Site is 65.2m AOD. The highest elevation along the southern part of the Site is 67.1m AOD. The 'Lightwood' Site slopes to a low point of 56.8m AOD as the unnamed watercourse flows under Easthampstead Road as it leaves the site.
- 9.31 LiDAR data indicates that the topography of the 'NKH' Site slopes downwards from north-east to the south-west. The ground levels across the Site slope from 66.3m AOD to 59.7m AOD.

Geology

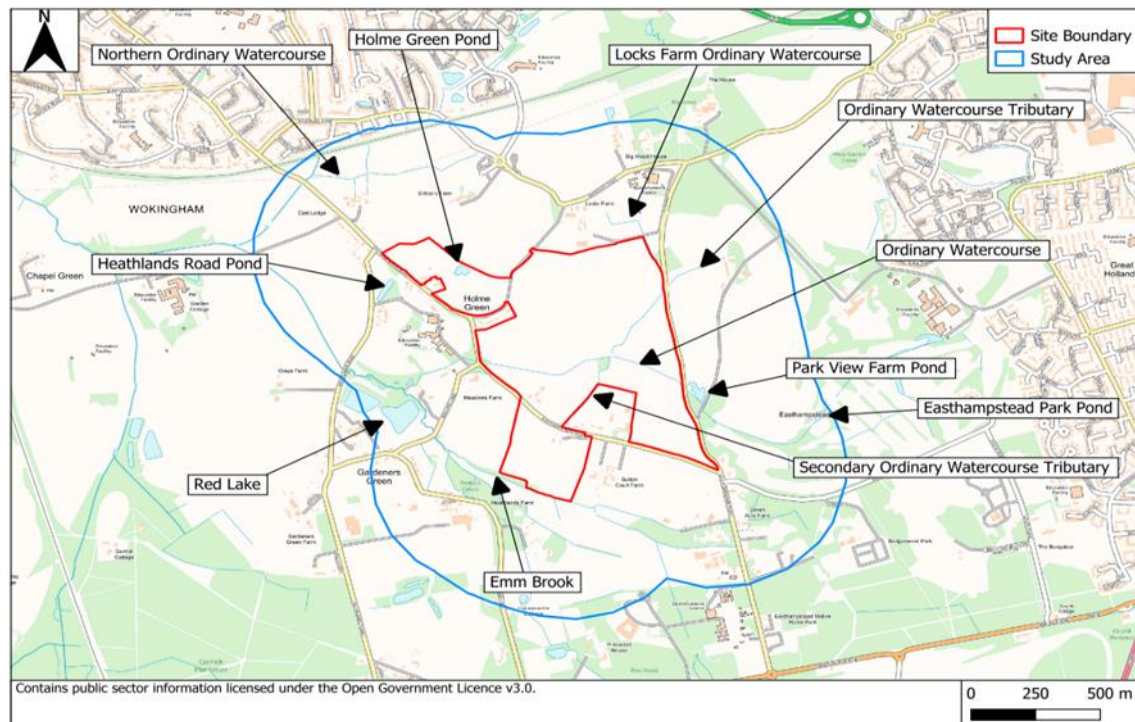
- 9.32 The British Geological Survey (BGS) 'Geology of Britain' online viewer indicates that the geology underlying the Site is predominantly London Clay Formation. There is some Bagshot Formation – sand in the south-west corner of the Site.
- 9.33 There are superficial deposits of Head – clay, silt sand and gravel adjacent to the Ordinary Watercourse. There are some areas of superficial deposits – sand and gravel across the eastern part of the 'NKH' Site and the western and central parts of the 'Lightwood' Site. There are no records of superficial deposits across the rest of the Site.
- 9.34 The Cranfield University 'Soilscapes' online viewer indicates that the majority of the Site overlies slowly permeable seasonally wet slightly acid but base rich loamy and clayey soils.

There is an area in the south-western corner of the Site which overlays freely draining slightly acid loamy soils.

