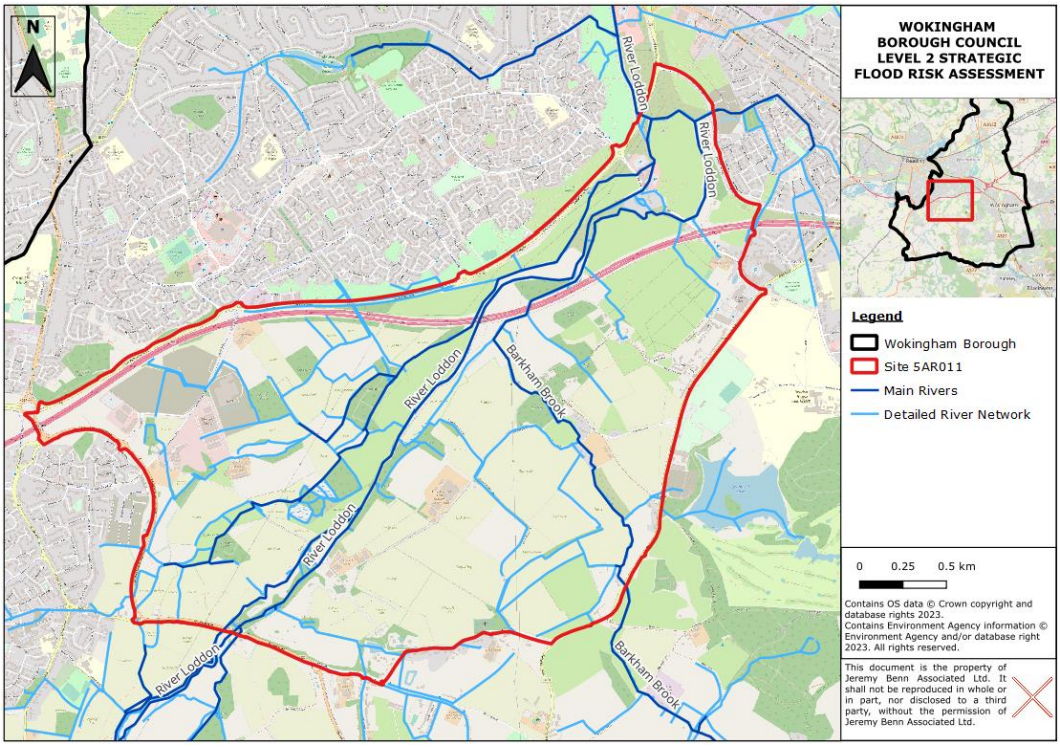
Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

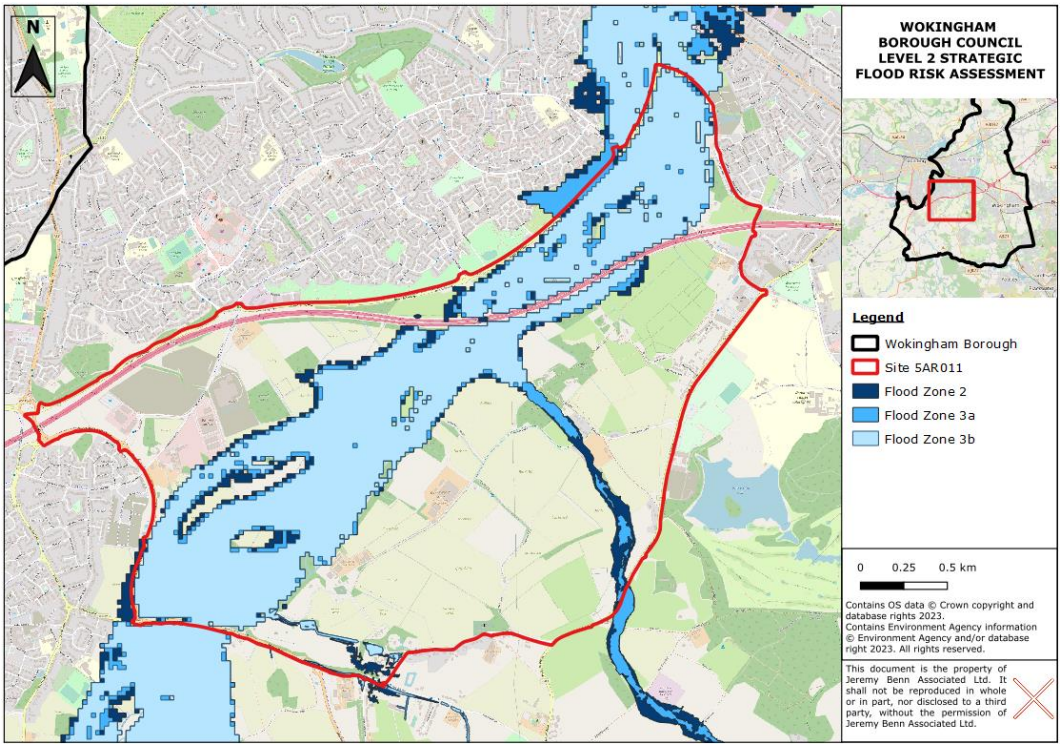
Site Code	**5AR011** Also includes 5AR014, 5AR015, 5AR025, 5AR029, 5AR030, 5AR032, 5SH012, 5SH049, 5WI001, 5WI002, 5WI015, 5WI018
Address	Arborfield strategic site
Area	735.4ha
Current land use	Predominantly greenfield, with brownfield areas such as Shinfield Studios to the north-west, and a small residential area to the west of Mole Road on the eastern site boundary.
Proposed land use	Mixed use garden community including employment floorspace

Sources of flood risk

Location of the site within the catchment	The site is located in the south-west of Wokingham Borough, on the southern border of Lower Earley. It is bordered by the urban centres of Shinfield to the west, and Winnersh to the east. The site is located on the confluence of Barkham Brook and the River Loddon at SU 76431 70022. Barkham Brook bisects the site, flowing from south-east to north-west, and has a predominantly rural catchment of approximately 1871ha. The River Loddon (Swallowfield to River Thames confluence) also bisects the site, flowing from south-west to north-east. The catchment is predominantly rural, and 5189.4ha.
Topography	1m LiDAR shows that the site generally slopes downwards towards the River Loddon and Barkham Brook. The western corner of the site is at a higher elevation of 71.6mAOD, and slopes down to the east, towards the River Loddon, around 39.6mAOD. The eastern and south-eastern sides of the site are at higher elevations of 56.4mAOD and 59.9mAOD respectively, and slope down towards the north-west and the River Loddon, approximately 39.7mAOD. The south-east of the site also slopes downwards towards the south, and Barkham Brook which lies at 40.2mAOD. Similarly, the south of the site slopes downwards towards the north and Barkham Brook. A raised motorway (M4) also runs east to west through the north of the site before following the north-western site border.
Existing drainage features	The River Loddon bisects the site, flowing from south-west to north-east. Barkham Brook flows from south-east to north-west, discharging into the River Loddon at SU 76431 70022.

	The site also contains an extensive network of field drainage features and unnamed watercourses (see Figure 1). Those in the north and north-west, far south, and far north-east discharge into the Loddon; those in the south-east discharge into Barkham Brook.  Figure 1: Existing drainage features in site 5AR011
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 29% of the site Flood Zone 3a covers 32% of the site Flood Zone 2 covers 35% of the site Flood Zone 1 covers 65% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** The Environment Agency's Flood Map for Planning has been used within the assessment of Barkham Brook. The detailed hydraulic model for the River Loddon updated by JBA in 2022 was used to assess flood risk from the River Loddon. The JBA 2023 detailed hydraulic model of Arborfield was used to assess fluvial flood risk in this area. **Flood characteristics:** Flood Zone 3b bisects the site channelled by the lower topography of the River Loddon, which flows from south-west to north-east. The modelled flood zone extends nearly 850m wide at the southern border of the site, it then splits into three different main areas as shown in Figure 2. The eastern extent is channelled by the lower topography of the River Loddon and

	measures a maximum of 332m wide, with maximum out of bank depths and velocities of 0.42m and 0.21m/s respectively in the 3.3% AEP event. The central extent measures 247m and is channelled by the lower topography of a small unnamed watercourses into The Swamp and other waterbodies. The maximum out of bank depths and velocities are 0.91m and 0.13m/s respectively in the 3.3% AEP event. The western extent measures a maximum of 184m wide and follows another unnamed watercourse through Shinfield Grange Conference Centre and Shinfield Studios. The maximum out of bank depths and velocities are 0.18m and 0.04m/s respectively in the 3.3% AEP event. The three extents combine again downstream of Shinfield Studios and flow north-east to the site border, which it then follows until the northern tip of the site. The flood extent of the River Loddon at this point is between 350m and 450m wide in extent and has maximum out of bank depths and velocities of 0.71m and 0.27m/s. The 1% AEP extent for Arborfield remains mostly in channel in this scenario; however, is shown to inundate Reading Road to a maximum depth of 0.15m. Flood Zone 3a follows the same pattern as 3b, as shown in Figure 2, extending 869m wide from the Loddon at the southern border. The eastern, central, and western extents split and measure 364m, 278m, and 236m wide respectively. Downstream, the River Loddon continues north-east to the northern site border and extends 390-490m wide. Barkham Brook flows south-east to north-west, where it discharges into the River Loddon at SU 76431 70022. At the upstream on the eastern border of the site, the flood extent measures a maximum of 80m wide onto the floodplains. This extends as you move downstream, increasing to 215m immediately upstream of its confluence with the River Loddon. Due to the lack of detailed hydraulic modelling, there was no depth or velocity data for Barkham Brook. The 1% AEP extent of Arborfield encroaches on the south-eastern corner of the site, posing a risk to Reading Road and a small cluster of properties. Maximum out of bank depth, velocity, and hazard here are 0.22m, 0.23m/s, and Very Low Hazard/Caution. Flood Zone 2 also extends out of bank of the River Loddon approximately 869m wide at the southern border of the site as shown in Figure 2. The eastern, central, and western extents split and measure 392m, 297m, and 252m wide respectively. The maximum depths and velocities for these flow paths are 0.71m and 0.23m/s, 0.99m and 0.23m/s, and 1.1m and 0.14m/s. Downstream, the River Loddon continues north-east to the northern site border and extends 390-490m wide out onto the floodplains. Maximum out of bank flood depth and velocity here is 1.25m and 0.32m/s. Barkham Brook also poses flood risk in Flood Zone 2. Again, the extent is narrower, approximately 121m wide from the river banks, towards the upstream near the eastern site border, and wider, approximately 242m, near its confluence with the River Loddon.

	The 0.1% AEP extent of the Arborfield model extends up to an additional 75m wide. Again, Reading Road is shown as being inundated, as are smaller access roads for a small cluster of properties. Maximum out of bank depth, velocity, and hazard here are 0.28m, 0.29m/s, and Very Low Hazard/Caution.  Figure 2: Fluvial flood risk to 5AR011
Surface water	**Proportion of site at risk:** **3.3% AEP** – 6% Max depth between 0.6m and 0.9m Max velocity between 0.5m/s and 1m/s **1% AEP** – 11% Max depth between 0.9m and 1.2m Max velocity between 1m/s and 2m/s **0.1% AEP** – 29% Max depth over 1.2m Max velocity between 1m/s and 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all scenarios. Similar to the fluvial Flood Zones, surface water flows south-west to north-east through

	the site, flowing towards areas of lower topography, where it is channelled into the River Loddon. Similarly, surface water also flows south-east to north-west, flowing towards areas of lower topography, where it is channelled into Barkham Brook. This is also the case for field drainage features and small unnamed watercourses that lie at lower topography than the surrounding land. In the 3.3% AEP event, surface water in the south and south-west of the site is channelled into, and mostly confined by, the River Loddon, and surrounding unnamed drainage features. Where surface water flows out of bank to the east of the River Loddon, the flood extent is up to 91m wide, with maximum depths of 0.6-0.9m, velocities of 0.25-0.5m/s, and hazard of Danger for Some. In the north of site, surface water ponds against the northern side of the raised highway (M4), to maximum depths of 0.3m-0.6m. North of this, most surface water is contained by the channel of the River Loddon. To the east of the site, surface water is channelled into Barkham Brook, but is not contained by the channel. The surface water flood extent measures approximately 71m wide at the eastern border of the site, with a maximum depth, velocity, and hazard of 0.3m-0.6m, 0.5m/s-1m/s, and 1.25-2. Further downstream on Barkham Brook, around 150m from its confluence with the River Loddon, the surface water flood extent is 116m wide, with maximum depth, velocity, and hazard of 0.6m-0.9m, 0.5m/s-1m/s, and 1.25-2. Surface water channelled by the unnamed drainage features in the south and south-west is not contained by the channel. Surface water maximum depth, velocity, and hazard in this area are 0.3m-0.6m, 0m/s-0.25m/s, and 0.75-1.25. Where surface water spills out of bank to the east of the River Loddon, around 1.3km downstream of the southern border, extents are up to 102m wide, with maximum depth, velocity, and hazard of 0.6-0.9m, 0.25-0.5m/s, and 1.25-2. Surface water also begins to flow to the west of the River Loddon up to 190m wide onto the surrounding low lying floodplain. In the north of site, surface water ponds against the northern side of the raised highway (M4), to maximum depths of 0.3m-0.6m. North of this, most surface water is contained by the channel of the River Loddon. To the east of the site, surface water surface water is channelled into Barkham Brook, but is not contained by the channel. The surface water flood extent measures approximately 79m wide at the eastern border of the site, with a maximum depth, velocity, and hazard of 0.6m-0.9m, 0.5m/s-1m/s, and 1.25-2. Further downstream on Barkham Brook, extends out onto the floodplains, around 150m from its confluence with the River Loddon, the surface water flood extent is 148m wide, with maximum depth, velocity, and hazard of 0.6m-0.9m, 1m/s-2m/s, and 1.25-2. In the 0.1% AEP event, surface water in the south of the site is channelled by the River Loddon and the network of small unnamed watercourses, but it overflows out onto the low-lying floodplains. Surface water reaches a

	maximum out of bank depth, velocity, and hazard of 0.6m-0.9m, 0.25m/s-0.5m/s, and 1.25-2. Downstream, the surface water that overflows onto the low-lying floodplains of the Loddon measures approximately 96m to the east, and 205m to the west. Maximum out of bank depth, velocity, and hazard here are 0.6m-0.9m, 0.5m/s-1m/s, and 1.25-2; and 0.9m-1.2m, 0.25m/s-0.5m/s, and 1.25-2 respectively. Ponding along the motorway (M4) now occurs on the north and south, to maximum of 0.6m-0.9m. The ponding on the south flows east along the edge of the motorway to the north-eastern border of the site. North of the M4, surface water is not contained in channel by the River Loddon. Maximum out of bank depths and velocities are 0.3m-0.6m and 0.25m/s-0.5m/s. To the east of the site, surface water is channelled into Barkham Brook, but is not contained in bank. The surface water flood extent measures approximately 141m wide at the eastern border of the site, with a maximum depth, velocity, and hazard of 0.9m-1.2m, 1m/s-2m/s and over 2. Further downstream on Barkham Brook, around 150m from its confluence with the River Loddon, the surface water flood extent is 203m wide, with maximum depth, velocity, and hazard of 0.9m-1.2m, 1m/s-2m/s, and over 2.
Reservoir	Reservoir flood mapping shows that areas of low lying topography are at risk of flooding from numerous reservoir extents. **Wet Day** The following reservoirs are channelled by the River Loddon in the Wet Day scenario, and flow south-west to north-east. • Bearwood Lake – flood extent is confined by the River Loddon channel and surrounding drainage features • Bramshill House Pond – flood extent is confined by the River Loddon channel • Tundry Pond – flood extent is confined by the River Loddon channel • Wellington Country Park Lake - flood extent is confined by the River Loddon channel and surrounding drainage features The following reservoirs are channelled by Barkham Brook in the Wet Day scenario, flowing south-east to north-west. They are subsequently discharged into the River Loddon before flowing north-east. • Bearwood Lake – Extent along Barkham Brook ranges between 78m and 247m wide, but is later confined by the River Loddon channel • Longmoor Lake - confined by Barkham Brook and the River Loddon channel The 'Wet Day' event seeks to estimate the effect of a breach at the same time as a 0.1% AEP river flood is occurring and suggests that the consequences of such a breach are similar to the modelled 0.1% AEP event river flood event, but probably would be associated with a much lower probability. **Dry Day** The following reservoirs are channelled by the River Loddon in the Dry Day scenario, and flow south-west to north-east.

	• Bearwood Lake - flood extent is channelled by lower topography of the River Loddon, with a maximum flood extent of 1.1km wide in the north of the site. • Bramshill House Pond – flood extent is channelled by lower topography of the River Loddon, with a maximum flood extent of 1.1km wide in the north of the site. • Maiden Erlegh Lake – flood extent is flow propagates upstream along the Loddon from the north of the site to the boundary of the M4 motorway • Queensmere - flood extent is flow propagates upstream along the Loddon from the north of the site to the boundary of the M4 motorway • Southlake - flood extent is flow propagates upstream along the Loddon from the north of the site to the boundary of the M4 motorway. • Tundry Pond – flood extent is channelled by lower topography of the River Loddon, with a maximum flood extent of 1.1km wide in the north of the site. • Wellington Country Park Lake - flood extent is channelled by lower topography of the River Loddon, with a maximum flood extent of 1.1km wide in the north of the site. The following reservoirs are channelled by Barkham Brook, flowing south-east to north-west. They are subsequently discharged into the River Loddon before flowing north-east. • Bearwood Lake – flood extent along Barkham Brook ranges between 128m and 626m wide but is later channelled by lower topography of the River Loddon, with a maximum flood extent of 1.1km wide in the north of the site. • Longmoor Lake - flood extent is confined by Barkham Brook and the River Loddon channel It is important to note that the Wet Day extent is up to 342m more extensive that the EA's FMfP Flood Zone 2, particularly along the River Loddon. For all reservoirs aside from Tundry Pond, flood extents encroaching the sites are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF data suggests that there is a band of land that is more susceptible to groundwater flooding that follows the path of the River Loddon, from the south-west of the site to the north-east. This band has a greater than 50% susceptibility to groundwater flooding. The south-east and far west of the site are at less than 25% risk of groundwater flooding. The JBA Groundwater emergence map provides a 5m resolution grid square, showing the likelihood of groundwater emergence based on groundwater levels. This map suggests there is no risk of groundwater emergence along the route of the River Loddon and Barkham Brook. However, the east of the River Loddon has higher groundwater emergence levels of between 0.025m and 5m of the surface. Similarly, the west of the

	River Loddon has groundwater levels at or very near the surface, as well as between 0.025m and 5m of the surface. As the results of the two datasets above show different scenarios along the River Loddon, this should be investigated further. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The north-western border of the site is located in the post-code area RG6 4. Since 2000, there are 60 recorded incidences of sewer flooding within the bounds of the site. These have occurred along Mole Road to the east of the site, and Arborfield Road along the southern border. Since 2000, there are over 286 recorded incidences of sewer flooding within 500m of the site. The majority of these occurred in the urban centres of Lower Earley, Shinfield, Winnersh, and Sindlesham. Thames Water has identified clusters of flooding within the Arborfield STW catchment. Thames Water recognise that Arborfield and Wokingham Sewage Treatment Works will reach quality and/or flow exceedance over the coming Amps. Further investigation is required to understand what upgrades will be required to manage this constraint.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show numerous instances of fluvial flooding bisecting the site along the River Loddon due to bank overtopping. The data shows maximum flood extents as being 924m wide at the southern border of the site. North of the M4, this extends to over 1.5km. This is shown to impact a large proportion of Lower Earley to the north of the site. There is no data available in these datasets of Barkham Brook. The WBC historic flood points show there are 9 recorded incidents of flooding within the site. These are mostly due to main river flooding, but there are also incidences of surface water flooding in the south and south-west of the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows that the site is not protected by any formal flood defences; however, natural high ground bisects the site, running along the western and eastern banks of the River Loddon. This is also the case for Barkham Brook.
Residual risk	There is a network of small unnamed drainage features shown in Figure 1 that discharge into the River Loddon which could pose residual risk if there was to be a blockage. There are also a series of culverts on these drainage features, which if blocked or partially blocked, could back up and inundate the site.

Emergency planning

Flood warning	This site spans the following three Flood Warning Areas: 061FWF24 River Loddon at Arborfield and Shinfield

	061FWF24L River Loddon at Lower Earley and Sindlesham 061FWF24 River Loddon at Winnersh and Woodley This site spans the following Flood Alert Area: 061WAF24 Lower River Loddon
Access and egress	There are numerous ways in which the site can be accessed, this includes via Lower Earley Way along the northern border, Hatch Farm Way along the north-eastern border, Mole Road along the eastern border, Church Lane along the south-eastern border, Arborfield Road and Reading Road along the southern border, and Cutbush Lane East off the Shinfield Eastern Relief Road along the western border. Access cannot be granted from the M4 motorway as this is a raised highway. All fluvial depths and velocities quoted in this section are derived from the 1% AEP plus 23% climate change (Higher Central allowance) event in the River Loddon model. All surface water depths and velocities quoted are derived from the 1% AEP plus 40% event. Fluvial flooding from the River Loddon in the north of the site impedes access from Lower Earley Way when accessing from the east. Fluvial depth and velocity here are shown to reach 0.58m and 0.33m/s. Hazard index was not made available for the River Loddon. Similarly, the River Loddon impedes access from Hatch Farm Way when accessing from the north. Maximum depth and velocity on the road are 1.22m and 0.31m/s. In the south of the site, the River Loddon also floods Reading Road along the south-west border to depths and velocities of 0.71m and 1.28m/s. This is also the case for Shinfield Eastern Relief Road when travelling from the south. Depths and velocities here are 0.62m and 0.1m/s. These flood depths would impede vehicular access and egress to the site from Lower Earley Way. Surface water also floods Lower Earley Way. At the west of the site, east of the A327 junction, flow paths along the road reach 0.26m, 1.53m/s, and Very Low Hazard/Caution depth, velocity, and hazard. Further east, surface water flowing across the road around the junction with Beeston Way experience depth, velocity, and hazard of 0.52m, 1.24m/s, and Danger for Most. At the north of the site, surface water channelled into the River Loddon also poses a risk to Lower Early Way, with depth, velocity, and hazard of 1.16m, 0.55m/s, and Danger for Most. Surface water also ponds on the northern tip of the site at the junction between Lower Early Way North and Hatch Farm Way to depths of 0.58m. A second location of surface water flooding on Hatch Farm Way is located south of Rhodes Close to depths and velocities of 1.21m and 0.58m/s. The roundabout with Mill Lane, Mole Road, and New Road on the north-eastern border is at significant surface water flood risk, to depths and velocities of 0.33m and 1.65m/s. Further south-west on Mole Road, north of Harrow Road, depths and velocities are 0.25m and 1.14m/s. On the south-eastern border, Barkham Brook channels surface water north across Mole Road. This surface water flow path inundates the road to depths and velocities of 1.97m and 2.95m/s. On the southern border, Arborfield Road and Shinfield

	Eastern Relief Road are impacted by surface water channelled by the lower topography around the River Loddon. Maximum road depths and velocities are 1.61m and 1.2m/s and 0.39m and 1.12m/s on Arborfield Road and Shinfield Eastern Relief Road respectively. Due to the depths and velocities mentioned above, it is highly likely that emergency access will be affected along all access routes. At present, safe access and egress cannot be demonstrated in the 1% AEP plus 40% climate change surface water event. Additionally, safe access and egress can only be demonstrated in the 1% AEP plus 23% climate change fluvial event when accessing the site from the north via Shinfield Eastern Relief Road, and from the South via Mole Road. In order to develop on this site, safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is/is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • The central (1% AEP plus 14% event) and the higher central (1% AEP plus 23% event) uplifts have been used to assess the impacts of climate change at this site/ • Detailed hydraulic modelling of the River Loddon shows the central climate change extent bisecting the site, flowing from south-west to north-east. The modelled extents measures approximately 891m, at the southern border of the site, and 636m at the northern border. • The River Loddon is most sensitive to climate change around the M4 raised motorway, with extents increasing by up to 75m to the west and 25m to the east in the higher central climate change event. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on surface water flood risk. • The River Loddon and Barkham Brook channel surface water through the areas of lower topography, as do the smaller field drainage features. • Where the River Loddon splits into three bands to the south of the site, surface water extents in the south measure 30m on the western path through Shinfield Grange Conference Centre and Shinfield Studios, 90m on the central path following small unnamed

	watercourses into The Swamp and other waterbodies, and 106m on the eastern path following the River Loddon. • Towards the north of the site, where surface water is channelled by the lower topography of the River Loddon, extents measure up to 188m wide. Additionally, ponding on 240m occurs to the west of the Loddon on an area of green space. • This site is extremely sensitive to climate change in the 1% AEP plus 40% climate change event, particularly in the south of the site, where extents increase by up to 140m. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand
	  ○ Superficial – Along the immediate floodplain of the River Loddon and Barkham Brook, the geology is mainly Alluvium - Clay, silt, sand, and gravel. Geology in the wider are if a combination of River Terrace Deposits, 2 - Sand and gravel and Brickearth - Clay, silt, and sand
	• Soils at the site consist of:
	  ○ The floodplain of the River Loddon consists of loamy and clayey floodplain soils with naturally high groundwater. Bands slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils lie either side of this
	Sustainable Drainage Systems (SuDS)
	• The north-west and south-east of the site is shown to have a low susceptibility to groundwater. As such, detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Groundwater monitoring is recommended to determine the seasonal variability of groundwater levels, as this may affect the design of the surface water drainage system. Below ground development such as basements may not be appropriate at this site.
	• The floodplain of the River Loddon however is at a higher susceptibility to groundwater flooding, and therefore groundwater flooding could occur at the surface which may flow to and pool within topographic low spots during very wet winters. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below

	ground development such as basements are not appropriate at this site. Where groundwater levels are indicated to be at or very near (within 0.025m) ground level, there is also a surface water flow path identified within a 1% AEP event, this may indicate where water will flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site. • BGS data indicates that the underlying geology is a combination of clay and river terrace deposits which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is partially located within Groundwater Source Protection Zone (SPZ) 1 and infiltration techniques may not appropriate for anything other than clean roof drainage. If infiltration is proposed for anything other than clean roof drainage in SPZ 1, a hydrogeological risk assessment should be undertaken to ensure that the system does not pose an unacceptable risk to the source of supply. Infiltration techniques should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints. • The site has three areas within its boundary designated by the Environment Agency as being a historic landfill site. These are located on the northern border between the M4 and Lower Earley Way, to the north-east north of Gipsy Lane, and at Park Farm House south of Julkes Lane. A thorough ground investigation will be required as part of a detailed site-specific FRA, to determine potential mitigation for contamination and the impact this may have on SuDS. As such, proposed SuDS should be discussed with the relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 1% AEP event.

	Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could include a blue-green corridor along the River Loddon and Barkham Brook and around areas of surface water ponding. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff to the River Loddon and Barkham Brook should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows. • As the sites merged to form 5AR011 share drainage features and flood mechanisms, all combined sites should be considered together at the masterplanning stage to optimise flood risk management to and from each individual site.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as ‘More Vulnerable’.

	The Exception Test is required for this site because development is located within Flood Zone 3a. Additionally, 'More Vulnerable' and 'Less Vulnerable' infrastructure should not be permitted within Flood Zone 3b.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is located in Flood Zone 3a and Flood Zone 3b, and in at significant surface water flood risk. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. • A detailed hydraulic model of Barkham Brook may be required at FRA stage to accurately represent the risk from these watercourses. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor

	levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site.

Key message

Development on this site is likely to be able to proceed if:

- The area of the site located in Flood Zone 3a and 3b, immediately surrounding the River Loddon and Barkham Brook remains undeveloped.
- Development is steered away from surface water flow paths, particularly towards the south and south-west of the site. A carefully considered and integrated flood resilient and sustainable drainage design is put forward, to carefully consider, manage and mitigate existing flood risk both to and from the site.
- Safe access and egress can be demonstrated in the 1% AEP plus climate change surface water and fluvial events. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere. At present, safe access and egress cannot be demonstrated in the 1% AEP plus 40% climate change surface water event. Additionally, safe access and egress can only be demonstrated in the 1% AEP plus 23% climate change fluvial event when accessing the site from the north via Shinfield Eastern Relief Road, and from the South via Mole Road.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the detailed hydraulic model for the River Loddon updated by JBA in 2022, the JBA 2023 detailed hydraulic model of Arborfield, and the Environment Agency's FMfP and RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and 3b around the River Loddon have been taken from the JBA 2022 detailed hydraulic model for the River Loddon and the JBA 2023 hydraulic model of Arborfield. Flood Zone 2 and 3a around Barkham Brook was identified through the Environment Agency's FMfP as there was no available detailed hydraulic modelling.
Climate change	The most recent uplifts (+14%, +23% and +46%) have been applied to the River Loddon hydraulic model to indicate the impacts on fluvial flood risk. The most recent uplifts (+25% and +40%) have been applied to the River Arborfield hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have been applied to the RoFSW map to indicate the impact on surface water flood risk.
Fluvial depth, velocity and hazard mapping	Depth and velocity data was derived for the 3.3%, 1% AEP, and 0.1% AEP events from the River Loddon hydraulic model. There was no hazard data made available for this model.

Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5BA010**
Address	Barkham Square
Area	58.4ha
Current land use	Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located on the north-east border of Arborfield Green Lakeside, in Arborfield Green, to the south-east of Langley Common Road (B3349). The site is located in the south of Wokingham Borough, in the upstream reaches of Barkham Brook, around 3.6km from its confluence with the River Loddon. The catchment is approximately 1871ha and is predominantly rural. Barkham Brook bisects this site, flowing through the centre from south to north. An unnamed watercourse also flows westerly along the northern border of the site, flowing into Barkham Brook immediately downstream of the site.
Topography	LiDAR shows land in the north-west of the site slopes downwards from east to west, towards Barkham Brook which is at a lower elevation than the rest of the site. This is mirrored in the south-east of the site, where land slopes downhill from south-east to north-west.
Existing drainage features	Barkham Brook bisects the site, flowing south-west to north-east. At this point the Brook is predominantly rural and flows north-east to its confluence with the River Loddon. A small drain also flows south-west to north-east, bisecting the west of the site. The drain then flows along the northern border of the site, discharging into Barkham Brook at NGR SU7776660. There is also a pond located in the south of the site on the left bank of Barkham Brook. There are additional drainage features surrounding the site; for example, an unnamed watercourse flows from the east, along the northern border of the site, and discharges into Barkham Brook. A network of drainage features to the north also discharge into the Brook, flowing along Langley Common Road, Barkham Road, and School Road.

Fluvial	**The proportion of site at risk:** Indicative Flood Zone 3b covers 2% of the site Flood Zone 3a covers 2% of the site Flood Zone 2 covers 6% of the site Flood Zone 1 covers 94% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g., Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** The Environment Agency's Flood Map for Planning has been used within this assessment. No detailed hydraulic modelling was available for this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. **Flood characteristics:** Flood Zone 2 of the Environment Agency's Flood Map for Planning shows fluvial flood risk bisecting the centre of the site following Barkham Brook, which flows from south-west to north-east. Flood Zone 2 extends up to 75m wide across the Brook. Flood Zone 3a also follows Barkham Brook, but only presents flood risk to the downstream half of the site. No modelled data was available for Barkham Brook, so Flood Zone 3a was used as an indicative Flood Zone 3b in this instance.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 3% of the site Max depth is between 0.9m and 1.2m Max velocity is between 1m/s and 2m/s **1% AEP** covers 5% of the site Max depth is greater than 1.2m Max velocity is between 1m/s and 2m/s **0.1% AEP** covers 12% of the site Max depth is greater than 1.2m Max velocity is between 1m/s and 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g., 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. No detailed hydraulic modelling was available for this assessment.

	Description of surface water flow paths: The surface water flood risk across this site mainly follows Barkham Brook, bisecting the site flowing south-west to north-east. The immediate floodplain of Barkham Brook is also shown to be at surface water flood risk at all available return periods. Due to the surrounding topography, the 1%AEP surface water flood map shows areas of flood risk similar to the fluvial mapping, which extends either side of Barkham Brook approximately 50m in total. In-channel depths are shown to exceed 1.2m in places with depths of up 0.6m on the floodplain. There are two surface water flow paths joining Barkham Brook along the right bank. An additional surface water flow path follows the drainage feature in the west of the site, flowing from the south-west to north-east. The flow path then diverts from the drain, and flows directly north-east to Barkham Brook, rather than following the drain along northern border. This flow path is shown in all available surface water events.
Reservoir	Reservoir flood mapping shows the site is bisected along the path of Barkham Brook during both the 'Wet Day' and 'Dry Day' reservoir scenarios. Longmoor Lake is located in Arborfield Green, approximately 0.5km from the site. Longmoor Lake's 'Dry Day' extent flows in a northerly direction through the centre of the site, following Barkham Brook, extending up to 50m wide across the Brook. The 'Wet Day' event seeks to estimate the effect of a breach at the same time as a 0.1% AEP river flood is occurring and suggests that the consequences of such a breach are similar to the modelled 0.1% AEP event river flood event but associated with a much lower probability. It is important to note that the reservoir 'Wet Day' scenario extent is larger than the extent of Flood Zone 2. The direction and location of the flow paths remain the same. These extents encroaching the site are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF dataset suggests that the entire site is at less than 50% risk of groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. This largely agrees with the AStGWF dataset, with the majority of the site shown to be at no risk due to the nature of the underlying geological deposits. However, the south-west of the site is shown to have groundwater levels between 0.025 and 0.5m below ground level. This extends approximately 250m into the site. In this area there is a risk of groundwater flooding to both surface and subsurface assets. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.