Surface Water Features

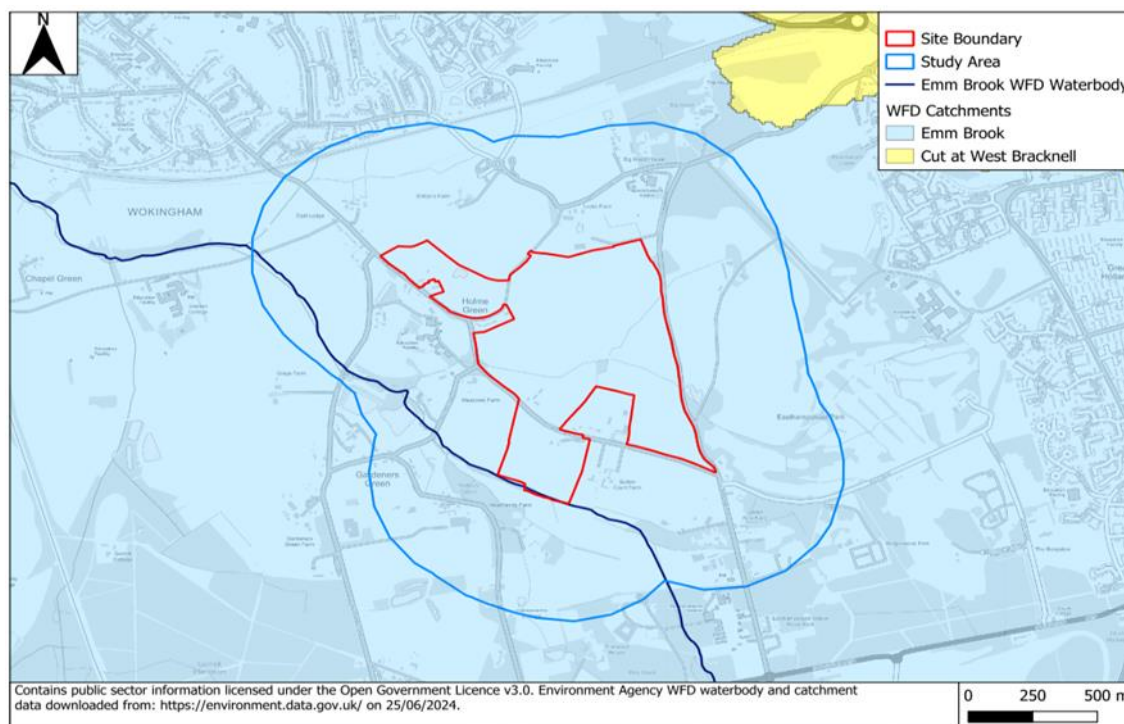
9.35 **Figure 9.4** shows the location of key surface water features within the study area.

Figure 9.4 – Key Surface Water Features within the Study Area



9.36 The Ordinary Watercourses flow towards the Emm Brook. The Emm Brook is a designated EA Main River. The Emm Brook flows in a north westerly towards the River Loddon, to the east of Woodley.

9.37 The Emm Brook WFD catchment is located within the study area. **Figure 9.5** shows the location of the WFD catchment and waterbody.