Sewers	The western border of the site is located in a postcode area RG40 4. Since 2000, there have been no recorded incidences of sewer flooding within the site but there have been 32 recorded incidences of sewer flooding within 500m of the site. The majority of these occurred along Langley Common Road at the south-west corner of the site.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that there are no recorded incidences within or immediately surrounding the site. Historic flooding records provided by Wokingham Borough Council identify three incidences of fluvial flooding on the surrounding highways: Langley Common Road and Barkham Street, which could cause access issues.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences; however, a short section of natural high ground borders the north of the site following an unnamed tributary of Barkham Brook. This natural defence provides some level of protection from this tributary, until it's confluence with Barkham Brook immediately downstream of the site.
Residual risk	Barkham Brook is culverted under a footpath at the northern border of the site. This poses a residual; risk to the site as in the event of a blockage, water could back up and encroach on the site.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning Area but is located in the Lower River Loddon (061WAF24LLoddon) Flood Alert Area.
Access and egress	Existing access to the site can be found via Langley Common Road that runs along the north-west border of the site, or via Commonfield Lane, connected to Barkham Street, which runs along the south-east border. Both access routes detailed above are impacted by surface water and fluvial flooding when entering the site from the north. Surface water depths on Langley Common Road and Barkham Street rise up to 0.9m and 0.7m respectively in the 1%AEP plus 40% climate change event, with the deepest areas immediately adjacent to Barkham Brook and its tributaries. When approaching the site from the south, Commonfield Lane is impacted by surface water flooding to a maximum of 0.25m in the 3.3%AEP plus 35% climate change scenario. In the 1%AEP plus 40% climate change scenario however, this rises to above 0.43m. The velocities on Commonfield Lane can increase to 0.85m/s and 0.86m/s for the two events respectively. Similarly, Langley Common Road is at surface water risk to depths of 0.34m and 0.46m for the 3.3%AEP plus 35% climate change and 1%AEP plus 40% climate change respectively. The maximum velocities for Langley Common Road are approximately 0.9m/s and 1.1m/s. As the site is bisected by a surface water flow path during this event, access to both the west and the east side of the site needs to be

	considered if access between them will not be possible during this flood event. Due to the depths and velocities mentioned above, it is highly likely that emergency access will be affected along both access routes. At present, safe access and egress cannot be demonstrated in the 1%AEP plus 40% climate change surface water event. In order to develop on this site, safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial/surface water event, which may involve raised access. Site drainage proposals should address the requirements for access and egress routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial** • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate change flood extent. Flood Zone 2 shows fluvial flood risk bisecting the centre of the site following Barkham Brook, which flows from south to north. Flood Zone 2 extends up to approximately 75m wide across the Brook. • The flow path following Barkham Brook is very sensitive to climate change. In Flood Zone 2, the flow path following Barkham Brook extends over 1km further upstream than in Flood Zone 3a, and is particularly wider on the right bank, likely due to the surrounding topography. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • The immediate floodplain of Barkham Brook is at surface water flood risk at all available climate change return periods and mainly follows Barkham Brook, bisecting the site flowing south to north. In the 1% AEP plus 40% climate change event the flow path extends up to 75m wide across the Brook. Two small tributaries on the right bank approximately 15m wide also act as surface water flow paths. • An additional 20m wide surface water flow path flows south-west to north-east through the north of the site, joining Barkham Brook downstream of the site. • Although no additional surface water flow paths emerge in the 1%AEP plus climate change, the existing paths are quite sensitive. Along Barkham Brook, the paths extend by up to an additional 4 to 14m.

	Similarly, flow paths along the drain in the north of the site extends by up to 16m in the upstream. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt, and sand.
	  ○ Superficial - Alluvium - Clay, silt, sand, and gravel
	• Soils at the site consist of:
	  ○ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
	Sustainable Drainage Systems (SuDS)
	• The site is considered to have a low susceptibility to groundwater. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Groundwater monitoring is recommended to determine the seasonal variability of groundwater levels, as this may affect the design of the surface water drainage system. Below ground development such as basements may not be appropriate at this site.
	• Across most of the site, groundwater levels are indicated to be at least 5m below ground level and groundwater flooding is not likely, however below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is loamy and clayey which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during all available return periods. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset

	should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could include a blue-green corridor along Barkham Brook and around areas of surface water ponding. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff to Barkham Brook should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as ‘More Vulnerable’. The exception test is required for this site because development designated as ‘More Vulnerable’ is located within Flood Zone 3a.

Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:**
	• At the planning application stage, a site-specific FRA will be required as the proposed development site is:
	  ○ Within Flood Zone 2 and 3a,
	  ○ In Flood Zone 1 where the SFRA shows it is at risk from other sources of flooding (specify which e.g. surface water, groundwater, reservoir), or will be during its lifetime

	• All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site. • A detailed hydraulic model of Barkham Brook may be required at FRA stage to accurately represent the risk from these watercourses.

Key message

Development is likely to be able to proceed if:

- The area of the site located in Flood Zone 3a, immediately surrounding Barkham Brook, is left undeveloped.
- Development is steered away from the additional surface water flow path in the north-west of the site, and the small flow paths in the south-east of the site that join Barkham Brook and these flow paths be incorporated and considered within the development site.
- In the absence of detailed hydraulic modelling, development should not be placed within the fluvial flood extents.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding in the eastern part of the site.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's FMfP and RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a have been taken from the Environment Agency's Flood Map for Planning. There is no detailed hydraulic modelling available at this location.
Climate change	The latest climate change allowances have been applied to the RoFSW map to indicate the impact on surface water flood risk. In the absence of detailed hydraulic modelling, Flood Zone 2 has been used as an indicative assessment of future fluvial risk at 1% AEP.
Fluvial depth, velocity and hazard mapping	There is no detailed hydraulic modelling available at this location.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

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Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5BA013**
Address	Woodlands Farm, Wood Lane, Barkham
Area	1.10ha
Current land use	Brownfield
Proposed land use	Residential – Gypsy and Traveller site

Sources of flood risk

Location of the site within the catchment	The site is located in the central extent of the Barkham Brook river catchment. The catchment is predominantly rural around the site. The Barkham Brook flows approximately 150m north east of the site in a northerly direction to its confluence with the River Loddon, approximately 3.2km north of the site.
Topography	1m LiDAR data shows that ground levels are greatest in the eastern of the site at around 51.8mAOD and fall in a north westerly direction towards Wood Lane where ground elevations are around 47.2mAOD
Existing drainage features	An unnamed land drain flows through the west of the site. The unnamed land drain flows in a north easterly direction into the Barkham Brook. A second tributary of the Barkham Brook is located 12m west of the site on the adjacent side of Wood Lane. The second tributary of the Barkham Brook also flows in a northerly direction into its confluence with the Barkham Brook.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:**

	The Environment Agency's Flood Map for Planning has been used within this assessment. **Flood characteristics:** The Environment Agency's Flood Map for Planning shows no fluvial flood risk to the site, as the entire site is within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 2% of the site Max depth is between 0.15 and 0.3m Max velocity is between 1 and 2m/s **1% AEP** covers 3% of the site Max depth is between 0.15 and 0.3m Max velocity is between 1 and 2m/s **0.1% AEP** covers 9% of the site Max depth is between 0.3 and 0.6m Max velocity is above 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is shown to be affected by surface water flooding in the 3.3%, 1% and 0.1% AEP events. In the 3.3% event, an area of surface water ponding is present in the centre of the site within a topographic depression. Flood depths within the area of ponding and the flow path are shallow and are between 0.15 and 0.3m. The rest of the site remains predominantly flood free in this event, apart from small area along the western site boundary where a flow path runs parallel to the site boundary, flowing in a north easterly direction towards the Barkham Brook. Flood depths are between 0.15 to 0.3m and flood velocities are between 1 to 2 m/s. These depths and velocities result in a maximum flood hazard of Caution. In the 1% AEP event, the area of ponding marginally increases in size with the extent of the flow path also marginally increasing and encroaching very slightly into the western part of the site along the boundary Flood depths in the area of ponding remain shallow and are below 0.3m and have a maximum velocity of between 1 and 2m/s and a maximum flood hazard of Danger for Most. Flood depths in the area of ponding remain shallow and

	are below 0.3m and have a maximum velocity of between 0.25 and 0.5m/s and a maximum flood hazard of Caution. In the 0.1% AEP event, two additional flow paths develop. The first flow path flows along the southern boundary of the site, entering part of the site before flowing into the larger flow path along Wood Lane. The second is a flow path develops from the area of ponding present in the 3.3% AEP and 1% AEP events in the centre of the site. This flow path flows in a northerly direction into a neighbouring site. The extent of the flow path along Wood Lane marginally increases in this event encroaching further into the western boundary of the site. Flood depths are predominantly less than 0.3m with two areas in the centre and along the western boundary of the site predicted to experience deeper flooding of up to 0.6m. Flood velocities within the centre and along the western boundary are a maximum of 1 to 2m/s and the maximum flood hazard rating is Danger for Some.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset shows that the entire site has a less than 25% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The JBA groundwater emergence map indicates that the site is not predicted to be at risk of groundwater flooding due to the nature of the underlying geological deposits. If groundwater flooding was to occur, it would likely emerge within the western part of the site where ground levels are lower. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG40 4. Prior to 2019, 47 incidents of sewer flooding had occurred within this postcode area. Between 2019 and 2022, four incidents of sewer flooding have occurred within this postcode area. These incidents are according to available incident records from Thames Water (from 2000 up to 1 May 2022).
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets do not have a record of any flooding on or surrounding the site. Historic flooding records provided by Wokingham Borough Council show one record of historic flooding on 6m west of the site. The source of flooding was attributed to surface water.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences.

Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Existing access to the site can be found from the B3030 King Street Lane. The access road is impacted by surface water flooding in all events. Surface water depths on Wood Lane rise up to 1.2m in the 0.1% AEP event. The access road is sensitive to the effects of climate change on surface water flood risk. In the 1% AEP plus climate change event, flood depths are between 0.3 to 1.2m along Wood Lane. Flood velocities in this event exceed 2m/s in places across Wood Lane and has a maximum hazard rating of Danger for all. Due to the depths and velocities mentioned above, it is highly likely that emergency access will be affected along the access route. At present, safe access and egress cannot be demonstrated in the 1% AEP plus climate change event. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial** • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate change flood extent. Flood Zone 2 shows fluvial flood risk does not affect the site therefore the site is unlikely to be sensitive to any changes in fluvial flooding as a result of climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • Between the 3.3% AEP and 3.3% AEP plus 35% climate change events, the extent of the areas of ponding marginally increases however no new areas of ponding or flow paths develop. • Between the 1% AEP and 1% AEP plus 40% climate change events, the extent of the area of ponding and the flow path along the west of

	the site increase. An additional flow path intersects the south of the site flowing in a westerly direction. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand
	  ○ Superficial - Alluvium - Clay, silt, sand and gravel
	• Soils at the site consist of:
	  ○ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soil.
	Sustainable Drainage Systems (SuDS)
	• The site is not considered to be susceptible to groundwater flooding, due to the nature of the local geological conditions. This should be confirmed through additional site investigation work.
	• BGS data indicates that the underlying geology is London Clay Formation and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local

	Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies caravans, mobile homes and park homes intended for permanent residential use as 'Highly Vulnerable'. The exception test is not required for this site because the site itself is not at fluvial flood risk or significant surface water flood risk.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site as the site is at risk of surface water flooding • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:**

	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Development buffers should be incorporated either side of the ordinary watercourses on the site and opportunities should be taken to provide environmental enhancements and where feasible reduce the risk of flooding on or off the site from all sources.

Key message

The development is likely to be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding where possible.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and indicative 3b have been taken from the Environment Agency's Flood Map for Planning.
Climate change	The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data were not available for this assessment.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 1% AEP plus climate change event.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5CV001**
Address	Land east and west of Park View Drive North
Area	13.33ha
Current land use	Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located to the north of Wokingham Borough, on the northern border of Charvil on New Bath Road. The site is located approximately 350m southwest of the River Loddon, which flows south to north to its confluence with the River Thames 2km downstream of the site at NGR SU778786. Approximately 700m downstream of the site, St Patrick's Stream and Marsh Stream, two small watercourses originating from the River Thames, discharge into the River Loddon from the west. In addition, the site is located approximately 660m southeast of the River Thames, which flows from southwest to northeast at this location.
Topography	1m LiDAR shows that the southwestern border of the site is at higher elevation (approximately 39mAOD) than the rest of the site. The north-eastern border of the site is at a lower elevation (approximately 34.4mAOD). The site slopes towards an existing drainage channel which runs along the northeast boundary of the site and the River Loddon, which flows parallel to the site, approximately 350m from the northeast site boundary.
Existing drainage features	The River Loddon runs parallel to the site, approximately 350m from the northeast site boundary. The River Loddon flows in a northerly direction at this location until its confluence with the River Thames, around 2km downstream of the site. The River Thames is located between 660m and 900m northwest of the site and flows from southwest to northeast in this area. An unnamed drain flows along the northeast border of the site flowing south to north into a series of field drainage features that discharge into the River Loddon. From the southeast corner, an additional drainage feature flows south into a tributary of the River Loddon.

Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 13% of the site Flood Zone 3a covers 18% of the site Flood Zone 2 covers 28% of the site Flood Zone 1 covers 72% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** The Environment Agency 2019 detailed hydraulic models of the River Thames (Pangbourne to Sonning) and River Thames (Sonning to Hurley) and the detailed hydraulic model for the River Loddon, updated by JBA in 2022, were available for this assessment. This site was shown to be at flood risk from all available models. Due to the River Thames (Pangbourne to Sonning) modelled flood extent being larger and of a higher resolution than the River Loddon model, and showing greater depths on the site than the River Thames (Sonning to Hurley) model, this model has been used to guide assessments for this site, and extract all extents, depths, hazards, and velocities. **Flood characteristics:** The eastern side of the site is affected during all modelled fluvial flood events. Flood Zone 2 extends between approximately 50m and 100m into the site along the entire northeast boundary of the site, originating from the River Loddon, which flows in a northerly direction approximately 350m northeast of the site. The maximum depth and velocity within the site are approximately 1.67m and 0.59m/s, with a maximum hazard classification of 'Danger for most'. Flood Zone 3a also extends along the full northeast site boundary by approximately 40m to 60m, with maximum depths and velocities within the site of approximately 1.28m and 0.48m/s, and a maximum hazard classification of 'Danger for most'. Flood Zone 3b also extends along the full northeast site boundary by approximately 30m to 50m, with maximum depths and velocities within the site of approximately 1.06m and 0.48m/s, and a maximum hazard classification of 'Danger for most'.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 1% of the site Max depth is between 0.6m and 0.9m Max velocity is between 1.0m/s and 2.0m/s **1% AEP** covers 2% of the site Max depth is between 0.6m and 0.9m Max velocity is between 1.0m/s and 2.0m/s

	0.1% AEP covers 5% of the site Max depth is between 0.6m and 0.9m Max velocity is between 1.0m/s and 2.0m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** Most of the site is shown to be unaffected by surface water flood risk in all events. During the 3.3% AEP event, there is a small surface water flow path which develops along the northeast site boundary along a drainage channel and a small area of ponding in the east side of the site. Maximum flood depths on the site are between 0.3 and 0.6m with velocities of up to 2.0m/s and a maximum hazard classification of 'Danger for most'. During the 1% AEP event, the flow path along the northeast of site boundary shows a similar extent to the 3.3% AEP event but becomes deeper in places, with depths of up to between 0.6 and 0.9m, and faster flowing, with velocities of up to 2.0m/s. The maximum hazard classification along this flow path is 'Danger for most'. The area of ponding in the east of the site extends further, particularly into the southeast corner of the site. Maximum flood depths in this area of ponding are between 0.3 and 0.6m with velocities of up to 1.0m/s and a maximum hazard classification of 'Danger for some'. During the 0.1% AEP event, the area of ponding in the southeast of the site connects with the flow path along the northeast boundary of the site and the flow path along the road to the south of the site. Maximum flood depths on the site are between 0.6 and 0.9m with velocities of up to 2.0m/s and a maximum hazard classification of 'Danger for most'. There are also a few isolated areas of surface water ponding which form in the centre and west of the site during this event and the area of ponding outside the site boundary in the northeast extends slightly west onto the site. Depths within these areas are shown not to exceed 0.3m with velocities of up to 1.0m/s and a maximum hazard classification of 'Danger for some'.
Reservoir	Reservoir flood mapping shows the site is not affected during the 'Dry Day' event. During the 'Wet Day' event, reservoir flood mapping shows the northeast edge of the site to be affected by flood extents from Bearwood Lake, Farmoor No.1 and No.2, Maiden Erlegh Lane (No.1), Queensmere, and Southlake reservoirs. The Farmoor No.1 and No.2 reservoir shows the greatest outline, extending between 80m and 100m into the site along the

	northeast boundary. The other reservoirs all affect a similar area of the site extending along the northeast boundary from the south approximately 350m along the site boundary. The 'Wet Day' event seeks to estimate the effect of a breach at the same time as a 0.1% AEP river flood is occurring and suggests that the consequences of such a breach are similar to the modelled 0.1% AEP event river flood event, but probably would be associated with a much lower probability. These extents encroaching the site are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF dataset shows the whole site has greater than 75% susceptibility to groundwater flooding. The JBA Groundwater emergence map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. Groundwater levels across the centre of the site and some of the eastern site boundary are shown to be at or near the surface (within 0.025m). This means that there is a risk of groundwater flooding to both surface and subsurface assets. Across the western half of the site groundwater levels are between 0.025m and 0.5m below the surface. This means that there is a risk of groundwater flooding to both surface and subsurface assets. There is also a band shown as no risk along the eastern edge of the site. This area is deemed to have a negligible risk from groundwater flooding due to the nature of the local geological deposits. Groundwater emerging on the site is likely to follow the topography and flow downhill from the southwest to the northeast across the site towards the River Loddon which flows adjacent to the northeast boundary. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area (RG10 9) with 108 recorded historic sewer flooding incidents, according to available incident records from Thames Water (from 2000 up to 1 May 2022), with 14 of these incidents occurring since 2019. However, no sewer flooding incidences have been recorded within the site boundary and only two incidences have been recorded within 100m of the site, one in 2002 and one in 2014.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show flood outlines which extend along the northeast boundary of the site adjacent to the River Loddon. The recorded flood outline dataset shows fluvial flooding incidences on the site in November 1974, December 2000, January 2003, July 2007, and Winter 2013-14. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding on the site but there are recorded incidences in January 2013 surrounding the site affecting roads and properties, predominantly as a result of fluvial flooding.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences; however, both the River Thames and River Loddon are bordered by natural high ground. This natural defence provides some level of protection from these watercourses.
Residual risk	The unnamed drainage channel which runs along the northeast boundary of the site appears to be culverted under New Bath Road (A4) to the south of the site. This could pose a residual risk to the site in the event of a blockage, which could cause water to back up to the south of the site and then overtop the A4 and flow onto the south of the site. However, this is unlikely to occur as LiDAR shows the elevation of the A4 is approximately 1.5m higher than the upstream channel elevation.

Emergency planning

Flood warning	The site is located in the 'River Loddon at Twyford, Charvil and Wargrave' (061FWF24Twyford) Environment Agency Flood Warning Area and the 'Lower River Loddon at the River Thames confluence at Twyford' (061WAF24Twyford) Environment Agency Flood Alert Area.
Access and egress	Existing access to the site is along Park View Drive North which runs from the A4 to the south of the site in a northerly direction to the west of the southern part of the site and then through the north of the site, where the site extends further west. The existing access remains unaffected during all modelled fluvial events. However, it is affected during all modelled surface water events. Within the surface water events there is an area of surface water ponding which starts to develop along Park View Drive North from the 3.3% AEP event. In the 3.3% AEP event, maximum depths are between 0.3 and 0.6m with velocities of up to 0.5m/s and a maximum hazard classification of 'Danger for some'. This may affect the ability for emergency vehicles to reach the site along Park View Drive North during a flood event, although there may be potential for them to divert along Charvil House Road and St Patrick's Avenue if the junction with Park View Drive North remains clear. In the 1% AEP event, the flood extent along Park View Drive North increases with maximum depths between 0.3 and 0.6m, velocities of up to 1.0m/s and a maximum hazard classification of 'Danger for some'. There is also some flood risk along the A4 at its junction with Park View Drive North, with depths of up to 0.3m. In the 0.1% AEP event, the surface water extents along both Park View Drive North and the A4 increase in size. Maximum depths along both Park View Drive North and the A4 at its junction with Park View Drive North are between 0.3 and 0.6m with velocities of up to 2.0m/s and a maximum hazard classification of 'Danger for most'. In the 1% AEP plus 40% climate change event, the maximum depth along Park View Drive North is 0.54m with a maximum velocity of 1.08m/s and a maximum hazard classification of 'Danger for most'. The maximum depth along the A4 at its junction with Park View Drive North is 0.37m with a maximum velocity of 1.34m/s and a maximum hazard classification of

	‘Danger for most’. Therefore, access and egress for emergency vehicles is likely to be affected during a surface water flood event. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events and has not currently been able to be demonstrated for the 1% AEP plus 40% surface water event as part of this assessment. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • The Thames (Pangbourne to Sonning) central and upper end allowances have been used to assess the impact of climate change on fluvial flood risk at the site. • Between the 1% AEP and 1% AEP plus 35% climate change events the fluvial extent remains confined to the east side of the site but increases in extent by up to approximately 20m in places. The maximum depth increases from 1.28m to 1.60m, and the maximum velocity increases from 0.48m/s to 0.55m/s. • Between the 1% AEP and 1% AEP plus 70% climate change events the fluvial extent remains confined to the east side of the site but increases in extent by up to approximately 20m in places. The maximum depth increases from 1.28m to 1.87m, and the maximum velocity increases from 0.48m/s to 0.61m/s. • This shows that the east side of the site is susceptible to increased fluvial flood risk due to climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact of climate change on surface water flood risk. • Between the 3.3% AEP and 3.3% AEP plus 35% climate change events there is a considerable increase in extent of the area of ponding in the southeast corner of the site. • Between the 1% AEP and 1% AEP plus 40% climate change events the area of ponding in the southeast of the site increases slightly in extent and some small additional areas of surface water ponding develop in the centre and south of the site. The area of ponding just outside the northeast site boundary also increases considerably in extent and starts to encroach slightly onto the site.

	• This shows that the site is susceptible to increased surface water flood risk due to climate change, particularly in the east of the site. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - Seaford Chalk Formation and Newhaven Chalk Formation (chalk)
	  ○ Superficial – varies across the site. The east side consists of alluvium (clay, silt, sand, and gravel), the centre consists of Kempton Park Gravel Member (sand and gravel) and the northwest corner consists of Taplow Gravel Member (sand and gravel).
	• Soils at the site consist of:
	  ○ Loamy and clayey floodplain soils with naturally high groundwater across most of the site.
	  ○ Freely draining slightly acid loamy soils along the western site boundary.
	Sustainable Drainage Systems (SuDS)
	• The AStGWF map shows the site is considered to be highly susceptible to groundwater flooding. Groundwater flooding could occur at the surface which may flow to and pool within topographic low spots during very wet winters. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• Groundwater levels are indicated to be at or very near (within 0.025m) ground level within central and eastern areas of the site and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate in these areas of the site.

	• BGS data indicates that the underlying geology is chalk which is likely to be free draining. This should be confirmed through infiltration testing, with the use of infiltration maximised as much as possible in accordance with the SuDS hierarchy. • The site is located within a Groundwater Source Protection Zone. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints. • The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths along the eastern site boundary during all modelled events. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • As the groundwater levels at this site are high, it is recommended that a liner is used if underground storage is constructed on the site. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and

	their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The exception test is required for this site because there is significant fluvial flood risk within all flood zones at the eastern side of the site and the development type is 'More Vulnerable'. 'More Vulnerable' development is not permitted within Flood Zone 3b.

Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:**
	• At the planning application stage, a site-specific FRA will be required as the proposed development site is:
	  ○ Within fluvial flood zones 2, 3a, and 3b
	  ○ Greater than one hectare
	  ○ At risk of other sources of flooding (surface water, groundwater, and reservoir)
	• All sources of flooding should be considered as part of a site-specific FRA.
	• Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage.
	• Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy.
	• The development should be designed with mitigation measures in place where required.
	Guidance for site design and making development safe:
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be

	safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site.

Key message

Development is likely to be able to proceed if:

- The area of the eastern side of the site located in Flood Zone 3b is left undeveloped.
- Development is steered away from the area of fluvial flood risk in the eastern side of the site and the small flow paths/areas of surface water ponding are incorporated and considered within the development design.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development steered away from the areas identified to be at risk of surface water flooding across the site.
- Safe access and egress can be demonstrated in the fluvial and surface water plus climate change events. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring areas.
- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the River Thames (Pangbourne to Sonning) hydraulic model (2019) and the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and 3b have been taken from the River Thames (Pangbourne to Sonning) (2019), the River Thames (Sonning to Hurley) (2019) and the River Loddon (2022) detailed hydraulic models.
Climate change	The central (35%) and upper end (70%) allowances were available for the River Thames (Pangbourne to Sonning) hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived from the River Thames (Pangbourne to Sonning) (2019) hydraulic model.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	5EA002
Address	Gasholders
Area	2.3ha
Current land use	Brownfield
Proposed land use	Employment

Sources of flood risk

Location of the site within the catchment	The site is located at the west border of Wokingham Borough and is within an existing industrial estate. The site is bordered by two railway lines: the Great Western mainline to the north and the North Downs Line to the south. The River Kennet borders the site to the west and the River Thames is located approximately 65m north of the site, to the north of the railway line. The site is mostly located within the River Thames catchment, the catchment area is 23859.2ha. A small part of the site is located within the River Kennet catchment; the catchment is 4888.7ha.
Topography	The Environment Agency 1m resolution LiDAR shows that the site generally slopes downhill from the east to the west of the site. The centre of the eastern part the site is low-lying. The railway lines to the north and south of the site are raised above the site by approximately 4m.
Existing drainage features	There are no existing drainage features within the site but there are two main rivers, the River Kennet and the River Thames, in the surrounding area around the site. The River Kennet flows adjacent to the western border of the site, flowing in a northerly direction to its confluence with the River Thames, approximately 65m north of the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers less than 1% of the site. Flood Zone 3a covers less than 1% of the site. Flood Zone 2 covers 1% of the site. Flood Zone 1 covers 99% of the site. *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood*

	Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%). **Available data:** The site is covered by the Environment Agency's Thames (Sonning to Hurley) 2019 modelling, Thames (Pangbourne to Sonning) 2019 modelling and Kennet (Tyle Mill to Thames Confluence) 2018 detailed flood modelling. The 2019 detailed hydraulic model for the Thames (Sonning to Hurley) was used in this assessment as this represents the worst case scenario. **Flood characteristics:** Overall, fluvial flood risk to the site is low. The site is marginally located within Flood Zones 2, 3a and 3b, which enter. the site from the western border. Only a minimal area of the site is within the flood zones; Flood Zone 2 extends approximately 9m into the site and Flood Zones 3a and 3b extend approximately 5m into the site. The site is located very close to the River Thames and the River Kennet and the surrounding north and west areas of the site are at very high fluvial flood risk. Fluvial water depths within the site reach 0.3m. The surrounding areas to the west of the site have flood water depths reaching 0.62m. Water velocities within the site are around 0.005m/s. The areas north of the site, located closest to the River Thames, have flood depths exceeding 4.5m.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 2% of the site. Max depth is between 0.30 and 0.60m. Max velocity is between 0.25 and 0.50m/s. **1% AEP** covers 4% of the site. Max depth is between 0.30 and 0.60m. Max velocity is between 0.25 and 0.50m/s. **0.1% AEP** covers 7% of the site. Max depth is between 0.60 and 0.90m. Max velocity is between 0.50 and 1.00m/s. *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is shown to be affected by surface water flooding during all modelled scenarios.

	For the 3.3% AEP scenario, the extent of surface water risk within the site is minimal. There is no significant flow path within the site but there is one area of surface water pooling located in the northeast side of the site. In this scenario, water depths are between 0.15 and 0.30m and water velocities are between 0.00 and 0.25m/s. For 1% AEP scenario, there is still no significant flow path within the site. The area of surface water pooling in the east part of the site has increased in extent and has formed a circular shape. This follows the depressions in the LiDAR which appear to be from former gas works which online imagery shows are no longer there. There is an additional area of surface water pooling in the centre of the site towards the south border. There is another area of surface water pooling located outside the south border of the site. In this scenario, water depths are between 0.60 and 0.90m and water velocities between 0.25 and 0.50m/s. For the 0.1% AEP scenario, the surface water coverage is located in the same areas as the 1% AEP scenario and has the same surface water pooling shape. This surface water pooling has increased in extent from the 1% AEP scenario. There are also two additional areas of surface water pooling located on the southwest and northwest borders of the site. In this scenario, water depths are between 0.60 and 0.90m and water velocities are between 0.50 and 1.00m/s.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency 'Dry Day' reservoir flood map. However, the reservoir flood mapping shows the west edge of the site to be affected by the 'Wet Day' flood extent from Whiteknights Lake reservoir. Approximately 0.1ha of the site is affected by the 'Wet Day' reservoir flooding extent, which extends 43m into the site from the west border. The area of the site affected by the 'Wet Day' reservoir flooding scenario from the reservoirs is larger than Flood Zone 2. These extents encroaching the site are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF dataset suggests that the entire site has greater than a 75% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. This shows that the majority of the site, approximately 1.6ha, has groundwater levels between 0.025 and 0.5m below the ground surface. Approximately 0.5ha of the west of the site has groundwater levels that are either at or very near (within 0.025) of the groundwater surface. In these areas there is a risk of groundwater flooding of surface and subsurface assets. The eastern border of the site has groundwater levels between 0.5m and 5m below the ground surface. In this area there is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.

	Based on the RoFSW dataset and the Environment Agency 1m resolution LiDAR it is likely that any groundwater that emerges will flow west towards the River Kennet. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in the postcode area (RG1 3) with no recorded historic sewer flooding incidents, according to available incident records from Thames Water (from 2000 up to 1 May 2022).
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that 0.03ha of the site in the west corner is within the recorded flood outline datasets. The site is not within the historic flood map dataset but the surrounding areas of the site 41m north and 8m west are within the historic flood map. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding on or surrounding the site.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences; however, there is natural high ground along the River Thames and River Kennet within the vicinity of the site. These natural defences provide some level of protection to the site.
Residual risk	Surface water is impounded to the south of the site behind the railway embankment. There is a residual risk of flooding to the site should this embankment fail, although this is unlikely. There is also a railway embankment to the north of the site which appears to hold back the fluvial flood extent in the 0.1% AEP event. There is a residual risk that should this railway embankment fail the fluvial extents could encroach south onto the site.

Emergency planning

Flood warning	The west of the site is located in the 'Properties closest to the River Thames from Scours Lane, Reading to Caversham Lakes' (061FWF23XReadCav) Environment Agency Flood Warning Area and the 'River Kennet from Thatcham down to Reading' (061WAF22LowerKen) Flood Alert Area.
Access and egress	There is very limited access to this site, as there is only one access route using Suttons Park Avenue on the eastern side of the site, connected to London Road (A4). Suttons Park Avenue can be accessed using London Road from the south or west. This access route is not affected by fluvial flooding from either the River Thames or the River Kennet. The site access is impacted by surface water. For the 3.3% AEP scenario, the site is accessible using this route as flood depths do not exceed 0.15m.

	For both the 1% and 0.1% AEP scenarios, the access road is affected by significant surface water flood risk with depths exceeding 1.2m where it passes beneath the A3290 flyover. During the 1% AEP plus 40% climate change event, depths along Suttons Park Avenue beneath the A3290 flyover are shown to reach a maximum of 2.7m, with velocities exceeding 2.0m/s and a maximum hazard classification of 'Danger for all'. The access road is completely inundated within these surface water flood events, so a site-specific assessment will need to interrogate in more detail the localised depths, velocities and hazard of surrounding roads to ensure safe access and egress can be achieved. Safe access and egress will need to be demonstrated in the 1% AEP plus 40% climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • The Thames (Sonning to Hurley) central and upper end allowances have been used to assess the impact of climate change on fluvial flood risk at the site. • Between the 1% AEP and 1% AEP plus 35% climate change event the fluvial extent remains confined to the west border of the site but increases in extent. The water depths increase from 0.03m to 0.04m, and velocities increase from 0.005m/s to 0.007m/s. • Between the 1% AEP and 1% AEP plus 70% climate change event the fluvial extent remains confined to the west border of the site but increases in extent. The water depths increase from 0.03m to 0.13m. • This shows that the west side of the site is susceptible to increased fluvial flood risk due to climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • Between the 1% AEP and 1% AEP plus 40% climate change scenario the surface water is located within the same areas of the site, but the extent has increase significantly. In the surrounding areas north, west and south of the site there is additional large surface water coverage that is not present in the 1% AEP scenario. There are also additional areas of surface water pooling on the northwest and southwest

	borders of the site. Velocities in the site reach 0.78m/s and water depths reach 0.59m. • Increases in the surface water pooling extent and additional areas of surface water pooling between the 1% AEP and 1% AEP plus 40% climate change scenarios suggests that the existing areas of surface water are sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock is Seaford Chalk Formation and Newhaven Chalk Formation.
	  ○ Superficial is Alluvium - Clay, silt, sand and gravel.
	• Soils at the site consist of:
	  ○ Loamy and clayey floodplain soils with naturally high groundwater.
	Sustainable Drainage Systems (SuDS)
	• The site is considered to be highly susceptible to groundwater flooding. Groundwater flooding could occur at the surface which may flow to and pool within topographic low spots during very wet winters. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• Groundwater levels are indicated to be at or very near (within 0.025m) ground level in the west and north of the site and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• BGS data indicates that the underlying geology is clayey which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the

	SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'Less Vulnerable'. 'Less Vulnerable' development is not permitted in Flood Zone 3b. The exception test is not required for this site because the development is classified as 'Less Vulnerable' and is not at significant risk from surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is shown to be located in fluvial Flood Zones 2, 3a and 3b and is at surface water flood risk. For surface water the site is particularly at risk in the 1% AEP, 0.1% AEP and 1% AEP plus 40% climate change events. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Development should be steered away from the appropriate 1% AEP plus climate change flood extent. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe.

	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site.

Key message

Development may be able to proceed if:

- Development is steered away from the west border of the site as this is affected by fluvial flooding.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk from both fluvial and surface water flooding.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. The access road to the site is at significant surface water risk in this event, so a site-specific assessment will need to interrogate in more detail the localised depths, velocities, and hazard of surrounding roads to ensure safe access and egress can be achieved.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If any flood mitigation measures implemented are tested to check they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the Thames (Sonning to Hurley) hydraulic model (2019) and the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and 3b have been taken from the Thames (Sonning to Hurley) (2019), Thames (Pangbourne to Sonning) (2019) and Kennet (Tyle Mill to Thames Confluence) (2018) detailed hydraulic models.
Climate change	The central (35%) and upper end (70%) allowances were available for the Thames (Sonning to Hurley) hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived from the Thames (Sonning to Hurley) hydraulic model.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.

Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	5FI003
Address	31 and 33 Barkham Ride
Area	5.4ha
Current land use	Brownfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located to the southeast of Wokingham Borough. The site is located within the east of the Barkham Brook catchment. This catchment is 1871ha. The site is mainly urban and is located west of the settlement Finchampstead. The southwest of the site borders the Barkham Ride Road and the site is approximately 1km west of Finchampstead road (B3016). The north and northwest of the site borders Rook's Nest Wood.
Topography	The Environment Agency 1m resolution LiDAR shows the site slopes downhill from the southeast of the site to north towards Rook's Nest Wood.
Existing drainage features	There is a drainage route from the Barkham Ride which flows in a northerly direction and splits in to two within the site, both joining tributaries which eventually lead to Barkham Brook to the northwest of the site. There is also a drainage channel directly along the length of the northern border which joins the drainage through the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site. Flood Zone 3a covers 0% of the site. Flood Zone 2 covers 0% of the site. Flood Zone 1 covers 100% of the site. *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:**

	The Environment Agency's Flood Map for Planning has been used within this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones **Flood characteristics:** There is no flooding shown for fluvial risk from the Environment Agency's Flood Map for Planning as the whole site is located within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 1% of the site. Max depth is between 0.30 and 0.60m. Max velocity is between 0.00 and 0.25m/s. **1% AEP** covers 3% of the site. Max depth is between 0.60 and 0.90m. Max velocity is between 0.00 and 0.25m/s. **0.1% AEP** covers 12% of the site. Max depth is between 0.60 and 0.90m. Max velocity is between 0.25 and 0.50m/s. *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The surface water flow path coverage of the site follows that of the drain flow within the site. In the 3.3% AEP event, there are two areas of surface water ponding within the site, but the coverage is minimal. The surface water coverage and flow is located in the centre of the site, directly where the unnamed drains are. The surface water at this AEP is located close to the existing unnamed roads within the site. The two areas of surface water pooling have maximum flood water depths between 0.30 and 0.60m, and water velocities between 0.25 and 0.50m/s. This is the same water depths and velocities for the surface water located in the surrounding area southeast of the site. The surface water hazard is classified as 'Very Low Hazard'. In the 1% AEP event, there are a further three areas of surface water ponding than in the 3.3% AEP scenario. These areas of surface water coverage are located sporadically around the centre of the site, similar to the 3.3% AEP. However, the flood water depths in the areas of surface water pooling have increased to between 0.60 and 0.90m, and water velocities remain between 0.25 and 0.50m/s. The maximum surface water hazard has increased to be between 'Danger for most'. In the 0.1% AEP event, the flow and coverage of the surface water is more continuous and is not in isolated areas within the site like the other AEP

	extents. The main surface water flow path follows that of the drainage feature flow, transecting from the south to the north of the site, suggesting that the drainage ditches are at capacity and overflowing to surrounding areas. For the 1% AEP extent there is a secondary surface water flow path, where the flow transects the site from the southeast to the north. The maximum water depths are between 0.60 and 0.90m, and water velocities are between 0.50 and 1.00m/s. The maximum hazard classification remains at 'Danger for most'. The flow paths of surface water follow the topography of the site. The coverage of surface water is mainly where the terrain is lower.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset suggests that the majority of the site (approximately 4 ha) is at less than 25% susceptibility to groundwater flooding. The rest (approximately 1.4 ha) of the site is at less than 50% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The groundwater emergence map suggests that the northwest of the site does not show risk of groundwater emergence due to the nature of the underlying geological deposits. However, most of the site is shown to have groundwater levels between 0.025 and 0.5m below the ground surface. This means that there is a risk of groundwater flooding to both surface and subsurface assets. Based on the RoFSW dataset, it is likely that any groundwater that emerges will flow in a northerly direction through the middle of the site, following the flow path of the drains. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG40 4. From 2000 to 1 May 2022 there were 51 recorded historic sewer flooding incidents, according to available incident records from Thames Water. There are no incidents of sewer flooding within the site. There are four recorded incidents of sewer flooding located to the east of the site in Finchampstead within 400m of the site. Approximately 730m east from the site on Barkham Ride, near the junction onto Finchampstead road, there is a cluster of eight incidents of sewer flooding.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets do not have a record of any flooding within or surrounding the site. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding within or surrounding the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows that the site is not protected by any formal or informal flood defences.

Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Existing access to the site can be found via Barkham Ride which runs along the southwest border of the site, which connects to Finchampstead road (B3016) or via St James Road and the existing estate, connected to Nash Gove Lane which runs to the east of the site. There is no impact on access or egress to the site from fluvial flooding. All the access routes detailed above are shown to be impacted by surface water flooding. The main A and B roads are less affected by surface water flooding than the smaller roads surrounding the site. Access to the site when entering from the southwest border via Barkham Ride, which connects to Finchampstead road (B3016) is impacted in the 1% AEP plus 40% climate change scenario. Surface water depths along Barkham Ride to the east of the site reach approximately 0.35m with velocities increasing up to 0.97m/s. Access to the site from the East via St James Road, connected to Nash Grove Lane is also impacted by surface water. In the 1% AEP plus 40% climate change scenario the water depths along Nash Grove Lane rise to 0.38m with velocities increasing up to 0.89m/s. Finally, when entering the site from the northwest via Barkham Street, connected to Barkham Road (B3349), Barkham Street is transected by surface water with depths in the 3.3% AEP plus 35% climate change scenario rising to 0.45m. In the 1% AEP plus 40% climate change scenario however, this rises to 0.66m with velocities up to 1.25m/s. Access to and from the site onto Barkham Ride along the southwest border of the site is shown to remain clear, however the surface water issues mentioned above could affect access and egress to and from the wider area and surrounding estate. This is likely to affect emergency access to and from the site. The site is also shown to be bisected by a surface water flow path during the 1% AEP plus 40% climate change scenario however depths remain below 0.15m in places to access across the site between the west and the east is likely to still be possible. Safe access and egress will need to be demonstrated in the 1% AEP plus 40% climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water

	flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate change flood extent. The site is not shown to be at fluvial risk with climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • In the 1% AEP plus 40% climate change event there is an additional flow path across the eastern corner of the site. This flow path is not present in the 1% AEP. Between 1% AEP and 1% AEP plus 40% climate change event the main flow which transects through the middle of the site increases in extent but still follows the same flow path. The surface water extent in the 1% AEP is isolated areas of surface water ponding which appears in the centre of the site. In the 1% AEP plus 40% climate change event the extent is a more continuous flow rather than isolated ponding. Within the site the surface water paths maximum water depths reach 0.80m, water velocities are 0.36m/s and hazard values are 1.38. • The differences in extent and flow between the 1% AEP and 1% AEP plus 40% climate change event suggest that the existing flow paths are quite sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock is a mix of Bagshot Formation – Sand and London Clay formation.
	  ○ There is no information available for the superficial geology.
	• Soils at the site consist of:
	  ○ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
	Sustainable Drainage Systems (SuDS)
	• The site is considered to have a low susceptibility to groundwater. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Groundwater monitoring is recommended to determine the seasonal variability of groundwater levels, as this may affect the design of the surface water drainage system. Below ground development such as basements may not be appropriate at this site.

	• Groundwater levels are indicated to be less than 0.5m below ground level during a 1% AEP event. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site. • BGS data indicates that the underlying geology is clayey which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during all available return period. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. The surface water flow paths that transect the site from the north to the south border during the 0.1% AEP and 1% AEP plus 40% climate change event suggests that this should be formed into a green corridor and incorporated in the site planning.

	• Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • There is a clear surface water flow path within the site at all extents. It is suggested that this is formed into a green corridor and incorporated in the site planning. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The Exception Test is not required for this site because the development classified as 'More Vulnerable' is not within Flood Zone 3a or at significant risk from surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is shown to be at surface water flood risk, particularly in the 0.1% AEP and 1% AEP plus 40% climate change events. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the

	development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • A buffer should be maintained around the ordinary watercourses on the site to allow access to maintain the watercourse. • Opportunities should be taken to provide environmental enhancements and where feasible reduce the risk of flooding on or off the site from all sources.

Key message

Development at this site is likely to be able to proceed if:

- Development is steered away from the two surface water flow paths, one that flows south to north through the centre of the site and the second which transects the eastern corner of the site, and that these flow paths be incorporated and considered within the development of the site.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding in the centre and southeast part of the site.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

- If any flood mitigation measures implemented are tested to check they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's FMfP and RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	In the absence of detailed hydraulic modelling, Flood Zones 2 and 3a have been taken from the Environment Agency's Flood Map for Planning. Flood Zone 3a has been used as an indicative Flood Zone 3b.
Climate change	The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. In the absence of detailed hydraulic modelling, Flood Zone 2 has been used as an indicative scenario for Flood Zone 3a plus climate change.
Fluvial depth, velocity and hazard mapping	There is no detailed hydraulic modelling available at this location.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5FI032**
Address	Honey Suckle Lodge, Commonfield Lane, Finchampstead
Area	0.3ha
Current land use	Greenfield
Proposed land use	Residential - Gypsy and Traveller site

Sources of flood risk

Location of the site within the catchment	The site is located in the upstream area of the Barkham Brook catchment. The catchment is predominantly rural. Barkham Brook flows approximately 1.2km north-east of the site in a northerly direction to its confluence with the River Loddon, approximately 4.7km north of the site.
Topography	1m LiDAR data shows that the site falls in a south-east direction, towards an unnamed tributary of Barkham Brook, which is at a lower elevation than the site.
Existing drainage features	There are no drainage features within the site boundary. An unnamed tributary of Barkham Brook flows in a westerly direction 10m south of the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** The Environment Agency's Flood Map for Planning has been used within this assessment. No detailed hydraulic modelling was available for this assessment. **Flood characteristics:**

	The Environment Agency's Flood Map for Planning shows no fluvial flood risk to the site. Due to the small size of the unnamed watercourse to the south of the site, it is unlikely to be represented within the modelling which informs the Flood Map for Planning however this watercourse may still pose a risk of flooding. The Environment Agency's Surface Water map may provide an indication of the flood extent of the unnamed tributary of Barkham Brook.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 3% of the site Max depth is between 0.15 and 0.3m Max velocity is less than 0.25m/s **1% AEP** covers 4% of the site Max depth is between 0.3 and 0.6m Max velocity is between 0.25 and 0.5m/s **0.1% AEP** covers 14% Max depth is between 0.3 and 0.6m Max velocity is between 0.5 and 1m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is shown to be affected by surface water flooding in the 3.3%, 1% and 0.1% AEP event. In the 3.3% AEP event, surface water ponds in the south and east corners of the site to shallow depths up to 0.3m, while the rest of the site remains at very low risk. Surface water flooding also occurs in topographic depressions to the east and south-west of the site. The source of flooding is likely to be overtopping of the unnamed tributary of Barkham Brook. In the 1% AEP event water ponds in the south of the site to a slightly greater extent and depth, reaching up to 0.6m in depth. The rest of the site remains at very low risk in this event. In the 0.1% AEP event, surface water ponding in the south of the site remains below 0.6m in depth but extends further onto the site and along the north-east and south-west boundaries, while covering the entire south-east boundary. Flood velocities are greatest along the western and eastern site boundaries where they are a maximum of 0.5 to 1m/s. The maximum flood hazard on the site is danger for most.

Reservoir	Reservoir flood mapping shows the majority of the site to be affected by the Dry Day flood extent from the Longmoor Lake reservoir. The Longmoor Lake reservoir is located approximately 630m east of the site. In the event of a reservoir breach, flood water is predicted to follow the course of the unnamed tributary of Barkham Brook. In the Wet Day reservoir flooding scenario, flood water extends further north through the site than the Dry Day extent, covering the majority of the site. The 'Wet Day' event seeks to estimate the effect of a breach at the same time as a 0.1% AEP river flood is occurring and suggests that the consequences of such a breach are similar to the modelled 0.1% AEP event river flood event, but probably would be associated with a much lower probability. These extents encroaching on the site are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF dataset shows that the entire site has an equal to or greater than 25% but less than 50% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. This mapping indicates that for the majority of the site, groundwater levels are either at or very near (within 0.025m of) the ground surface. Within the north corner of the site, the map indicates that groundwater levels are between 0.025m and 0.5m below the ground surface. Based on the RoFSW dataset, it is likely any groundwater that emerges will follow the local topography going south towards the unnamed tributary of Barkham Brook. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG40 4. Prior to 2019, 47 incidents of sewer flooding had occurred within this postcode area. Between 2019 and 2022, four incidents of sewer flooding have occurred within this postcode area. These incidents are according to available incident records from Thames Water (up 1 May 2022).
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that there are no recorded incidents within or immediately surrounding the site. Historic flooding records provided by Wokingham Borough Council identify one incidence of surface water and ordinary watercourse flooding on the

	surrounding highway 250m from the proposed development site. This is unlikely to affect access to and from the site.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	The site is currently accessed through the caravan park which is to the north of the site. Vehicular and pedestrian access to the caravan park is from Commonfield Lane to the north of the site. The access route detailed above is not impacted by fluvial flooding. During the 3.3%, 3.3% plus climate change, 1%, 1% plus 40% climate change and 0.1% AEP surface water events, flooding is predicted to impact Commonfield Lane. The 0.1% AEP covers a large portion of the road running from east to west. In the 1% AEP plus 40% climate change event, flood depths are shallow and are predominantly less than 0.3m and flood velocities are between 0.3 to 0.6m/s. The maximum flood hazard rating is 'Danger for Most'. Vehicular access to and from the site should still be possible during a flood event. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial** • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate change flood extent. Flood Zone 2 shows fluvial flood risk does not affect the site therefore the site is unlikely to be sensitive to any changes in fluvial flooding as a result of climate change. **Surface Water**

	• The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • The floodplain of the unnamed tributary of Barkham Brook is predicted to affect surface water flooding on the site during all available climate change return periods. • Although no additional surface water flow paths emerge in the 1% AEP plus climate change, the existing paths are quite sensitive. Along Barkham Brook, the paths extend by up to an additional 4-8m. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - Bagshot Formation - Sand
	  ○ Superficial - None
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater
	Sustainable Drainage Systems (SuDS)
	• Groundwater levels are indicated to be at or very near (within 0.025m) ground level and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• BGS data indicates that the underlying geology is Bagshot Formation comprised of Sand which is likely to be free draining. This should be confirmed through infiltration testing, with the use of infiltration maximised as much as possible in accordance with the SuDS hierarchy.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of

	controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 3.3%, 1% and0.1% AEP events. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied.

	The NPPF classifies caravans, mobile homes and park homes intended for permanent residential use as 'Highly Vulnerable'. The exception test is not required for this site because the site is not at fluvial risk or at significant risk from surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is at risk of surface water flooding in the east and south corners. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

Key message

The development is likely to be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding in the eastern and southern parts of the site.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and indicative 3b have been taken from the Environment Agency's Flood Map for Planning.
Climate change	The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data were not available for this assessment.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	5HU006
Address	Land on the north side of Orchard Road, Hurst
Area	1.3ha
Current land use	Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located in the Twyford Brook river basin and is 41.24km^2 in size. The site is located in the downstream extent of the catchment on the edge of an urban area. The Twyford Brook flows approximately 1.35km north of the site in a north easterly direction to its confluence with the River Loddon, approximately 2.6km north of the site.
Topography	1m LiDAR data shows that ground levels are greatest in the south of the site at around 39.9m AOD, particularly along the southern site boundary, and fall in a northerly direction towards a slight topographic depression in the north western part of the site at 38.6m AOD. Along the northern site boundary, ground levels fall slightly in a southerly direction towards the north western part of the site.
Existing drainage features	An unnamed tributary of the Twyford Brook is located 195m west of the proposed development. This watercourse flows in a northerly direction towards its confluence with the Twyford Brook.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:**

	The Environment Agency's Flood Map for Planning has been used within this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. **Flood characteristics:** The Environment Agency's Flood Map for Planning shows no fluvial flood risk to the site as the entire site is within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 0% of the site **1% AEP** covers 0% of the site **0.1% AEP** covers 2% of the site Max depth is between 0.15 and 0.3m Max velocity is less than 0.25m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is shown to be affected by surface water flooding in the 0.1% AEP event. In the 3.3% event and the 1% AEP the site is not at risk of flooding. In the 0.1% AEP event there is two areas of surface water ponding on the site. The first along the western boundary and the second in the north western part of the site where there is a small topographical depression. Surface water ponds in this corner to depths of up to 0.3m, with a maximum velocity of less than 0.25m/s and a resulting hazard of Caution.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset shows that the entire site has a greater than >75% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The AStGWF correlates with the JBA groundwater emergence map which indicates that across the entire site, groundwater levels are either at or very near (within 0.025m of) the ground surface. This means there is a risk of groundwater flooding to both surface and subsurface assets.

	This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG10 0. Prior to 2019, 63 incidents of sewer flooding had occurred within this postcode area. Between 2019 and 2022, seven incidents of sewer flooding have occurred within this postcode area. These incidents are according to available incident records from Thames Water (up 1 May 2022).
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that there is one recorded incidences within the site. The flood event occurred in 2003 and flooding was attributed to the exceedance of channel capacity. Historic flooding records provided by Wokingham Borough Council identify once incidence of surface water and ordinary watercourse flooding on the surrounding highway 250m from the proposed development site. This should not affect access to and from the site.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Access to the site is currently available from School Road. Access to and from the site will not be affected by fluvial flooding. School Road is predicted to experience surface water flooding in the 1% plus climate change and 0.1% AEP events. In the 1% plus climate change event, flood depths along School Road are shallow and are below 0.3m and has a maximum velocity of 0.64m/s which results in a hazard rating of caution. In the 0.1% AEP event, flood depths along School Road are below 0.3m and has a maximum velocity of 1m/s which results in a hazard rating of caution for the majority of the road with very isolated areas predicted to experience higher hazard ratings. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate change flood extent. Flood Zone 2 shows fluvial flood risk does not affect the site therefore the site is unlikely to be sensitive to any changes in fluvial flooding as a result of climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • In the 1% AEP plus 40% climate change, an additional area of surface water ponding develops within the topographic depression in the north western part of the site. This is not present in the 1% AEP event. Flood depths are below 0.3m with a maximum velocity of less than 0.3m/s which results in a hazard rating of caution. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Predominantly London Clay Formation- Clay, silt and sand with the north and north western part of the site underlain by Lambeth Group- Clay, silt and sand.
	  ○ Superficial - Kempton Park Gravel Member - Sand and gravel
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater
	Sustainable Drainage Systems (SuDS)
	• The site is considered to be highly susceptible to groundwater flooding. Groundwater flooding could occur at the surface which may flow to and pool within topographic low spots during very wet winters. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• Groundwater levels are indicated to be at or very near (within 0.025m) ground level and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic

	low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site. • BGS data indicates that the underlying geology is London Clay Formation and Lambeth Group and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff. • The site is located within a Groundwater Source Protection Zone. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water ponding during the 0.1% AEP event. Existing areas of ponding should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development.

	• Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The exception test is not required for this site because the site is not in Flood Zone 3a or at significant risk of surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site has an area greater than one hectare. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates.

	• Development should be steered away from the appropriate 1% AEP plus appropriate allowance for climate change flood extent. • Arrangements for safe access and egress will need to be provided for the 1% AEP rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site.

Key message

The development is likely to be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding in the eastern part of the site.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2 and 3a have been taken from the Environment Agency's Flood Map for Planning. Flood Zone 3a has been used as a proxy for Flood Zone 3b in the absence of detailed modelling.
Climate change	Fluvial Flood Zone 2 has been used as a proxy for climate change in the absence of detailed modelling. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data were not available for this assessment.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5HU009, 5HU010, 5HU015, 5HU017, 5HU020, 5HU021, 5HU022, 5HU023, 5HU041, and 5HU047**
Address	Oak View Farm, Forest Road
Area	227.2ha
Current land use	Primarily greenfield, with small brownfield locations such as Oak View Farm, Harp Farm, and other residential properties off Forest Road and Warren House Road.
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located in the east of Wokingham borough, to the north of Wokingham. It lies immediately north of the raised A329 highway, to the east of the Winnersh Interchange junction. The northern half of the site is located within the catchment of Twyford Brook. This catchment is 4124ha, largely rural, and drains north. The southern half of the site lies in the Emm Brook catchment, which is 4242ha, moderately urbanised, and drains to the south.
Topography	1m LiDAR shows that the site is located on a hill. The peak of the hill is located at SU 81148 70819 near the centre of the site, south of Forest Road. Areas of lower topography are located to the north-west of the site bordering the M4 (approximately 47.66mAOD) and to the south-west bordering the A329 (approximately 45.62mAOD). The northernmost corner also lies at lower elevations (approximately 43.01mAOD). The site is also bordered by raised highways on the south (A329), west (Winnersh Interchange), and north (M4).
Existing drainage features	An unnamed watercourse flows across the south-east corner of the sites, from east to south-west. Entering the site from the eastern border, the open channel flows along the field boundary. Satellite imagery and LiDAR suggest this watercourse is then culverted under Warren House Road. The watercourse remains culverted until it emerges south of the A329 highway south of the site. In addition, eight small unnamed drainage features flow outwards from the high ground in the centre of the site, to the outer border of the site. Three of these drainage features flow from the northern hillside to the northern border, two north-east, and one north-west. Three of the drainage features flow off the south-eastern hillside, discharging into the upstream reaches of

	Emm Brook. Similarly, the final three flow off the south-western hillside and discharge into Emm Brook around 1.1-1.5km downstream.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers less than 1% of the site Flood Zone 3a covers less than 1% of the site Flood Zone 2 covers 1% of the site Flood Zone 1 covers 99% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** WSP's detailed 2020 hydraulic model of the Emm Brook has been used within this assessment. The Environment Agency review of the Emm Brook model noted that whilst this model was fit for purpose to update the Flood Map for Planning, the levels were not suitable for use in site-specific Flood Risk Assessments. Therefore, it is advised that the suitability of this modelling to inform this site is reviewed by the developer to determine if any further modelling work is needed. **Flood characteristics:** Most of the site is located within fluvial Flood Zone 1 with a small area of fluvial flood risk in the southeast corner of the site. Flood Zone 3a and the Flood Zone 3b functional floodplain proxy follow the open channel at the south-east of the site. Water flows out of bank at the eastern border creating a 45m wide flow path to the north, inundating the adjacent field. A further small area of ponding to the west of Warren House Road. Warren House Road remains dry. Flood Zone 2 also shows overtopping on the northern side of the field drain. This extent in the adjacent field measures up to 104m wide. The field to the west is also shown as having significant ponding in Flood Zone 2, extending approximately 160m west from Warren House Road. Warren House Road remains dry. Maximum flood depths on the site are 0.84m in the 1% AEP event increasing to 1.31m in the 0.1% AEP event. Maximum velocities on the site are 0.93m/s in the 1% AEP event and decreasing to 0/71m/s in the 0.1% AEP event. The corresponding maximum hazard rating for both the 1% AEP and 0.1% AEP events is 'Danger for most'.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 3% of the site Max depth is between 0.9m and 1.2m Max velocity is between 1m/s and 2m/s **1% AEP** covers 5% of the site

	Max depth is over 1.2m Max velocity is between 1m/s and 2m/s **0.1% AEP** covers 15% of the site Max depth is over 1.2m Max velocity is over 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all scenarios. In the 3.3% AEP event, surface water is mostly contained within drainage channels, and begins to overtop into the surrounding floodplain in the 1% AEP event. In the 0.1% AEP event, surface water overtops all drainage features and creates numerous flow paths down the hillside, to the north in particular. There is significant surface water flooding in the south-east of the site, surrounding a culverted watercourse. In the 3.3% AEP event, the surface water flood risk is channelled into, and mostly confined by, the drainage features flowing down the hillside. In the north-west of the site, there is also evidence of surface water ponding to a maximum depth, velocity, and hazard of over 1.2m, 0.5m/s to 1m/s, and Danger to Most. In the south-east of the site around the unnamed watercourse is culverted under the site, a large area of surface water ponding is shown at the three surrounding field boundaries. This is to a maximum depth, velocity, and hazard of over 1.2m, 0.5m/s to 1m/s, and Danger to Most. In the 1% AEP event, surface water channels in the north east of the site are unable to confine the water. Extents here measure up to 58m wide on the eastern border, and have a maximum depth, velocity, and hazard of 0.15m to 0.3m, 0.5m/s to 1m/s, and Very Low Hazard/Caution. Surface water ponding depth, velocity, and hazard in the north-west remain at over 1.2m, 0.5m/s to 1m/s, and Danger to Most. Surface water also ponds against the site's southern boundary with the A329 in the south-west where the site is at lower elevation. Here, the maximum depth, velocity, and hazard is 0.9m to 1.2m, 1m/s to 2m/s, and Danger for Most. Around the culverted watercourse in the south-east corner of the site, the extents measure 122m north and 36m south from the open channel. The extent in the field to the west extends 220m south-west. Maximum depth, velocity, and hazard here is over 1.2m, 0.5m/s to 1m/s and Danger for Most. Warren

	House Road is also inundated in this event to a depth, velocity, and hazard of 0.6m to 0.9m, 1m/s to 2m/s, and Danger to Most. In the 0.1%AEP event, surface water is channelled by areas of lower topography such as the unnamed drainage features, but it overflows onto the surrounding floodplain. In the north and north-west of the site, the out of bank depth, velocity, and hazard reach 0.9m to 1.2m, 1m/s to 2m/s, and Danger for Most. The surface water flow path in the north-east flowing to the eastern border of the site measures up to 77m wide, and has a maximum depth, velocity, and hazard of 0.3m to 0.6m, 1m/s to 2m/s, and Danger to Most. The surface water ponding against the A329 in the south-west of the site extends up to 98m north of the highway, and has a maximum depth, velocity, and hazard of over 1.2m, 1m/s to 2m/s, and Danger to All. Around the culverted watercourse in the south-east of the site, the flood extent inundates the adjacent fields all the way to the eastern border of the site. The extents measure up to 248m north and 165m south. Maximum depth, velocity, and hazard is over 1.2m, 1m/s to 2m/s, and Dangerous for All.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset shows that the entire site has a below 25% risk of groundwater flooding. The JBA Groundwater Emergence Map provides a 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. This map suggests the majority of the site is at no risk from groundwater emergence. Along the northern border, east of Wokingham Road, the site is shown to have groundwater emergence levels of between 5m and 0.025m from the surface. Areas bordering the M4 seem to have higher groundwater levels between 0.025m and 0.5m below ground level. In addition, the peak of the hill, in the centre of the site has slightly higher groundwater levels of between 0.5m and 5m from the surface. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The centre of this site is located in a postcode area RG40 5. Since 2000, there have been no recorded incidences of sewer flooding within the site boundary. Since 2000, there has been one recorded incidence of sewer flooding within 500m of the site. This occurred in the north-east of Wokingham near Victoria Gardens. These incidents are according to available incident records from Thames Water (from 2000 up to 1 May 2022).

Flood history	The Environment Agency's historic flooding and recorded flood outline datasets do not show any occurrences of flooding within the site; however, they detail numerous instances of fluvial flooding along Emm Brook, approximately 155m south of the southern border of the site. Historic flooding records provided by Wokingham Borough Council do not show any records of flooding on or surrounding the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows that the site is not protected by any formal flood defences.
Residual risk	The unnamed tributary in the south-east of the site is culverted under the Warren House Road and the downstream field. This could pose residual risk to the site in the event of a blockage, which could cause water to back up and encroach on the eastern side of the site. In addition, Flood Zone 3a and 2 suggest that if this was to occur, it is likely that extents could overtop Warren House Road and flood the field to the west.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	There are two main access routes that run through the site. The first, Twyford Road, runs north to south around 650m from the western border of the site; and the second, Forest Road, runs east to west from the eastern border of the site, until it's junction with Twyford Road at SU 80732 71043 The main access routes are shown to be unaffected during all modelled fluvial events. The southeast corner of the site can be accessed along Warren House Road which runs in a north to south direction in the east of the site. Although this road is surrounded by fluvial flood risk, the road itself is shown to remain clear during all modelled fluvial events. In the 1% AEP plus 40% climate change surface water event, Twyford Road is at risk of flooding when accessed from the north and south. Approximately 900m north of the site, a large surface water flow path flowing towards Twyford Brook flows west to east over the road. Maximum depth, velocity, and hazard here are 0.32m, 0.48m/s, and Dangerous to Most. It is likely these flood depths would impede vehicular access and egress to the site from the north. When accessing the site from the south, Emm Brook flows over Twyford Road from east to west. The maximum flood depth, velocity, and hazard here is 0.26m, 0.64m/s, and Danger for Some. This could be an overestimation, as the surface water flood map does not consider culverts. Further investigation would need to be undertaken to assess this as a viable access route. In addition, there are two minor surface water flow paths cross Twyford Road in the site, to maximum depth, velocity, and hazard of 0.21m, 0.25m/s, and Very Low Hazard/Caution

	Forest Road is also shown to be at surface water flood risk in the 1%AEP plus 40% Climate Change event where it crosses the unnamed watercourse at SU 82381 71028. Here, the maximum depth, velocity, and hazard are 0.74m, 106m/s, and Dangerous for All. This is unlikely to be a viable access point for vehicular access. In order to develop on this site, safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • The 1% AEP plus 25% climate change event for the Emm Brook model was available for this assessment. • Between the 1% AEP and 1% AEP plus 25% events there is a small increase in flood extent within the site however the fluvial flood risk remains confined to the southeastern corner of the site around the open channel field drain. • Flood depths in the southeastern corner of the site are shown to increase from 0.84m to 0.98m with climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • Surface water is channelled via area of lower elevation, such as the eight unnamed drainage features that flow off the sides of the hill at the centre of the site. Three of these drainage features flow from the northern hillside to the northern border, two north-east, and one north-west. Three of the drainage features flow off the south-eastern hillside, discharging into the upstream reaches of Emm Brook. The final three flow off the south-western hillside and discharge into Emm Brook around 1.1-1.5km downstream. • Key areas of surface water flooding include the site's southern border with the A329 where water ponds up to a maximum depth, velocity, and hazard is over 1.2m, 1m/s-2m/s, and Dangerous for All. In addition, the field boundaries surrounding the culverted watercourse in the south-east of the site flood to a maximum depth, velocity, and hazard of over 1.2m, 1m/s-2m/s, and Danger to All.

	Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	Geology & Soils
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand.
	  ○ Superficial – River Terrace Deposits, 6 - Sand and gravel.
	• Soils at the site consist of:
	  ○ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
	Sustainable Drainage Systems (SuDS)
	• The majority of the site is considered to have a low susceptibility to groundwater. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Groundwater monitoring is recommended to determine the seasonal variability of groundwater levels, as this may affect the design of the surface water drainage system. Below ground development such as basements may not be appropriate at this site.
	• BGS data indicates that the underlying geology is mainly rich loamy and clayey soils and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff.
	• The site is located within a Groundwater Source Protection Zone. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints.
	• The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment.
	• In areas of greenfield in the site, surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• In brownfield areas of the site, surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during all available AEP

	events. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could include a blue-green corridor along Emm Brook and around areas of surface water ponding. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff to Emm Brook should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows. • The potential to utilise areas of surface water flood risk or ponding for green space, conveyance, and amenities.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as ‘More Vulnerable’. The exception test is required for this site because development is located within Flood Zone 3a.
Requirements and guidance for site-	**Flood Risk Assessment:**

specific Flood Risk Assessment	• At the planning application stage, a site-specific FRA will be required as the proposed development site is within Flood Zone 3a and Flood Zone 2, and at risk of surface water flooding. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • WBC as Lead Local Flood Authority provide guidance on culverts within development, available to download here, and should be consulted at an early stage. Some main points from this guidance are wherever practical WBC will seek to have culverted watercourses restored to open channels. WBC would also oppose planning consent for any building over a culvert as the culvert may, in the future, need to be repaired, replaced or up-rated if conditions in the catchment change. There is also the need to maintain an overland flow route if the culvert is blocked or its capacity exceeded. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk.

	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Due to the shared drainage mechanisms, all sites combined to make 5HU009 should be considered together at masterplanning stage to optimise flood risk management to and from each individual site. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site.

Key message

Development on this site is likely to be able to proceed if:

- The area of the site located in Flood Zone 3a and indicative Flood Zone 3b in the south-east of the site is left undeveloped.
- Development is steered away from additional surface water flow paths, particularly around the borders of the site. A carefully considered and integrated flood resilient and sustainable drainage design is put forward, to manage existing surface water flow paths to mitigate risk both to and from the site and provide betterment where possible.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere. A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- The development takes into consideration the culvert within the site and its capacity, consulting with the Lead Local Flood Authority at an early stage.
- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another), is left undeveloped.
- The developer reviews the suitability of the Emm Brook model to inform this site and carries out any further modelling work deemed necessary.