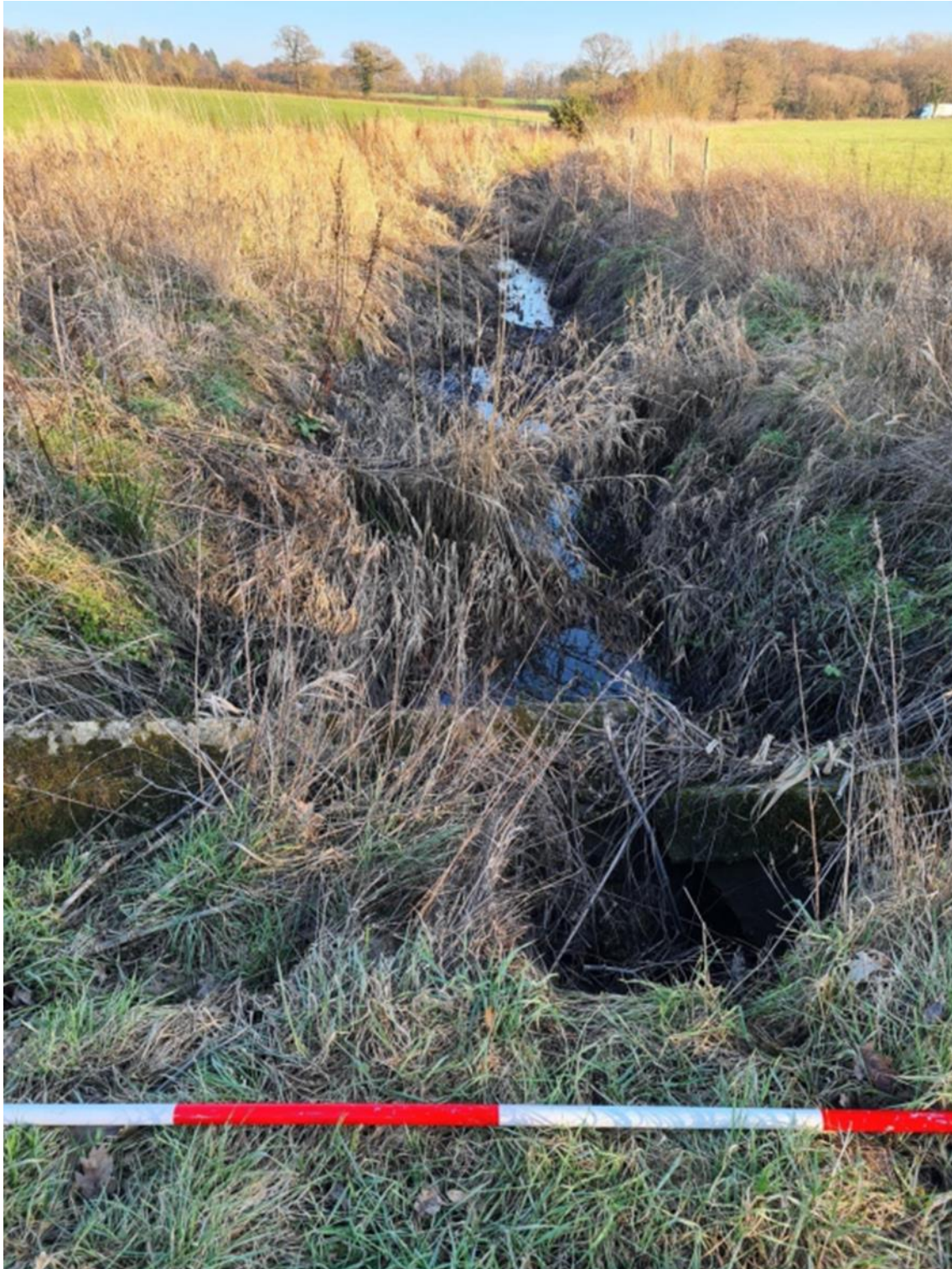
Figure 9.5 – WFD Catchments

- 9.38 The EA Catchment Data Explorer shows that the Emm Brook has a Moderate ecological status (2022). The watercourse is not heavily modified.
- 9.39 A site visit was carried out in February 2023 and observations were made of the watercourses within the Site.
- 9.40 **Figure 9.6** and **9.7** shows photographs of the Ordinary Watercourse.

Figure 9.6 – Photograph of the Ordinary Watercourse



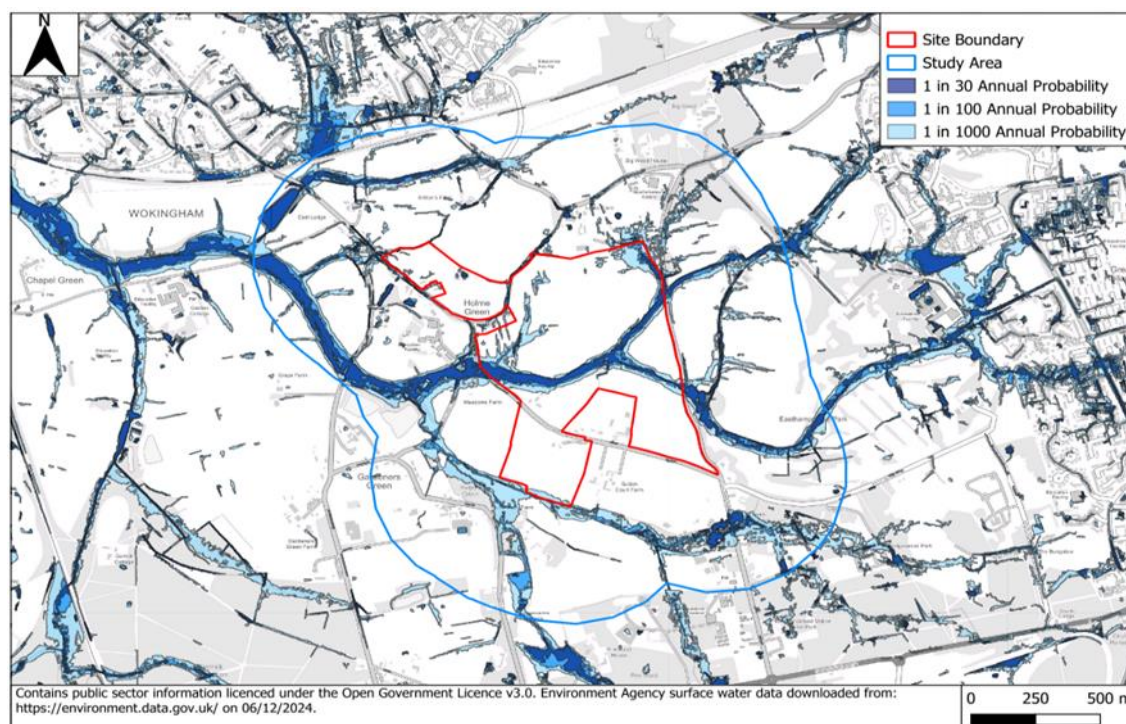
Figure 9.7 – Photograph of the Ordinary Watercourse



- 9.41 At the Site, the channel of the Ordinary Watercourse is typically 4-5m wide from top of banks. The banks are well defined. The topographical survey shows that the ground levels to the north of the Ordinary Watercourse are up to 1m greater than the ground levels to the south of the Ordinary Watercourse. This is supported by site observations.
- 9.42 The Ordinary Watercourse tributary is typically 2.5-3.5m wide from top of banks. The secondary Ordinary Watercourse tributary is located under dense undergrowth so was not picked up within the topographical survey.
- 9.43 Emm Brook is typically 3-5m wide from top of banks.
- 9.44 There are a number of unnamed Ordinary Watercourses within the study area. The Ordinary Watercourses flow towards the Ordinary Watercourse and Emm Brook.
- 9.45 There is one pond with the Site boundary; 'Holme Green' Pond. The pond appears to be an ornamental pond which is not hydraulically connected to the watercourses. This pond will be removed as part of the development.
- 9.46 Park View Pond is located to the east of Old Wokingham Road. The pond is thought to be hydraulically connected to the Ordinary Watercourse. Easthampstead Park Pond is located to the east of the study area. It appears to be hydraulically connected to the Ordinary Watercourse. Red Lakes are located to the south of Emm Brook. They are part of the Holme Grange Fishery. The ponds are thought to be hydraulically connected to the Emm Brook. Heathlands Road Pond is located between Heathlands Road and Easthampstead Road. It does not appear to be hydraulically connected to a watercourse.