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2 and 3a have been taken from the Emm Brook detailed hydraulic model (2020). Due to there being no availability of a 3.3% AEP flood extent, the 1% AEP extent was used as an indicative Flood Zone 3.
Climate change	The higher central allowance (25%) was available for the Emm Brook hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived for the 1%AEP and 0.1%AEP events from the Emm Brook hydraulic model (2020).
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.

Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	5HU030
Address	Land north-west of Hogmoor Lane
Area	4.0ha
Current land use	Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located in the central east of the Wokingham Borough. The site is approximately 560m south of Twyford Brook; this catchment has an area of 4124.2ha. The site is also located approximately 515m east of the River Loddon; this catchment has an area of 5189.4ha. The site is rural and is located between the villages of Hurst and Whistley Green. It is located between two roads, Hurst Road (A321) and Hogmoor Lane. The southwest of site borders Hurst Road/Wokingham Road (A321) and the east of the site borders Hogmoor Lane. The west of the site borders the village of Whistley Green.
Topography	The Environment Agency 1m resolution LiDAR shows that the site generally slopes downhill from the west to the east of the site and from the south to the north of the site. However, there is higher ground along the northern boundary, which is an existing field boundary.
Existing drainage features	Online mapping shows a small drainage channel which runs along the southern part of the eastern boundary of the site. There are also several drainage features surrounding the site. There is an unnamed drain which flows along Hurst Road approximately 145m west of the site. There is an unnamed drain which flows along Lodge Road (B3030) approximately 200m west of the site. These drains flow in a northerly direction to join the River Loddon. There are also two drains located parallel to the eastern border of the site, approximately 60m east of the site, flowing north towards Twyford Brook. The north and south areas surrounding the site do not have any drainage features.

Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 5% of the site. Flood Zone 3a covers 5% of the site. Flood Zone 2 covers 8% of the site. Flood Zone 1 covers 92% of the site. *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** The detailed hydraulic model for the Loddon Lower, updated by JBA in 2022, was used in this assessment. **Flood characteristics:** The site is located within Flood Zone 2, 3a and 3b. Only the northeast corner of the site is located within the Flood Zones. Approximately 0.3ha of the site is within Flood Zone 2. Approximately 0.2ha of the site is within Flood Zone 3a and 3b. Fluvial flood water depths close to the north-east border of the site reach 0.41m. Further into the site, the water depths decrease to 0.12m.
Surface water	**Proportion of site at risk: SW layer 76** **3.3% AEP** covers 1% of the site. Max depth is between 0.30 and 0.60m. Max velocity is between 0.00 and 0.25m/s. **1% AEP** covers 3% of the site. Max depth is between 0.30 and 0.60m. Max velocity is between 0.25 and 0.50m/s. **0.1% AEP** covers 13% of the site. Max depth is between 0.30 and 0.60m. Max velocity is between 0.50 and 1.00m/s. *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is affected from all surface water scenarios. For the 3.3% AEP scenario, the coverage of surface water within the site is minimal. There is a surface water flow path transecting the northeast to

	southeast of the site and a further flow path starting to form along the east border of the site, but it is not a continuous flow path. For the 1% AEP scenario, a second area of surface water pooling has formed in the northeast corner of the site. Also, there is an additional area of surface water pooling near the north border of the site. The area of surface water pooling outside the southwest border of the site is larger in extent. The surface water flow path along the southeast border of the site is larger in extent and is now a continuous flow path. The surface water flow path east of the site has encroached into the site through the northeast corner. For the 0.1% AEP scenario, there are two new areas of surface water pooling within the centre of the site. The areas of surface water pooling in the northeast corner and the north border of the site are larger than in the 1% AEP scenario. Also, the surface water flow path from the east has encroached further into the northeast corner of the site. The surface water pooling in the outside the southwest border of the site is now a continuous surface water flow path in the 0.1% AEP scenario.
Reservoir	Reservoir flood mapping shows the northeast corner of the site to be affected by the Wet Day flood extents from the Bearwood Lake and Southlake reservoirs. The Bearwood Lake reservoir affects a larger area of the site, extending approximately 60m into the site. The wet day scenario from the reservoirs is larger than Flood Zone 2. These extents encroaching the sites are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF dataset suggests that the entire site has greater than 75% susceptibility to groundwater flooding. This is confirmed by the JBA groundwater emergence map, which shows that the entire site has groundwater levels that are either at or very near (within 0.025m) of the ground surface. This means that groundwater flooding of surface and subsurface assets is possible. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. Based on the RoFSW dataset and the Environment Agency 1m resolution LiDAR it is likely that any groundwater that emerges will flow/pool in the northeast and northwest low-lying areas of the site. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area (RG10 0) where, from 2019 to 1 May 2022, there were 70 recorded historic sewer flooding incidents, according to available incident records from Thames Water. There are no incidents of sewer flooding within the site. There are 17 records of flooding in the surrounding area of the site. There is a cluster of eight records of flooding in the village of Whistley Green approximately 185m west of the site. There is one record east of the site on the Hinton

	Road junction. There are two records located 630m south of the site. Finally, there are five records 180m southeast of the site.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that 1.1ha of the northeast side of the site is within the historic flood map and the recorded flood outline dataset. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding on the site. However, there were three records of flooding in the surrounding area of the site, one 2013 record 450m north of the site and two records, dated 2008 and 2013, within 800m south of the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows that the site isn't protected by any formal flood defences; however, there is natural high ground located along some sections of the drainage channels to the east and west of the site. There is also natural high ground along both banks of the River Loddon to the west of the site. This natural defence may provide some level of protection from the drainage channels and the River Loddon.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning Area but 0.14ha of the northeast side of the site is within the Lower River Loddon (061WAF24LLoddon) Flood Alert Area.
Access and egress	The site is accessible via three routes, from the southeast using Hogmoor Lane connected to Poplar Lane, from the southwest using Hurst Road (A321) and from the south using Hurst Road (A321) connected to Tape Lane. Access to the site from the north along Hogmoor Lane is affected by fluvial flooding in all modelled fluvial events as the road is inundated to the northeast of the site. However, the site is still accessible using Hurst Road and Tape Lane from the south which are not shown to be affected by fluvial flooding. The site access is impacted by surface water. For the 3.3% AEP scenario, all routes above are likely to be accessible as flood water depths are between 0.15 and 0.30m. For both the 1% AEP and 0.1% AEP scenarios, there is a surface water flow path along Hurst Road A321, but the site is still likely to be accessible via this route as flood water depths do not exceed 0.30m. But access to the site using Hogmoor Lane connected to Poplar Lane is likely to be affected as water depths are between 0.30 and 0.60m; surface water flow paths have entirely covered this access route. For the 1% AEP plus 40% climate change scenario, access to the site using Hogmoor Lane, connected to Poplar Lane, will be very difficult as maximum water depths reach 1.13m and water velocities reach 0.90m/s with a maximum hazard classification of 'Danger for most'. Access to the

	site using Hurst Road will be difficult as maximum water depths reach 0.43m with water velocities up to 0.6m/s and a maximum hazard classification of 'Danger for most'. There are some access and egress issues using the above routes due to fluvial and surface water flooding; it is likely that emergency access will be affected but there are other accessible routes to the site. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • The 1% AEP plus 14% (central allowance) and plus 23% (higher central allowance) events show the same extent as the 1% AEP event within the site, just affecting the northeast corner of the site. • However, fluvial flood depths on the site are shown to increase slightly with a maximum of 0.27m in the 1% AEP event and a maximum of 0.30m in the 1% AEP plus 23% climate change event. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • Between the 3.3% AEP scenario and the 3.3% plus 35% climate change, the surface water flow path outside the east border of the site has increased in extent significantly and has encroached into the east border of the site. The two areas of surface water pooling located on the southeast border of the site have increased in extent and have formed a continuous flow path. There are two more additional areas of surface water pooling within the site**.** • In the 1% AEP plus 40% climate change scenario the surface water has similar flow paths along the east and southeast borders of the site to those in the 1% AEP scenario. The encroachment of surface water into the northeast corner of the site from the east surface water flow path is larger in the 1% AEP plus 40% climate change scenario. The pooling of surface water along the southeast border of the site in the 1% AEP scenario is a continuous surface water flow path in the 1% AEP plus 40% climate change scenario. The areas of surface water pooling near the north border of the site have increased in extent in the 1% AEP plus 40% climate change scenario. There is an additional

	area of surface water pooling within the centre of the site in the 1% AEP plus 40% climate change scenario. • The increase in surface water flow path extents and the additional areas of surface water pooling between the 1% AEP and 1% AEP plus 40% climate change event suggest that the existing areas of surface water are sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock is Lambeth Group - Clay, silt and sand.
	  ○ Superficial geology is Kempton Park Gravel Member - Sand and gravel.
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater, naturally wet.
	Sustainable Drainage Systems (SuDS)
	• The site is considered to be highly susceptible to groundwater flooding. Groundwater flooding could occur at the surface which may flow to and pool within topographic low spots during very wet winters. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• Groundwater levels are indicated to be at or very near (within 0.025m) ground level and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• BGS data indicates that the underlying geology is clayey which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.

	• The site is located within a Groundwater Source Protection Zone. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 3.3%, 1% and 0.1% AEP events. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public

	open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. 'More Vulnerable' development is not permitted in Flood Zone 3b. The exception test is required for this site because development classified as 'More Vulnerable' is within Flood Zone 3a.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is shown to be allocated in fluvial Flood Zones 2, 3a and 3b and at surface water flood risk. For surface water the site is particularly at risk in the 1% AEP, 0.1% AEP and 1% AEP plus 40% climate change events. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design

	and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

Key message

Development is likely to be able to proceed if:

- Development is steered away from the northeast corner of the site as this is affected by fluvial flooding. As well development should be away from the northeast corner and north border of the site due to significant surface water flow paths and pooling, and that these be incorporated and considered within the development of the site.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk from both fluvial and surface water flooding.
- Safe access and egress can be demonstrated in the 1% AEP plus climate change fluvial and surface water events. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If any flood mitigation measures implemented are tested to check they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the Loddon Lower hydraulic model (2022) and the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and 3b have been taken from the Loddon Lower detailed hydraulic model (2022).
Climate change	The most recent uplifts have been applied to the Loddon Lower hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived from the Loddon Lower hydraulic model.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.

Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5HU054**
Address	Poppies Farm, Hurst
Area	2.21ha
Current land use	Brownfield and Greenfield
Proposed land use	Pitches for Gypsy and Travellers

Sources of flood risk

Location of the site within the catchment	The site is located within the catchment of the Twyford Brook. The catchment area is approximately 4100ha. The site is located in the southern extent of the catchment on the edge of an urban area. The Twyford Brook flows through the catchment in a westerly direction, approximately 3km west of the site.
Topography	1m LiDAR data shows that ground levels are greatest along the south eastern boundary at around 51.3mAOD of the site and fall in a north westerly direction towards an unnamed access road along the western boundary of the site at around 44.4mAOD.
Existing drainage features	A drainage ditch is located along the western boundary of the site. The ditch flows in a northerly direction towards Pound Lane before flowing in a westerly direction parallel to the road.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** The Environment Agency's Flood Map for Planning has been used within this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones.

	Flood characteristics: The Environment Agency's Flood Map for Planning shows no fluvial flood risk to the site as the entire site is within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 4% of the site Max depth is between 0.6 and 0.9m Max velocity is between 1.0 and 2.0m/s **1% AEP** covers 5% of the site Max depth is between 0.6 and 0.9m Max velocity is between 1.0 and 2.0m/s **0.1% AEP** covers 13% of the site Max depth is between 0.6 and 0.9m Max velocity is greater than 2.0m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is shown to be affected by surface water flooding in the 3.3%, 1% and 0.1% AEP events. In the 3.3% event, a surface water flow path flows in a southerly direction into the western part of the site along the western boundary. Flood depths are up to 0.9m, with a maximum velocity of up to 2.0m/s and a maximum resulting hazard of 'Dangerous for Most'. A small area of surface water ponding is also present along the northern boundary of the site in a topographic depression. Flood depths within this area of ponding are up to 0.9m, with a maximum velocity of 1.0m/s and a maximum resulting hazard of 'Dangerous for Most'. The indicative location of flood water from the unnamed drain is also represented within the RoFSW map. This shows that flood water is channelled within the banks of the watercourse and does not overtop into the wider site. In the 1% AEP event, the extent of the surface water flow path to the south of the site increases with the path splitting into two separate flow paths prior to reaching the site. The first flow path flows into the western part of the site, flowing along the western boundary. Flood depths marginally increase with a wider area predicted to experience flooding up to 0.9m, with a maximum velocity of 1.0 to 2.0m/s and a maximum resulting hazard of 'Dangerous for Most'. The second flow path flows into the unnamed drain

	flowing through the west of the site and results in a small part of the unnamed drain overtopping into the site. Flood depths are predominantly shallow with most of the area predicted to experience flood depths of between 0.15 and 0.3m, with a maximum velocity of 1.0 to 2.0m/s and a maximum resulting hazard of 'Caution'. The area of ponding in the north of the site does not increase in size and flood depths remain up to 0.9m. In the 0.1% AEP event, the extent of surface water flooding in the western part of the site significantly increases. The flow path from the south of the site increases in extent, resulting in surface water flowing through the western part of the site and overtopping the unnamed drain into the site. Flood depths in these areas are predominantly shallow with less than 0.3m of flood water predicted, with some smaller areas predicted to experience flooding between 0.3 and 0.9m. Flood velocities are predominantly quick and are between 1.0 and 2.0m/s across the majority of the site with a maximum resulting hazard of 'Dangerous for Most'. The area of ponding in the north of the site increases resulting in an additional area of ponding in the north of the site. Flood depths in this area are shallow and are less than 0.15m. An additional area of ponding is also present along the eastern boundary of the site with flood depths predicted to be shallow and less than 0.3m.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset shows that the entire site has a less than 25% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The AStGWF map correlates with the emergence map and indicates that the site is not predicted to be at risk of groundwater flooding due to the nature of the underlying geological deposits. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in the postcode area RG10 0. Prior to 2019, 63 incidences of sewer flooding occurred within this postcode area. Between 2019 and 2022, seven incidences of sewer flooding occurred within this postcode area. These incidents are according to available incident records from Thames Water (2000 - 2022). None of these incidences were on or in close proximity to the site.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets do not have a record of any flooding on or surrounding the site. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding on or surrounding the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows the site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Existing access to the site can be found from the unnamed access road in the west of the site which connects to Pound Lane 250m north of the site. Access to and from the site will not be affected by fluvial flooding. Surface water flooding in the 1% AEP plus climate change and 0.1% AEP events result in flood depths of less than 0.3m across the unnamed access road. In the 1% AEP plus climate change event, flood velocities are a maximum of 0.9m/s which results in a hazard rating of 'Caution'. In the 0.1% AEP event, flood velocities are a maximum of 1 to 2m/s which results in a maximum hazard rating of 'Dangerous for Most'. Therefore, vehicular access and egress to the site may be impeded. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate change flood extent. Flood Zone 2 shows fluvial flood risk does not affect the site therefore the site is unlikely to be sensitive to any changes in fluvial flooding as a result of climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • In the 3.3% AEP plus 35% climate change event, a flow path from the south of the site flows into the western part of the site, flooding the

	access road and the western area of the site. Flood depths are predominantly shallow, less than 0.3m, apart from an area in the west of the site which is predicted to flood to depths of up to 0.6m. • In the 1% AEP plus 40% climate change event, the extent of the flow path present in the 3.3% AEP plus 35% climate change marginally increases, resulting in flooding within a similar extent to the 0.1% AEP event. Flood depths remain predominantly shallow across the majority of the site, less than 0.3m, apart from in the western part of the site where depths of up between 0.6 and 0.9m are predicted. • Between the 1% AEP and 1% AEP plus 40% climate change events the flow path in the west of the site increases slightly in extent and the area of ponding in the north of the site develops into a small flow path. This shows that surface water flood risk at the site is sensitive to increases due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand
	  ○ Superficial - None
	• Soils at the site consist of:
	  ○ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils.
	Sustainable Drainage Systems (SuDS)
	• The site is not considered to be susceptible to groundwater flooding, due to the nature of the local geological conditions. This should be confirmed through additional site investigation work.
	• BGS data indicates that the underlying geology is London Clay and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff.
	• The site is located within a Groundwater Source Protection Zone. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the

	permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 1% AEP and 0.1% AEP events. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies caravans, mobile homes and park homes intended for permanent residential use as 'Highly Vulnerable'. The Exception Test is not required for this site because the site is located at fluvial risk or at significant risk of surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is over one hectare. • All sources of flooding should be considered as part of a site-specific FRA.

	• Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Development buffers should be incorporated either side of the ordinary watercourses on the site and opportunities should be taken to provide environmental enhancements and where feasible reduce the risk of flooding on or off the site from all sources.

Key message

The development is likely to be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding where possible.

- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, and 3a have been taken from the Environment Agency's Flood Map for Planning. Flood Zone 3a has been used as a proxy for Flood Zone 3b in the absence of detailed modelling.
Climate change	Fluvial Flood Zone 2 has been used as a proxy for climate change in the absence of detailed modelling. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data were not available for this assessment.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	5RU001, 5RU002, 5RU003, 5RU004, 5RU005, and 5RU006
Address	Land to the north of Reading Road
Area	232.57ha
Current land use	Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located in the northeast of the Wokingham Borough. The site is mainly greenfield and is located between the settlements of Ruscombe and Hare Hatch. Loddon Road (A3032) goes through the middle of the northern two site parcels. Waltham Road (B3024) runs along the northeast border of the site, which runs between the middle of the site. The rail line Great Western Main Line also runs through the middle of the site parcels. The watercourse surrounding the site is the River Loddon which is located 1.1km west of the site; this catchment is 5189.39ha. As well, part of the site is within the catchment of Twyford Brook, this catchment has an area of 4124.2ha.
Topography	The Environment Agency 1m resolution LiDAR shows that the topography of the site slopes downhill from the west to the east of the site. The southwest of the site is more low-lying than the remaining west of the site. The northeast, southeast and east of the site are the lowest elevation areas of the site.
Existing drainage features	There are several drainage features within and surrounding the site. The Twyford Brook flows southwest along the southeast corner of the site towards the River Loddon. There are several drains, one unnamed drain transects through the middle of site flowing south through the site and under the railway line to join Twyford Brook. Three other unnamed drains, located in the southern parcel of the site, flow in a southerly direction across the southeast border of the site to join Twyford Brook.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 6% of the site. Flood Zone 3a covers 6% of the site. Flood Zone 2 covers 7% of the site. Flood Zone 1 covers 93% of the site.

	The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%). **Available data:** The 2 detailed hydraulic model for the Loddon Lower, updated by JBA in 2022, was used in this assessment. **Flood characteristics:** The site is located within Flood Zone 2, 3a and 3b. Only the southern portion of the site is located within the Flood Zones, so as a whole site, the risk is fairly low. However, considering this southern site parcel alone for development, the risk is higher. Approximately 15.8ha of the site is within Flood Zone 2. Approximately 14.6ha is within Flood Zone 3b and 14.4ha is within Flood Zone 3a. Maximum depths on site the are shown to reach 1.55m in Flood Zone 3a, increasing to 1.87m in Flood Zone 2 close to the southern border.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 2% of the site. Max depth is between 0.90 and 1.20m. Max velocity is between 0.50 and 1.00m/s. **1% AEP** covers 6% of the site. Max depth is between 0.90 and 1.20m. Max velocity is between 0.50 and 1.00m/s. **0.1% AEP** covers 21% of the site. Max depth is more than 1.20m. Max velocity is between 1.00 and 2.00m/s. *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is affected during all surface water scenarios. For the 3.3% AEP scenario, there are multiple areas of surface water pooling within and in the surrounding areas of the site. There are approximately 12 areas of surface water pooling in the north and northeast areas of the site. Flow paths start to form following topography, flowing from the northeast to the southwest towards Twyford Brook and the railway line. The most significant depths are in the areas of ponding in the centre of the site and in the northeast with depths exceeding 1.2m. Depths along the

	flow path in the north of the site remain mostly below 0.3m. The depths of pooling along the north side of the embankment are mostly between 0.15m and 0.6m. For the 1% AEP scenario, the surface water flow paths which were forming in the 3.3% AEP scenario have increased in extent and are now continuous flow paths, flowing southwest towards the Loddon and impounding against the railway line. Depths along the flow paths mostly remain below 0.6m but there are areas with significant depths exceeding 1.2m where there are topographic low points, particularly in the centre and northeast of the site. Depths in the water impounded along the railway line have increased from the 3.3% AEP event, with a large area with depths of up to 0.9m. There is a third surface water flow path which transects the site from the railway embankment through the south of the site towards the Twyford Brook. There are additional areas of surface water pooling located on the east border of the site. Depths along this flow path are mostly between 0.15m and 0.6m but there are small areas with depths of up to 0.9m. For the 0.1% AEP scenario, there are more significant additional areas of surface water pooling in the southwest of the site. The areas of surface water pooling located in the east border of the site now form a large continuous flow path which joins the southeast and northeast flow path to form one continuous flow path. The extent of the surface water flow paths has increased significantly. The most significant depths are found along the impounding at the railway line, with depths now exceeding 1.2m in areas, and in the topographic low points in the centre and northeast of the site, with depths exceeding 1.2m. There are also considerable increases in depth along the flow paths from the 1% AEP event, particularly in the southwest of the site with depths of up to 1.2m. Velocities are low across the southwest area of flooding, remaining mostly below 0.25m/s however velocities are shown to reach 2.0m/s along most of the flow paths through the north and east of the site. Hazard classifications across most areas of risk are between ‘Danger for some’ and ‘Danger for most’ with a maximum hazard classification of ‘Danger for all’ in some of the topographic low spots with the most significant water depths.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency ‘Dry Day’ reservoir flood map. However, the reservoir flood mapping shows the southeast corner of the site to be affected by the ‘Wet Day’ flood extents from Bearwood Lake, Maiden Erlegh Lake (No.1) and Southlake reservoirs. Approximately 16.88ha of the site is affected by ‘Wet Day’ reservoir flooding; the reservoir flooding extends 210m into the site from the southern border. The areas of the site affected by ‘Wet Day’ reservoir flooding scenario from the reservoirs is larger than Flood Zone 2. These extents encroaching the sites are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF dataset suggests that the majority of the site, approximately 121.5ha, has less than a 25% susceptibility to groundwater flooding, across the northwest and southwest areas of the site. Approximately 33.5ha of the

	site has between a 25% and 50% susceptibility to groundwater flooding located in the centre and east of the site. Also, approximately 77.5ha of the site has between a 50% and 75% susceptibility to groundwater flooding, located in the northwest and southwest areas of the site. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater flood emergence based on groundwater levels. The JBA Groundwater Emergence Map shows the southwest of the site has groundwater levels at least 5m below the ground surface. In this area flooding from groundwater is not likely. The majority of the site is at no risk from groundwater due to the nature of the underlying geological deposits, located in east, south and southwest areas of the site. The northwest and west of the site has groundwater levels between 0.5 and 5m below the ground surface. In these areas there is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely. The northwest, northeast and centre of the site have groundwater levels between 0.025 and 0.5m below ground surface. Within these areas there is a risk of groundwater flooding to both surface and subsurface assets. Based on the RoFSW dataset and the Environment Agency 1m resolution LiDAR, it is likely that any groundwater that emerges will flow west in various flow paths through the site and will pool mainly in the west of the site. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The majority of the site is located in postcode area (RG10 9) and the rest is in postcode area (RG10 0) with 108 recorded historic sewer flooding incidents in RG10 9, according to available incident records from Thames Water (from 2000 up to 1 May 2022). There are no incidents of sewer flooding within the site. There are approximately 63 recorded incidents in the areas surrounding the site. Two incidents are located approximately 1.53km southeast of the site. The rest of the sites are located within 1.1km west and southwest of the site, located within the settlement of Twyford.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show approximately 12.8ha of the south of the site is within the historic flood map and a recorded flood outline from 1974. The historic flood map and recorded flood outlines are located approximately 1.1km west and southwest of the site. Historic flooding records provided by Wokingham Borough Council shows one record of historic flooding on the east border of the site, located on Waltham Road. However, shows no records of historic flooding in the surrounding area of the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows that the site is not protected by any formal flood defences but there is natural high ground along both

	banks of Twyford Brook to the south of the site. This may offer some protection to the site from this watercourse.
Residual risk	There is an embanked railway line which runs through the middle of the site parcels. This poses a residual risk as water is impounded to the north of the embankment which would cause flooding to the south of the site if the embankment were to fail, although this is unlikely to occur. Furthermore, there is a drain flowing south through the site towards Twyford Brook which is culverted beneath the railway line. Should this culvert become blocked, water could back up and cause flooding to the site parcel to the north of this culvert.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning Area but the southern border of the site is located within the Lower River Loddon (061WAF24LLoddon) Flood Alert Area.
Access and egress	The site is accessible via the southwest using Stanlake Lane, from the west using New Bath Road (A4), the north using London Road (A3032) connected to Bath Road, from the northeast via Castle End Road connected to Milley Lane and from the east using Waltham Road/Twyford Road (B3024). Access to most of the site remains unaffected during all the modelled fluvial flood events. Access to the southern parcel of the site from the east will be affected as Waltham Road (B3024), which runs along the south of the site is affected by fluvial flooding, with the greatest depths of up to 0.55m in the 1% AEP plus 14% climate change event where the road runs along the north side of the southern parcel. However, this parcel should be able to be accessed from the west where the roads are not affected by fluvial flooding. The site access is impacted by surface water in all modelled events. During the 3.3% AEP event, access to the site via London Road may be restricted as there are areas of surface water risk along the road to both the east and west of the site. There is also a flow path which forms along Castle End Road to the east of the site and Twyford Road to the southeast of the site. Water depths mostly remain below 0.3m but there are areas with depths of up to 0.6m. However, access to the site along New Bath Road and Stanlake Lane from the west remains unaffected during the 3.3% AEP event. During the 1% AEP event, access to the site via London Road may be restricted as there is a flow path which bisects the site along the southern boundary of the northern parcel. This affects the road to both the east and west of the site with depths of up to 0.6m. However, the northern parcel should still be accessible along New Bath Road from the west. There are also flow paths along Castle End Road and Twyford Road which may restrict access. Water depths mostly remain below 0.3m but there are areas with depths of up to 0.6m.

	Access along Stanlake Lane from the west still remains unaffected during the 1% AEP event. During the 1% AEP plus 40% climate change event, access and egress onto Stanlake Lane and New Bath Road remains clear within the vicinity of the site, however there are surface water flow paths which above could affect access and egress to and from the wider area and surrounding estate. All the other access roads surrounding the site are affected by surface water risk. A site-specific assessment will need to interrogate in more detail the localised depths, velocities, and hazard of surrounding roads to ensure safe access and egress can be achieved. There are also several surface water flow paths which bisect the site, so access and egress between the bisected areas of the site will need to be considered to ensure safe access and egress to all areas of the site. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • The 1% AEP plus 14% climate change and 1% AEP plus 23% climate change events show slight increases in extent from the 1% AEP event in the south of the site but still only impact the south parcel of the site. • Maximum depths on the site increase from 1.18m in the 1% AEP event up to 1.73m in the 1% AEP plus 23% climate change event. • This shows that fluvial flood risk at the site is sensitive to increases due to climate change, with slight increases in extent but more considerable increases in water depth. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • In the 1% AEP plus 40% climate change event, the surface water shows flow paths in similar areas as in the 1% AEP event but the extent has increased significantly. The flow paths in the 1% AEP plus 40% climate change event are more continuous and joined together than in the 1% AEP event. In the 1% AEP plus 40% climate change event there are several additional areas of surface water pooling. The

	surface water depths in the 1% AEP plus 40% climate change event exceed 1.3m. • The differences in surface water pooling extent and depth between the 1% AEP and 1% AEP plus 40% climate change event suggest that the existing flow paths are quite sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock is a combination of Seaford Chalk Formation and Newhaven Chalk Formation and Lambeth Group - Clay, silt and sand.
	  ○ Superficial is a combination of River Terrace Deposits, 4 - Sand and gravel and Head - Clay, silt, sand and gravel.
	• Soils at the site consist of:
	  ○ A combination of loamy and clayey soils which are slightly acidic with naturally high groundwater.
	Sustainable Drainage Systems (SuDS)
	• The site is considered to have a moderate susceptibility to groundwater. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• Groundwater levels are indicated to be less than 0.5m below ground level during a 1% AEP event across parts of the east, north and centre of the site, Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate in these areas of the site.
	• BGS data indicates that the underlying geology is clayey which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.

	• The site is located within a Groundwater Source Protection Zone. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints. • The site has areas within its boundary designated by the Environment Agency as being a historic landfill site. A thorough ground investigation will be required as part of a detailed site-specific FRA, to determine potential mitigation for contamination and the impact this may have on SuDS. As such, proposed SuDS should be discussed with the relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 3.3, 1 and 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies.

	• Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The exception test is required for this site because the development classified as 'More Vulnerable' is within Flood Zone 3a and the site is at significant risk from surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is shown to be at both a fluvial flood zone 2, 3a and 3b and surface water flood risk. For surface water the site is particularly at risk in the 1% AEP, 0.1% AEP and 1% AEP plus 40% climate change events. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. Consultation with Network Rail should also be undertaken at an early stage due to the railway embankment and culvert which run through the centre of the site parcels. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development

	across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site. • A detailed hydraulic model of the unnamed watercourses within and bordering the site may be required at FRA stage to accurately represent the risk from these watercourses.

Key message

Development is likely to be able to proceed if:

- Development is steered away from the southern boundary of the site as this area is affected by fluvial flooding. As well, development should be steered away from the north border, northeast and northwest corners of the site due to significant surface water pooling and flow paths, and that these be incorporated and considered within the development of the site.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk from both fluvial and surface water flooding.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If any flood mitigation measures implemented are tested to check they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the Lower Loddon hydraulic model (2022) and the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and 3b have been taken from the Loddon Lower detailed hydraulic model (2022).
Climate change	The most recent uplifts have been applied to the Loddon Lower hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived from the Lower Loddon (2022) hydraulic model.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5SH023 and 27**
Address	Land east and west of Hyde End Road
Area	10.48 ha
Current land use	Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located in the Loddon (Swallowfield to River Thames confluence) catchment basin. The River Loddon flows approximately 275m east of the site in a northern direction to its confluence with the River Thames, approximately 6km north of the site.
Topography	Local topography shows that the site slopes gently downhill to the east, towards the River Loddon floodplain.
Existing drainage features	There is evidence of a drainage channel along the boundary of the western site flowing in southerly direction underneath Hyde End Road and then flowing in an easterly direction which dissects the site to the east of Hyde End Road just north of Langley Mead car park. There is also evidence of a drain flowing along the northern border of the eastern site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 1% of the site Flood Zone 3a covers 1% of the site Flood Zone 2 covers 3% of the site Flood Zone 1 covers 97% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** The Loddon Lower 1D-2D ESTRY-TUFLOW detailed hydraulic model, updated by JBA in 2022, was used within this assessment.

	Flood characteristics: The site is partially at risk of fluvial flooding. The Loddon Lower flood extents show the southeast border of the site is located within Flood Zone 2, Flood Zone 3a and Flood Zone 3b. Flood Zone 2 extends up to 60m west into the site in the southeast corner. The maximum depth on the site is 0.76m and the maximum velocity is 0.1m/s. Flood Zone 3a extends up to 60m west into the site in the southeast corner. The maximum depth on the site is 0.23m and the maximum velocity is 0.03m/s. Flood Zone 3b also extends up to 60m west into the site in the southeast corner. The maximum depth on the site is 0.21m and the maximum velocity is 0.03m/s. The northeast corner of the site is also slightly affected by fluvial flooding, with all three events showing the same extent in this area.
Surface water	**Proportion of site at risk:** **3.3% AEP covers 1% of the site** Max depth between 0.6 and 0.9m Max velocity between 0.5 and 1.0m/s **1% AEP covers 5% of the site** Max depth between 0.6 and 0.9m Max velocity between 1.0 and 2.0m/s **0.1% AEP covers 24% of the site** Max depth between 0.9 and 1.2m Max velocity greater than 2.0m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The sites are shown to be affected by surface water flooding in the 3.3%, 1% and 0.1% AEP events. The eastern site is shown to be affected by flooding in the 3.3% AEP event along the most northerly and easterly boundary of the site. There is a surface water flow path along Hyde End Road which encroaches on the northern boundary of the site, an isolated area of pooling in the north of the site and a surface water flow path which flows along the eastern boundary of the site. Maximum flood depths on the site are between 0.6 and 0.9m,

	although most depths are shown to remain below 0.3m. Maximum velocity is up to 1.0m/s with a maximum hazard classification of 'Danger for most'. In the 1% AEP the surface water flow path along Hyde End Road enters the site in the north and flows in a south easterly direction through the site, bisecting the northeast corner of the site, to join the flow path to the east of the site. Maximum flood depths on the site are between 0.6 and 0.9m, although most depths are shown to remain below 0.3m. Maximum velocity is up to 2.0m/s with a maximum hazard classification of 'Danger for most'. The far west site remains clear of surface water flooding in both the 3.3% AEP and 1% AEP. In the 0.1% AEP event there is a large surface water flow path which flows in an easterly direction through the north of the site to join the River Loddon to the east of the site. Maximum depths are between 0.9 and 1.2m although large parts of the flow path have depths which remain below 0.3m. The maximum velocity is greater than 2m/s with a maximum hazard classification of 'Danger for most'. There is also an isolated area of pooling on the eastern site in the centre and a small flow path which develops on the western site.
Reservoir	The site is not shown to be within the 'Dry Day' extent from the reservoir flood mapping. Reservoir flood mapping shows the east side of the site to be affected by the Wet Day flood extents from Lake Bearwood, Bramshill House Pond, Tundry Pond and Wellington Country Park Lake. These extents affect the extreme east side of the site, extending up to 70m within the site boundary. The 'Wet Day' event seeks to estimate the effect of a breach at the same time as a 0.1% AEP river flood is occurring and suggests that the consequences of such a breach are similar to the modelled 0.1% AEP event river flood event, but probably would be associated with a much lower probability. These extents encroaching the site are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF dataset shows that over 90% entire of the site has a greater than 75% susceptibility to groundwater flooding. The western edge of the site has a less than 25% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater flood emergence based on groundwater levels. This shows groundwater levels in the eastern side of the site (east of Hyde End Road) are within 0.025m of the ground surface. In the western side of the site, groundwater levels are shown to be between 0.025m and 0.5m below the surface. This means that there is a risk of groundwater flooding to both surface and subsurface assets across the site.