Pluvial Flood Risk

- 9.47 **Figure 9.8** shows an extract from the EA Risk of Flooding from Surface Water dataset indicating the pluvial flood risk across the Site.

Figure 9.8 – EA Risk of Flooding from Surface Water

- 9.48 Areas are presented against the following return periods; 1 in 30 annual probability (3.3%), 1 in 100 annual probability (1%) and 1 in 1000 annual probability (0.1%).
- 9.49 There are areas of localised surface water ponding within the 'NKH' Site associated with low points in the topography and along the western border which corresponds with the location of a drainage ditch.
- 9.50 There are several surface water flow routes through the 'Lightwood' site, as shown in **Figure 9.3**. The flow route through the centre of the Site flowing from east to west is associated with the Ordinary Watercourse. The flow route which flows from the north-east part of the 'Lightwood' Site is associated with the Ordinary Watercourse tributary.
- 9.51 The channels of the Ordinary Watercourse and Ordinary Watercourse tributary appear to be poorly defined within the EA surface water mapping. This is overestimating the flow route. The EA surface water mapping is strategic scale and therefore does not pick up localised, site specific detail or small features due to the resolution of the modelling.
- 9.52 One key feature not represented within the EA surface water mapping is a ditch which runs along the northern boundary of the 'Lightwood' Site. The ditch was noted during a site visit, undertaken in February 2023 by ALP. The ditch effectively would intercept overland flow from the northern part of the Site and direct it to the north-east corner of the site where its flow would continue along the ditch line and into the Ordinary Watercourse tributary. The extent of the surface water mapping in the north-east corner of the 'Lightwood' Site is overestimated in

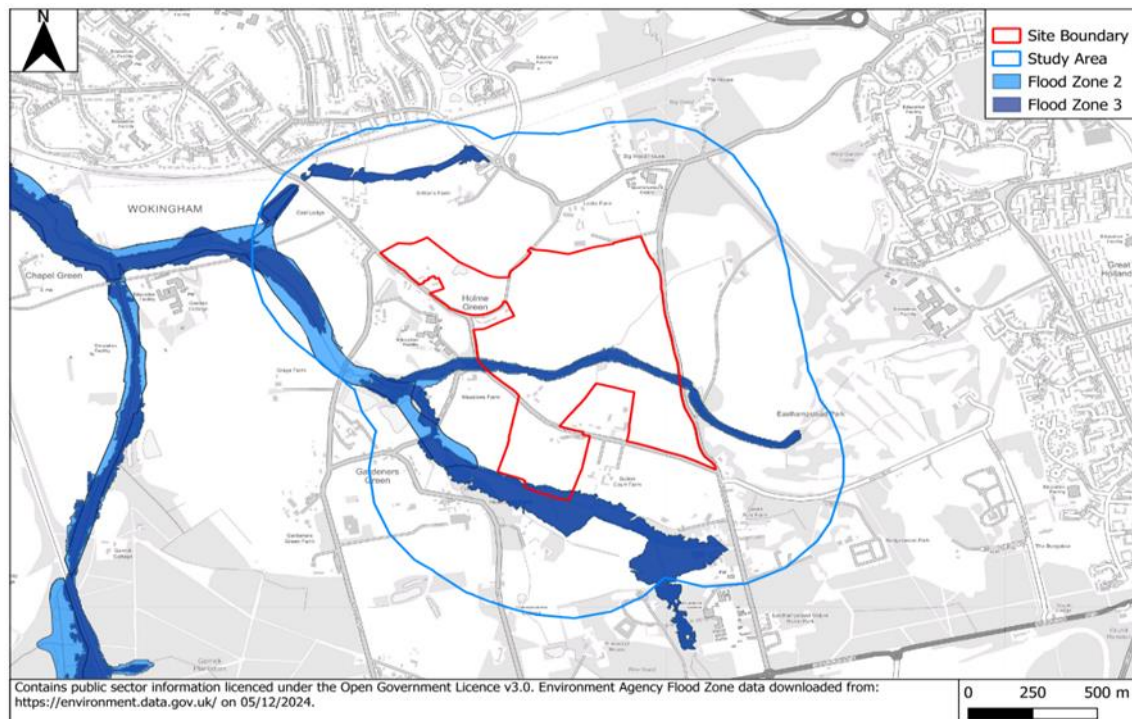
the EA surface water mapping because the EA mapping does not pick up on this localised feature.

- 9.53 There is a flow route along the southern boundary of the 'Lightwood' Site. This flow route is associated with Emm Brook which flows to the south of the 'Lightwood' Site.
- 9.54 There is a flow route near the western boundary of the 'Lightwood' Site which originates entirely from within the 'Lightwood' Site boundary.
- 9.55 There are some localised areas of ponding within the 'Lightwood' Site which area associated with low lying areas in the topography.
- 9.56 **Figure 9.6** indicates that there is a flow route along Holme Green Lane/Byway 30. This flow route flows from north-east to south-west. The topographical survey indicates that there is a drainage ditch to the east and west of Holme Green Lane/ Byway 30. It is likely that the surface water would flow along this drainage ditch. The topographical survey shows that the ditches are approximately 0.5m to 1m in deep and between 3m and 4m from top of bank.