	Based on the ROFSW dataset, it is likely any groundwater that emerges either side of Hyde End Road will likely follow the local topography flowing in an easterly direction towards the River Loddon. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG2 9 with 172 recorded historic sewer flooding incidents, according to available incident records from Thames Water (up 1 May 2022). Two incidents have been recorded less than 100 metres away with the first one occurring in 2002 being 20 metres away from the most northerly boundary of the site, and the second incident being 90 metres south of the site in 2018. Both incidents involved one property.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show records of flooding in the east side of the site extending approximately 30m west into the site. The recorded flood outlines dataset shows the site was affected by flooding in 1990, 1991, and 2007. These incidences all occurred as a result of the River Loddon exceeding channel capacity.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is located in the River Loddon and River Blackwater at Swallowfield (061FWF24Swllowfd) Environment Agency Flood Warning Area and the Lower River Loddon (061WAF24LLoddon) Flood Alert Area.
Access and egress	Safe access and egress will need to be demonstrated in the 1% AEP plus 40% climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment. Existing access to the sites is from Hyde End Road which runs north to south between the eastern and western sites. There is a road which runs west from Hyde End Road along the northern boundary of the western site and two tracks which runs east into the eastern side. The access from Hyde End Road remains unaffected during all modelled fluvial events. Hyde End Road is affected by surface water flooding in all modelled events, both north and south of the sites and between the sites where there is a surface water flow path which follows the path of the road. In the 3.3% AEP event, depths along Hyde End Road to the north and south of the site are up to 0.6m, with depths along the road of up to 0.3m between the two sites. In the 1% AEP event. In the 1% AEP event, the maximum depths remain the same but the flow paths increase in extent

	along the road. In the 0.1% AEP event, the flow path along Hyde End Road extends along the entire length of the road within the vicinity of the sites. Maximum depths are up to 0.9m along the road to the north and south of the site, with depths of up to 0.6m between the sites. In the 1% AEP plus 40% climate change event, there are surface water flow paths along most of Hyde End Road within the vicinity of the site. Depths along the road to the north of the site reach approximately 0.96m, with velocities of up to 2.04m/s and a maximum hazard classification of 'Danger for most'. Depths along the road to the south of the site reach approximately 0.57m, with velocities of up to 1.33m/s and a maximum hazard classification of 'Danger for most'. Safe access and egress to both sites is not currently shown to be possible during the 1% AEP plus 40% climate change event. Safe access and egress will need to be demonstrated in the 1% AEP plus 40% climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • 1% AEP plus 14% climate change uplift shows very little change in extent, with marginal increases onto the site. • 1% AEP plus 14% climate change uplift shows increases in depth of around 0.2m at the south east area of the site. • 1% AEP plus 14% climate change uplift shows no significant increase in velocity. • 1% AEP plus 23% climate change uplift shows increases in extent, onto the site in the south-eastern corner. • 1% AEP plus 14% climate change uplift shows increases in depth of around 0.3m at the southeast area of the site. • 1% AEP plus 23% climate change uplift shows no significant increase in velocity of around 0.2m/s. • There are no hazard grids available for either climate change uplift. **Surface Water** • 3.33% AEP plus 35% climate change uplift shows additional flooding in the far north corner to the far eastern corner on the far eastern side of the site and the northern corner of the western part of the site. • 3.33% AEP plus 35% climate change uplift shows no significant increase in depth in previously inundated areas.

	• 3.33% AEP plus 35% climate change uplift shows an increase of velocity from 0.25, to up to 0.5m/s^2 in the south-eastern part of the site. • 3.33% AEP plus 35% climate change uplift shows no significant increase in hazard. • 1% AEP plus 40% climate change shows additional flooding in the northern part of the site, and there is pooling of surface water in the south-western area of the site, in addition to flooding in the south-eastern corner of the site. • 1% AEP plus 40% climate change uplift shows increases from 0.15m, to up to 0.3m in the north-eastern part of the site. • 1% AEP plus 40% climate change uplift shows no significant increase in velocity. • 1% AEP plus 40% climate change uplift for the hazard index shows increases from dangerous for some too dangerous for most. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand
	  ○ Superficial – River Terrace Deposits, 2 - Sand and gravel
	• Soils at the site consist of loamy soils with naturally high groundwater.
	Sustainable Drainage Systems (SuDS)
	• The site is considered to be highly susceptible to groundwater flooding. Groundwater flooding could occur at the surface which may flow to and pool within topographic low spots during very wet winters. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• Groundwater levels are indicated to be at or very near (within 0.025m) ground level and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided

	above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site • BGS data indicates that the underlying geology is London Clay and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff. • The site is not located within a historic landfill site. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 3.3%, 1%, 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • The site is not located in a groundwater Source Protection Zone (SPZ) • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Due to the presence of high water levels it is recommended that a liner is used if underground storage is constructed on site. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The exception test is required for this site because 'More Vulnerable' development is located within Flood Zone 3a.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** At the planning application stage, a site-specific FRA will be required as the proposed development site is: • Within Flood Zones 2, 3 or 3b • Within Flood Zone 1 with a site area of greater than one hectare • Within Flood Zone 1 where the SFRA shows it will be at risk of flooding from rivers in the future • Is in Flood Zone 1 where the SFRA shows it is at risk from surface water and groundwater flooding during its lifetime Other considerations: • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Development should be steered away from the appropriate 1% AEP plus appropriate allowance for climate change flood extent. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design

	and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site. • A detailed hydraulic model of the unnamed watercourses within and bordering the site may be required at FRA stage to accurately represent the risk from these watercourses.

Key message

The development is likely to be able to proceed if:

- The area of the site located in Flood Zone 3b is left undeveloped.
- Mitigation measures are put in place due to the susceptibility of the site from groundwater flooding.
- Development is steered away from the western site and the most northerly part of the east site due to the risk of surface water flooding.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding across the site.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change fluvial and 1% AEP plus 40% climate change surface water events.
- Any flood mitigation measures implemented are tested to check they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the Loddon Lower 1D-2D ESTRY-TUFLOW hydraulic model (2022) and the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and 3b have been taken from the Loddon Lower 1D-2D ESTRY-TUFLOW detailed hydraulic model (2022).
Climate change	The most recent uplifts have been applied to the Loddon Lower hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived from the Loddon Lower 1D-2D ESTRY-TUFLOW hydraulic model.

Surface water	The RoFSW map has been used to define areas at risk from surface water flooding. This map has also been uplifted for the 3.33% AEP and 1% AEP climate change scenarios.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5SO008 and 5SO005**
Address	Sonning Golf Club
Area	2.13ha
Current land use	Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located within the grounds of Sonning Gold Club, to the south east of the junction between Bath Road (A4) and Pound Lane. The site is located in the north west of Wokingham Borough, between the urban centres of Sonning and Woodley, and lies in the River Loddon catchment, around 4km from its confluence with the River Thames. This catchment is approximately 5,189ha and is predominantly rural, with the River Loddon running south to north.
Topography	1m LiDAR shows that the site is relatively flat, with topography not varying by more than 1.5mAOD throughout. The north-west corner of the site, and the middle of the site is slightly elevated at 54.5mAOD and 54.9mAOD respectively, then compared to the rest of the site where topography varies from 53.5mAOD up to 54.0mAOD.
Existing drainage features	There are no drainage features within the bounds of the site. A series of small drainage features are approximately 300m east of the site. The River Loddon channel is around 1.8km east of the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:**

	The Environment Agency's Flood Map for Planning has been used within this assessment. No detailed hydraulic modelling was available for this assessment. **Flood characteristics:** There is no flood risk shown in this site for any return period within the FMfP. The site is entirely within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 2% of the site Max depth is between 0.3m and 0.6m Max velocity is between 0m/s and 0.25m/s **1% AEP** covers 6% of the site Max depth is between 0.3m and 0.6m Max velocity is between 0.5m/s and 1m/s **0.1% AEP** covers 16% of the site Max depth is between 0.3m and 0.6m Max velocity is between 1m/s and 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** Surface water flooding is mainly confined to the south of the site. In the 3.3% AEP and 1% AEP events, there is only minor surface water ponding to a maximum depth, velocity, and hazard of 0.3m to 0.6m,0.5m/s to 1m/s, and 'Danger for some'; whereas in the 0.1% AEP event, there is a larger surface water flow path that flows the site and is around 27m wide to a maximum depth, velocity, and hazard of 0.3m to 0.6m, 1m/s to 2m/s, and 'Danger for most'. The flow path originates from the eastern border on Pound Lane and flows through the site in a westerly direction. Additional areas of minor surface water ponding occur to the north of the site to a maximum depth of 0.15m to 0.3m and velocity between 0.25m/s and 0.5m/s in the 0.1% AEP event.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset suggests the entire site is over 75% susceptible to groundwater flooding. This is supported by the JBA Groundwater Emergence Map which suggests groundwater emergence levels are between 0.5m and 5m below ground level. This means that there is a risk of flooding to subsurface assets but surface manifestation of groundwater is unlikely. The JBA

	Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in postcode area RG4 6. There have been no recorded incidences of sewer flooding within the site in records provided by Thames Water from 2000 up to 1 May 2022. There are 25 recorded incidences of sewer flooding within 500m of the site; the majority of which occurred south of the site around Pound Lane, or north of Bath Road (A4).
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that there are no recorded incidences within or immediately surrounding the site. Historic flood events provided by Wokingham Borough Council identify no incidences of flooding within the site. One recorded incident in 2013 occurred on the junction between Reading Road (A4) and Pound Lane approximately 220m from the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows the site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Existing access to the site can be found via Pound Lane or Duffield Road that run along the eastern border of the site. Both roads mentioned above are impacted by surface water at all modelled return periods. Surface water depth and velocity in the 3.3% AEP plus 35% climate change rise to a maximum of 0.55m and 0.32m/s respectively on Pound Lane, and 0.43m and 0.39m/s on Duffield Lane. The maximum hazard rating is 'Danger for some' for both access routes. In the 1% AEP plus 40% climate change, this increases to 0.62m and 0.42m/s and 0.53m and 0.53m/s respectively. Therefore, access and egress for emergency vehicles is likely to be impeded. Access could be granted from Bath Road which runs east to west to the north of the site. Bath Road is at risk of minor surface water flooding, mostly ponding. When accessing from the east on Bath Road the maximum depth and velocity are 0.37m and 0.12m/s, when accessing from the east they are 0.13m and 0.23m/s. The maximum hazard rating is 'Danger for most' for both access routes. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water

	flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances **Fluvial** • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate change flood extent. • There is no risk of fluvial flooding shown at any of the modelled climate change events. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • In the 3.3% AEP plus 35% climate change and 1% AEP plus 40% climate change, a surface water flow path originating on Pound Lane flows east across the site towards the drainage network 300m east of the site. This flow path is approximately 21m wide on the western border and 26m on the eastern border in the 1% AEP plus 40% climate change event. • This site can be considered quite sensitive to climate change. The surface water extent in the 1% AEP plus 40% climate change is up to 10m wider than 1% AEP event. • Additional areas of minor surface water ponding also occur to the north of the site. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - Lambeth Group - Clay, silt and sand
	  ○ Superficial - River Terrace Deposits, 4 - Sand and gravel
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater
	Sustainable Drainage Systems (SuDS)
	• The site is considered to be highly susceptible to groundwater flooding. Groundwater flooding could occur at the surface which may flow to and pool within topographic low spots during very wet winters. Detention and attenuation features should be designed to prevent

	groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site. • Groundwater levels are indicated to be between 0.5 and 5m below ground level and there is a risk of flooding to subsurface assets and below ground development such as basements. Groundwater monitoring is recommended to determine the seasonal variability of groundwater levels, as this may affect the design of the surface water drainage system. • BGS data indicates that the underlying geology is loamy with naturally high groundwater and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during all available return periods. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface

	water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The exception test is required for this site because the site is located in an area at high risk of surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is: ○ In Flood Zone 1 where the SFRA shows it is at risk from other sources of flooding (specify which e.g. surface water, groundwater, reservoir), or will be during its lifetime • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy

	should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

Key message

Development is likely to be able to proceed if:

- Development is steered away from the surface water flow paths in the south of the site, and the small areas of surface water ponding in the north. These flow paths should be incorporated and considered within the development site.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding in the eastern part of the site.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's FMfP and RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a have been taken from the Environment Agency's Flood Map for Planning. There is no detailed hydraulic modelling available at this location.
Climate change	The latest climate change allowances have been applied to the RoFSW map to indicate the impact on surface water flood risk. In the absence of detailed hydraulic modelling, Flood Zone 2 has been used as an indicative assessment of future fluvial risk at 1% AEP.

Fluvial depth, velocity and hazard mapping	There is no detailed hydraulic modelling available at this location.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5WI004, 5WI006 and 5WI010**
Address	Land off Poplar Lane and Watmore Lane
Area	32.6ha
Current land use	Predominantly greenfield, with brownfield sites such as a school in the south, and the northern tip.
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located to the west of Winnersh, between the limit of the town and the Winnersh Interchange junction (M4 and A329M). The site is located in the centre of Wokingham Borough, in the downstream reaches of the Emm Brook, around 2.5km upstream of its confluence with the River Loddon. The catchment is approximately 4242ha and is mostly rural. The Emm Brook bisects this site, flowing from the south-east to north through the site, then following the north-west border until the end of the site. At this point, the Emm Brook is moderately urbanised, flowing through Wokingham, Emm Brook town, and Winnersh downstream of the site.
Topography	1m LiDAR shows that the south-western part of the site is at higher elevation (around 53.6m AOD) than the rest of the site. The south-eastern part of the site is lower elevation at around 42.2m AOD as it slopes down towards the Emm Brook. The northern part of the site mirrors this, sloping downhill from north to south. The gradient is much shallower on the northern half of the site where the maximum elevation is around 39.5m AOD. The north, east, and south of the site is also bordered by raised motorways.
Existing drainage features	The Emm Brook bisects the site, flowing from the south-east to north through the site. To the south of Wheatfield primary school, a drain flows west to east following a field boundary, bisecting the site. It discharges into the Emm Brook at NGR SU794706 upstream of the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 18% of the site Flood Zone 3a covers 18% of the site Flood Zone 2 covers 21% of the site Flood Zone 1 covers 79% of the site

	The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%). **Available data:** The Emm Brook detailed hydraulic model (2020) was used in this assessment. Due to there being no availability of a 3.3% AEP flood extent, the 1% AEP extent was used as an indicative Flood Zone 3b, and therefore is the same as Flood Zone 3a. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. The Environment Agency review of the Emm Brook model noted that whilst this model was fit for purpose to update the Flood Map for Planning, the levels were not suitable for use in site-specific Flood Risk Assessments. Therefore, it is advised that the suitability of this modelling to inform this site is reviewed by the developer to determine if any further modelling work is needed. **Flood characteristics:** Flood Zone 2 of the Environment Agency's Flood Map for Planning shows fluvial flood risk bisecting the north of the site, following Emm Brook, which flows from south-east to north. Flood Zone 2 extends approximately 15 to 30m on the left bank and 100 to 150m on the right bank. Flood Zone 2 extends upstream to approximately 40m from the M4 highway, with maximum depths and velocities of 0.62m and 1.67m/s. Flood Zone 3a and Flood Zone 3b also follow the Emm Brook and have a similar flood extent. They extend between 5-25m on the left bank and 35-130m on the right bank, only marginally less than the EA FMfP Flood Zone 2. Flood Zone 3a and 3b extends upstream to approximately 70m from the M4 highway, with a maximum depth and velocity of 0.76m and 1.68m/s. When compared with the 5%AEP the Flood Zone 3b follows the same pattern, and the distance in which the extent extends on wither bank is mostly within ±10m. The 5%AEP extent extends to approximately 175, from the M4 highway.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 7% of the site Max depth is between 0.6m and 0.9m Max velocity is between 0.25m/s and 0.5m/s **1% AEP** covers 12% of the site Max depth is between 0.9m and 1.2m Max velocity is between 0.5m/s and 1m/s **0.1% AEP** covers 28% of the site Max depth is over 1.2m Max velocity is between 1m/s and 2m/s

	The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage). **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all scenarios. Similar to the fluvial Flood Zones, Surface water flows south-east to north through the site following topography, where it is channelled in the Emm Brook. Surface water flooding during all return periods also extends into the low-lying immediate floodplain of the Emm Brook, particularly to the north-west. In the 3.3% AEP event, surface water is channelled in to, and mostly confined by the banks of the Emm Brook in the upstream half of the site. Where the Emm Brook begins to follow the north-western site border, the surface water flood extent increases, and the eastern low-lying floodplains of the Emm Brook are flooded to a maximum depth, velocity, and hazard of 0.6m-0.9m, 0.25m/s-0.5m/s, and 1.25-2 respectively. In the 1% AEP event, the surface water flood extent is 90m wider than the 3.3% AEP event on the eastern floodplains, getting wider as you move downstream. An additional flow path flowing from Groveland's Avenue also enters the site and flows along the north-western border, following the topographic lows. In the 0.1% AEP event, the surface water flood extent is about 90m wide in the east of the site and 150m wide in the north, extending out further into the low-lying floodplains than the 1% AEP event. There are also 4 additional surface water flow paths that join the Brook from the west. One of which follows the southern site boundary. Furthermore, the flow path from Groveland's Avenue also widens to around 17m and flows along the north-west border into the Emm Brook. The maximum depth, velocity, and hazard in the 1% AEP event are over 1.2m, 1-2m/s, and 1.25-2 respectively.
Reservoir	The low-lying floodplains surrounding the Emm Brook that bisect the site are shown to be at risk of reservoir flooding in both the wet day and dry day scenarios according to the EA reservoir flood maps. These extents are from the Queensmere Lake reservoir. Queensmere Lake is located in the south of Wokingham Borough. The Dry Day event shows that flooding is mainly confined to the banks of the Emm Brook, following topography. There is a small amount of flooding at the upper north of the site, on the eastern floodplains of the Emm Brook. The Wet Day event extent is much wider than the dry day, extending between 125 and 180m from the banks of the Brook. The flooded area is also more extensive than the EA's FMfP Flood Zone 2, where it floods surrounding low-lying floodplains of the Emm Brook.

	These extents encroaching the sites are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF data suggests that the north of the site has a between 50% to 75% susceptible to groundwater flooding, whereas, the south of the site is between 25% and 50% susceptible to flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The emergence mapping shows the majority of the site being at no risk to groundwater emergence. The southern 250m of the site have groundwater emergence levels of between 0.025m and 0.5m of the surface. An additional 200m band of higher groundwater levels (between 0.5m and surface level) bisects the site on the western bank of the Emm Brook. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The western border of the site is located in a postcode area RG41 5. Since 2000, there are no incidences of sewer flooding within the site. Since 2000, there are 89 incidences of sewer flooding within 500m of the site. The majority of these occurred in the urban area of Winnersh to the west of the site.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that there are numerous records of fluvial flooding within the site boundary, due to bank overtopping along the Emm Brook. The recorded flood outlines show the extents bisecting the site extending approximately 180m wide across the floodplains of the Emm Brook. Furthermore, the outline shows this flooding impacting surrounding highways such as Robin Hood's Lane, the Winnersh interchange, and roads in the housing development to the west of the site which may be used for access and egress to this site. Historic flooding records provided by Wokingham Borough Council also identify incidences of fluvial flooding along the Emm Brook impacting the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows that the site is not protected by any formal flood defences; however, natural high ground bisects the site, running along the western and eastern banks of the Emm Brook.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	Parts of this site are located in the 'Emm Brook at Wokingham' (061FWF24Wokinghm) Environment Agency Flood Warning Area and the 'Emm Brook' (061WAF24EmmBrook) Flood Alert Area.

Access and egress	Access and egress to the site is possible through the housing development to the west on Watmore Lane, Woodward Close, Maidensfield, or Grovelands Avenue. All access routes through the housing development mentioned above are at surface water flood risk to a maximum depth of 0.12m, 0.27m, 0.39m, and 0.34m respectively in the 1% AEP plus 40% climate change event. Access to this housing development can be found via Reading Road and Robin Hood Lane. When accessing the development from the south on Reading Road, the Emm Brook does not pose a significant fluvial flood risk; however, surface water flows in areas of lower topography, and is channelled into the Emm Brook. Maximum surface water depths at Reading Road and Woosehill roundabout are up to 2.3m and velocities up to 1.4m/s in the 1% AEP plus 40% climate change event, meaning access and egress for emergency vehicles is likely to be impeded. An additional surface water flow path around 1km north-west on Reading Road has maximum flood depths and velocities of 0.28m and 0.37m/s in the 1% AEP plus 40% climate change event. When accessing the development from the north via Robin Hood Lane, there is significant fluvial and surface water risk. The Emm Brook crosses Robin Hood Lane at SU784715 with maximum fluvial depths and velocities of 2.4m and 1.33m/s in the 1% AEP plus 25% climate change event. To the south on Robin Hood Lane, a significant surface water flow path is channelled by the railway line. Maximum depths and velocities here are 1.7m and 0.4m/s in the 1% AEP plus 40% climate change event. Furthermore, Robin Hood Lane then joins Reading Road; which as mentioned previously, is also at significant surface water risk. Due to the depths and velocities mentioned above, it is highly likely that emergency access will be affected along all access routes. At present, safe access and egress cannot be demonstrated in the 1% AEP plus 40% climate change event. In order to develop on this site, safe access and egress will need to be demonstrated in the 1% AEP plus 40% climate change fluvial/surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial**

	• Detailed modelling of the higher central climate change extent of the Emm Brook shows fluvial flood risk bisecting the north of the site, following the Emm Brook, which flows from south-east to north. The modelled extent widens approximately 15 to 30m on the western bank and 100 to 150m on the eastern bank. It extends upstream to approximately 70m from the M4 highway. • The Emm Brook is not too sensitive to climate change on the left and right banks, and the width of the extents change by around 5m. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • The immediate floodplain of the Emm Brook is at surface water flood risk at all available climate change return periods. In the 1% AEP plus 40% climate change event the flooding extends to 140m wide across the Brooks floodplains • Additional small surface water flow paths emerge, particularly on the western bank, with water flowing into the Brook. • This site is very sensitive to climate change in regard to surface water flooding with all flow paths extending by a considerable amount. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	Geology & Soils
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand.
	  ○ Superficial – Combination of River Terrace Deposits, 2 - Sand and gravel and Alluvium - Clay, silt, sand, and gravel.
	• Soils at the site consist of:
	  ○ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
	Sustainable Drainage Systems (SuDS)
	• The south of the site is considered to have a low susceptibility to groundwater. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Groundwater monitoring is recommended to determine the seasonal variability of groundwater levels, as this may affect the design of the surface water drainage system. Below ground development such as basements may not be appropriate at this site.
	• Groundwater levels on the southern tip and along a 42m wide band bisecting the site are indicated to be between 0.5 and 5m below ground level and there is a risk of flooding to subsurface assets and below ground development such as basements. Groundwater monitoring is recommended to determine the seasonal variability of

	groundwater levels, as this may affect the design of the surface water drainage system. • BGS data indicates that the underlying geology is a combination of clay and river terrace deposits and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff. • The site is partially located within Groundwater Source Protection Zone (SPZ) 1 and infiltration techniques may not appropriate for anything other than clean roof drainage. If infiltration is proposed for anything other than clean roof drainage in SPZ 1, a hydrogeological risk assessment should be undertaken to ensure that the system does not pose an unacceptable risk to the source of supply. Infiltration techniques should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints. • The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could include a blue-green corridor along the Emm Brook and around areas of surface water ponding. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should

	take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff to the Emm Brook should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The exception test is required for this site because development designated as 'More Vulnerable' is located within Flood Zone 3a and is at risk from surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is located in Flood Zone 3a and is at risk from surface water flooding or will be in its lifetime. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk.

	For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site. • Opportunities to incorporate any environmental or watercourse improvements/enhancements/removal of in-channel structures or NFM as part of the development should be reviewed by developers. • A buffer should be maintained between any development and watercourses. Opportunities should be sought to provide environmental enhancements and where feasible reduce the risk of flooding on or off the site from all sources.

Key message

Development is likely to be able to proceed if:

- The area of the site located in Flood Zone 3a, immediately surrounding the Emm Brook, is left undeveloped.
- Development is steered away from additional surface water flow paths along the southern border and areas of surface water ponding.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere. A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- The developer reviews the suitability of the Emm Brook model to inform this site and carries out any further modelling work deemed necessary.

Mapping information

The key datasets used to make planning recommendations for this site were the Emm Brook hydraulic model (2020) and the Environment Agency's FMfP and RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2 and 3a have been taken from the Emm Brook detailed hydraulic model (2020). Due to there being no availability of a 3.3% AEP flood extent, the 1% AEP extent was used as an indicative Flood Zone 3b.
Climate change	The higher central allowance (25%) was available for the Emm Brook hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have been applied to the RoFSW map to indicate the impact on surface water flood risk.
Fluvial depth, velocity, and hazard mapping	Depth, velocity, and hazard data was derived for the 1% AEP and 0.1% AEP events from the Emm Brook hydraulic model (2020).
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5WI008**
Address	Winnersh Plant Hire, Winnersh
Area	1.59 ha
Current land use	Brownfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located within the catchment of the River Loddon from Swallowfield to the River Thames confluence. The catchment is approximately 5190ha and is predominantly urbanised. The site is located within the central part of the catchment. The River Loddon flows through the catchment in a northerly direction.
Topography	1m LiDAR data shows that ground levels are predominantly flat across the site with ground levels ranging between 39.2 and 39.5mAOD. Localised areas of higher topography are present in the centre and south of the site and have ground levels of between 39.8 and 41.8mAOD.
Existing drainage features	Two watercourses are present within close proximity to the site, the first is the River Loddon which flows in a northerly direction 300m south of the site. The River Loddon is an Environment Agency designated Main River. The second watercourse is an unnamed land drain which flows in a westerly direction 180m west of the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 21% of the site Flood Zone 2 covers 73% of the site Flood Zone 1 covers 27% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:**

	The Loddon Lower 1D-2D ESTRY-TUFLOW detailed hydraulic model, updated by JBA in 2022, has been used for this assessment. **Flood characteristics:** The majority of the site is located in Flood Zone 2. Several areas of the site (southwest and in the middle) are predicted to be dry due to the localised increases in topography in these areas. The source of the flood water is the River Loddon. Flood Zone 3a extends over a small part of the south of the site. Maximum flood depths on the site are shown to reach 0.47m in Flood Zone 3a and increase up to 0.71m in Flood Zone 2. The site is not located in Flood Zone 3b, though this is close to the site boundary.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 1% of the site Max depth is between 0.3 and 0.6m Max velocity is less than 0.25m/s **1% AEP** covers 13% of the site Max depth is between 0.3 and 0.6m Max velocity is between 0.25 to 0.5m/s **0.1% AEP** covers 55% of the site Max depth is between 0.3 and 0.6m Max velocity is between 1 to 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** In the 3.3% AEP event, surface water ponds along the eastern border. Flood depths are predominantly below 0.3m with small areas predicted to flood up to 0.6m. Flood velocities are slow and are less than 0.25m/s and has a resulting maximum flood hazard rating of 'Dangerous for Some'. In the 1% AEP event, several additional areas of ponding appear in the west and northeast of the site with a minor increase in the size of the areas of ponding present on the site in the 3.3% AEP event. Flood depths remain below 0.6m. Flood velocities are predominantly less than 0.25m/s with

	small areas predicted to experience velocities of up to 0.5m/s and has a resulting maximum flood hazard rating of ‘Dangerous for Some’. In the 0.1% AEP event, flooding across the site significantly increases. A large part of the site is shown to be affected by surface water ponding, predominantly in the north and west, as well as along the southern boundary. Flood depths are between 0.15 to 0.6m. Flood velocities are predominantly less than 0.25m/s across the site with small areas predicted to experience velocities of up to 2m/s and has a resulting maximum flood hazard rating of ‘Dangerous for Most’.
Reservoir	Reservoir flood mapping shows the site is not affected by the ‘Dry Day’ flood extents however the site is affected by the ‘Wet Day’ flood extents from eight reservoirs: Bearwood Lake, Bramshill House Pond, Longmoor Lake, Maiden Erlegh Lake (No.1), Queensmere, Southlake, Tundry Pond, and Wellington Country Park Lake. The 'Wet Day' event seeks to estimate the effect of a breach at the same time as a 0.1% AEP river flood is occurring and suggests that the consequences of such a breach are larger than the extent of Flood Zone 2, resulting in almost the entire site being flooded during this event. The risk of reservoir flooding is associated with a much lower probability of flooding than Flood Zone 2. These extents encroaching the sites are deemed as high risk, with the exception of Tundry Pond, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF dataset shows that the entire site has greater than a 75% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The JBA Groundwater Emergence Map indicates that groundwater levels are either at or very near (within 0.025m of) the ground surface. This means that there is a risk of groundwater flooding to both surface and subsurface assets. Based on the RoFSW dataset, it is likely any groundwater that emerges will flow to the north and south-western parts of the site, following the local topography. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG10 0. Prior to 2019, 18 incidents of sewer flooding had occurred within this postcode area. Between 2019 and 2022, 205 incidents of sewer flooding have occurred within this postcode area. These incidents are according to available incident records from Thames Water (from 2000 up to 1 May 2022).

Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that flooding occurred in September 1968 as a result of the channel capacity being exceeded. Historic flooding records provided by Wokingham Borough Council show one record of historic flooding 20m north of the site as a result of surface water being unable to drain into the River Loddon.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows that natural high ground is present along the River Loddon which may provide some level of protection to the site from this watercourse.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is located in the 'River Loddon at Winnersh and Woodley' (061FWF24Winnersh) Environment Agency Flood Warning Area and the 'Lower River Loddon' (061WAF24LLoddon) Flood Alert Area.
Access and egress	The site is currently accessed from two locations, the first is along the northern boundary from the A329 Reading Road and the second is along Greenacres Lane along the eastern boundary of the site. Both access routes are predicted to be significantly impacted by fluvial and surface water flooding entering the site from the north. In the 1% AEP plus 14% climate change fluvial flood event, the A329 Reading Road is completely inundated to the west of the site. However, access may be possible to the east of the site where Reading Road and Greenacres Lane are not shown to be affected by fluvial flooding. However, the fluvial flood risk is in close proximity to Reading Road and all surrounding roads are inundated within the higher return period events so a site-specific assessment will need to interrogate in more detail the localised depths, velocities and hazard of surrounding roads to ensure safe access and egress can be achieved. In the 1% plus 40% climate change surface water flood event, flood depths along the A329 Reading Road are predominantly shallow and are below 0.3m. Flood velocities along the road vary and reach a maximum of 0.6m/s which has a corresponding maximum hazard rating of 'Dangerous for Most'. Along Greenacres Lane, flood depths are predominantly up to 0.6m with a small area predicted to flood to depths of up to 0.9m. Flood velocities are less than 0.6m/s and have a maximum hazard rating of 'Dangerous for Most'. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events. Site drainage proposals should address the requirements for access routes, avoid impeding surface

	water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial** • Between the 1% AEP and 1% AEP plus 14% (central allowance) and 23% (higher central allowance) events there is a significant increase in fluvial flood risk across the site. • The 1% AEP event only impacts the south and western border of the site but the 1% AEP plus 14% climate change extent also covers the north of the site. There is then a slightly further increase in extent for the 1% AEP plus 23% climate change event. • This shows that fluvial flood risk across the site is highly sensitive to the effects of climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • In the 1% AEP plus 40% climate change event, the extent of surface water ponding across the site is significantly larger than that of the 1% AEP event. Flood depths are below 0.6m and the velocity remains below 0.3m/s. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – London Clay Formation
	  ○ Superficial - River Terrace Deposits,
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater
	Sustainable Drainage Systems (SuDS)
	• The site is considered to be highly susceptible to groundwater flooding. Groundwater flooding could occur at the surface which may flow to and pool within topographic low spots during very wet winters. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated

	zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site. • Groundwater levels are indicated to be at or very near (within 0.025m) ground level and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site. • BGS data indicates that the underlying geology is London Clay and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment. • Proposed attenuation features such as basins, ponds and tanks should be located outside of Flood Zone 3 to avoid the potential risks to the hydraulic capacity or structural integrity of these features. Surface water outfalls that discharge into the River Loddon may be susceptible to surcharging due to water levels in the River Loddon. The impacts of tide locking/flood flows will need to be considered in terms of the attenuation storage requirements of the site and placement of the outfalls. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The exception test is required for this site because 'More Vulnerable' development is located within Flood Zone 3a and is at significant risk of surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is within Flood Zones 2 and 3a and is at significant risk of surface water flooding. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance

	for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

Key message

There may be challenges to developing large parts of this site due to the coverage of fluvial flood risk in the climate change event, as well as surface water risk. The current site does not allow for safe development for its lifetime. If development is to proceed at the site, the following will need to be addressed:

- A carefully considered and integrated flood resilient and sustainable design is put forward. To ensure that the proposed development is safe from flooding for its lifetime.
- Safe access and egress will need to be demonstrated in the 1% AEP plus 40% climate change surface water event and 1% AEP plus climate change fluvial flood event. All surrounding roads in the vicinity of the site are inundated in the fluvial and surface water climate change events, so detailed modelling should be undertaken, and a site-specific flood risk assessment will need to assess the depth, velocity and hazard of surrounding roads to ensure safe access and egress can be achieved. Where alterations to the site are proposed in order to achieve safe access and egress, this will need to be demonstrated without displacing flood risk elsewhere.
- A site-specific FRA should demonstrate that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA.
- Due to the significant areas of flooding both on and surrounding the site, betterment will need to be considered an incorporated into the site design to reduce the flood risk to the site and surrounding area.

Mapping information

The key datasets used to make planning recommendations for this site were the Loddon Lower hydraulic model (2022) and the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and 3b have been taken from the Lower Loddon detailed hydraulic model (2022).
Climate change	The most recent uplifts have been applied to the Lower Loddon hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.

Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived from the Lower Loddon hydraulic model.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5WI009 and 5WI019**
Address	Land on the north-west Side of Old Forest Road
Area	2.0ha
Current land use	Brownfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located to the north-west of Emm Brook town, south of the M4 motorway and the Winnersh Interchange junction, bordering Old Forest Meadows. The site is located in the centre of Wokingham Borough, in the downstream reaches of Emm Brook, around 2.5km upstream of its confluence with the River Loddon. The catchment is approximately 4242ha and is mostly rural. Tributaries and drains discharging into Emm Brook flow to the north-east of the site.
Topography	1m LiDAR shows the topography of the site slopes slightly downwards from south-west (49.6mAOD) to north-east (47.0mAOD), towards the small drainage features in the north. There are also two high points within the middle of the site at around 50.0mAOD.
Existing drainage features	There are no drainage features within the bounds of the site. Emm Brook flows south-east to north-west, approximately 170m from the site boundary. Additional small land drains flow to the north-east of the site, discharging into Emm Brook approximately 210m downstream of the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).*

	Available data: The 2020 detailed hydraulic model for Emm Brook was used in this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. The Environment Agency review of the Emm Brook model noted that whilst this model was fit for purpose to update the Flood Map for Planning, the levels were not suitable for use in site-specific Flood Risk Assessments. Therefore, it is advised that the suitability of this modelling to inform this site is reviewed by the developer to determine if any further modelling work is needed. **Flood characteristics:** There is no flood risk shown in this site for any return period. The site is located entirely within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers less than 1% of the site Max depth is between 0 and 0.15m Max velocity is between 1 and 2m/s **1% AEP** covers 4% of the site Max depth is between 0 and 0.15m Max velocity is between 1 and 2m/s **0.1% AEP** covers 30% of the site Max depth is between 0.15 and 0.3m Max velocity is between 1 and 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** In the 3.3% AEP scenario, minor surface water ponding on Old Forest Road is shown to encroach on the site at the southern end to a maximum depth, velocity, and hazard of 0m to 0.15m, 0.5m/s to 1m/s, and Very Low Hazard/Caution. The 1% AEP extent shows and increase in the area of ponding mentioned above, where it forms into a flow path forming flowing from south-west to north-east towards the drain to the east end to a maximum depth, velocity, and hazard of 0.15m to 0.3m, 1m/s to 2m/s, and Very Low Hazard/Caution. This flow path is significantly more pronounced in the 0.1% AEP, spanning roughly 25m. In this scenario, a second flow paths forms to the north, around 8 to 10m wide, flowing in the same direction down the length of the site. The maximum depth, velocity, and hazard here is 0.15m to 0.3m, 1m/s to 2m/s, and Very Low Hazard/Caution

Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset suggests that the entire site is at less than 50% risk of groundwater flooding. This is confirmed by the JBA Groundwater emergence map, which suggests the site is at no risk due to the nature of the underlying geological deposits The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The western border of the site is located in a postcode area RG41 5. Since 2000, there have been no incidences of sewer flooding recorded within the site. Since 2000, there have been 25 incidences of sewer flooding within 500m of the site. The majority of these occurred in the urban area of Emm Brook town to the south of the site. These incidents are according to available incident records from Thames Water (from 2000 up to 1 May 2022).
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that there are no incidences of flooding within the site; however, approximately 80m north and 140m east of the site boundary, there are numerous reports of flooding due to bank overtopping along Emm Brook. Historic flooding records provided by Wokingham Borough Council identify three instances of fluvial flooding close to the site on Emm Brook.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows that site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Existing access to the site can be found via Toutley Road and Old Forest Road off Reading Road. Access along Toutley Road and Old Forest Road from the west remains clear during all modelled fluvial flood events. During the 1% AEP plus 40% climate change event, there are two surface water flow paths which affect Toutley Road to the west of the site. Depths along the road reach approximately 0.33m and 0.36m with maximum velocities of 0.26m/s and 0.53m/s. The maximum hazard rating of both flow paths is 'Danger for Most'. Furthermore, Toutley Road is accessed via

	Reading Road. When accessing from the south along Reading Road, there is surface water risk channelled along the path of Emm Brook which is shown to pose a significant risk to the highway, with depths of up to 2.3m, velocities up to 1.4m/s, and a maximum hazard rating of 'Danger for All'. However, in this area Emm Brook is culverted beneath Reading Road which is not represented within the Environment Agency RoFSW map. Therefore, it is likely that the risk in this area is overestimated within the RoFSW map, but this will need to be assessed further in a site-specific FRA. There is also additional surface water flooding further west along Reading Road with depths of up to 0.42m, velocities of up to 0.99m/s, and a maximum hazard rating of 'Danger for Some'. When accessed from the north, surface water flow paths up to 0.37m deep also impede access. Old Forest Road is subject to surface water flooding of up to 0.28m in depth, 1.7m/s in velocity, and with a maximum hazard classification of 'Danger for Some'. Like Toutely Road, Old Forest Road is accessed via Reading Road, which as mentioned previously is subject to surface water flooding. Due to the depths and velocities mentioned above, it is highly likely that emergency access will be affected along all access routes. At present, safe access and egress cannot be demonstrated in the 1% AEP plus 40% climate change surface water event. A site-specific assessment will need to interrogate in more detail the localised depths, velocities, and hazard of surrounding roads to ensure safe access and egress can be achieved. In order to develop on this site, safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • Detailed modelling for the 1% AEP plus 25% climate change event shows there is no risk of fluvial flooding to the site. • This site is not sensitive to fluvial climate change. **Surface Water** • The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.

	• In the 1% AEP plus 40% climate change event, the existing surface water flow path in the 1% AEP event extends, to a maximum of 30m, and flows lengthways along the south-east of the site. A secondary flow path flows lengthways along the north-west of the site and is around 8 to 10m wide. The Hazard rating remains as Very Low Hazard/Caution within the site. • This site is quite sensitive to climate change as the existing flow paths extend and additional ones are formed in the north of the site. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand.
	  ○ Superficial – Combination of River Terrace Deposits, 2 - Sand and gravel and Alluvium - Clay, silt, sand, and gravel.
	• Soils at the site consist of:
	  ○ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
	Sustainable Drainage Systems (SuDS)
	• The site is not considered to be susceptible to groundwater flooding, due to the nature of the local geological conditions. This should be confirmed through additional site investigation work.
	• BGS data indicates that the underlying geology is a combination of clay and river terrace deposits and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff to Emm Brook should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as ‘More Vulnerable’. The exception test is required for this site because the site is located in an area at high risk of surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is at risk from surface water flooding or will be in its lifetime. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning

	Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

Key message

Development is likely to be able to proceed if:

- Development is steered away from the surface water flow paths in the north-west and south-east of the site, and any additional surface water ponding, and these flow paths be incorporated and considered within the development site.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere. A site-specific assessment will need to interrogate in more detail the localised depths, velocities, and hazard of surrounding roads to ensure safe access and egress can be achieved.

- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- The developer reviews the suitability of the Emm Brook model to inform this site and carries out any further modelling work deemed necessary.

Mapping information

The key datasets used to make planning recommendations for this site were the Emm Brook hydraulic model (2020) and the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2 and 3a have been taken from the Emm Brook detailed hydraulic model (2020). Due to there being no availability of a 3.3% AEP flood extent, the 1% AEP extent was used as an indicative Flood Zone 3b.
Climate change	The higher central allowance (25%) was available for the Emm Brook hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have been applied to the RoFSW map to indicate the impact on surface water flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived for the 1%AEP and 0.1%AEP events from the Emm Brook hydraulic model (2020).
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5WI011**
Address	Wheatsheaf Close, Winnersh
Area	0.73ha
Current land use	Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located within the catchment of the River Loddon. The catchment is approximately 5200ha and the site is located in the central extent of the catchment on the edge of an urban area. The River Loddon flows through the catchment in a northerly direction, approximately 750m northwest of the site.
Topography	The site is predominantly flat with a gradual decrease in site levels from the eastern boundary where ground levels are approximately 55.3mAOD to the western boundary where ground levels are approximately 52.9mAOD.
Existing drainage features	An unnamed tributary of the River Loddon flows in a northerly direction 700m north of the site. The River Loddon itself flows in a northerly direction approximately 750m northwest of the site. No other watercourses are present within the site boundary or in close proximity to the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** The Environment Agency's Flood Map for Planning has been used within this assessment. No detailed hydraulic modelling was available for this assessment.

	Flood characteristics: The Environment Agency's Flood Map for Planning shows no fluvial flood risk to the site as the entire site is within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 0% of the site **1% AEP** covers 0% of the site **0.1% AEP** covers 18% of the site Max depth is between 0.3 and 0.6m Max velocity is between 1 and 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** In the 3.3% event and the 1% AEP the site is not at risk of flooding. The site is shown to be affected by surface water flooding in the 0.1% AEP event. In the 0.1% AEP event a flow path, originating to the south of the site, flows in a northerly direction through and out of the site. Surface water depths along the flow path are predominantly shallow and are less than 0.3m, with small areas predicted to flood to depths of between 0.3-0.6m. The maximum velocity is0.5 to 1m/s for the flow path, with a resulting hazard of Caution. Small areas of ponding are also present in the eastern corner of the site and in the centre of the site. The velocities within the flow path are predominantly between 0.25 to 1m/s with some small areas at higher velocities of 1 to2m/s with isolated areas predicted to have a higher hazard rating of Dangerous for most.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset shows that the entire site has between a 25% and 50% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. This indicates that across the entire site, groundwater levels are between 0.025 and 0.5m below the ground surface. This means that there is a risk of groundwater flooding to both surface and subsurface assets.

	This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG41 5. Prior to 2019, 205 incidents of sewer flooding had occurred within this postcode area. Between 2019 and 2022, 18 incidents of sewer flooding have occurred within this postcode area. These incidents are according to available incident records from Thames Water (from 2000 up 1 May 2022). There are no recorded incidences on the site but there are seven recorded incidences within 100m to the east side of the site.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets do not have a record of any flooding on or surrounding the site. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding on or surrounding the site.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Access to the site is currently available from Gypsy Lane along the northern boundary of the site. The access road is predicted to be affected by surface water ponding in the 3.3% AEP plus 35% climate change event and is crossed by a surface water flow path in the 1% AEP plus 40% climate change and 0.1% AEP events. In the 3.3% AEP event, flood depths in the area of ponding are shallow and are below 0.3m. In the 1% AEP plus climate change event, flood depths across the flow path are shallow and are less than 0.3m, with a maximum velocity of between 0.6 to 0.9m/s and a resulting hazard of 'Caution' with some minor areas predicted to be at a higher hazard rating. This means access and egress for emergency vehicles may be impeded during a surface water flood event. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial** • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate change flood extent. Flood Zone 2 shows fluvial flood risk does not affect the site therefore the site is unlikely to be sensitive to any changes in fluvial flood risk as a result of climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • There is no risk to the site in the 3.3% AEP event but in the 3.3% AEP plus 35% climate change event a couple of areas of ponding develop in the north of the site. Depths on the site are up to 0.32m with a maximum velocity of 0.61m/s and a corresponding hazard classification of 'Danger for some'. • There is no risk to the site in the 1% AEP event but in the 1% AEP plus 40% climate change event a flow path develops which flows through the site in an north-westerly direction. Depths on the site are up to 0.37m with a maximum velocity of 1.19m/s and a corresponding hazard classification of 'Danger for most'. • This indicates that the surface water flood risk at the site is sensitive to the impacts of climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand
	  ○ Superficial - River Terrace Deposits - Sand and gravel.
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater
	Sustainable Drainage Systems (SuDS)
	• Groundwater levels are indicated to be less than 0.5m below ground level during a 1% AEP event. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.

	• BGS data indicates that the underlying geology is London Clay Formation and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 1% AEP plus climate change and 0.1% AEP events. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use

	of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The exception test is not required for this site because the site is not at fluvial or significant surface water risk. However, it is highlighted that the site is bisected by a surface water flow path in the 1% AEP plus 40% climate change event, and it is recommended that this is taken into account in any planning applications.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is at risk of surface water flooding. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development

	across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

Key message

The development is likely to be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding in the eastern part of the site.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2 and 3a have been taken from the Environment Agency's Flood Map for Planning. Flood Zone 3a has been used as a proxy for Flood Zone 3b in the absence of detailed modelling.
Climate change	Fluvial Flood Zone 2 has been used as a proxy for climate change in the absence of detailed modelling. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data were not available for this assessment.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5WI012 and 5WI021**
Address	Land to the rear of Bulldog Garage, Reading Road
Area	1.2ha
Current land use	Brownfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located to the north-west of Emm Brook town, south of the M4 motorway and the Winnersh Interchange junction. The site is located in the centre of Wokingham Borough, in the downstream reaches of Emm Brook, around 2.5km upstream of its confluence with the River Loddon. The catchment is approximately 4242ha and is mostly rural. Tributaries and drains discharging into Emm Brook, flow to the north-east of the site.
Topography	1m LiDAR shows the topography of the site slopes downwards from west to east, from 54.5mAOD to 49.2mAOD, towards the small drainage features in the east.
Existing drainage features	There are no drainage features within the bounds of the site. Emm Brook flows south-east to north-west, approximately 600m from the site boundary. Additional small land drains flow to the north-east and west of the site, discharging into Emm Brook approximately 700m downstream of the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b cover 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:**

	The 2020 detailed hydraulic model for Emm Brook was used in this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. The Environment Agency review of the Emm Brook model noted that whilst this model was fit for purpose to update the Flood Map for Planning, the levels were not suitable for use in site-specific Flood Risk Assessments. Therefore, it is advised that the suitability of this modelling to inform this site is reviewed by the developer to determine if any further modelling work is needed. **Flood characteristics:** There is no flood risk shown in this site for any return period within the FMfP. The entire site is within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 15% of the site Max depth is between 0.9m and 1.2m Max velocity is between 0.5m/s and 1m/s **1% AEP** covers 18% of the site Max depth is greater than 1.2m Max velocity is between 1m/s and 2m/s **0.1% AEP** covers 21% of the site Max depth is greater than 1.2m Max velocity is between 1m/s and 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** Surface water flooding occurs within the site in all AEP events. In all return periods, surface water flooding is mainly confined to the eastern 50m of the site, which is the lowest lying part of the site. This is a major surface water flow path that flows from the south and into the site, channelled into the drainage feature immediately north the site. Maximum depth, velocity and hazard classification here range from over 1.2m, 0.5m/s to 1m/s, and 'Danger for most' in the 3.3% AEP event, to over 1.2m, 1m/s to 2m/s, and 'Danger for most' in the 1% AEP event, to over 1.2m, 1m/s to 2m/s, and 'Danger for most' in the 0.1% AEP event. There is also additional minor surface water ponding in the western corner along the access road in the 0.1% AEP event, with a hazard classification of 'Very Low Hazard'.

Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset suggests the entire site is between 25% to 50% susceptible to groundwater flooding. This is largely confirmed by the JBA Groundwater emergency map which suggests the west of the site, extending 114m into the site, has groundwater emergence levels of between 0.025m and 0.5m of the surface. The western corner of the site is shown to have a thin band in which groundwater levels are at or very near the surface. In these areas there is a risk of groundwater flooding to surface and subsurface assets. The east of the site is shown as having no risk of groundwater emergence due to the nature of the underlying geological deposits. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The western border of the site is located in postcode area RG41 5. Since 2000, there have been six incidences of sewer flooding within 500m of the site. The majority of these occurred in the urban area of Emm Brook town to the south-west of the site. These incidents are according to available incident records from Thames Water (from 2000 up to 1 May 2022).
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that there are no recorded incidences within or immediately surrounding the site. Historic flooding records provided by Wokingham Borough Council identify no incidences of fluvial flooding within the site or on any of the surrounding highways.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows that site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Existing access to this site can be found via Reading Road, Toutley Road, or Lenham Close off Old Forest Road. When accessing the site from the east via Toutely Road, Emm Brook flows underneath the road from south to north to a maximum depth, velocity, and hazard of 1.46m, 0.9m/s, and Danger to All in the 1% AEP plus 25% Climate Change event. At this point, Toutely Road is raised by approximately 1.6m which is less that the maximum flood depths; therefore,

	the road is unlikely to be inundated here. On Reading Road, when accessing the site from the south, despite Emm Brook flowing south to north at the junction with Woosehill, modelled fluvial data shows that the road is not inundated in Flood Zone 2 or 3. There are two surface water flow paths that inundate Toutely Road east of the site in the 1% AEP plus 40% Climate Change event, one along the railway line, another is channelled by the lower elevation of an unnamed drainage feature. The depth, velocity, and hazard of these flow paths are 0.33m and 0.36m, 0.26m/s and 0.56m/s, and Danger for Some and Danger for Most respectively. Reading Road is also at risk of surface water flooding in the 1% AEP plus 40% Climate Change event. When accessed from the south, the highway is subject flooding around Emm Brook and the Woosehill junction up to 1.74m in depth and 1.55m/s in velocity in the 1% AEP plus 40% climate change event, with a hazard rating of Danger for All. It is important to note that this surface water event was run with LiDAR that is not representative of the current road conditions and does not include the raise highway. As such, the depths quotes are extremely uncertain and likely to be an overestimation. Further investigation of surface water flooding is required for this location. Surface water depths and velocities of Lenham Close are 0.12m and 0.1m/s, with a hazard rating of Very Low Hazard/Caution. However, there is a major surface water flow path that runs south to north with maximum depths of over 1m, separating the road from the site meaning it is not a viable access point. Due to the depths and velocities mentioned above, it is highly likely that emergency access will be affected along all access routes. At present, safe access and egress cannot be demonstrated in the 1% AEP plus 40% climate change surface water event. In order to develop on this site, safe access and egress will need to be demonstrated in the 1% AEP plus 40% climate change fluvial/surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances **Fluvial** • Detailed modelling for the 1% AEP plus 25% climate change event shows there is no risk of fluvial flooding to the site. • This site is not sensitive to fluvial climate change. **Surface Water**

	• The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk. • The major surface water flow path that flows through the east of the site into the drainage feature immediately downstream, extends 50 to 60m into the site in the 1% AEP plus 40% climate change event. This is approximately 10m further than the 1% AEP event in the southeast corner of the site but mostly less than 3m further. • An additional area of ponding also extends into the site in the western corner during the 1% AEP plus 40% climate change event, which remains outside the site during the 1% AEP event. • This site is only slightly sensitive to climate change in regard to surface water flooding as there are limited additional flow paths and the large flow path only extends approximately an additional 3m into the site along most of the eastern boundary. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand.
	  ○ Superficial – Combination of River Terrace Deposits, 2 - Sand and gravel and Alluvium - Clay, silt, sand, and gravel.
	• Soils at the site consist of:
	  ○ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
	Sustainable Drainage Systems (SuDS)
	• Groundwater levels are indicated to be less than 0.5m below ground level across the western half of the site during a 1% AEP event. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• BGS data indicates that the underlying geology is a combination of clay and river terrace deposits and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site.

	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff to Emm Brook should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as ‘More Vulnerable’. The exception test is required for this site because the site is located in an area at high risk of surface water flooding.

Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is at risk from surface water flooding or will be in its lifetime. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

Key message

Development is likely to be able to proceed if:

- Development is steered away from the large surface water flow path through the west of the site and any additional surface water ponding.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- The developer reviews the suitability of the Emm Brook model to inform this site and carries out any further modelling work deemed necessary.

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's FMfP and RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2 and 3a have been taken from the Emm Brook detailed hydraulic model (2020). Due to there being no availability of a 3.3% AEP flood extent, the 1% AEP extent was used as an indicative Flood Zone 3b.
Climate change	The latest climate change allowances have been applied to the RoFSW map to indicate the impact on surface water flood risk. The higher central allowance (25%) was available for the Emm Brook hydraulic model to indicate the impacts on fluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived for the 1%AEP and 0.1%AEP events from the Emm Brook hydraulic model (2020).
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5WI014**
Address	69 King Street Lane, Winnersh
Area	1.25ha
Current land use	Brownfield and Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located to the southeast of Reading and is bordered by King Street Lane (B3030) to the northwest and residential properties along Alder Mews to the west. The site is located within the catchment of the River Loddon. The catchment is approximately 5190ha and the site is located in the centre of the catchment. The site is located in an urbanised area of the River Loddon catchment. The River Loddon flows through the catchment in a northerly direction, approximately 735m west of the site.
Topography	1m LiDAR data shows that ground levels are generally highest in the south of the site at around 54.0mAOD, particularly along the southern site boundary and fall in a northerly direction towards the B3030 to a level of 51.7mAOD. There are also areas of higher ground at a level of approximately 55mAOD in the north eastern part of the site, although these appear to have resulted from the filtering of the LiDAR from the existing land use (appears to be storage of waste material).
Existing drainage features	An unnamed tributary of the River Loddon flows along the eastern boundary of the site in an open channel. After passing the site, the watercourse flows in a northerly direction through Winnersh before flowing west and flowing into the River Loddon approximately 1km north of the site. An unnamed land drain is located along the southern boundary of the site and receives overland flows from the land to the south of the site. The drain flows in an easterly direction and discharges into the unnamed tributary of the River Loddon.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site

	The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%). **Available data:** The Environment Agency's Flood Map for Planning has been used within this assessment. **Flood characteristics:** The Environment Agency's Flood Map for Planning shows no fluvial flood risk to the site as the entire site is within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 1% of the site Max depth is between 0.3 and 0.6m Max velocity is between 0.5 and 1m/s **1% AEP** covers 2% of the site Max depth is between 0.3 and 0.6m Max velocity is between 0.5 and 1m/s **0.1% AEP** covers 37% of the site Max depth is between 0.6 and 0.9m Max velocity is between 1 and 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is shown to be affected by surface water flooding in the 3.3%, 1% and 0.1% AEP events. In the 3.3% event, flood water is present along the southern, western and eastern boundaries of the site with the rest of the site remaining unaffected in this event. Flood water corresponds with the areas of low topography as well as the drains and unnamed tributary of the River Loddon which border the site and is shown to remain mostly confined to the drainage channels. Flood depths remain predominantly below 0.3m with maximum depths of between 0.3 and 0.6m. Flood velocities reach a maximum of between 0.5 and 1m/s and have a resulting hazard classification of 'Very Low Hazard'.

	In the 1% AEP event, flood water follows a similar path to that in the 3.3% AEP event, ponding in topographic depressions and following the channels of the watercourses surrounding the site. An additional area of ponding is present in the north of the site in a topographic depression. Flood depths are predominantly below 0.3m with some small areas with depths of up to 0.6m. Flood velocities reach a maximum of between 0.5 and 1m/s and have a resulting hazard classification of 'Very Low Hazard'. In the 0.1% AEP event, flood risk to the site increases considerably. Two flow paths to the south of the site converge at the southwestern corner of the site, resulting in a flow path flowing in a northerly direction through the site and converging with a significant area of ponding in the north and to the north of the site. Flood depths across the majority of the site are shallow (less than 0.15m) with more significant flood depths present in the northern part of the site. Flood depths are deepest at the site entrance where they are between 0.6 and 0.9m. Flood velocities are over 0.5m/s across a significant part of the site with the majority of the site predicted to experience velocities of over 0.25m/s and have a resulting maximum hazard classification of 'Danger for most'.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset shows that the entire site has between a 25% and 50% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. This indicates that across the entire site, groundwater levels are between 0.025m and 0.5m below the ground surface. This means that there is a risk of groundwater flooding to both surface and subsurface assets. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG41 5. Prior to 2019, 205 incidents of sewer flooding have occurred within this postcode area. Between 2019 and 2022, 18 incidents of sewer flooding have occurred within this postcode area. These incidents are according to available incident records from Thames Water (from 2000 up to 1 May 2022). There are no recorded incidents on the site, but 12 incidences have occurred within 30m northwest of the site.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets do not have a record of any flooding on or surrounding the site. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding on the site. An incident of flooding is present

	175m northeast of the site along King Street Lane. Flooding has been attributed to a blocked gully.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences.
Residual risk	There is a residual risk to the site from the watercourse which flows in a northerly direction along the eastern border of the site and is then culverted beneath King Street Lane to the north of the site. If this culvert was to become blocked, water could back up onto the site.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Existing access to the site can be found in the north with a track which runs south into the site from the B3030 King Street Lane. Access to and from the site is not shown to be affected by fluvial flooding. The access road is impacted by surface water flooding in all modelled events. Surface water depths on the B3030 King Street Lane reach a maximum of 1.2m in the 0.1% AEP event. The access road is sensitive to the effects of climate change on surface water flood risk. In the 1% AEP plus 40% climate change event, flood depths are between 0.3 to 0.9m along the B3030 King Street Lane. Flood velocities in this event are between 0.5 and 2m/s across the B3030 King Street Lane and have a corresponding hazard rating of 'Danger for most'. Due to the depths and velocities mentioned above, it is highly likely that emergency access will be affected. At present, safe access and egress cannot be demonstrated in the 1% AEP plus 40% climate change event. In order to develop on this site, safe access and egress will need to be demonstrated in the 1% AEP plus climate change surface water event. Site drainage proposals should address the requirements for access and egress routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial** • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate change flood extent. Flood Zone 2 shows fluvial flood risk does not

	affect the site therefore the site is unlikely to be sensitive to any changes in fluvial flooding as a result of climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • Between the 3.3% AEP and the 3.3% AEP plus 35% climate change events, a flow path from the south of the site extents 60m into the site and ponds. The flow path along King Street Lane to the north of the site encroaches onto the site and the risk channelled along the drainage channels along the eastern and southern site boundaries increase in extent. • Between the 1% AEP and 1% AEP plus 40% climate change events, a flow path develops which bisects the site from south to north. The flow path splits as it flows into the buildings within the north of the site, separating into two separate flow paths which continue to flow north towards the King Street Lane (B3030). • Additional surface water flow paths are shown to emerge with climate change showing surface water risk at the site is quite sensitive to increases with climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand
	  ○ Superficial - River Terrace Deposits - Sand and gravel.
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater
	Sustainable Drainage Systems (SuDS)
	• Groundwater levels are indicated to be within 0.025m to 0.5m of the ground level and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• BGS data indicates that the underlying geology is London Clay Formation and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site

	discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • As the groundwater levels at this site are high it is recommended that a liner is used if underground storage is constructed on the site. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public

	open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. It is recommended that the exception test is required for this site due to the significant surface water risk across the site and the 'More Vulnerable' development type.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site as the site is at risk of surface water flooding and is over one hectare. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe.

	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Development buffers should be incorporated either side of the ordinary watercourses on the site and opportunities should be taken to provide environmental enhancements and where feasible reduce the risk of flooding on or off the site from all sources.

Key message

The development is likely to be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding where possible.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. The existing access to the site is inundated in the surface water climate change event so a site-specific flood risk assessment will need to assess the depth, velocity and hazard of surrounding roads to ensure safe access and egress can be achieved. Where alterations to the site are proposed in order to achieve safe access and egress, this will need to be demonstrated without displacing flood risk elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2 and 3a and indicative 3b have been taken from the Environment Agency's Flood Map for Planning. Flood Zone 3a has been used as a proxy for Flood Zone 3b in the absence of detailed modelling.
Climate change	Fluvial Flood Zone 2 has been used as a proxy for climate change in the absence of detailed modelling. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data were not available for this assessment.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5WK006**
Address	Land south of Gipsy Lane, Wokingham
Area	3.87 ha
Current land use	Brownfield / Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located within the catchment of the Emm Brook. The catchment is approximately 4200ha and is predominantly urban. The site is located in the central part of the catchment. The Emm Brook flows through the catchment in a north-westerly direction, bordering the site.
Topography	1m LiDAR data shows that the site levels fall in a south westerly direction towards the Emm Brook. Site levels are greatest in the northeast of the site at around 62mAOD and are lowest in the western part of the site at around 49.52mAOD. The site is bound to the north by a railway embankment.
Existing drainage features	Two watercourses are present within close proximity to the site, the first is the Emm Brook, an Environment Agency designated Main River which flows along the southern boundary of the site. The second is an unnamed land drain which flows in a westerly direction along part of the western boundary of the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 20% of the site Flood Zone 3a covers 20% of the site Flood Zone 2 covers 24% of the site Flood Zone 1 covers 76% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:**

	WSP's 2020 detailed hydraulic model for the Emm Brook was used in this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. The Environment Agency review of the Emm Brook model noted that whilst this model was fit for purpose to update the Flood Map for Planning, the levels were not suitable for use in site-specific Flood Risk Assessments. Therefore, it is advised that the suitability of this modelling to inform this site is reviewed by the developer to determine if any further modelling work is needed. **Flood characteristics:** All Flood Zones are present within the southern and western portions of the site. The Environment Agency's Flood Map for Planning shows Flood Zone 2 encroaching along the site's southern boundary, entering the site and flooding the western part of the site. The source of the flood water is the Emm Brook. Flood Zone 3a also has a similar flood extent to that of Flood Zone 2 and extends over a small part of the south and west of the site and a large area in the west of the site. In-channel depths reach 1.56m in the Flood Zone 3a and 1.96m in Flood Zone 2, whilst depths across the floodplain on the site reach 0.82m in Flood Zone 3a and 1.26m in Flood Zone 2. Due to there being no availability of a 3.3% AEP flood extent, the 1% AEP extent was used as an indicative Flood Zone 3b, and therefore is the same as Flood Zone 3a. When compared with the 5% AEP the Flood Zone 3b follows the same pattern with the majority of flood water present in the western part of the site and a small area of flood water present along the southern and eastern boundary.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 15% of the site Max depth is between 0.6 and 0.9m Max velocity is between 1 and 2m/s **1% AEP** covers 20% of the site Max depth is between 0.6 and 0.9m Max velocity is between 1 and 2m/s **0.1% AEP** covers 34% of the site Max depth is over 1.2m Max velocity is over 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).*

	Available data: The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The Emm Brook is a major source of surface water conveyance, flowing in a north-westerly direction along the southern and western boundaries due to the lower topography. The surface water flood extents largely follow this conveyance route of the Emm Brook floodplain. In the 3.3% AEP event, surface water predominantly flows and ponds in the western part of the site with a small part of the southern border of the site at risk of flooding. Flood depths in this area are shallow and are a maximum of between 0.6 and 0.9m and flood velocities are slow and are less than 0.25m/s. The area of ponding has a maximum hazard rating of 'Dangerous for Most'. Flood water along the southern boundary follows the course of the Emm Brook and does not significantly extend into the site. Flood depths and velocities are associated with those experienced in the channel of the river. In the 1% AEP event, the extent of surface water ponding in the western part of the site increases affecting a larger area of the site. Flood depths in this area are shallow and are a maximum of between 0.6 and 0.9m and flood velocities are slow and are less than 0.25m/s. The area of ponding has a maximum hazard rating of 'Dangerous for Most'. Flood water along the southern boundary follows the course of the Emm Brook and does not significantly extend into the site. Flood depths and velocities are associated with those experienced in the channel of the river. An isolated area of ponding is present in the centre of the site and is predicted to experience depths of up to 0.6m and has a maximum hazard rating of 'Dangerous for Most'. In the 0.1% AEP event, the southern extent of the site is at risk of surface water flooding from a flow path following the course of the Emm Brook. Flood depths range across the site and are deepest in the western part of the site where flood depths are over 1.2m. Flood velocities are a maximum of 1 to 2m/s and result in a maximum flood hazard rating of 'Danger for All'. There is also a small surface water flow route close to the eastern boundary, flowing from the railway embankment in a south-westerly direction and entering the Emm Brook close to the south-eastern corner of the site.
Reservoir	Reservoir flood mapping shows the south western part of the site to be affected by the 'Dry Day' flood extents from the Queensmere reservoirs. Flooding from this reservoir extends along the Emm Brook through Wokingham.

	The 'Wet Day' event seeks to estimate the effect of a breach at the same time as a 0.1% AEP river flood is occurring and suggests that the consequences of such a breach are similar to the modelled 0.1% AEP event river flood event, but probably would be associated with a much lower probability. These extents encroaching the sites are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF dataset shows that the entire site has less than a 25% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The JBA Groundwater Emergence Map indicates that across the majority of the site is not at risk of groundwater flooding. A small area in the north of the site, groundwater levels are between 0.025m and 0.5m below the ground surface. Based on the RoFSW dataset, it is likely any groundwater that emerges will flow to the south and south-western parts of the site, following the local topography. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG40 2 with three recorded historic sewer flooding incidents, according to available incident records from Thames Water (from 2000 up to 1 May 2022).
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show the site previously flooded on the 6th March 1947 and in July 2007 as a result of the channel capacity being exceeded. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding on the site. Two incidents of flooding have occurred within 250m of the site. The source of flooding can be attributed to surface water and ordinary watercourse flooding.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows that the site is not protected by any formal flood defences; however, natural high ground running along the right and left banks of the Emm Brook along the southern boundary of the site.
Residual risk	There is no residual risk to the site from flood risk management structures. The railway embankment to the north of the site holds back an area of surface water ponding. If this embankment was to collapse, flood water could flow onto the site in a surface water flood event.