Fluvial Flood Risk

- 9.57 **Figure 9.9** shows an extract from the EA's Flood Map for Planning which indicates the fluvial flood risk across the Site.

Figure 9.9 – EA Flood Map for Planning



9.58 **Figure 9.9** shows that the majority of the Site lies within Flood Zone 1. Flood Zone 1 is defined as 'Low Probability' – land at less than 1 in 1000 (0.1%) annual probability of river or sea flooding.

9.59 Land adjacent to the unnamed Ordinary Watercourse in the 'Lightwood' Site is shown to be located within Flood Zones 2 and 3. Flood Zone 2 is defined as 'land between a 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of river flooding, or land having between a 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of sea flooding'. Flood Zone 3 is defined as 'land at 1 in 100 (1%) or greater annual probability of river flooding, or 1 in 200 (0.5%) or greater annual probability of sea flooding'.

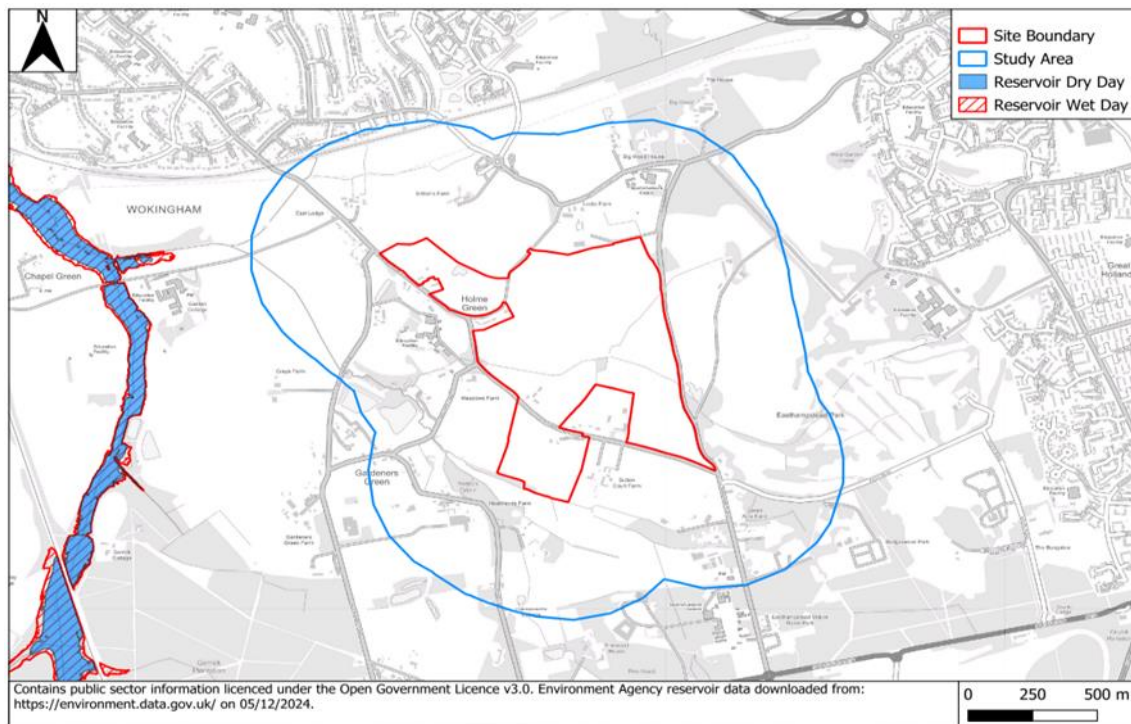
Groundwater Flood Risk

9.60 The WBC Level 1 SFRA, Appendix A, Figures D3 and E3 contain mapping which shows the EA areas susceptible to groundwater flooding. The mapping shows that the western part of the Site is located within a 1km² grid square which less than 25% of the area is susceptible to groundwater flooding. The central and eastern part of the Site is located within a 1km² grid square of which between 25% and 50% of the area is susceptible to groundwater flooding. The southern part of the Site is located within a 1km² grid square of which between 50% and 75% of the area is susceptible to groundwater flooding.

9.61 The WBC Level 1 SFRA, Appendix A, Figures D3 and E3 contain mapping which shows the groundwater emergence, depth below the ground surface dataset. The mapping indicates that there is an area to the north of the Ordinary Watercourse there is an area where groundwater is between 0.025m and 0.5m below the ground surface and less than 0.025m below the ground surface. The area to the south of Easthampstead Road and south-eastern corner of the site is shown to have a groundwater level of between 0.025m – 0.5m below the ground surface and less than 0.025m below the ground surface. The mapping does not include data for the rest of the Site.

Reservoir Flood Risk

9.62 **Figure 9.10** shows an extract from the EA Flood Risk from Reservoirs mapping which indicates the areas that would be at risk of flooding in the event of a reservoir breach.

Figure 9.10 – EA Reservoir Flood Risk

- 9.63 **Figure 9.10** indicates that the entire Site is located outside of the area at risk of flooding in the event of a reservoir breach. The Site is therefore at a low risk of flooding from reservoirs.

Existing Surface Water Drainage Infrastructure

- 9.64 Asset location plans were provided by Thames Water. A copy of the asset location plans is provided within **Appendix 9.1**. The Thames Water asset location plans indicate that there are no surface water drainage sewers within the Site. The risk of flooding from surface water drainage is therefore considered to be low.

Summary of Baseline Conditions

- 9.65 The baseline conditions as described above are grouped into four areas that could be impacted upon by changes to the Site hydrology because of the development. These are pluvial, fluvial, groundwater, reservoir and surface water drainage.
- 9.66 The 'NKH' Site has isolated areas of surface water ponding which is associated with low points in the topography within the site. The 'Lightwood' Site has several surface water flow routes within the Site and localised areas of ponding associated with low points in the topography. There is a surface water flow route along Holme Green Lane/ Byway 30.
- 9.67 The majority of the Site is located within Flood Zone 1. The areas adjacent to the Ordinary Watercourse and Emm Brook in the 'Lightwood' Site area located within Flood Zones 2 and 3.

- 9.68 The risk of groundwater flooding across the majority of the Site is considered to be low to medium. The risk of groundwater flooding adjacent to the Ordinary Watercourses is considered to be medium to high.
- 9.69 The EA Risk of Flooding from Reservoirs mapping indicates that the entire 'Site' is located outside of the area at risk of flooding in the event of a reservoir breach. The entire 'Site' is therefore at low risk of reservoir flooding.
- 9.70 Thames Water asset location maps indicate that there are no surface water sewers within the Site boundary. The risk of flooding from surface water drainage sewers is therefore considered to be low.
- 9.71 As such it can be said that the majority of the Proposed Development is in an area with little or no risk of flooding.

Future Baseline Conditions

- 9.72 Ignoring the effects of climate change, if the Proposed Development was not brought forward, the baseline conditions for the Site would remain similar to present with regards to hydrology and flood risk. This assumes that any existing drainage infrastructure and/or watercourses are well maintained and the current level of protection continues.
- 9.73 The volume and intensity of rainfall events is expected to increase with the effects of climate change. The increase in precipitation volume and intensity may cause an increase in fluvial and surface water flooding and increase the pressure on sewage infrastructure. Groundwater levels could increase with an increase in the overall volume of rainfall. The impact of climate change would occur with or without the Proposed Development.

Assessment of Effects

Effects During Construction

Increased Pollution of Surface Water and Groundwater Features

- 9.74 During the construction spills of oils or hazardous materials could decrease the surface water quality. Runoff of pollutants from the site compounds can be toxic to aquatic life and reduce the quality of groundwater and surface water.
- 9.75 Construction activities will be located close to the Emm Brook and the Ordinary Watercourse. Without mitigation measures, pollutants could be washed into the watercourses or groundwater.
- 9.76 Appropriate interceptors will be incorporated into the drainage strategy. Spill kits will be available and site workers will be trained in how to use them. Any captured pollutants will be removed before the operation phase.
- 9.77 The sensitivity of the Ordinary Watercourse is considered to be low. With the implementation of the temporary drainage strategy and actions within the CEMP, the magnitude of change is considered to be minor. There is likely to be a direct, temporary, short-term, minor adverse (not significant) effect.

- 9.78 The sensitivity of Emm Brook is considered to be high. With the implementation of the temporary drainage strategy and actions within the CEMP, the magnitude of change is considered to be minor. There is likely to be a direct, temporary, short-term, minor adverse (not significant) effect.
- 9.79 The sensitivity of the London Clay Formation is considered to be medium. With the implementation of the temporary drainage strategy and actions within the CEMP, the magnitude of change is considered to be minor. There is likely to be a direct, temporary, short-term, minor adverse (not significant) effect.

Increased Sedimentation of Surface Water Features due to Surface Erosion

- 9.80 During the construction phase the mobilisation and subsequent runoff of sediment from construction activities including clearance, excavation, stockpiling, vehicle movements, spillages and disposal could reduce the surface water quality.
- 9.81 Surface water runoff with a high sediment content can have a direct adverse effect on the water quality through increasing the turbidity, covering aquatic vegetation and substrate, and impact invertebrate and fish communities feeding and spawning areas. Indirect adverse effects can occur when the sediment contains pollutants including heavy metals and pesticides.
- 9.82 The effects of the construction phase would reduce when the construction phase finished.
- 9.83 The sensitivity of the Ordinary Watercourse is considered to be low. With the implementation of the temporary drainage strategy and actions within the CEMP, the magnitude of change prior to mitigation is considered to be minor. There is likely to be a direct, temporary, short-term, negligible (not significant) effect.
- 9.84 The sensitivity of Emm Brook is considered to be high. With the implementation of the temporary drainage strategy and actions within the CEMP, the magnitude of change prior to mitigation is considered to be minor. There is likely to be a direct, temporary, short-term, negligible (not significant) effect.

Increased Flood Risk Associated with the Temporary Works within the Fluvial and Surface Water Flood Zones

- 9.85 The construction of the Proposed Development may increase flood risk. Flood storage areas and flow routes may be impacted by the construction activities and impact pathways and have an impact on downstream receptors. The compaction of the ground and increase in impermeable areas could increase the surface water runoff and increase the peak flows.
- 9.86 There is a Medium and High risk of fluvial flooding alongside the Emm Brook and Ordinary Watercourse. The surface water flood extents are similar to the fluvial extents along Emm Brook and the Ordinary Watercourse. There are additional surface water flow routes along the Ordinary Watercourse tributary and the secondary Ordinary Watercourse tributary watercourse corridors.

- 9.87 A temporary drainage strategy will be implemented for the construction phase to attenuate surface water flows and provide treatment where necessary. A CEMP will be implemented detailing the mitigation measures including no materials to be stored within the floodplain. Flood risk awareness training will be delivered to the site workers.
- 9.88 The flood risk is dependent on the magnitude of the flood event and the depth of flooding to the Site. The risk of a significant flood event occurring during the construction phase is considered to be relatively low.
- 9.89 The sensitivity of the site workers is considered to be very high. With the implementation of the temporary drainage strategy and actions within the CEMP, the magnitude of change prior to mitigation is considered to be minor. There is likely to be a direct, temporary, short-term, negligible (not significant) effect.

Effects During Operation

Increased Pollution of Surface Water and Groundwater Features

- 9.90 Surface water containing silt or pollutants may runoff into surface water or groundwater features via the newly constructed roads. Untreated, polluted surface water runoff could runoff into the surface water drainage features, watercourses or groundwater bodies.
- 9.91 The nature of the spills and polluted runoff is anticipated to be minor due to the residential nature of the Proposed Development. The greater risks are from the movement of vehicles around the development and residents disposing of chemicals. The general runoff of the surface water runoff is reasonable as it primarily originates from rainfall onto hardstanding areas and rooves.
- 9.92 Inherent mitigation measures will be used including filtration in the SUDS features and water quality treatment stages. The discharge into watercourses will be limited therefore limiting significant volumes of surface water flows entering the watercourses carrying pollutants.
- 9.93 The sensitivity of the Ordinary Watercourses is considered to be low. With the implementation of the drainage strategy and actions within the CEMP, the magnitude of change prior to mitigation is considered to be minor. There is likely to be a direct, temporary, short-term, negligible (not significant) effect.
- 9.94 The sensitivity of the Emm Brook is considered to be high. With the implementation of the drainage strategy and actions within the CEMP, the magnitude of change prior to mitigation is considered to be minor. There is likely to be a direct, temporary, short-term, negligible (not significant) effect.
- 9.95 The sensitivity of the London Clay Formation is considered to be medium. With the implementation of the drainage strategy and actions within the CEMP, the magnitude of change prior to mitigation is considered to be minor. There is likely to be a direct, temporary, short-term, negligible (not significant) effect.

Increased Flood Risk to the Proposed Development Including People and Property Outside of the Proposed Development

- 9.96 Without mitigation measures in place, the Proposed Development could increase the impermeable area of the Site causing an increase in the overland flow and an increase in flood risk which could effect the Site users and offsite.
- 9.97 With inherent mitigation measures in place, it ensures that there is no increase in flood risk. All built development will be located within Flood Zone 1 'Low risk'. Finished floor levels of the development will be greater than 150mm above the finished ground levels. Surface water discharge into the watercourses will be limited to the QBAR value.
- 9.98 The sensitivity of the Site residents and visitors is considered to be very high. With the implementation of the temporary drainage strategy and actions within the CEMP, the magnitude of change prior to mitigation is considered to be negligible. There is likely to be a direct, temporary, short-term negligible (not significant) effect.

Proposed Mitigation

- 9.99 Mitigation measures are proposed where effects are identified, with the aim of avoiding, reducing, or compensating for potential adverse effects and maximising potential for beneficial effects. The most effective measures are those that are 'designed in' to the scheme (inherent mitigation measures), leading to the avoidance of identified impacts or a reduction in impact magnitude.

Inherent Mitigation Measures

- 9.100 A sequential approach to the layout of the Site was used during the master planning of the Site. For example, residential development located within Flood Zone 1 and SANG located in areas of Flood Zone 2 and 3 and watercourse corridors along the surface water drainage flow routes.
- 9.101 The implementation of a temporary drainage strategy during the construction phase and a surface water drainage basins incorporated into the Site layout.
- 9.102 The implementation of such a surface water drainage strategy incorporating SuDS will include filtration and conveyance, attenuation and controlled discharge of surface water runoff, thus mimicking existing Greenfield conditions and reducing flood risk both on and off site.
- 9.103 Finished floor levels will be set a suitable freeboard above the design flood event including an appropriate allowance for climate change. This will be subject to detailed design.

Standard Mitigation

- 9.104 The general practices that will be undertaken during the construction phase comprise many standard mitigation measures. A CEMP will be prepared as part of the detailed design phase which will set out the standard mitigation measures.

Actionable Mitigation

- 9.105 It is acknowledged that over time, if not appropriately managed, the potential build-up of sediments within the attenuation basin features has the potential to result in the accidental release of physical contaminants to sensitive surface water receptors. To mitigate this potential impact, a commitment is made to ensure that the attenuation basin features are drainage infrastructure are appropriately managed and maintained throughout the duration of the operational phase of the development. A maintenance schedule detailing how these features are to be managed and maintained has not yet been agreed. This will need to be developed further during the detailed design phase.

Residual Effects

- 9.106 The residual effects during the construction and operation phases are the same as pre-mitigation as the effects are mitigated through inherent mitigation measures.

Cumulative Effects Assessment

- 9.107 Cumulative effects during construction includes the mobilisation of runoff of sediment into the watercourses and spillages of oil or pollutants. Mitigation measures will be put in place to manage the effects and reduce the magnitude and significance of effects. It is anticipated that similar measures will be used at the other sites to meet standard requirements.
- 9.108 The cumulative effects during construction are negligible.
- 9.109 Cumulative effects from an increase in flood risk is considered to be negligible. Each development is assumed to have followed the NPPF planning guidance and will, therefore, not result in any increase in flood risk off site.
- 9.110 There are cumulative impacts that could be considered minor beneficial in terms of further attenuating and restricting surface water runoff into nearby watercourses and improving the water quality from appropriate SuDS design.

Limitations and Assumptions

- 9.111 The assumptions made, and their limitations are summarised below.
- 9.112 The EA flood risk data which includes the Flood Map for Planning, Risk of Flooding from Surface Water, risk of reservoir flooding, historic flood extents, WFD catchments and Main Rivers is representative of the hydrology and flood risk conditions to the Site.
- 9.113 The WBC SFRA flood risk data is representative of the flood risk conditions at the Site.
- 9.114 The topographical survey carried out by MK Surveyors is representative of the ground levels across the Site.
- 9.115 The limitations identified above have not prevented a full assessment of the likely significant environmental effects of the Proposed Development.

Summary of Effects

- 9.116 A summary of effects can be found in **Table 9.5** in relation to significant of effect.

Table 9.5 – Summary of Effects

Potential Impact	Significance of Effect	Mitigation Measures	Residual Effect after mitigation
Increased pollution of surface water and ground water features.	Negligible – not significant		Negligible – not significant
Increased sedimentation of surface water features due to surface erosion.	Negligible – not significant		Negligible – not significant
Increased flood risk associated with temporary works within the fluvial and surface water flood zones.	Negligible – not significant		Negligible – not significant
Increased flood risk to the Proposed Development including people and property outside of the Proposed Development.	Negligible – not significant		Negligible – not significant

Conclusion

Introduction

- 9.117 This assessment has been undertaken to determine the potential effects of the Proposed Development on hydrology and flood risk.

Baseline Conditions

- 9.118 The EA Flood Map for Planning shows that the majority of the Site is located within Flood Zone 1 (land with less than 1 in 1000 annual probability of flooding). There are areas of Flood Zone 2 (land with between 1 in 100 and 1 in 1000 annual probability of fluvial flooding) and Flood Zone 3 (land with greater than 1 in 100 annual probability of fluvial flooding) along the Ordinary Watercourse and Emm Brook watercourse corridors.
- 9.119 The EA Risk of Flooding from Surface Water mapping shows that the majority of the Site has a 'Very Low' risk (less than 1 in 1000 annual probability) of surface water flooding. There are areas of 'Low' (between 1 in 100 and 1 in 100 annual probability), 'Medium' (between 1 in 30 and 1 in 100 annual probability) and 'High' (greater than 1 in 30 annual probability) risk of surface water flooding are primarily located along the watercourse corridors.

Likely Significant Effects

- 9.120 The likely significant effects during the construction phase include:
- Increased pollution of surface water and groundwater features;

- Increased sedimentation of surface water features due to sediment mobilisation and runoff;
- Increase in flood risk associated with the temporary works located within the fluvial and surface water flood zones.

9.121 The likely significant effects during the operation phase include:

- Polluted surface water discharging into the watercourses or groundwater from the new road network;
- Increase in flood risk to the Proposed Development and to people and property offsite.

Mitigation and Enhancement

9.122 The following mitigation measures will be incorporated into the Proposed Development to mitigate the effects.

9.123 A temporary drainage strategy will be implemented to mitigate the onsite flows, mitigate the risk of flooding and pollution entering the watercourses during the construction phase.

9.124 A CEMP will be in place for the construction work. The CEMP will include measures to mitigate the effects of physical and chemical contamination from entering the surface water and groundwater.

9.125 The drainage strategy will be inherent to the design of the Proposed Development in the operation phase// The drainage strategy will mitigate the impact of surface water runoff and sediment runoff to the receiving waterbodies. SuDS will be used in accordance with the relevant local and national guidance.

9.126 The Proposed Development will be raised above the 1 in 100 annual probability +45% climate change allowance flood level. The finished floor levels of the built development will be 150mm above the finished ground level.

9.127 The Proposed Development should not have basements proposed to mitigate the effects of groundwater flooding occurring, unless detailed groundwater analysis is carried out.

Conclusion

9.128 With mitigation measures in place, there are no adverse significant effects on hydrology of flood risk.