Emergency planning

Flood warning	The site is located in the Emm Brook at Wokingham (061FWF24Wokinghm) Environment Agency Flood Warning Area and the Emm Brook (061WAF24EmmBrook) Flood Alert Area.
Access and egress	Online imagery shows an unnamed track which appears to provide existing vehicular access to the site, running south from Gipsy Lane beneath the railway line. The access road is not shown to be affected by fluvial flooding. Surface water flooding in the 1% AEP plus 40% climate change and 0.1% AEP events result in flood depths of less than 0.3m across a small part of Gipsy Lane. In the 1% AEP plus 40% climate change event, flood velocities reach a maximum of 1.2m/s which results in a maximum hazard rating of 'Caution'. In the 0.1% AEP event, depths remain shallow and are below 0.3m. Flood velocities are a maximum of 1 to 2m/s which results in a maximum hazard rating of 'Caution'. Therefore, vehicular access and egress to the site may be slightly impeded. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances." **Fluvial** • Detailed modelling of the higher central climate change extent of the Emm Brook shows fluvial flood risk along the south the site, following the Emm Brook, which flows from east to west. The modelled extent widens in the western part of the site and slightly encroaches into the eastern and southern boundaries. • Between the 1% AEP and 1% AEP plus 25% climate change events the fluvial flood extent along the Brook only widens slightly within the site. The maximum in-channel depths are shown to increase from 1.56m to 1.69m whilst the maximum depths across the floodplain on the site increase from 0.82m to 0.97m showing fluvial flood risk at the site is sensitive to increases with climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk.

	• In the 1% AEP plus climate change, the extent of flooding is similar to that of other surface water flood events with flood water ponding in the south of the site. A flow path flows from north to south through the eastern part of the site. No additional areas of surface water ponding appear across the site. The extent of flooding is smaller than the extent of flooding in the 0.1% AEP event. Flood depths are a maximum of above 1.2m and velocities are a maximum of above 1.2m/s which results in a hazard rating of dangerous for all. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – London Clay Formation- Clay, Silt, sand and Bagshot Formation - Sand.
	  ○ Superficial - Head - Clay, silt, sand, gravel and Alluvium - Clay, silt, sand and gravel.
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater
	Sustainable Drainage Systems (SuDS)
	• The site is considered to have very low susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• The site is not considered to be susceptible to groundwater flooding, due to the nature of the local geological conditions. This should be confirmed through additional site investigation work.
	• BGS data indicates that the underlying geology is London Clay Formation and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment.
	• Proposed attenuation features such as basins, ponds and tanks should be located outside of Flood Zone 2 and 3 to avoid the potential risks to the hydraulic capacity or structural integrity of these features. Surface water outfalls that discharge into the Emm Brook River may

	be susceptible to surcharging due to water levels in the Emm Brook River. The impacts of flood flows will need to be considered in terms of the attenuation storage requirements of the site and placement of the outfalls. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during all surface water flood events. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. 'More Vulnerable' development is not permitted in Flood Zone 3b. The exception test is required for this site because 'More Vulnerable' development is located in Flood Zone 3a.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is located in Flood Zones 2 and 3 • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor

	levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

Key message

The development is likely to be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of fluvial and surface water flooding, which is along the southern boundary and the western part of the site.
- Safe access and egress can be demonstrated in both the fluvial and surface water plus climate change events. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere. site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of fluvial and surface water flooding on the site and to neighbouring properties.
- The developer reviews the suitability of the Emm Brook model to inform this site and carries out any further modelling work deemed necessary.

Mapping information

The key datasets used to make planning recommendations for this site were the Emm Brook hydraulic model (2020) and the Environment Agency's FMfP and RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2 and 3a have been taken from the Emm Brook detailed hydraulic model (2020). Due to there being no availability of a 3.3% AEP flood extent, the 1% AEP extent was used as an indicative Flood Zone 3b.
Climate change	The higher central allowance (25%) was available for the Emm Brook hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived from the Emm Brook hydraulic model.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5WK029**
Address	Station Industrial Estate, Oxford Road, Wokingham
Area	0.65ha
Current land use	Brownfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located in the southeast of Wokingham Borough in the west side of Wokingham. It is bordered by the North Downs railway line and Wokingham train station to the east, and Oxford Road to the southwest. To the northwest it is bordered by residential properties along Mount Pleasant. The site is located within the catchment of the Emm Brook. The catchment area is approximately 4200ha and the site is located in the urbanised part of the catchment. The Emm Brook flows through the catchment in a northerly direction, approximately 390m west of the site.
Topography	1m LiDAR shows that the site is predominantly flat with ground levels falling from a ground level of 55.3mAOD along the eastern boundary in a south westerly direction towards Oxford Road, along the western boundary of the site where ground levels are 55.6mAOD.
Existing drainage features	The EA's Detailed River Network shows a culverted watercourse which runs through the centre of the site in a westerly direction towards Emm Brook. Emm Brook is located 400m west of the site. The watercourse flows in a northerly direction towards its confluence with the River Loddon 5km upstream of the site.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).*

	Available data: The Environment Agency's Flood Map for Planning has been used within this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. **Flood characteristics:** The Environment Agency's Flood Map for Planning shows no fluvial flood risk to the site as the entire site is located within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 0% of the site **1% AEP** covers 6% of the site Max depth is between 0.15 and 0.3m Max velocity is between 1 and 2m/s **0.1% AEP** covers 27% of the site Max depth is between 0.3 and 0.6m Max velocity is between 1 and 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is not shown to be affected by surface water flooding in the 3.3% AEP event. The site is shown to be affected by surface water flooding in the 1% and 0.1% AEP events. In the 1% AEP event, two areas of surface water risk are present on the site. The first is in the north of the site where the flow path along the railway line encroaches onto the site and the second is an area of ponding in the south of the site. In this event flood depths remain below 0.3m. Flood velocities are slow for the northern area and are less than 0.25m/s and have a corresponding hazard rating of 'Very Low Hazard'. In the southern area of ponding flood velocities are between 0.25 and 2m/s and have a corresponding hazard rating of 'Very Low Hazard'. In the 0.1% AEP event, three flow paths develop on the site. A surface water flow path is present to the east of the site and flows in a westerly direction towards the site. The flow path splits into two flow paths at the railway line to the east of the site, the first flow path flowing north across a small area of the north of the site and the second flowing through the centre of the site, bisecting the site. A third flow path flows in a northerly direction along the railway line before flowing in a westerly direction across the site. The existing buildings on the site affect the conveyance of flood water across the site. In this event flood depths for the central and southern flow

	path are shallow and are below 0.3m. Flood depths in the northern flow path are deeper and are between 0.3 and 0.6m. Flood velocities are between 0.25 and1m/s across the northern flow path and have a corresponding maximum hazard rating of 'Danger for some'. The central flow path is also predicted to experience velocities between 0.25 and 1m/s and has a maximum hazard rating of 'Danger for some'. Flood velocities for the southern flow path are between 0.25 and 2m/s and have a maximum flood hazard rating of 'Danger for some'.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset shows that the entire site has greater than a 25% and less than a 50% susceptibility to groundwater flooding. The JBA Groundwater Emergence map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The JBA Groundwater Emergence map indicates that the majority of the site is not predicted to be at risk of groundwater flooding due to the nature of the underlying geological deposits. Across the north of the site and along the southern boundary, groundwater levels are between 0.025m and 0.5m below the ground surface. There is also a small area in the northeast with groundwater levels either at or very near (within 0.025m) the ground surface. This means that there is a risk of groundwater flooding to both surface and subsurface assets. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG41 2. From 2000 to 2018, three incidences of sewer flooding occurred within this postcode area. Between 2019 and 2022, one incident of sewer flooding occurred within this postcode area. These incidents are according to available incident records from Thames Water (2000 - 2022). None of these incidents are on or surrounding the site.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets do not have a record of any flooding on or surrounding the site. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding on or surrounding the site.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences.
Residual risk	There is a culvert which runs under the railway line to the east of the site and then beneath the site in a westerly direction towards Emm Brook. This presents a residual risk to the site as in the event of a collapse or blockage this could cause flooding at the site.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Existing access to the site can be found from Oxford Road, which runs along the southwest border of the site boundary. The access is not affected by fluvial flooding in any of the modelled events. The access route is impacted by a surface water flow path flowing in a westerly direction through the south of the site in the 1% AEP and 0.1% AEP scenarios as well as in the 3.3% AEP plus 35% climate change and 1% AEP plus 40% climate change scenarios. Flood depths in the 3.3% AEP plus 35% climate change and 1% AEP plus 40% climate change scenarios along Oxford Road are shown to remain below 0.3m. Flood velocities across Oxford Road vary between 0.5 and 2m/s. During the 1% AEP plus 40% climate change event the site is bisected by a flow path flowing east to west through the centre of the site. Depths along this flow path are shown to reach a maximum of approximately 0.38m which may impact access and egress between the north and south of the site. In order to develop on this site, safe access and egress will need to be demonstrated in the 1% AEP plus 40% climate change surface water event to both the north and south parts of the site. Site drainage proposals should address the requirements for access and egress routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. Fluvial • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate change flood extent. Flood Zone 2 shows fluvial flood risk does not affect the site therefore the site is unlikely to be sensitive to any changes in fluvial flooding as a result of climate change. Surface Water • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • Between the 3.3% AEP and 3.3% AEP plus 35% climate change events there is a significant increase in surface water risk on the site. The flow path to the east of the site develops flowing west along the railway line and overtopping onto the eastern boundary of the site. The flow path across the south end of the site also develops. • Between the 1% AEP and 1% AEP plus 40% climate change events the existing flow paths increase in extent and a new flow path develops which flows east to west through the centre of the site, bisecting the site.

	• This shows that surface water flood risk at the site is highly susceptible to increases as a result of climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand and Bagshot Formation - Sand
	  ○ Superficial - Head - Clay, silt, sand and gravel.
	• Soils at the site consist of:
	  ○ Freely draining slightly acid loamy soils
	Sustainable Drainage Systems (SuDS)
	• Groundwater levels are indicated to be less than 0.5m below ground level during a 1% AEP event in the north of the site and along the southern boundary and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate in these areas of the site.
	• BGS data indicates that the underlying geology is London Clay Formation and Bagshot Formation which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The exception test is not required for this site because it is not located in an area of fluvial flood risk, and it should be possible to develop around the surface water flood risk across the site. However, it is highlighted that the site is bisected by a surface water flow path in the 1% AEP plus 40% climate change event, and it is recommended that this be taken into account in any planning applications.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is at risk of surface water flooding. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • WBC as Lead Local Flood Authority provide guidance on culverts within development, available to download here, and should be consulted at an early stage. Some main points from this guidance are wherever practical WBC will seek to have culverted watercourses restored to open channels. WBC would also oppose planning consent for any building over a culvert as the culvert may, in the future, need to be repaired, replaced or up rated if conditions in the catchment change. There is also the need to maintain an overland flow route if the culvert is blocked or its capacity exceeded. • Consultation with Network Rail should also be undertaken due to the close proximity of the railway line and the culvert which runs through the site. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:**

	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g., raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Where possible opportunities should be taken to open up the culverted watercourse on the site and provide environmental enhancements.

Key message

Development is likely to be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding where possible.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event to both the northern and southern areas of the site, as the site is bisected by a surface water flow path during this event.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- The development takes consideration of the culvert within the site, consulting with both Network Rail and the Lead Local Flood Authority at an early stage.

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning and RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2 and 3a have been taken from the Environment Agency's Flood Map for Planning. Flood Zone 3a has been used as a proxy for Flood Zone 3b in the absence of detailed modelling.
Climate change	Fluvial Flood Zone 2 has been used as a proxy for climate change in the absence of detailed modelling. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data were not available for this assessment.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5WK042**
Address	Woodside Caravan Park, Blagrove Lane, Wokingham
Area	0.99ha
Current land use	Brownfield and Greenfield
Proposed land use	Gypsy and Traveller Site

Sources of flood risk

Location of the site within the catchment	The site is located in the southeast side of Wokingham Borough, to the southwest of Wokingham. The site is bordered by Blagrove Lane to the east and greenspaces to the north, west and south. There is an electricity substation located to the northwest of the site. The site is located within the catchment of the Emm Brook. The catchment is approximately 4200ha and is predominantly urban. Emm Brook flows through the catchment in a northerly direction, approximately 680m east of the site.
Topography	1m LiDAR shows ground levels are highest at around 58.83mAOD in the south western corner of the site and fall in an easterly direction towards the eastern boundary where ground levels are lowest at 54.50mAOD at the access road. This land continues to fall to the east of the site. Surrounding the site, the land is shown to slope downhill towards the site from both the north, west and southwest.
Existing drainage features	There are several drainage features surrounding the site. A network of land drainage features are present around the north, western, southern and eastern boundaries of the site. These watercourses flow into an unnamed watercourse along the north eastern boundary of the site and then flow north east in a culvert through Wokingham into the Emm Brook.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site Flood Zone 3a covers 0% of the site Flood Zone 2 covers 0% of the site Flood Zone 1 covers 100% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood*

	Zone 3 percentage. Flood Zone1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%). **Available data:** The Environment Agency's Flood Map for Planning has been used within this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. **Flood characteristics:** The Environment Agency's Flood Map for Planning shows no fluvial flood risk to the site as the entire site is within Flood Zone 1.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers1% of the site Max depth is between 0.6m and 0.9m Max velocity is between 0.5 and 1m/s **1% AEP** covers 4% of the site Max depth is between 0.9m and 1.2m Max velocity is between 1 and 2m/s **0.1% AEP** covers 37% of the site Max depth is greater than 1.2m Max velocity is between 1 and 2m/s *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is shown to be affected by surface water flooding in the 3.3%, 1% and 0.1% AEP events. In the 3.3% AEP event, flood water is present along the eastern boundary of the site with the rest of the site remaining unaffected in this event. Flood water corresponds with the areas of low topography on Blagrove Lane and on the eastern edge of the site. Flood depths are predominantly between 0.15 to 0.6m with a small area predicted to experience depths of up to 0.9m. Flood velocities are slow and are less than 0.5m/s with a small area predicted to experience velocities of up to 1m/s. The site has a maximum flood hazard classification of 'Dangerous for Most'. In the 1% AEP event, the extent of surface water flooding across Blagrove Lane is increased with flood water pooling in a topographic depression in the east of the site. Flood depths are predominantly between 0.15 to 0.3m

	and flood velocities are slow and are less than 0.5m/s with a small area predicted to experience velocities of between 1 and 2m/s. The site has a maximum flood hazard of 'Dangerous for Most'. In the 0.1% AEP event, flood risk to the site increases significantly. A significant flow path forms to the north west of the site. The flow path then flows in an easterly direction through the site before converging with the flow path on Blagrove Lane. Flood depths across the flow path are predominantly below 0.3m with depths increasing as the flow path converges with the flow path on Blagrove Lane. Depths within the eastern part of the site are 0.3 to 0.9m. Flood velocities across the flow path are slow and are up to 0.5m/s across the site with much faster velocities of up to 2m/s along Blagrove Lane. The site has a maximum flood hazard of 'Dangerous for Most'.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset shows that the entire site has less than a 25% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater flood emergence based on groundwater levels. The JBA groundwater emergence map indicates that the site is not predicted to be at risk of groundwater flooding due to the nature of the underlying geological deposits. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area RG41 4. Prior to 2019, five incidents of sewer flooding occurred within this postcode area. Between 2019 and 2022, three incidents of sewer flooding occurred within this postcode area. These incidents are according to available incident records from Thames Water (from 2000 up to 1 May 2022). None of these incidents occurred on or in close proximity to the site.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets do not have a record of any flooding on or surrounding the site. Historic flooding records provided by Wokingham Borough Council show one record of flooding 30m east of the site. The source of flooding has been attributed to watercourse flooding.

Flood risk management infrastructure

Defences	The site is not protected by any formal flood defences.
Residual risk	The open drainage channel which runs along the northern boundary of the site is then shown to enter a culvert to the northeast of the site which then

	runs through Wokingham into Emm Brook to the east. This presents a residual risk to the site as should this culvert become blocked water may back up onto the site.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Existing vehicular access to the site can be found along a track which heads west into the site from Blagrove Lane to the east. Access to and from the site is shown not to be affected by fluvial flooding. The access road is impacted by surface water flooding in all modelled events. Significant surface water flooding is predicted at the current access point for the site with flood depths predicted to be up to 0.9m in the 0.1% AEP event along the access track on the site and up to 1.2m along Blagrove Lane where it borders the site. The access road is sensitive to the effects of climate change on surface water flood risk. In the 3.3% AEP plus 35% climate change and 1% AEP plus 40% climate change events, significant surface water flooding is present at the access point to the site with flood depths between 0.3 and 0.9m. In the 1% AEP plus 40% climate change event depths along Blagrove Lane to the east of the site reach a maximum of 1.05m, with velocities of up to 1.85m/s and a corresponding hazard classification of 'Dangerous for some'. Due to the depths mentioned above, it is highly likely that emergency access will be affected along the existing access route during a surface water flood event. Safe access and egress will need to be demonstrated in the 1% AEP plus 40% climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • In the absence of detailed modelling, the Flood Map for Planning Flood Zone 2 can be used as an indicative 1% AEP plus climate

	change flood extent. Flood Zone 2 shows fluvial flood risk does not affect the site therefore the site is unlikely to be sensitive to any changes in fluvial flood risk as a result of climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • In the 3.3% AEP plus 35% climate change event, a flow path from the west of the site flows through the site and ponds in the eastern part of the site. This flow path is not present during the 3.3% AEP event. Flood depths are predominantly below 0.6m with a localised area predicted to flood to deeper depths of up to 1.2m. • In the 1% AEP plus 40% climate change event, the flow path through the site also develops which is not present within the 1% AEP event. extent. Flood depths along the main flow path through the site are up to 0.9m with a localised depression predicted to flood to depths of over 1.2m. • The development of additional surface water flow paths between the 1% and 1% AEP plus 40% climate change events show the site is highly sensitive to increased surface water flood risk as a result of climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock - London Clay Formation - Clay, silt and sand
	  ○ Superficial – no information is available about the superficial deposits at the site.
	• Soils at the site consist of:
	  ○ Freely draining slightly acid loamy soils
	Sustainable Drainage Systems (SuDS)
	• The site is not considered to be susceptible to groundwater flooding, due to the nature of the local geological conditions. This should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is London Clay formation and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.

	• The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of a surface water flow path during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies caravans, mobile homes and park homes intended for permanent residential use as 'Highly Vulnerable'. It is recommended that the exception test is required for this site due to the significant surface water flow path which flows through the site and the 'Highly Vulnerable' development type.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is at risk of surface water flooding. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor

	levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Development buffers should be incorporated either side of the ordinary watercourses on the site and opportunities should be taken to provide environmental enhancements and where feasible reduce the risk of flooding on or off the site from all sources.

Key message

The development may be able to proceed if:

- Development is steered away from the surface water flow path through the north of the site.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk of surface water flooding where possible.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. The existing access road is impacted by considerable surface water flooding during the 1% AEP plus 40% climate change event, so a site-specific assessment will need to interrogate in more detail the localised depths, velocities and hazard of surrounding roads to ensure safe access and egress can be achieved.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning and RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, and 3a have been taken from the Environment Agency's Flood Map for Planning. Flood Zone 3a has been used as a proxy for Flood Zone 3b in the absence of detailed modelling.
Climate change	Fluvial Flood Zone 2 has been used as a proxy for climate change in the absence of detailed modelling. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data were not available for this assessment.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	5WK045
Address	Land at Bridge Retail Park
Area	0.57ha
Current land use	Brownfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located to the east of Wokingham Borough within the Emm Brook Catchment. The catchment is 4242ha and the Emm Brook flows in a westerly direction approximately 12m south of the site. The site is urban and is located within Wokingham. It is located between two railway lines; the Waterloo to Reading line borders the north of the site and the North Downs line runs to the southwest of the site. The site is located between two roads, the east of the site borders Finchampstead Road (A321) and Oakey Drive is located approximately 10m west of the site. The A321 roundabout is located approximately 73m south of the site. The west of the site borders Oakey Drive Play Area.
Topography	The Environment Agency 1m resolution LiDAR shows that the topography of the site is mainly low lying. LiDAR shows that the site slopes downhill slightly from the north to the south of the site towards The Emm Brook. The railway line which borders the site to the north is situated at a higher elevation than the site.
Existing drainage features	The Emm Brook is the main drainage feature which flows along the south border of the site in a westerly direction. To the southeast of the site, the Emm Brook is joined by an unnamed drainage channel which flows in a northerly direction towards its tributary with the Emm Brook.
Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site. Flood Zone 3a covers 0% of the site. Flood Zone 2 covers 25% of the site. Flood Zone 1 covers 75% of the site. *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood*

	Zone 3 percentage. Flood Zone 1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%). **Available data:** WSP's 2020 detailed hydraulic model for the Emm Brook was used in this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. The Environment Agency review of the Emm Brook model noted that whilst this model was fit for purpose to update the Flood Map for Planning, the levels were not suitable for use in site-specific Flood Risk Assessments. Therefore, it is advised that the suitability of this modelling to inform this site is reviewed by the developer to determine if any further modelling work is needed. **Flood characteristics:** The site is located within Flood Zone 2. Only the south of the site is shown to be at a fluvial flood risk, with approximately 0.14 ha of the site within Flood Zone 2. Flood depths on the site reach 0.99m. Flood depths are the deepest closest to the south and southeast border of the site. As distance increases into the site from the site borders the depths of the fluvial flooding decrease. Approximately 20m into the site depths are 0.27m. The site is not within Flood Zone 3a or Flood Zone 3b which are shown to mostly remain confined to the channel of the Emm Brook which is located approximately 10m south of the site.
Surface water	**Proportion of site at risk: surface water:** **3.3% AEP** covers 2% of the site. Max depth is between 0.15 and 0.30m. Max velocity is between 0.00 and 0.25m/s. **1% AEP** covers 6% of the site. Max depth is between 0.30 and 0.60m. Max velocity is between 0.25 and 0.50m/s. **0.1% AEP** covers 36% of the site. Max depth is more than 1.20m. Max velocity is between 0.50 and 1.00m/s. *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding during all modelled events. In the 3.3% AEP event, surface water risk within the site is minimal. There are two areas of surface water flood risk in the southeast of the site where

	the surface water channelled along the path of the Emm Brook to the south of the site encroaches slightly into the site. In the 1% AEP event, the location of surface water risk within the site is the same as that in the 3.3% AEP event, in the southeast corner of the site, however the extent of the surface water is larger than in the 3.3% AEP event. In the 0.1% AEP event, the extent of surface water risk within the site increases significantly. Approximately 0.2 ha of the site is affected by surface water risk. The main area of surface water risk is still in the southeast of the site with depths exceeding 1.2m in places. There are additional areas of surface water pooling along the west and north borders of the site. Surface water flood risk on the site is shown to be affected by the existing development on the site, with areas of pooling around the existing buildings in the north and south of the site. The surface water risk follows the topography of the site, with the majority of the risk located in the low-lying southeast area of the site.
Reservoir	Reservoir flood mapping shows the southern border of the site to be affected by the 'Dry Day' flood extent from the Queensmere reservoir. The 'Wet Day' flood extent shows the Queensmere reservoir affecting approximately 0.17ha of the south-eastern corner of the site. The 'Wet Day' scenario is larger than the Flood Zone 2 extent, suggesting that this reservoir flooding would make the fluvial flooding worse. These extents encroaching the sites are deemed as high risk, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.
Groundwater	The AStGWF dataset suggests that the majority of the site (approximately 0.4ha) is at between a 25% and 50% susceptibility to groundwater flooding. The southeast corner of the site is shown to be at less than 25% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. This suggests that the entire site does not show a risk of groundwater emergence due to the nature of the underlying geological deposits. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area (RG40 2). Between 2000 and 2019 there were three recorded historic sewer flooding incidents, according to available incident records from Thames Water. These incidences of sewer flooding are located to the northeast and east of the site in Wokingham within approximately 430m of the site.

Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show that the south and southeast corner of the site have a record of historic flooding. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding within the site. However, there are records of flooding in the area surrounding the site. There is one record of flooding approximately 32m south of the site and a further three records within approximately 320m east of the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows the site is not protected by any formal flood defences; however, Emm Brook is bordered by natural high ground where it flows to the south of the site. This natural defence provides some level of protection from this tributary.
Residual risk	The embanked railway line to the north of the site presents a residual risk to the site as surface water is shown to be impounded to the north of the embankment and if this were to fail could cause flooding on the site, although this is unlikely. Emm Brook is also culverted beneath the railway line to the west of the site. If this culvert was to become blocked water could back up and inundate the site.

Emergency planning

Flood warning	The south and southeast of the site are located in the 'Emm Brook at Wokingham' (061FWF24Wokinghm) Environment Agency Flood Warning Area and the 'Emm Brook' (061WAF24EmmBrook) Flood Alert Area.
Access and egress	Due to the railway lines located to the north and southwest of the site, the site has limited access options. Existing access is from a track which heads west from Finchampstead Road/Denmark Street (A321) which borders the site to the east. Oakey Drive also runs in a north-westerly direction around the south of the site from the A321 in the east. Access from the south along the A321 is affected by fluvial flooding from Emm Brook during all modelled events. Flood depths at the junction between Oakey Drive and A321 exceed 0.85m within the 0.1% AEP event (Flood Zone 2). However, the access along the A321 from the north and the access track into the site both remain unaffected during all the modelled flood events. The A321 to the east of the site is affected by surface water flooding during all modelled surface water events. In the 3.3% AEP event the site is likely to remain accessible along the A321 from the north as maximum surface water depths along the A321 are between 0.15 and 0.30m north of the access track although they are up to 0.6m south of the access track. In the 1% AEP event the site is also shown to likely remain accessible along the A321 from the north as surface water depths do not exceed 0.30m to the north of the track.

	For the 0.1% AEP scenario there is a flow path which forms along the length of the A321 along the east of the site with maximum depths of up to 0.6m where the track leaves the A321. The existing building in the south of the site is shown to be completely surrounded by surface water flood risk with depths exceeding 1.2m in places. In the 1% AEP plus 40% climate change event, the flow path along the A321 is shown to be fast flowing but remain below 0.3m depths, with depths along the A321 by the access track of approximately 0.21m with velocities of up to 2.49m/s and a maximum hazard classification of 'Danger for some'. Therefore, access and egress for emergency vehicles may still be possible during the 1% AEP plus 40% climate change surface water flood event but this will require further investigation as part of a site-specific assessment. Safe access and egress will need to be demonstrated in the 1% AEP plus 40% climate change surface water event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • The 1% AEP plus 25% climate change scenario (higher central allowance) was available to assess climate change from Emm Brook. • In the 1% AEP plus 25% climate change event, the fluvial flood extent is not shown to affect the site. The fluvial flood risk is shown to remain mostly confined to the channel of Emm Brook to the south border of the site and shows the same extent as Flood Zone 3a (1% AEP event). **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • The surface water coverage in the 1% AEP event is confined to the southeast corner of the site. Whereas in the 1% AEP plus 40% climate change event there are additional surface water paths which form along the northern and western borders of the site channel by the existing buildings on the site. The surface water extent in the 1% AEP plus 40% climate change event is considerably larger than the 1% AEP event. In the 1% AEP plus 40% climate change event the surface water encroaches a lot further into the site from the southeast corner than in the 1% AEP event.

	• The differences in extent and the additional flow paths between the 1% AEP and 1% AEP plus 40% climate change event suggest that surface water flood risk at the site is quite sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock is London Clay Formation - Clay, silt and sand.
	  ○ No information on superficial deposits is available.
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater.
	Sustainable Drainage Systems (SuDS)
	• The site is not considered to be susceptible to groundwater flooding, due to the nature of the local geological conditions. This should be confirmed through additional site investigation work.
	• BGS data indicates that the underlying geology is clayey which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. It is recommended that the exception test is required for this site because the development is classified as 'More Vulnerable' and the site is at a significant risk from surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is located in Flood Zone 2 and is at surface water flood risk. For surface water the site is particularly at risk in the 1% AEP, 0.1% AEP and 1% AEP plus 40% climate change events. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates.

	• Development should be steered outside of the appropriate 1% AEP plus appropriate allowance for climate change flood extent (plus an additional buffer where appropriate). • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site.

Key message

There may be challenges to developing the south part of this site due to the coverage of fluvial and surface water flood risk. However, development may be able to proceed if:

- Development is steered away from the southeast area of the site as this is affected by fluvial flooding.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk from both fluvial and surface water flooding. However, this may be constricted by the small size of the site.
- Safe access and egress can be demonstrated in both the fluvial and surface water plus climate change events. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If any flood mitigation measures implemented are tested to check they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- The developer reviews the suitability of the Emm Brook model to inform this site and carries out any further modelling work deemed necessary.

Mapping information

The key datasets used to make planning recommendations for this site were the Emm Brook hydraulic model (2020) and the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and 3b have been taken from the Emm Brook detailed hydraulic model (2020).

Climate change	The higher central allowance (25%) was available for the Emm Brook hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived from the Emm Brook hydraulic model.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	**5WO004**
Address	Land at Sandford Mill Pumping Station
Area	0.64ha
Current land use	Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located in the east side of Woodley, south of Bluebell Crescent and east of Mowhawk Way. The site lies within the middle of the Loddon (Swallowfield to Thames confluence) catchment. This catchment is approximately 5189ha and predominantly urban in nature. The River Loddon flows in a northerly direction adjacent to the east boundary of the site. The confluence of Emm Brook and the River Loddon is located approximately 50m south of the site.
Topography	LiDAR shows the site slopes downhill from west to east towards Emm Brook which flows outside the eastern site boundary. Elevations on the site vary from approximately 44.3mAOD at its highest elevation in the west to 37.0mAOD at its lowest elevation in the east.
Existing drainage features	Online mapping shows there are no existing drainage features within the site boundary. The River Loddon flows in a northerly direction adjacent to the east boundary of the site. Emm Brook flows in a westerly direction to the southeast of the site with its confluence with the River Loddon located approximately 50m south of the site. Despite the urbanised catchment, both the River Loddon and Emm Brook are predominantly rural in nature upstream of the site as they flow through Dinton Pastures Country Park. There is an unnamed drainage channel which joins the River Loddon approximately 300m downstream of the site and a couple of small unnamed drainage channels which join the River Loddon upstream of the site within Dinton Pastures Country Park.

Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 7% of the site Flood Zone 3a covers 7% of the site Flood Zone 2 covers 7% of the site Flood Zone 1 covers 93% of the site *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** The Environment Agency's detailed hydraulic model for the River Loddon, updated by JBA in 2022, was used in this assessment. There is also a detailed hydraulic model for Emm Brook which covers this area; however, the River Loddon model has been used for this assessment as it shows a greater extent and the flood risk to the site is predominantly from the River Loddon. The Environment Agency review of the Emm Brook model noted that whilst this model was fit for purpose to update the Flood Map for Planning, the levels were not suitable for use in site-specific Flood Risk Assessments. Therefore, it is advised that the suitability of this modelling to inform this site is reviewed by the developer to determine if any further modelling work is needed. **Flood characteristics:** Flood Zones 2 (0.1% AEP), 3a (1% AEP) and 3b (3.3% AEP) all show the same extent within the site, extending west from the eastern boundary of the site, where the River Loddon flows adjacent to the site. The flood risk extends approximately 20m into the site along the northern boundary and approximately 10m into the site along the southern boundary. It should be noted that the extents show a straight line through the site, which is likely a function of the 2D resolution of the model compared with the size of the site. A higher resolution model would likely produce a more realistic looking flood outline. The underlying topography which slopes quite steeply uphill from east to west across the site means that the flood risk is confined to the eastern side of the site. Fluvial depths on the site vary between approximately 0.62m and 0.72m for the 1% AEP event and 0.92m and 1.01m for the 0.1% AEP event.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 0% of the site **1% AEP** covers 2% of the site Max depth between 0.3m and 0.6m Max velocity less than 0.25m/s **0.1% AEP** covers 2% of the site Max depth between 0.6m and 0.9m Max velocity between 0.25 and 0.50m/s

	The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage). **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** Overall, surface water flood risk to the site is very low. There is no surface water flood risk shown to the site in the 3.3% AEP event. During the 1% AEP event, surface water is confined to the channel of the River Loddon to the east of the site. There is also a small area of ponding which forms in the centre of the site close of the southern boundary. Depths in this area of ponding are shown to reach between 0.3m and 0.6m with velocities remaining below 0.25m/s and a maximum hazard classification of 'Danger for some'. During the 0.1% AEP event, the area of ponding in the centre of the site extends slightly in size but the maximum depths remain between 0.3m and 0.6m, with velocities of up to 0.50m/s and a maximum hazard classification of 'Danger for some'. The flood extent which follows the path of the River Loddon remains confined to the eastern site boundary with maximum depths on the site between 0.6m and 0.9m, velocities up to 0.50m/s and a maximum hazard classification of 'Danger for most'.
Reservoir	Reservoir flood mapping shows the eastern boundary of the site to be affected by the 'Dry Day' flood extents from Bearwood Lake, Black Swan Lake Dinton Pastures, Queensmere, and Southlake. The Black Swan Lake Dinton Pastures extent affects slightly more of the site than the other extents but still only covers a minimal area (less than 1% of the total site area). Flooding from these reservoirs extends along the River Loddon. The site is also affected by the 'Wet Day' flood extents from Bearwood Lake, Bramshill House Pond, Maiden Erlegh Lake (No.1), Queensmere, Southlake, and Tundry Pond. The flood extents remain confined by the topography to the eastern boundary along the path of the River Loddon only inundating a maximum of 4% of the total site area. The 'Wet Day' event seeks to estimate the effect of a breach at the same time as a 0.1% AEP river flood is occurring and suggests that the consequences of such a breach are similar to the modelled 0.1% AEP event river flood event, but probably would be associated with a much lower probability. These extents encroaching the sites are deemed as high risk, with the exception of Tundry Pond, which means that in the very unlikely event the reservoir fails it is predicted that there is a risk to life.

Groundwater	The AStGWF dataset suggests that the entire site has a greater than 75% susceptibility of groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The JBA groundwater emergence map shows 'no risk' in the lowest eastern side of the site which means that this area is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits. There is then a band through the centre of the site where groundwater levels are between 0.025m and 0.5m below the surface which means there is a risk of groundwater flooding to both surface and subsurface assets and there is the possibility of groundwater emerging at the surface locally. If water was to emerge in this area, the underlying topography suggest this water would flow through the site in an easterly direction towards the River Loddon. Groundwater levels across the west half of the site are shown to be between 0.5m and 5m below the surface which means that there is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area (RG5 4) with 329 recorded historic sewer flooding incidents, according to available incident records from Thames Water (from 2000 up to 1 May 2022), with 32 of these incidences occurring since 2019. There are five recorded incidences which fall within a 20m radius of the site.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets show records of flooding across the eastern half of the site, extending approximately 100m across the site from the eastern boundary. The recorded flood outline dataset has records of fluvial flooding on the site in March 1947, November 1974, December 1981, February 1990, February 1991, and July 2007. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding on or surrounding the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows the site is not protected by any formal flood defences; however, the River Loddon to the east of the site is bordered by natural high ground along both banks, which runs along the eastern boundary of the site. This natural defence provides some level of protection from this watercourse.
Residual risk	There is no residual risk to the site from flood risk management structures.

Emergency planning

Flood warning	The eastern half of the site is located in the 'River Loddon at Winnersh and Woodley' (061FWF24Winnersh) Environment Agency Flood Warning Area

	and the ‘Lower River Loddon’ (061WAF24LLoddon) Environment Agency Flood Alert Area.
Access and egress	The site boundary has been digitised in a way which suggests that there are plans to construct an access track to the site from Mohawk Way to the west. Access to the site from the west is shown to remain unaffected during all modelled fluvial flood events. The proposed access track from Mowhawk Way and the section of Mowhawk Way within the immediate vicinity of the site is also shown to remain unaffected during all modelled surface water events. However, there are some areas of surface water risk which develop along Mowhawk Way to the north of the site (north of the roundabout) and to the south of the site (around the junction with Beaver Way) in all modelled surface water events. Depths along Mowhawk Way to the north and south of the site are shown to reach between 0.3m and 0.6m in the 3.3%, 1% and 0.1% AEP events. Velocities along Mowhawk Way to the north of the site reach a maximum of between 0.5 and 1m/s in the 3.3% and 1% AEP events and between 1 and 2m/s in the 0.1% AEP event, however in all events there are large areas where the velocities remain below 0.25m/s. The maximum hazard classification is ‘Danger for some’ in the 3.3% and 1% AEP events and ‘Danger for most’ in the 0.1% AEP event. Velocities along Mowhawk Way to the south of the site reach a maximum of between 0.25 and 0.5m/s within the 3.3% and 1% AEP events although mostly they remain below 0.25m/s. Maximum velocities in the 0.1% AEP event are between 0.5 and 1m/s but with large areas that still remain below 0.25m/s. The maximum hazard classification is ‘Danger for some’ in the 3.3% and 1% AEP events and ‘Danger for most’ in the 0.1% AEP event. This means that the ability for emergency vehicles to access the site during surface water flood events may be affected. Alternative accesses to the track from Mowhawk Way may be possible and would need to be considered during a site-specific Flood Risk assessment. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water

	flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • The River Loddon detailed hydraulic model was re-run as part of this assessment with the latest climate change uplifts (+14%, +23% and +46%). • The site is not shown to be susceptible to climate change with all the climate change runs showing the same extent as the 1% AEP event within the site. It should be noted that the extents show a straight line through the site, which is likely a function of the 2D resolution of the model compared with the size of the site. A higher resolution model would likely produce a more realistic looking flood outline. **Surface Water** • The Environment Agency's RoFSW was uplifted with the latest climate change allowances. • There is no flood risk shown to the site during the 3.3% AEP event however during the 3.3% AEP plus 35% climate change event the area of ponding within the centre of the site forms and the flow path following the path of the River Loddon also forms and touches the eastern boundary of the site. • Between the 1% AEP and the 1% AEP plus 40% climate change events the surface water ponding in the centre of the site gets slightly larger and the flow path following the path of the River Loddon reaches the site along the entire eastern boundary, rather than just the northeast corner as in the 1% AEP event. • This shows that surface water flood risk at the site is susceptible to increases due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – London Clay Formation (clay, silt, and sand).
	  ○ Superficial – River Terrace Deposits, 3 (sand and gravel) across the west and centre of the site and Alluvium (clay, silt, sand and gravel) in the east of the site. There is a small band in the centre of the site where no information on superficial deposits is available.
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater in the west and centre of the site.
	  ○ Loamy and clayey floodplain soils with naturally high groundwater in the east side of the site.
	Sustainable Drainage Systems (SuDS)

	• The AStGWF map shows the site is considered to be highly susceptible to groundwater flooding. Groundwater flooding could occur at the surface which may flow to and pool within topographic low spots during very wet winters. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site. • The JBA groundwater emergence map shows groundwater levels are indicated to be less than 0.5m below ground level during a 1% AEP event across a central band of the site. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements may not appropriate within this area of the site. • BGS data indicates that the underlying geology is predominantly clay and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a historic landfill site but is located within 250m of a landfill site. Therefore, there could be amenity, dirt, and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local

	Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff to the River Loddon should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. 'More Vulnerable' development is not permitted in Flood Zone 3b. The exception test is required for this site because 'More Vulnerable' development is planned in a site which is at risk of flooding in all the fluvial Flood Zones.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is located within the fluvial Flood Zones and is also shown to be at surface water and reservoir flood risk. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy.

	• The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Development should be steered outside of the appropriate 1% AEP plus climate change flood extent. • In the absence of suitable high resolution detailed modelling, all development should be steered away from the extent of Flood Zone 2. Hydraulic modelling should be carried out to determine the level of risk on the site and to set the height of any mitigation measures. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere. • Opportunities should be explored at the earliest possible stage to reduce flood risk (from all sources) on and off the site.

Key message

The development is likely to be able to proceed if:

- The area of the site along the eastern boundary which is located in Flood Zone 3b is left undeveloped.
- In the absence of suitable high resolution detailed modelling, all development is steered away from the extent of Flood Zone 2. Hydraulic modelling should be carried out to determine the level of risk on the site and to set the height of any mitigation measures.

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area of ponding in the centre of the site identified to be at risk of surface water flooding.
- Safe access and egress can be demonstrated in the 1% AEP plus climate change fluvial and surface water events.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring areas.
- Any flood mitigation measures implemented are tested to check they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the River Loddon hydraulic model (2022) and the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	Flood Zones 2, 3a and 3b have been taken from the 1D-2D ESTRY-TUFLOW River Loddon detailed hydraulic model (2022).
Climate change	The most recent uplifts have been applied to the River Loddon hydraulic model to indicate the impacts on fluvial flood risk. The latest climate change allowances have also been applied to the RoFSW map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Depth, velocity, and hazard data was derived from the River Loddon hydraulic model.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	5WW009
Address	Ravenswood Village
Area	47.6ha
Current land use	Brownfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located in the southeast edge of the Wokingham Borough. The site is located in the headwaters of the Emm Brook catchment. The catchment is 4242.1ha and is located 1.25km east of the site. Heath Lake is located approximately 170m east of the site and is 186.8ha. The site has both rural and urban areas. The settlement Ravenswood is located within the site and the site is located west of the settlement Crowthorne. The site is located between New Wokingham Road and Lower Wokingham Road (A321). The north of the site borders Nine Mile Ride B3430. The west of the site borders the North Downs railway line. The east of the site borders Heathlake Nature Reserve and the south and southeast of the site borders East Berkshire Golf Club.
Topography	The Environment Agency 1m resolution LiDAR shows that the topography of the site is mainly low lying. The LiDAR shows that the site slopes uphill to the southeast of the site where Ravenswood settlement is located.
Existing drainage features	There are multiple drainage features within and around the site. There is an unnamed drainage feature which flows along the southwest border of the site. Also, there is an unnamed drain which flows along the west border of the site which transects through the west border of the site at two locations. The five drains flow in various directions in the flat area of the land within the site, but eventually go west through the site and meet at the railway line with the other smaller drain which bends round the southern boundary of the site. This drain then flows under the railway line and continues to the Emm Brook.

Fluvial	**The proportion of site at risk:** Flood Zone 3b covers 0% of the site. Flood Zone 3a covers 32% of the site. Flood Zone 2 covers 54% of the site. Flood Zone 1 covers 46% of the site. *The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%).* **Available data:** The fluvial extents for the WSP 2020 detailed hydraulic model for Emm Brook did not extend enough upstream to cover the site so the Environment Agency's Flood Map for Planning has been used within this assessment. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. **Flood characteristics:** The site is located within Flood Zone 2 and 3a. The northern half of the site is mainly at a fluvial flood risk in both Flood Zone 2 and 3a. Approximately 25.4ha of the site is within Flood Zone 2. Areas of the site within Flood Zone 2 are mainly the southwest, west, and east borders of the site. The FMfP Flood Zones are conservative in this area, as there is no detailed modelling present representing the small drains or structures, hence the extent is shown to spread across the area of low-lying land. The area of the site within Flood Zone 3a is approximately 15.2ha. The areas of the site within Flood Zone 3a are similar to Flood Zone 2 but the extent is less. The EA's FMfP does not represent Flood Zone 3b, therefore Flood Zone 3a should be used as a conservative estimation in the absence of modelled data. This should be refined at FRA stage. There was no depth or velocity extent data available for this site. It is recommended that a detailed hydraulic model of the drainage network through the site from Heath Lake is constructed in a FRA, to confirm and refine the flood risk at the site.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 5% of the site. Max depth is between 0.30 and 0.60m. Max velocity is between 0.25 and 0.50m/s. **1% AEP** covers 10% of the site. Max depth is between 0.90 and 1.20m. Max velocity is between 0.50 and 1.00m/s. **0.1% AEP** covers 42% of the site. Max depth is more than 1.20m. Max velocity is between 1.00 and 2.00m/s.

	The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage). **Available data:** The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is affected from all surface water scenarios. For 3.3% AEP scenario, the coverage of surface water within the site is low, with the main flow path is along the south and southwest border of the site, converging towards the railway embankment. There are also 5 very small areas of surface water pooling within the centre of the site. There are also 3 areas of surface water pooling along the east border of the site. For the 1% AEP scenario, the coverage of surface water within the site is similar to the 3.3% AEP scenario. The extent of the surface water flow path along the south and southwest border of the site is larger and more continuous than the 3.3% AEP scenario. There are more areas of surface water pooling than in the 3.3% AEP scenario and the extents are larger. The surface water flow path and pooling within the site are not connected. For the 0.1% AEP the extent of surface water extent within the site is more significant. The location of the main surface water flow path is the same as in the 3.3% and 1% AEP scenarios, but the extent is larger. The location of surface water pooling in the 3.3% and 1% AEP scenario, is the same in the 0.1% AEP scenario but the surface water is now one continuous area of surface water ponding rather than separate areas of pooling, which is focussed in the low-lying drainage network area in the northern half of the site. In the 0.1% AEP scenario the main surface water flow path flows into and merges with the area of surface water within the site, which then flows out of the site to the west. The surface water pooling and extent follows the topography of the site, the majority of the surface water is located in the low-lying areas of the site and where the unnamed drains are located.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset suggests that the site has less than a 25% susceptibility to groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The JBA Groundwater Emergence Map suggests that the majority of the site, approximately 32.7ha across the centre and south, does not show a risk of groundwater emergence due to the nature of the underlying

	geological deposits. The rest of the site, approximately 14.9ha across the north, is shown to have groundwater levels between 0.025 and 0.5m below the ground surface. In this area there is a risk of groundwater flooding to both surface and subsurface assets. Based on the RoFSW dataset, it is likely any groundwater that emerges will flow along the southwest border of the site, and flow from the west to the east of the site through the northern part of the site. Any groundwater that emerges will likely follow the topography of the site and emerge in the low-lying areas of the site. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area (RG45 6). From 2000 to 1 May 2022 there were 16 recorded historic sewer flooding incidents, according to available incident records from Thames Water. There are no incidents of sewer flooding within the site. There are two recorded incidents of sewer flooding located approximately 1.15km east of the site in Crowthorne. There is also a cluster of seven recorded sewer flooding incidents located approximately 1.3km southeast of the site.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets do not have a record of any flooding within the site but there is a historic flood outline record for 1947 in the surrounding area to the west of the site. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding on the site. There is one record of flooding 80m west of the site and there is a group of seven records of flooding clustered to the east of the site within the settlement Crowthorne.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows the site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures. A Flood Risk Assessment should investigate and confirm the role and connection of Heath Lake to the drainage network in the site, as well as confirming whether this is perched and therefore potentially provides a residual risk to the site should it over top. No information on the lake was available for this assessment.

Emergency planning

Flood warning	The site is not located in the Environment Agency Flood Warning Area but is located in the 'Emm Brook' (061WAF24EmmBrook) Flood Alert Area.
Access and egress	The site is accessible from the north using a private road connected to Nine Mile Ride (B3430) and is accessible from the south using Ravenswood Avenue connected to Duke's Ride (B3348). There is also an access route along the eastern boundary of the site. This access route is for pedestrian access only. The footpath is connected to Heathermount Drive which connects to New Wokingham Road.

	The north access route is affected by fluvial flooding as the private road connected to Nine Mile Ride (B3430) is inundated in Flood Zone 2. The access road to the east provides a route from the south, avoiding the large area of flood risk across the drainage network, but this is also inundated in Flood Zone 2. No fluvial velocity or depth data is available for the site, so this should be confirmed in a detailed model at FRA stage. This will likely refine results and reduce flood risk by representing the drains and structures in detail, rather than a coarser representation in the FMfP. The site has surface water coverage at all surface water scenarios. For the 3.3% AEP scenario the site is accessible from both directions as surface water depths are between 0.15 and 0.30m. For the 1% AEP scenario the site is only accessible from the north and east. The site is not accessible from the south using Ravenswood Avenue as it is transected by a large surface water flow path, with depths between 0.30 and 0.60m. However, detailed modelling using survey and structure information may refine this risk. For the 0.1% AEP event, the site access proves more difficult, due to the expanse of flooding in the middle of the site and along the eastern access road. In both locations surface water transects the private road connected to Nine Mile Ride (B3430) and Ravenswood Avenue, with depths exceeding 0.30m. For the 1% AEP plus 40% climate change scenario, the site is accessible from the north using the private road which is along the east border of the site water depths do not exceed 0.3m and water velocities of 0.4m/s. All other routes have access difficulty due to flood water depths reaching 1.06m. The site is difficult to access using the footpath along the eastern border of the site as the maximum flood water depths reach 0.55m. Maximum water velocities for the path are 0.97m/s. The access the site using the footpath along the east border of the site is affected by surface water. For the 3.3% AEP scenario, the site will be difficult to access using this route as maximum water depths are between 0.30-0.60m, hazard values are between 1.25 and 2.00 and water velocities between 0.50 and 1.00m/s. The 1% AEP scenario, the maximum water depths, hazard and velocities remain the same as in the 3.3% AEP scenario. For the 0.1% AEP scenario, hazard values remain the same as in the 3.3% and 1% scenarios, but maximum water depths and velocities increased to be between 0.60-0.90m and between 1.00-2.00m/s. There are access and egress issues via the above routes due to the surface water depths. It is highly likely that emergency access will be affected along both access routes. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events. Site drainage proposals should address the requirements for access routes, avoid impeding surface

	water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances **Fluvial** • There is no detailed hydraulic modelling available for this site, so, the Environment Agency's Flood Map for Planning Flood Zone 2 has been as a proxy. The areas of the site most likely to be affected by climate change fluvial flooding would be the southwest border of the site and the north part of the site, from the northwest to the northeast border of the site. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • Between the 3.3% AEP scenario and the 3.3% AEP plus climate change, the surface water flow path along the south and southwest border of the site has increase in extent. Between the two scenarios the surface water pooling has increased in extent, significantly in the northern part of the site. surface water flow path maximum flood water depths are 1.53m and water velocities are 0.90m/s. • In the 1% AEP plus 40% climate change scenario the main surface area flow path is the same as in the 1% AEP scenario, where there is a continuous flow path along the south and southwest borders of the site. The flow path in the 1% AEP plus 40% climate change scenario is more continuous than in the 1% AEP scenario. This flow path then merges with the surface water coverage in the northern part of the site. The surface water coverage in the 1% AEP plus 40% climate change scenario is much more significant than the 1% AEP scenario, where the surface water extent is separate areas of pooling than a continuous single area as in the 1% AEP plus 40% climate change scenario. Along the east border of the site the coverage of surface water is larger in 1% AEP plus 40% climate change scenario event. • Between the 1% AEP scenario and the 1% AEP plus 40% climate change scenario the surface water flow path maximum water depths are 1.88m and water velocities are 1.46m/s. • The differences in extent and the additional continuous flow paths between the 1% AEP and 1% AEP plus 40% climate change scenarios suggest that the existing flow paths are very sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended

	lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock is a combination of Bagshot and Windlesham Formation.
	  ○ Superficial is Alluvium.
	• Soils at the site consist of:
	  ○ Naturally wet very acid sandy and loamy soils
	Sustainable Drainage Systems (SuDS)
	• Across the north of the site, groundwater levels are indicated to be less than 0.5m below ground level during a 1% AEP event. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• BGS data indicates that the underlying geology is loamy and clayey which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site.
	• Where possible, proposed attenuation features such as basins, ponds and tanks should be located outside of Flood Zone 2 to avoid the potential risks to the hydraulic capacity or structural integrity of these features. Surface water outfalls that discharge into the Emm Brook may be susceptible to surcharging locking due to water levels in the Emm Brook. The impacts of tide locking/flood flows will need to be considered in terms of the attenuation storage requirements of the site and placement of the outfalls.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 3.3%, 1% and 0.1% AEP events. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.

	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as ‘More Vulnerable’. The exception test is required for this site because the development classified as ‘More Vulnerable’ is within Flood Zone 3a or at significant risk from surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is located in fluvial Flood Zones 2 and 3a and is at surface water flood risk. For surface water the site is

	particularly at risk in the 1% AEP, 0.1% AEP and 1% AEP plus 40% climate change events. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage. • Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

Key message

Development is likely to be able to proceed if: • Development is steered away from the northern part of the site around the drainage network and the west and southwest borders of the site as this is affected by both fluvial and surface water flooding.

- As there is no detailed model available, the FMfP shows a conservative picture of flood risk at the site, as the detail of the drains and structure survey is not incorporated. A detailed hydraulic model at FRA stage should be constructed to confirm the risk, which will likely refine the flood risk extents within the site. The connection to Heath Lake should also be investigated to see if this poses any residual risk.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the area identified to be at risk from both fluvial and surface water flooding.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere.
- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If any flood mitigation measures implemented are tested to check they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping information

The key datasets used to make planning recommendations for this site were the Environment Agency's FMfP and RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	In the absence of detailed hydraulic modelling, Flood Zones 2 and 3a have been taken from the Environment Agency's Flood Map for Planning. Flood Zone 3a has been used as an indicative Flood Zone 3b.
Climate change	The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. In the absence of detailed hydraulic modelling, Flood Zone 2 has been used as an indicative scenario for Flood Zone 3a plus climate change.
Fluvial depth, velocity and hazard mapping	There is no detailed hydraulic modelling available at this location.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.

Wokingham Borough Council
Level 2 Strategic Flood Risk Assessment
Detailed Site Summary Table

Site details

Site Code	5WW030, includes 5WW017 and 5WW026
Address	South Wokingham Master Planning Area extension
Area	48ha
Current land use	Predominantly greenfield with some buildings in the northeast and west of the site.
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The site is located on the east border of Wokingham Borough. The site is mainly greenfield and is located northeast of the settlement Holme Green. The site is bordered by Easthampstead Road to the west, Old Wokingham Road to the east and Waterloo Road to the north. The Waterloo to Reading Line is located approximately 605m north of the site. The site is within the headwaters of the Emm Brook catchment, which has an area of 4242.1ha.
Topography	The Environment Agency 1m resolution LiDAR shows that the site generally slopes downhill from north to south towards the Emm Brook. The south border and southeast corner of the site are the lowest lying areas where the Emm Brook flows. Elevations on the site vary from 68.7mAOD in the north of the site down to 56.7mAOD in the south of the site.
Existing drainage features	The Emm Brook flows west along the south border of the site. There is an unnamed watercourse which enters the site in the east beneath Old Wokingham Road and flows in a south-westerly direction through the site to join the Emm Brook on the southern border of the site. Two additional unnamed drains form in the northeast of the site and flow in a southerly direction to join this watercourse on the eastern site border. There is another unnamed drain located 180m east of the site which flows in a southerly direction to join the Emm Brook upstream of the site.
Fluvial	**The proportion of site at risk:** Indicative Flood Zone 3b covers 2% of the site. Flood Zone 3a covers 2% of the site. Flood Zone 2 covers 3% of the site. Flood Zone 1 covers 97% of the site.

	The percentage flood zones quoted show the percentage of the site at flood risk from that particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3 percentage. Flood Zone1 is the remaining area outside Flood Zone 2 (Flood Zone 2 + Flood Zone 1 = 100%). **Available data:** The Environment Agency's Flood Map for Planning has been used within this assessment. The fluvial extents for WSP's 2020 detailed hydraulic model for the Emm Brook did not extend far enough upstream to cover the site so the Environment Agency's Flood Map for Planning has been used. Please see Section 3.2 of the main Level 2 SFRA report for information on indicative flood zones. The Environment Agency review of the Emm Brook model noted that whilst this model was fit for purpose to update the Flood Map for Planning, the levels were not suitable for use in site-specific Flood Risk Assessments. Therefore, it is advised that the suitability of this modelling to inform this site is reviewed by the developer to determine if any further modelling work is needed. **Flood characteristics:** The site is located within Flood Zone 2 and 3a. The southern border of the site is at a fluvial flood risk from Emm Brook, which flows in a westerly direction along the south border of the site. Flood Zone 2 encroaches 40m into the site from the south border. Flood Zone 3a encroaches 30m into the site and affects the south border of the site. The EA's Flood Map for Planning does not represent Flood Zone 3b, therefore Flood Zone 3a should be used as a conservative estimation in the absence of modelled data. This should be refined at FRA stage. There was no depth, hazard, or velocity data available for this site.
Surface water	**Proportion of site at risk:** **3.3% AEP** covers 3% of the site. Max depth is between 0.6 and 0.9m. Max velocity is between 1.0 and 2.0m/s. **1% AEP** covers 6% of the site. Max depth is between 0.9 and 1.2m. Max velocity is between 1.0 and 2.0m/s. **0.1% AEP** covers 16% of the site. Max depth is more than 1.2m. Max velocity is more than 2.0m/s. *The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 1% AEP includes the 3.3% AEP percentage).* **Available data:**

	The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. **Description of surface water flow paths:** The site is affected from all surface water scenarios. For the 3.3% AEP scenario, there are approximately seven areas of surface water pooling within the site. There are areas of surface water pooling located within the site near the east border. Surface water is channelled along the unnamed watercourse which transects the site from the east border and then joins Emm Brook and flows west along the south border of the site. This flow path has maximum water depths between 0.6 and 0.9m, water velocities between 1.0 and 2.0m/s and a maximum hazard classification of 'Danger for some'. For the 1% AEP scenario, the areas of surface water pooling within the site increase in extent and there are additional, approximately six, areas of surface water pooling within the site. The surface water flow channelled along the unnamed watercourse and Emm Brook increases in extent and the areas of surface water pooling within the east border of the site increase in extent and join the flow path that is flowing west. The area of surface water pooling located within the site near the south border joins with the flow path along the south border of the site. Along this flow path, maximum flood water depths are between 0.9 and 1.2m, water velocities are between 1.0 and 2.0m/s and the maximum hazard classification is 'Danger for some'. For the 0.1% AEP scenario, the surface water flow paths and pooling extent have increased significantly from the other AEP scenarios. The surface water flow paths are located in the same areas as in the other AEP scenarios. The surface water flow path which forms in the southwest corner of the site has increased in extent and flows south to join the main surface water flow path flowing west along the south border of the site, channelled along Emm Brook. The areas of surface water pooling within the east border of the site that have joined the main surface water flow path have increased in extent within the site significantly. Along the main flow path, maximum flood water depths exceed 1.2m, water velocities exceed 2.0m/s and the maximum hazard classification is 'Danger for most'.
Reservoir	The site is not shown to be at risk of reservoir flooding from the Environment Agency reservoir flood maps.
Groundwater	The AStGWF dataset suggests that the majority of the site, approximately 40.5ha, has a susceptibility of groundwater flooding between 25% and 50%. The northwest corner and west border of the site, approximately 7.5ha, have less than a 25% susceptibility of groundwater flooding. The JBA Groundwater Emergence Map, provided as 5m resolution grid squares, shows the susceptibility of an area to groundwater emergence based on groundwater levels. The groundwater emergence map shows that the majority of the site, approximately 32.7ha, is at no risk of groundwater flooding due to the nature of the underlying geological deposits. In the

	centre of the site there is approximately 10.6ha which has groundwater levels between 0.025m and 0.5m below the ground surface and approximately 3ha has groundwater levels either at or very near (0.025m of) the ground surface. In these areas there is a risk of groundwater flooding to both surface and subsurface assets. There is also approximately 1.7ha which has groundwater levels between 0.25m and 0.5m below the ground surface. Within these areas there is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely. Based on the RoFSW dataset and the Environment Agency 1m resolution LiDAR, it is likely that any groundwater that emerges will flow south towards Emm Brook which flows along the south border of the site. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.
Sewers	The site is located in a postcode area (RG40 3) with no recorded historic sewer flooding incidents, according to available incident records from Thames Water (from 2000 up to 1 May 2022).
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets do not have a record of any flooding on or surrounding the site. Historic flooding records provided by Wokingham Borough Council did not show any records of flooding within the site but there is one record of flooding located 55m northwest from the west border of the site.

Flood risk management infrastructure

Defences	The Environment Agency AIMS dataset shows the site is not protected by any formal flood defences.
Residual risk	Emm Brook is culverted beneath Easthampstead Road to the west of the site. This presents a residual risk as if this culvert was to become blocked water could back up and result in flooding on the site.

Emergency planning

Flood warning	The site is not located in an Environment Agency Flood Warning Area but is within the Emm Brook (061WAF24EmmBrook) Flood Alert Area.
Access and egress	The site is accessible via three routes, from the north of the site using Waterloo Road connected to William Heelas Way from the north or Peacock Lane from the east, from the west of the site using Easthampstead Road connected to Old Wokingham Road and from the east of the site using Old Wokingham Road connected to Peacock Lane. During all modelled fluvial events the site can be accessed from the east along Peacock Lane and then Waterloo Road. The site may also be accessible along Peacock Lane and then Old Wokingham Road to the east of the site, however, an unnamed watercourse crosses Old Wokingham Road which is not represented in the EA Flood Map for Planning so may present a fluvial risk along the road which should be confirmed in a detailed model at FRA stage should access be proposed along this road.

	Access to the site from the north along William Heelas Way and Waterloo Road, and from the west along Easthampstead Road, is shown to be affected during all modelled fluvial events as the roads are partially inundated by Flood Zone 2 and Flood Zone 3a. The site has surface water coverage at all surface water scenarios. For the 3.3% AEP scenario the site is likely to be accessible from the west using Easthampstead Road and from the north using Waterloo Road as water depths on these roads do not exceed 0.3m. However, access to the site from the east will be difficult as a surface water flow path transects Old Wokingham Road at the confluence of two unnamed drainage channels, with maximum flood water depths between 0.6 and 0.9m and maximum water velocities between 1.0 and 2.0m/s. For the 1% AEP scenario, all routes show potential access difficulties. Water depths along Waterloo Road to the north remain mostly below 0.3m but there are areas with water depths between 0.3 and 0.6m, with velocities between 0.5 and 1.0m/s and a maximum hazard classification of 'Danger for some'. This is the same for access to the east and the west of the site as water depths are between 0.60 and 0.90m, water velocities are between 1.0 and 2.0m/s and the maximum hazard classification is 'Danger for most'. For the 1% AEP plus 40% climate change scenario access to the site from all directions may be affected as water depths exceed 0.30m. Along Waterloo Road to the north, water depths are up to 0.4m and velocities are up to 0.8m/s. Along Old Wokingham Road to the east, water depths are up to 1.02m with velocities up to 1.4m/s. Along Easthampstead Road to the west, water depths are up to 1.09m with velocities up to 0.9m/s. During all modelled surface water events the flow channelled along the unnamed watercourse in the southeast of the site bisects the site meaning access to the southeast corner of the site will need to be considered separately. There is no detailed modelling available for Emm Brook along the southern border of the site and its unnamed tributary which bisects this corner of the site. A detailed model may be required at FRA stage to accurately represent the risk from these watercourses. There are potential access and egress issues via the above routes due to surface flooding which may affect emergency access and egress to the site. Safe access and egress will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk in the wider catchment.
Dry Islands	The site is not located on a dry island.

Climate change

Implications for the site	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. Please see Section 4.4 of the main Level 2 SFRA report for information on fluvial models and climate change allowances. **Fluvial** • In the absence of detailed hydraulic modelling, the Environment Agency's Flood Map for Planning Flood Zone 2 has been as a proxy to assess the potential impacts of climate change on the site. • Flood Zone 2 shows a slightly larger extent than Flood Zone 3a along the southern border of the site showing the site has slight susceptibility to increased flood risk with climate change. **Surface Water** • The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. • Between the 3.3% AEP and 3.3% AEP plus 35% climate change scenarios, the main surface water risk remains in the same location channelled along Emm Brook flowing west along the south border of the site. Within the 3.3% AEP plus 35% climate change scenario, there are additional areas of surface water pooling within the site and the areas of pooling present in the 3.3% AEP scenario have increased in extent. The areas of surface water pooling located within the site near the southwest corner have increased in extent and joined the flow path along the south border in the 3.3% AEP scenario plus 35% climate change scenario. • In the 3.3% AEP plus 35% climate change scenario, the maximum depths in the surface water flow path channelled along Emm Brook are 0.9m, with water velocities up to 1.66m/s. • Between the 1% AEP and 1% AEP plus 40% climate change scenarios, the main surface water risk remains in the same location channelled along Emm Brook flowing west along the south border of the site. Within the 1% AEP plus 40% climate change scenario, there are additional areas of surface water pooling within the site and the areas of pooling present in the 1% AEP scenario have increased in extent. • In the 1% AEP plus 40% climate change scenario the maximum flood depths in the surface water flow path channelled along Emm Brook are 1.3m, with water velocities up to 1.8m/s and a maximum hazard classification of 'Danger for all'. • The increase in surface water flow path extents and the additional areas of surface water pooling suggest that the existing areas of surface water risk are sensitive to increases with climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock is London Clay Formation - Clay, silt and sand.
	  ○ Superficial is River Terrace Deposits, 6 - Sand and gravel.
	• Soils at the site consist of:
	  ○ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
	Sustainable Drainage Systems (SuDS)
	• The site is considered to have a low susceptibility to groundwater. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Groundwater monitoring is recommended to determine the seasonal variability of groundwater levels, as this may affect the design of the surface water drainage system. Below ground development such as basements may not be appropriate at this site.
	• Groundwater levels are indicated to be at least 5m below ground level across large parts of the site and groundwater flooding is not likely, however below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is clayey which is likely to be free draining. This should be confirmed through infiltration testing, with the use of infiltration maximised as much as possible in accordance with the SuDS hierarchy.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 1%, 0.1%, 3.3% plus climate change and 0.1% plus climate change AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (Local Planning Authority, Lead Local Flood Authority, and Environment Agency) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.

NPPF and planning implications

Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The sequential test will need to be passed before the exception test is applied. The NPPF classifies residential development as 'More Vulnerable'. The exception test is required for this site because the development classified as 'More Vulnerable' is within Flood Zone 3a or at significant risk from surface water flooding.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific FRA will be required as the proposed development site is shown to be located in both fluvial Flood Zone 2, Flood Zone 3a and is at surface water flood risk. For surface water the site is particularly at risk in the 1% AEP, 0.1% AEP, 3.3% AEP plus 35% climate change and 1% AEP plus 40% climate change events. • All sources of flooding should be considered as part of a site-specific FRA. • Consultation with the Local Authority, Lead Local Flood Authority, Water Company, and the Environment Agency should be undertaken at an early stage.

	• Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Wokingham Borough Council's Local Plan Policy's and Wokingham Borough Council's SuDS Strategy. • The development should be designed with mitigation measures in place where required. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates. • Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

Key message

Development is likely to proceed if:

- Development is steered away from the south border of the site as this is affected by both fluvial flooding and surface water flooding.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk from both fluvial and surface water flooding, particularly along the southern border and southeast corner of the site.
- Safe access and egress can be demonstrated in the 1% AEP plus 40% climate change surface water event. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere. A detailed hydraulic model of Emm Brook along the southern border of the site and the unnamed watercourses within the site may be required at FRA stage to accurately represent the risk from these watercourses.

- A site-specific FRA demonstrates that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- If any flood mitigation measures implemented are tested to check they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- The developer reviews the suitability of the Emm Brook model to inform this site and carries out any further modelling work deemed necessary.

Mapping information

The key datasets used to make planning recommendations for this site were the Emm Brook hydraulic model (2020), the Environment Agency's FMfP and the Environment Agency's RoFSW map. More details regarding data used for this assessment can be found below.

Flood Zones (actual risk)	In the absence of detailed hydraulic modelling, Flood Zones 2 and 3a have been taken from the Environment Agency's Flood Map for Planning. Flood Zone 3a has been used as an indicative Flood Zone 3b.
Climate change	The latest climate change allowances have been applied to the RoFSW map to indicate the impact on pluvial flood risk. In the absence of detailed hydraulic modelling, Flood Zone 2 has been used as an indicative scenario for Flood Zone 3a plus climate change.
Fluvial depth, velocity and hazard mapping	For the access and egress section depth, velocity, and hazard data was derived from the Emm Brook hydraulic model where available. For the other fluvial flood sections there is no detailed hydraulic modelling available at this location.
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW.