



Great Brighams Mead, Reading

Flood Risk Assessment

On behalf of **McKay Securities PLC**



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Executive Summary

This Flood Risk Assessment (FRA) has been prepared by Peter Brett Associates LLP (PBA), now part of Stantec, to support a proposed change of use under Permitted Development Rights from office to residential, at Great Brighams Mead on Vastern Road in Reading.

In accordance with the fundamental objectives of the National Planning Policy Framework (NPPF), the FRA demonstrates that:

- (i) The development is safe;
- (ii) The development does not increase flood risk; and,
- (iii) The development does not detrimentally affect third parties.

The Environment Agency (EA) Flood Zone map shows the site is located in Flood Zone 3 'High Probability' of the River Thames (as defined in Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change' Table 1) as follows:

Flood Zone 3 'High Probability' (greater than 1 in 100 (>1.0%) annual probability of river flooding)

The proposals are for a change of use from 'Less Vulnerable' office to 'More Vulnerable' residential use (ref: NPPF PPG Table 2). As a proposed change of use, the proposal is not subject to the Sequential or Exception Test, as confirmed in Paragraph 164 of the NPPF, subject to a FRA confirming the proposed development is safe from flooding over its design life.

The NPPF PPG 'Climate Change Allowances' guidance confirms the site criteria requires consideration of peak river flow allowances ranging from +35% ('Higher Central' allowance) to +70% ('Upper End' allowance).

The flood risk mitigation strategy for the development consists of the following elements:

- Ground floor levels will be a minimum of 38.66m AOD. This is 300mm above the modelled 1 in 100 annual probability +35% allowance for climate change flood level, and is also above the 'Upper End' +70% scenario flood level;
- As a change of use, with no impact on building footprint or external ground levels, the development will have no impact on flood flow routes or floodplain storage capacity over the site;
- Safe access is available in the 1 in 100 annual probability flood event. In more extreme scenarios, allowing for climate change, there will be significant advance warning and the residual risk will be addressed through a Flood Management and Evacuation Plan in line with the requirements of the Reading Strategic Flood Risk Assessment (SFRA).

The site is located in an area that will be defended by the planned EA Flood Alleviation Scheme (FAS) for North Reading and Lower Caversham. However, the protection provided by this FAS have been ignored when developing the mitigation strategy, so the site will fully address flood risk irrespective of whether this FAS is progressed.

In summary, the FRA demonstrates that the proposed development is safe and in accordance with the requirements of national and local planning policy.

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Summary of Key FRA Data

Aspect of flood risk	Applicable Guidance/ Source of Data	Summary	Section of FRA
Site Location	n/a	Reading RG1 8DJ	2
Existing Ground Levels	Topographic Survey by WLS	External ground levels range from 37.7m AOD to 38.4m AOD. Existing building floor level is 38.2m AOD	2.2
Primary source of flood risk	n/a	River Thames	3
Presence of flood defences	n/a	No existing defences. Potential future protection from Reading and Caversham FAS.	2.6
Proposed Development	Proposals by AHMM Architects	Proposed change of use from office to residential, to provide 110 units	5.1
Planning Aspects			
Flood Risk Vulnerability	Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change'	'More Vulnerable'	5.2
Flood Zone		Flood Zone 3a 'High Probability'	3.1
Sequential Test		Sequential Test not required for change of use	5.3
Exception Test		Exception Test not required	5.4
Applicable Climate Change Allowances	EA climate change allowances guidance	+35% (Higher Central) +70% (Upper End) (Thames River Basin District)	4
Reference Flood Levels			
Present Day	EA 2018 Thames 'Sandford to Mapledurham' model (Abingdon Flood Schemes Mapping 2017)	1 in 20 annual probability = 37.56m AOD 1 in 100 annual probability = 38.06m AOD 1 in 1000 annual probability = 38.48m AOD	3.4
Climate Change		1 in 100 annual probability +35%= 38.36m AOD 1 in 100 annual probability +70%= 38.54m AOD	4
Proposed Mitigation Measures			
Ground Floor Levels	BS8533:2017 RBC L1 SFRA section 12.3 EA Thames Area guidance	Proposed floor level = 38.66m AOD	6.1
Floodplain Storage	RBC L1 SFRA Section 12.5 EA Thames Area guidance	Proposed change of use – no impact on floodplain storage	6.2
Flood Flow Routes	RBC L1 SFRA Section 12.6	Proposed change of use – no impact on floodplain flows	6.2
Safe Access	RBC L2 SFRA Section 3.4	Continuous safe access available at present day 1 in 100 annual probability event. Proposed management plan to address residual risk in climate change scenarios.	6.3
Surface Water Drainage	RBC SFRA	No change to existing drainage arrangements	6.4

Abbreviations

ABI	-	Association of British Insurers
BGS	-	British Geological Survey
CDM	-	Construction (Design and Management)
CIRIA	-	Construction Industry Research and Information Association
DDA	-	Disability Discrimination Act
DEFRA	-	Department for Environment, Food and Rural Affairs
EA	-	Environment Agency
FAS	-	Flood Alleviation Scheme
FDC	-	Flood Defence Consent
FHR	-	Flood Hazard Rating
FMfSW	-	Flood Map for Surface Water
FRA	-	Flood Risk Assessment
FRAP	-	Flood Risk Activity Permit
FRMP	-	Flood Risk Management Plan
GIS	-	Geographic Information System
LLFA	-	Lead Local Flood Authority
M. AOD	-	Metres Above Ordnance Datum (Newlyn)
NPPF	-	National Planning Policy Framework
PFRA	-	Preliminary Flood Risk Assessment
PPG	-	Planning Practice Guidance
SuDS	-	Sustainable Drainage Systems
SFRA	-	Strategic Flood Risk Assessment
RBC	-	Reading Borough Council
UKCP18	-	United Kingdom Climate Change Projections 2018 Study

1 Introduction

1.1 Scope of Report

- 1.1.1 This Flood Risk Assessment (FRA) has been prepared by Stantec UK ('Stantec') on behalf of our client, McKay Securities plc., to support a planning application for a proposed change of use under Permitted Development Rights (PDR) from office to residential use, at Great Brighams Mead, Reading.
- 1.1.2 The report is based on the available flood risk information for the site as detailed in **Section 1.2**, and prepared in accordance with the planning policy requirements set out in **Section 1.3**. The scope of the FRA is consistent with the National Planning Policy Framework (NPPF) requirements and the 'Site-specific Flood Risk Assessment Checklist' from the associated Planning Practice Guidance (PPG).
- 1.1.3 Stantec has many years of experience in, amongst other areas, the assessment of flood risk, hydrology, flood defence and river engineering. The authors and reviewers of the document are all experienced engineers and members of chartered institutions such as the Chartered Institution of Water and Environmental Management (CIWEM) or the Institution of Civil Engineers (ICE).

1.2 Sources of Information

- 1.2.1 The FRA has been prepared based on the following sources of information:
- Environment Agency (EA) published '**Open Data**' datasets available online, reproduced with OS mapping under licence to Stantec (contains Ordnance Survey data © Crown copyright and database right [2020], contains Environment Agency information © Environment Agency and database right) (see **Appendix A**);
 - Topographic survey of the site (Drawing reference 16/295/100-A) undertaken by Warner Surveys Ltd. in October 2016 (see **Appendix B**);
 - **Proposals** by Allford Hall Monaghan Morris Architects (see **Appendix C**);
 - **EA Product 4 data** (ref. THM_124288, May 2019) including historic flood data, flood defence information, modelled flood extents and flood levels from the EA River Thames (Sandford to Mapledurham) 2018 hydraulic model, provided from the 'Abingdon Flood Schemes' mapping study completed June 2017 (see **Appendix D**);
 - **EA Product 5, 6 and 7 hydraulic model data** for the EA River Thames (Sandford to Mapledurham) 2018 hydraulic model;
 - The Reading Borough Council (RBC) **Preliminary Flood Risk Assessment (PFRA)**, June 2011;
 - The Reading Borough Council (RBC) **Level 1 Strategic Flood Risk Assessment (SFRA)**, June 2017;
 - The Reading Borough Council (RBC) **Level 2 Strategic Flood Risk Assessment (SFRA)**, December 2017.

1.3 Relevant Planning Policy

1.3.1 This FRA has been prepared in accordance with the relevant national, regional and local planning policy and statutory authority guidance as follows:

- National policy contained within the **National Planning Policy Framework (NPPF)** updated March 2020, issued by Communities and Local Government, with reference to Section 14 'Meeting the challenge of climate change, flooding and coastal change';
- The **Planning Practice Guidance (PPG)** released in March 2014 ('Flood Risk and Coastal Change' section) and updated to incorporate the EA '**Flood Risk Assessments: Climate Change Allowances**' guidance (most recently updated July 2020);
- EA regional guidance contained in the '**Thames Area Climate Change Allowances – Guidance for their use in flood risk assessments**' (January 2017), and '**Thames Guidance Statement – Safe Access/Egress for LPAs**' (August 2016);
- Local planning policy contained within the new '**Reading Borough Local Plan**', adopted November 2019, which replaces the Core Strategy, with specific reference to **Policy EN18 'Flooding and Sustainable Drainage Systems'**, which states:

Development will be directed to areas at lowest risk of flooding in the first instance, following the Sequential and Exceptions Test set out in the NPPF, and taking into account the effects of climate change. It will consider flooding from all sources, including fluvial, surface water, groundwater and sewer flooding. Where development in areas at risk of flooding is necessary, it will not reduce the capacity of the flood plain to store floodwater, impede the flow of floodwater or in any way increase the risks to life and property arising from flooding. Wherever possible, development should be designed to reduce flood risk, both on- and off-site.

All major developments must incorporate sustainable drainage systems (SuDS) as appropriate and in line with the Government's Technical Standards. Smaller schemes are encouraged to incorporate SuDS, where possible. Runoff rates should aim to reflect greenfield conditions and, in any case, must be no greater than the existing conditions of the site. Schemes should ensure that the movement of water through vertical infiltration as well as horizontal run-off does not worsen contamination effects. Wherever possible, SuDS provision should maximise ecological benefits, link into the existing Green Network, incorporate tree planting and landscaping and avoid damage to existing significant trees, including through changes to the site hydrology. All new developments in areas of flood risk should give priority to SuDS.

- Local planning policy contained within the new '**Reading Borough Local Plan**', adopted November 2019, which replaces the Core Strategy, with specific reference to **Policy EN18 'Flooding and Sustainable Drainage Systems'**, which states:

All developments will demonstrate how they have been designed to incorporate measures to adapt to climate change. The following measures shall be incorporated into development...

- *...All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change."*

1.4 Caveats and Exclusions

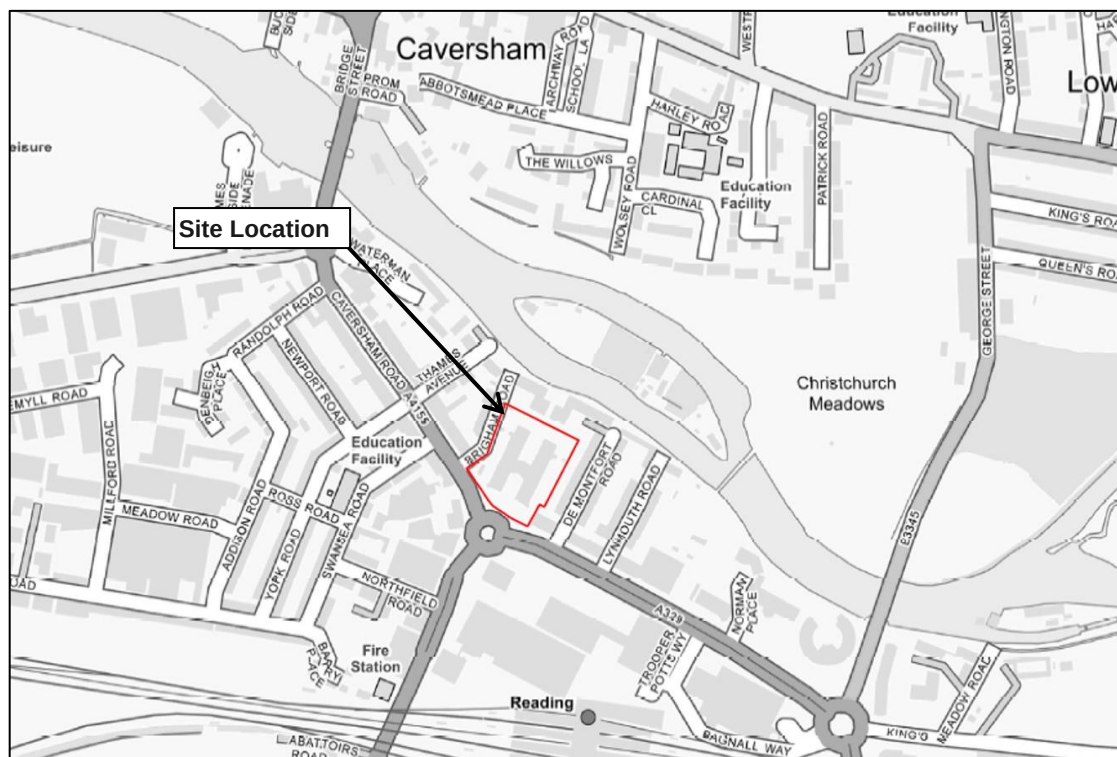
- 1.4.1 This FRA has been prepared in accordance with the NPPF, the associated PPG and Local Planning Policy. The proposed flood management (including ground floor level recommendations) and surface water management strategies are based on the relevant British Standards (BS8533), the standing advice provided by the EA or based on common practice.
- 1.4.2 The Construction (Design and Management) Regulations 2015 (CDM Regulations) will apply to any future development of this site which involves “construction” work, as defined by the CDM Regulations. As such it is the responsibility of the proposed developer (ultimate client) to fulfil its duties under the CDM Regulations.
- 1.4.3 The approach for the FRA and proposals for the surface water management strategy are based on the requirements of the EA and RBC in its role as Lead Local Flood Authority (LLFA). The findings of this FRA are based on data available at the time of the study and on the subsequent assessment that has been undertaken in relation to the development proposals as outlined in **Section 5**. As such, we recommend the end user reviews the validity of the flood data on an annual basis with the EA.
- 1.4.4 It should be noted that the insurance market applies its own tests to properties in terms of determining premiums and the insurability of properties for flood risk. Those undertaking development in areas which may be at risk of flooding are advised to contact their insurers or the Association of British Insurers (ABI) to seek further guidance prior to commencing development. Stantec does not warrant that the advice in this report will guarantee the availability of flood insurance either now or in the future.

2 Site Setting

2.1 Site Description

- 2.1.1 The 1.1ha site is located to the north of central Reading, off the roundabout linking the A4155 Caversham Road with the A329 Vastern Road/Inner Distribution Road (IDR), at postcode RG1 8DJ and OS grid reference 471,360m E, 174,220m N – see **Figure 2-1**.
- 2.1.2 The site lies within the administrative boundary of RBC.

Figure 2-1: Site Location Plan (not to scale)



- 2.1.3 The site consists of a three-storey office building in a 'H' plan configuration, which is surrounded by external car parking. It is currently occupied by the telecommunications company 'Three'.
- 2.1.4 The site is bordered by residential development to the east and north, Brigham Road to the west and Vastern Road to the south. Vehicular and pedestrian access to the site is provided from the south via an entrance off the roundabout. Additional pedestrian access is available via gates along the northern and western boundaries.

Figure 2-2: View north towards site entrance



2.2 Topography

- 2.2.1 The topographic survey by Warner Surveys Ltd. is provided in **Appendix B** and shows that the site is relatively flat with levels ranging from 37.72m AOD, adjacent to the northern boundary and at the southern building entrance, to 38.4m AOD at the site entrance off Vastern Road.
- 2.2.2 The building ground floor level is at 38.20m AOD.
- 2.2.3 EA LIDAR survey data, as shown within **Appendix A**, shows that the site lies at a similar elevation to other surrounding areas on either side of the Thames, with those elevations gradually decreasing eastwards along the corridor of the River Thames. Levels are significantly higher to the south of the site in the centre of Reading city centre, where a nominal ridge separates the Thames from the Kennet catchment to the south-east.

2.3 Hydrological Setting

- 2.3.1 The **River Thames** is the dominant watercourse in the area and flows east, approximately 50m to the north of the site.
- 2.3.2 The River Thames at its closest point to the site is bifurcated as it flows around Fry's Island, between Caversham Bridge (upstream of the site) and Reading Bridge (downstream).
- 2.3.3 Caversham Lock lies approximately 500m downstream of the site and maintains a Standard Head Water Level (SHWL) for the upstream reach in the vicinity of the site, at 36.59m AOD.

Figure 2-3: River Thames, view from Christchurch Bridge towards Caversham Bridge



- 2.3.4 The **River Kennet** flows north-east through the centre of Reading approximately 900m to the south-east of the site, and its confluence with the River Thames is 1.7km east of the site at Kennetmouth. Downstream of this point are the Caversham Lakes, a series of large lakes on the north side of the River Thames channel.
- 2.3.5 The other watercourse of relevance to the site is the **Vastern Ditch**, a former land drainage channel that has been subsumed into the surface water sewer network, that flows in a culvert along the north side of Vastern Road, to the east of the site. The watercourse emerges into a small channel on the south side of Caversham Lock which outfalls to the River Thames immediately downstream of the lock.

2.4 Geology and Hydrogeology

- 2.4.1 The British Geological Survey (BGS) Geology of Britain Viewer suggests that the site lies on superficial deposits of the Langley Silt Member overlying the bedrock of the Seaford Chalk Formation and Newhaven Chalk Formation (White Chalk). Alluvium is shown overlying the Terrace Deposits on the line of the River Thames to the north of the site and is possibly present on the site. the natural strata may also be overlain by Made Ground associated with the previous and present developments of the site.
- 2.4.2 From consideration of the geomorphological and topographical setting of the site, it is expected that groundwater level will be approximately consistent with the typical river level of the River Thames to the north, at approximately 36.5m AOD, however locally higher water levels may be present following periods of prolonged rainfall and elevated river levels.
- 2.4.3 The site does not lie within an EA Groundwater Source Protection Zone; however, it does lie within a 'Drinking Water Safeguard Zone' for surface water. The site lies on a Principal designated bedrock aquifer, and within an area of Groundwater Vulnerability designated 'Major Aquifer High'.

2.5 Flood Defences

- 2.5.1 The EA P4 data in **Appendix D** indicates the site is not currently protected by flood defences.

- 2.5.2 The EA is currently developing the design for a Reading and Caversham Flood Alleviation Scheme (FAS) to reduce flood risk to the area from the River Thames, with an intended planning submission in 2021 and completion by Summer 2023. The current proposed scheme features new and reinforced flood walls, flood gates and embankments along the edge of the floodplain, and a new flood alleviation channel to be constructed within Christchurch Meadows to the north-east of the site.
- 2.5.3 The proposed scheme would significantly reduce the extent of flooding affecting the area surrounding the site during the 1 in 200 annual probability flood event, preventing any out of banks flooding on the south bank between Caversham Bridge and Reading Bridge – as shown on **Figure 2-4**.

Figure 2-4: 1 in 200 annual probability flood extents post-FAS (extract from EA proposals)



- 2.5.4 The EA has previously advised that a new hydraulic model has been developed through the Reading area (Mapledurham to Hurley) to inform the design of the FAS. A new request has been made for this data, but it is understood this modelling has been delayed and no date has been advised for its release.
- 2.5.5 It should be noted that any benefits afforded to the site through the FAS have not been taken into consideration for the purposes of flood mitigation within this FRA. As such, all benefits provided by the FAS will be in addition to the proposed mitigation measures described in **Section 6**.

3 Overview of Flood Risk

3.1 EA Flood Maps

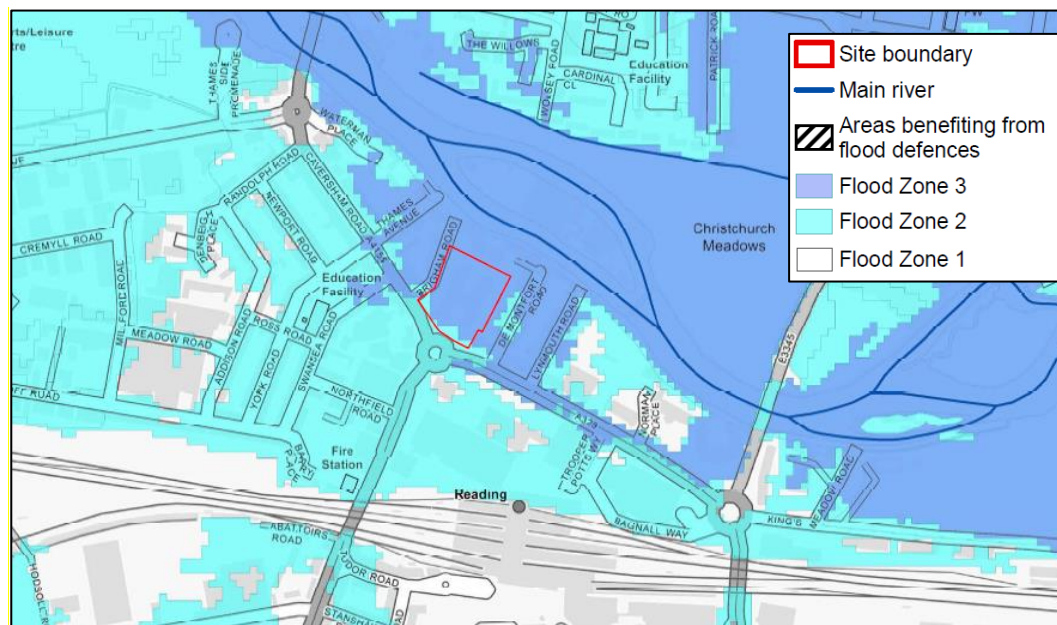
3.1.1 The following maps have been taken from the Stantec GIS flood maps report in **Appendix A** based on the EA Opendata datasets available online and reproduced with OS mapping under licence to Stantec.

Flood Zone Map

3.1.2 The first phase in identifying whether a site is potentially at risk of flooding is to consult the EA's Flood Zone maps, available on the EA's website. This provides an initial indication of the extent of the Flood Zones, which is more detailed site-specific level survey and modelled flood levels. The Flood Zones are defined in Table 1 of the Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change' section as follows:

- **Flood Zone 1 'Low Probability'** – Land at less than 1 in 1000 (0.1%) annual probability of river or sea flooding;
- **Flood Zone 2 'Medium Probability'** – Land between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of river flooding, or between 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of sea flooding;
- **Flood Zone 3 'High Probability'** – Land at 1 in 100 (1%) or greater annual probability of river flooding, or 1 in 200 (0.5%) or greater annual probability of sea flooding;

Figure 3-1: EA Flood Zone Map



3.1.3 The EA Flood Zone map indicates the majority of the site within **Flood Zone 3 'High Probability'**. Areas along the southern boundary of the site are located within **Flood Zone 2 'Medium Probability'**.

3.1.4 The access route south via the IDR is in Flood Zone 2, whereas the routes east and west (via Vastern Road and Caversham Road respectively) have sections within Flood Zone 3.

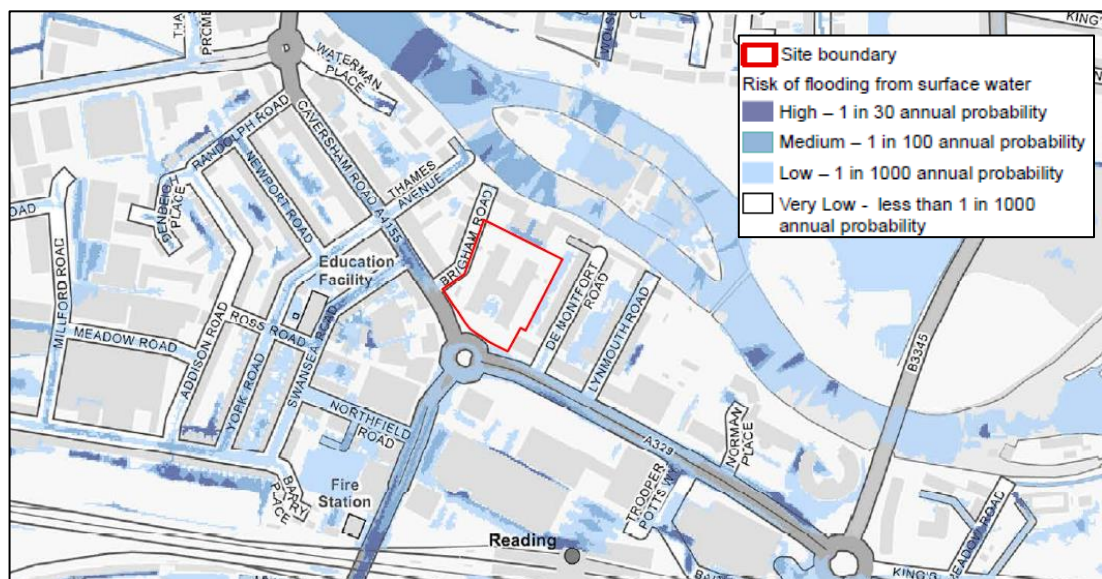
Flood Risk from Reservoirs Map

- 3.1.5 The EA provides maps showing the risk of flooding in the event of a breach from reservoirs, based only on large reservoirs (over 25,000 cubic metres of water).
- 3.1.6 While these are no longer available for download as part of the EA Opendata dataset, they remain available for review on the .GOV.UK 'Long Tern Flood Risk Information' at <https://flood-warning-information.service.gov.uk/long-term-flood-risk/>
- 3.1.7 These confirm that the site is not within the predicted flood extents of such an event.

Flood Risk from Surface Water

- 3.1.8 The EA 'Flood Map for Surface Water' ('FMfSW') shows where areas could be potentially susceptible to surface water flooding in an extreme rainfall event. The latest mapping assesses flooding resulting from severe rainfall events based on the following three scenarios:
 - 1 in 30 (3.3%) annual probability rainfall event ('High' risk);
 - 1 in 100 (1%) annual probability rainfall event ('Medium' risk);
 - 1 in 1000 (0.1%) annual probability rainfall event ('Low' risk).
- 3.1.9 Land at lower than 1 in 1000 (0.1%) annual probability of flooding is considered to be 'Very Low' risk of flooding

Figure 3-2: EA Flood Map for Surface Water

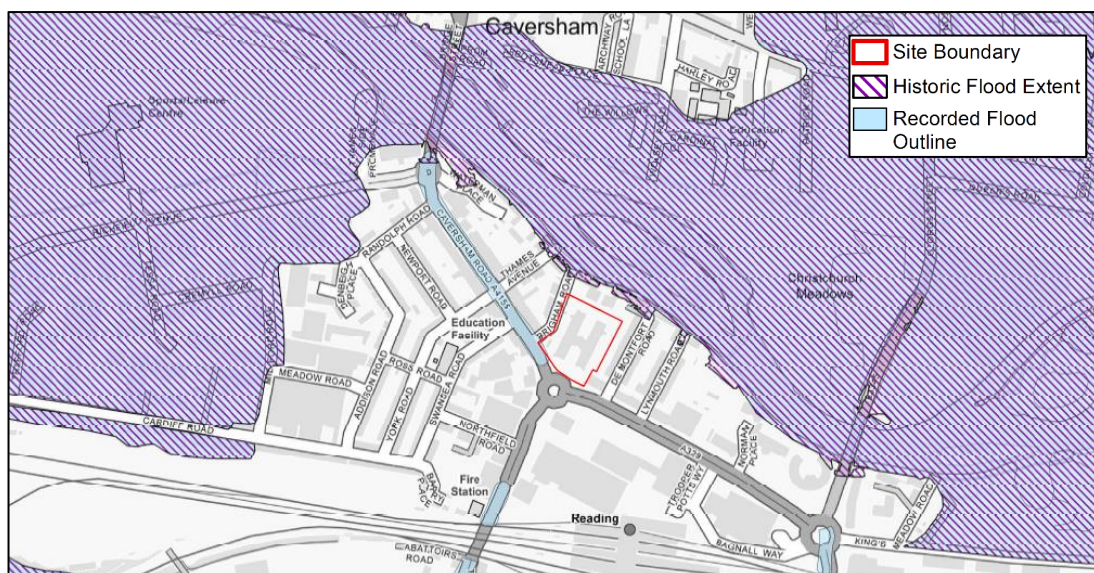


- 3.1.10 The Surface Water Flood Map indicates that the majority of the site is at a 'Very Low' risk of surface water flooding, with a localised area of lower ground that is shown to have a 'Low' risk of surface water flooding to the immediate south of the building.
- 3.1.11 It should be noted that the surface water maps are generated using a generic methodology on a national scale, whereby rainfall is routed over a ground surface model. The analysis does not take account of any specific local information on below-ground drainage infrastructure and infiltration, although an adjustment is included in urban areas to account for the impact of sewerage and a standard infiltration allowance based on soil type. Consequently, the mapping provides a guide to potentially vulnerable areas based on the general topography of an area.

Historic Flood Map

- 3.1.12 The EA 'Historic Flood Map' is a dataset showing the maximum extent of all individual recorded flood outlines from river, the sea and groundwater and shows areas of land that have previously been subject to flooding.
- 3.1.13 The EA also provided individual recorded flood outlines as part of the Product 4 package of flood data (**Appendix D**). This provides records of the floods of 1947, 2000, 2002 and 2014.
- 3.1.14 Cross reference between the two sources of data confirms that the most severe 'historic flood extent' for the area is derived from the recorded floodplain of the 1947 flood. This was the greatest flood of the last century (and the greatest flood since 1894) and was largely due to rare meteorological circumstances whereby an extensive period of heavy snowfall was rapidly followed by a rapid thaw combined with heavy rainfall, which could not percolate into the still frozen ground.
- 3.1.15 The records indicate the site was unaffected in the historic flood events, although the 1947 outline is shown on the P4 data as causing flooding along Caversham Road to the west of the site.

Figure 3-3: EA Historic Flood Map



3.2 RBC Preliminary Flood Risk Assessment

- 3.2.1 The RBC Preliminary Flood Risk Assessment (PFRA) was prepared by Peter Brett Associates (PBA, now Stantec) in 2011 and provides a high-level assessment of flood risk issues within the Borough. This document has been reviewed and key information of relevance to the site has been extracted.
- 3.2.2 Records within the PFRA indicate that there were two incidences of groundwater flooding in the vicinity of the site between 2000 and 2003, but no other site-specific data is provided.

3.3 Strategic Flood Risk Assessment

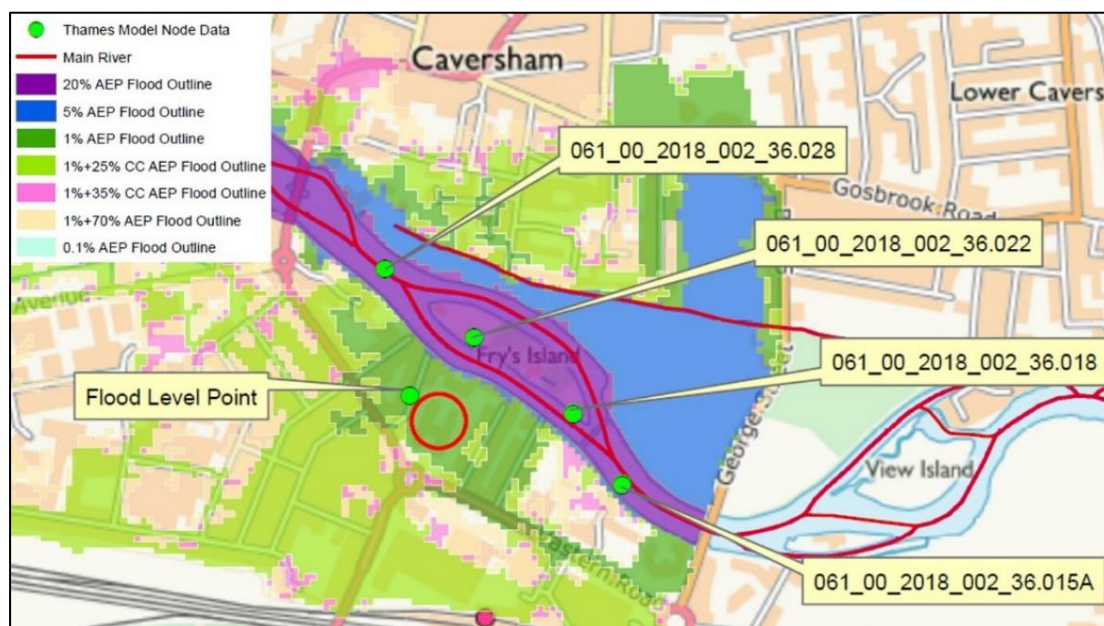
- 3.3.1 The current RBC Strategic Flood Risk Assessment (SFRA) Level 1 and Level 2 reports were prepared by PBA in 2017 and provide advice to RBC on flood risk issues within the Borough. This document has been reviewed and key information of relevance to the site has been extracted.

- **Historic Flooding:** Map F1 provides the EA historic floodplain map, consistent with the 'historic flood extent' discussed in **Section 3.1**. Maps F2_N1, F1-N2 and F2-N3 show historic flooding records affecting the north of Reading for 9 recorded flood events between 1947 and 2013/14. These show that the site was not affected in any of the recorded events;
- **Flood Zone:** Map F4_N shows the Flood Zone maps across the area, indicating the site is mainly in Flood Zone 3a. This is largely consistent with the current EA mapping on **Figure 3-1**, but the latter shows minor differences as it is based on more recent EA River Thames and River Kennet modelling and therefore this SFRA map is superseded by the latest version;
- **Modelled Flood Extents:** SFRA map series reference F_5 provides modelled present day and climate change flood extents through the Borough. As mentioned above, this mapping has subsequently been updated to take account of the new EA River Thames and River Kennet modelling and therefore this map is superseded by the information discussed in **Section 3.4**;
- **Surface Water:** SFRA map series reference F_6 provides the surface water flood risk through the Borough. These outputs are consistent with the surface water flood maps discussed in **Section 3.1**;
- **Reservoir Breach:** SFRA Map F_7 shows the flood risk associated with reservoir breach in the area (the only reservoir affecting the Borough being Whiteknights Lake at Reading University). The mapping confirms that any flooding as a result of a breach is limited to land to the south-east of Reading and the site is unaffected;
- **Groundwater:** SFRA Map F_8 provides a high level overview of areas susceptible to groundwater flooding, taken from a national dataset and based on underlying geological conditions across 1km grid squares. The site is shown in an area at 'less than 25%' susceptibility;
- **Sewers:** Map F_9 provides a summary of Thames Water sewer flooding incidents by postcode, indicating the site postcode area of the site has 21-50 recorded sewer flooding incidents from both internal and external sources.

3.4 EA River Thames 'Sandford to Mapledurham' Model 2018

- 3.4.1 The EA has provided their detailed 'Product 4' flood risk information (EA ref THM_124288 – see **Appendix D**). This includes data extracted from the 2018 Thames 'Sandford to Mapledurham' 1D-2D model (also referred to as Abingdon Flood Schemes Mapping 2017), including modelled flood extents, flood levels and flood hazard mapping. The 2018 model has been produced more recently than the model used to generate mapping within the SFRA and forms the basis of the latest EA Flood Zone mapping. This model is therefore considered to be the best available information for assessing flood risk to the site.
- 3.4.2 **Figure 3.4** shows flood extents from the 2018 EA modelling. These extents indicate the site is located outside of the 1 in 20 (5%) annual probability but within the 1 in 100 (1.0%) annual probability flood extent. The site is therefore located within Flood Zone 3a 'High Probability'.

Figure 3-4: EA Modelled Flood Extents – Sandford to Mapledurham 2018 Model



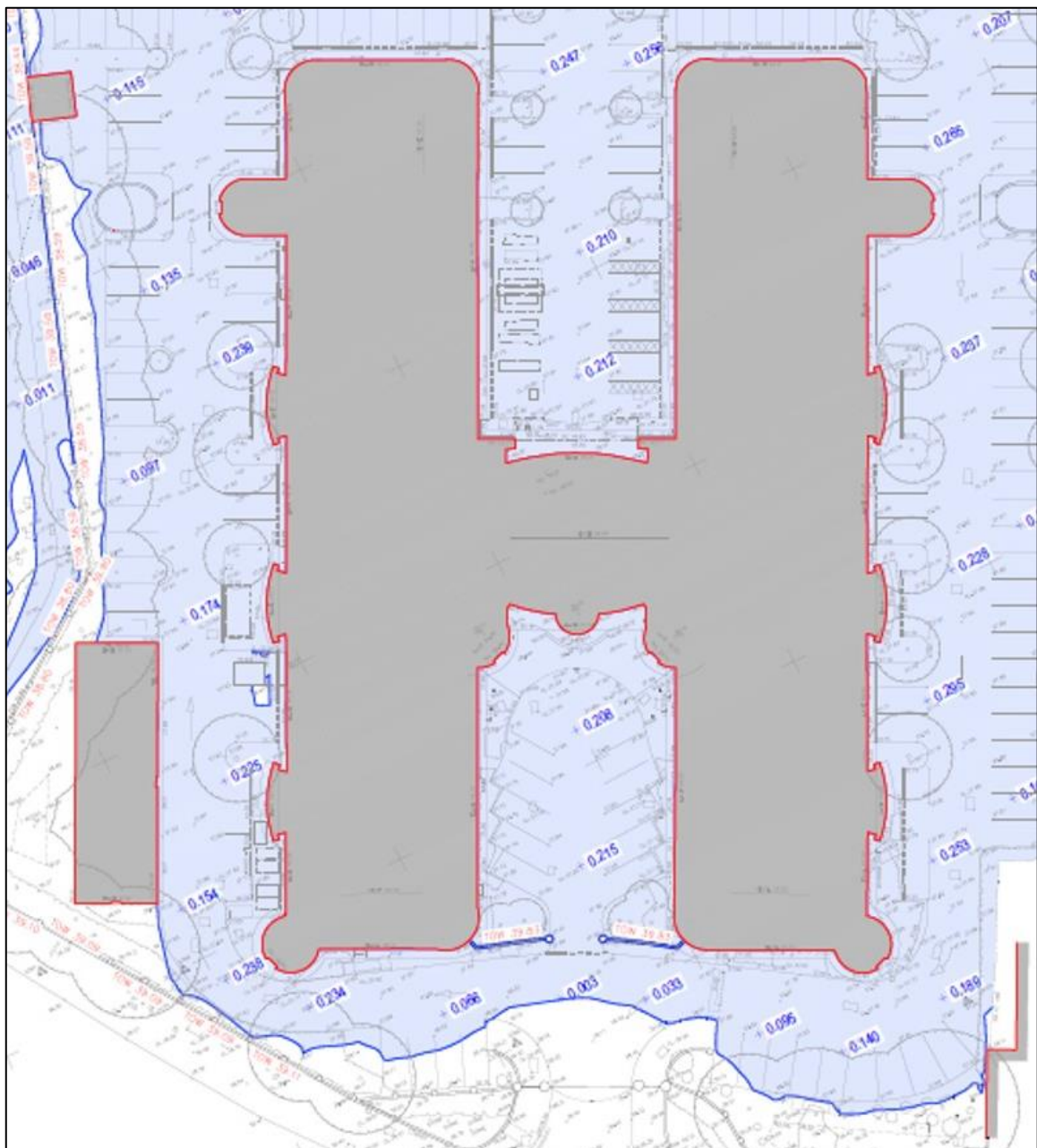
- 3.4.3 The modelled present day flood levels across the site are summarised in **Table 3-1** below. Flood levels are taken from the provided floodplain result node at the site, but where no result is available (i.e., because the site is not impacted by flooding) then the result is provided from the closest in-channel node (i.e., node reference '061_00_2018_002_36.022' to the immediate north).

Table 3-1: EA Modelled Flood Levels – Present Day

Flood Event (Annual Probability)	Modelled Flood Level, m AOD
1 in 5 (20%)	37.14
1 in 20 (5%)	37.56
1 in 100 (1%)	38.06
1 in 1000 (0.1%)	38.48

- 3.4.4 The modelled 1 in 100 annual probability flood level in **Table 3-1** has been superimposed onto the site topographic and is presented on **Stantec drawing 48968/4001/001** in **Appendix E**, an extract of which is shown in **Figure 3-5**.

Figure 3-5: Detailed Flood Extents and Max Depths – present day 1 in 100 annual probability event



3.4.5 Comparison of the topographic survey with the modelled flood levels indicates:

- **1 in 100 annual probability event:** The site is typically impacted to maximum depths of approximately 200mm on all sides of the building, with the southern boundary of the site rising out of the floodplain. Existing building floor level is 140mm above flood level;
- **1 in 1000 annual probability event:** The site is typically impacted to maximum depths of approximately 600mm on all sides of the building. The southern boundary is also affected, albeit to shallow depths of approximately 100mm. Existing building floor level is 280mm below flood level.

3.4.6 The potential impacts of climate change over the lifetime of the proposed development have been considered so that mitigation measures can be designed accordingly and are discussed in **Section 4**.

4 Impact of Climate Change

- 4.1.1 In considering flood risk to the site, it is necessary to fully consider the potential impacts of climate change for the lifetime of the development within the mitigation measures.
- 4.1.2 In February 2016 the EA released new guidance on the application of climate change allowances in flood risk assessments:
- <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>
- 4.1.3 This guidance provides contingency allowances for potential increases in peak river flow in Table 1, and for potential increases in rainfall intensity in Table 2.
- 4.1.4 The peak river flow allowances table provides a range of allowances based on percentile (i.e., the degree of certainty of an event occurring, based on the range of climate change scenarios assessed through scientific investigations). The provided allowances are also subject to the vulnerability classification of the proposed use and the river basin district of the site.
- 4.1.5 The conditions at the site and consequent peak river flow allowances to be considered as part of the FRA are as detailed in **Table 4-1**.

Table 4-1: Climate Change – Peak River Flow Allowances

River Basin District	Flood Zone	Flood Risk Vulnerability Classification	Range of Climate Change Allowances requiring consideration (2070–2115)	
			Higher Central	Upper End
Thames	3a	More Vulnerable	+35%	+70%

- 4.1.6 The applicable climate change flood levels at the site, as provided in the EA Product 4 data in **Appendix D**, are summarised below:

Table 4-2: EA Modelled Flood Levels – Climate Change

Flood Event (1 in 100 Annual Probability plus climate change allowance)	Modelled Flood Level, m AOD
+35% climate change	38.36
+70% climate change	38.54

- 4.1.7 **Stantec drawing 48968/4001/002** in **Appendix E** shows the reference 1 in 100 annual probability +35% climate change allowance floodplain and the associated maximum flood

depths in this scenario, based on the detailed topographic survey. Comparison of ground levels and flood levels indicates:

- **+35% climate change scenario:** The site is typically impacted to maximum depths of approximately 500mm on all sides of the building, with the southern entrance of the site rising out of the floodplain, before dropping back in at the roundabout. Existing building floor level is 160mm below flood level;
- **+70% climate change scenario:** The site is typically impacted to maximum depths of approximately 700mm on all sides of the building, with the southern entrance of the site also impacted, albeit to shallow depths of approximately 100mm. Existing building floor level is 340mm above flood level.

4.1.8 The climate change flood levels have been used as a basis for the design of mitigation measures discussed in **Section 6**.

5 Proposed Development and Sequential Test

5.1 Proposed Development

- 5.1.1 This FRA accompanies a proposed change of use under permitted development rights, from office to residential use, to provide 110 residential units within Great Brighams Mead.
- 5.1.2 Details of the proposals by Allford Hall Monaghan Morris Architects are included in **Appendix C**.

5.2 Flood Risk Vulnerability

- 5.2.1 PPG 'Flood Risk and Coastal Change' Table 2 confirms the '*Flood risk vulnerability classification*' of a site, depending upon the proposed usage. This classification is subsequently applied to PPG 'Flood Risk and Coastal Change' Table 3 to determine whether:
- The proposed development is suitable for the flood zone in which it is located, and;
 - Whether an Exception Test is required for the proposed development.
- 5.2.2 The proposed change of use is from 'Less Vulnerable' office development to 'More Vulnerable' residential development. As a change of use, the proposal is not subject to the Sequential Test or Exception Test, as confirmed in Paragraph 164 of the NPPF.

6 Flood Mitigation Strategy

6.1 Building Design

Ground Floor Levels

- 6.1.1 Standard requirements for ground floor levels of new development are set out in BS8533:2017 'Assessing and Managing Flood Risk in New Development – Code of Practice'. This recommends floor levels are set a minimum of 300mm above the modelled 1 in 100 annual probability plus allowance for climate change flood level.
- 6.1.2 This is also consistent with the guidance from the EA and the recommendations in the RBC SFRA.
- 6.1.3 Based on the reference 1 in 100 annual probability +35% climate change allowance flood level of 38.36m AOD, **it is proposed that the internal floor level of all habitable development is increased to a minimum of 38.66m AOD.**
- 6.1.4 This elevated floor level demonstrates the new residential scheme will have the following freeboard above reference flood events:
- 600mm above the present day 1 in 100 annual probability level;
 - 180mm above the extreme present day 1 in 1000 annual probability level;
 - 120mm above the 'Upper End' 1 in 100 annual probability +70% allowance for climate change flood level.
- 6.1.5 This demonstrates that the redevelopment will be above all reference flood levels, including the extreme events and climate change scenarios that would otherwise cause internal flooding based on the existing building ground floor level of 38.20m AOD.

6.2 Floodplain Storage and Flow Routes

- 6.2.1 Any new development located in the vicinity of a watercourse should be constructed such that it does not detrimentally impact on flow routes or reduce the available floodplain storage over a site; either of which could potentially cause an increase in flood levels on-site or elsewhere. This is considered up to the benchmark of the 1 in 100 annual probability plus allowance for climate change fluvial flood level.
- 6.2.2 As a change of use, no alterations are proposed either to the existing building footprint or the external ground levels. As such, there will be no impact on flood flow routes or floodplain storage capacity.

6.3 Safe Access

- 6.3.1 It is necessary to consider and incorporate safe access arrangements as part of the mitigation, to ensure the users/occupants of the development are safe in times of flooding.
- 6.3.2 Consideration of the safety of any pedestrian route has been based on the guidance in the EA document '*Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1*'.

6.3.3 The 'hazard to people' classification has four ratings:

- **Very low hazard** – caution (Flood Hazard Rating ('FHR') less than 0.75)
- **Danger for some** – i.e., children, the elderly and infirm (FHR between 0.75 and 1.25)
- **Danger for most** – includes the general public (FHR between 1.25 and 2.0)
- **Danger for all** – includes the emergency services (FHR greater than 2.0)

6.3.4 Due to the developed nature of the area, it is assumed that velocities would be very low, in which case the pedestrian routes would still be considered a 'Very Low Hazard' for depths up to 250mm.

6.3.5 The RBC SFRA Level 2 sets out the following hierarchy to be applied when considering the provision of safe access for 'more vulnerable' development:

More Vulnerable Development:

- a) The preference is to have a continuous dry route at the 1 in 100 annual probability plus appropriate allowance for climate change event;**
- b) If (a) is not achievable, then developer should assess if safe access is available at the current 1 in 100 annual probability flood event (in accordance with Defra flood hazard guidance);**

If (b) is achievable, then it is considered safe access in more extreme events could be addressed through provision of a site 'Flood Management and Evacuation Plan', subject to a detailed analysis of the flood hazard along the route and RBC emergency planning department approval;

If (b) is not achievable, it is recommended that the site is not suitable for new (or intensification of) permanent residential development and other uses should be considered (i.e. 'Less Vulnerable' commercial/office development).

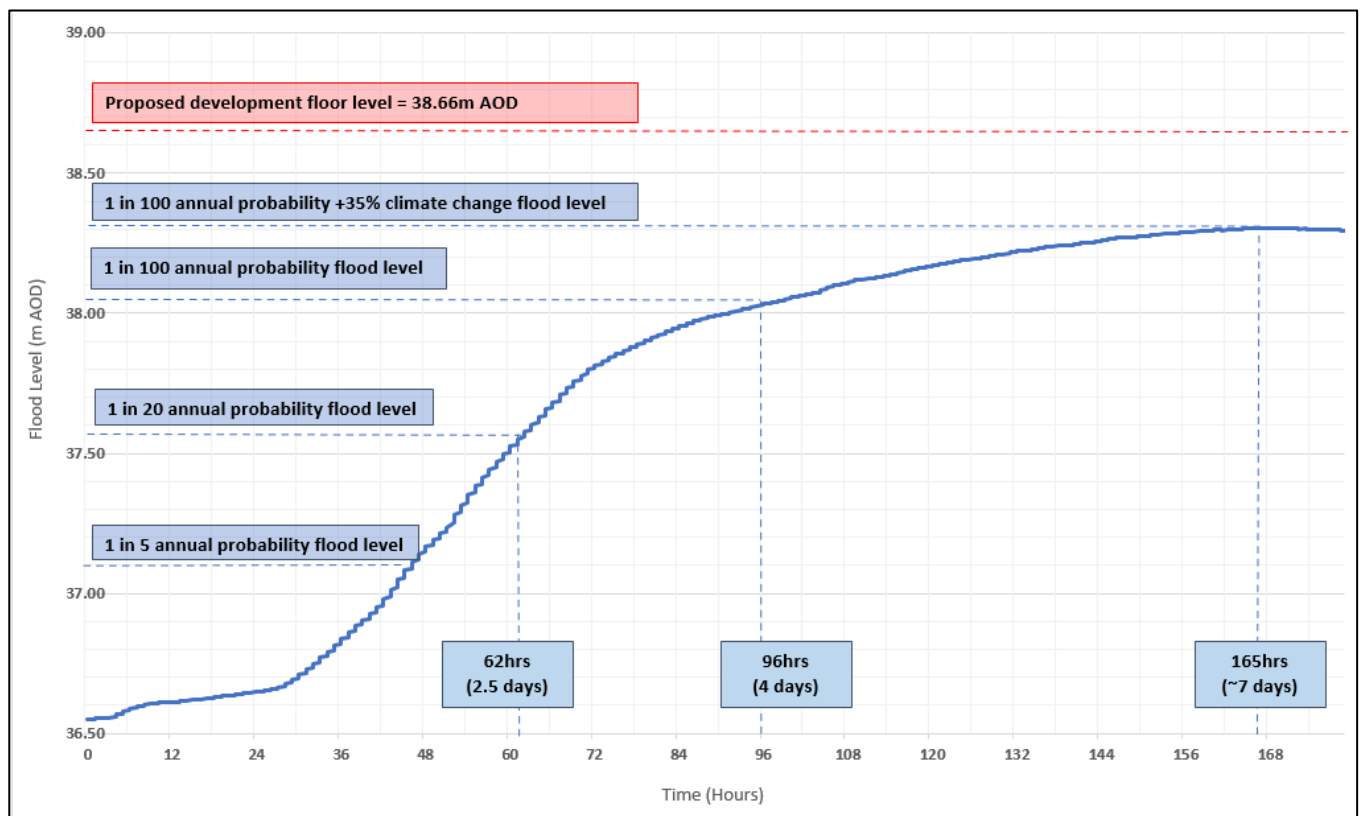
6.3.6 The pedestrian route to land outside the floodplain is a short distance of 50m from the building entrance to Vastern Road, immediately south of the site. The ground level along the route drops from 38.2m AOD at the building, down to a minimum of 37.83m AOD within the car parking area, before rising to 38.40m AOD at the site entrance off Vastern Road.

6.3.7 **Stantec drawing 48968/4001/002** in **Appendix E** shows the impact in the reference 1 in 100 annual probability +35% climate change scenario and indicates a maximum flood depth of 530mm on this route at the peak of this flood event. As such, criterion (a) could not be achieved.

6.3.8 **Stantec drawing 48968/4001/001** in **Appendix E** shows the impact in the present day 1 in 100 annual probability scenario and indicates a maximum flood depth of 230mm on this route at the peak of this flood event. As such, a continuous safe access route in this event is achievable and a 'Flood Risk Management Plan' (FRMP) will be prepared for the residential scheme in accordance with criterion (b) of the RBC SFRA.

- 6.3.9 The FRMP will be produced in order to ensure that residents are provided with sufficient advance warning to evacuate the site prior to the access routes becoming blocked. As detailed in the Reading SFRA, the River Thames is a slow-responding catchment and there has been widespread public awareness of prior flood events in the area several days before the area was affected, and there would be visual signs of wider flooding and the slowly rising floodwater from the site for a period of days before any access routes are compromised.
- 6.3.10 The timing of the onset of flooding was considered in further detail to assess the above assumptions on safe access, informed by the hydrograph extracted from the adjacent river node to the site for the reference 1 in 100 annual probability +35% allowance for climate change flood event – see **Figure 6.1**.

Figure 6-1: River Thames Hydrograph, Reading - 1 in 100 annual probability +35% climate change



6.3.11 The hydrograph can be summarised as follows:

- **T=0hrs:** Model starts - Flood levels begin to rise in the area;
- **T=48hrs (2 days):** River Thames reaches 1 in 5 annual probability flood level. Flood levels are elevated by 500mm above normal level, but remain in-banks through Reading. Continuous dry access to site remains available;
- **T=66hrs (2.5 days):** River Thames reaches 1 in 20 annual probability flood level. Floodplain extends across Christchurch Meadow to the north of the river, and the Thames footpath is flooded). Continuous dry access remains available;
- **T=96hrs (4 days):** River Thames reaches 1 in 100 annual probability flood level. Shallow flooding occurs around the site and the floodplain impacts residential areas to the immediate east and in Lower Caversham. Vastern Road remains unaffected. Continuous safe access remains available;

- **T=165hrs (7 days):** River Thames reaches 1 in 100 annual probability +35% allowance for climate change flood level. Floodplain impacts wider areas of Reading between the River Thames and the railway line, and along Vastern Road and Caversham Road. **Continuous safe access unavailable.**

6.3.12 It is noted that the overall rate of rise reflects the slow responding nature of the watercourse – i.e.:

- From start of the flood event to the present day 1 in 100 annual probability flood level – water level rises a total of 1,470mm (SHWL of 36.59m AOD to 38.06m AOD) over 96 hours – an average rate of rise of just under **15mm per hour**;
- Between the present day 1 in 100 annual probability flood level – when safe access remains available - to the peak climate change flood level, this rate of rise reduces significantly to a rise of 300mm over 69 hours – an average of just **4mm per hour**.

6.3.13 It should also be noted that the EA's proposed new FAS, as described in **Section 2.5**, would reduce flood risk to the areas surrounding the site and it is therefore likely that safe access arrangements will be improved further in the future.

6.4 Surface Water Drainage

6.4.1 As of April 2015, the Lead Local Flood Authority (LLFA) has become a statutory consultee on planning applications for surface water management.

6.4.2 As the intention of SuDS is to mimic the natural drainage regime of the undeveloped site, the NPPF PPG states the following (consistent with the Building Regulations H3 hierarchy):

...the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- into the ground (infiltration),***
- to a surface water body,***
- to a surface water sewer, highway drain or another drainage system,***
- to a combined sewer***

6.4.3 Since the proposal is for a change of use of the existing buildings, there will be no impact on surface water drainage which will continue to utilise the existing drainage arrangements.

7 Residual Risk

- 7.1.1 It is difficult to completely guard against flooding since extreme events greater than the design standard event are always possible, however, it is practicable to minimise the risk by allowing a substantial freeboard (safety margin) and by using suitable construction and management techniques as follows:
- To minimise residual risks, such as climate change and other uncertainties, floor levels of the proposed residential scheme will be elevated to a minimum of at 38.66m AOD; 300mm above the EA-modelled 1 in 100 annual probability +35% allowance for climate change design flood level and above the equivalent +70% scenario. They will also be a suitable freeboard above surrounding ground in order to mitigate the residual risk from surface water flooding in an extreme rainfall event.
 - Continuous safe access will be available at the present day 1 in 100 annual probability flood event. Continuous safe access is compromised at the peak of the more extreme climate change scenarios and therefore a Flood Risk Management Plan will inform occupants of the measures to take in the event of a flood to the area, in accordance with Reading SFRA requirements. It is noted that the River Thames is slow responding and it would be a period of days before safe access was compromised, and should evacuation not be possible, safe refuge is available across the site above the design flood level.
- 7.1.2 As such, the residual risk is considered to be acceptable for the lifetime of the development.
- 7.1.3 The above measures are based on the flood risk based on a precautionary approach that no new flood defence measures are implemented in the area. However, the EA has proposals for the Reading and Caversham Flood Alleviation Scheme, which would significantly reduce the flood risk to the area of defence and result in no flooding to the site or surrounding access routes at the 1 in 200 annual probability plus climate change level).

8 Conclusions

8.1.1 This Flood Risk Assessment (FRA) has been prepared by Stantec and supports a planning application at Great Brighams Mead, Reading, for a change of use under permitted development rights from office use to residential use.

8.1.2 This FRA concludes that:

- Environment Agency (EA) Flood Zone mapping and modelled flood data shows that the site lies within **Flood Zone 3a 'High Probability'** (land at a 1 in 100 or greater annual probability of river flooding).
- The proposed residential use is considered 'More Vulnerable' and replaced the 'Less Vulnerable' office use. As a change of use, the proposal is not subject to the Sequential or Exception Test, as confirmed in Paragraph 164 of the NPPF.
- National climate change guidance set out in the Planning Practice Guidance (PPG) confirms that the site conditions require consideration of increases in peak river flow of +35% to +70% (Thames River Basin, Flood Zone 3a, More Vulnerable development).
- Flood data from the EA Thames 'Sandford to Mapledurham' 2018 model have been extracted around the site. This provides a present-day 1 in 100 annual probability flood level of 38.06m AOD, which affects the external site area to shallow depths.
- At the reference 1 in 100 annual probability plus 35% allowance for climate change flood level of 38.36m AOD, external flooding is more significant around the site, and the existing building (at 36.20m AOD) would be subject to shallow flooding.
- The proposed mitigation strategy demonstrates the development is safe through a number of measures as follows:
 - Ground floor levels are to be raised to 38.66m AOD or above, providing a 300mm freeboard above the design 1 in 100 annual probability +35% allowance for climate change flood level and above the +70% scenario by 120mm;
 - As a change of use, the scheme features no change to building footprint and no alterations to external ground levels. As such, there will be no impact on floodplain storage capacity or flood flow routes.
 - As a change of use, the proposals will have no impact on the surface water drainage arrangements over the site.
 - Safe access is available during the present day 1 in 100 annual probability event. Provision of a 'Flood Risk Management Plan' will ensure that residents of the proposed development can receive sufficient warning to evacuate the site before flooding begins to affect the area in a more severe climate change scenario in accordance with the Reading Borough Council (RBC) Strategic Flood Risk Assessment (SFRA).

8.1.3 In conclusion, the future occupants and users of the proposed development will be safe from flooding and there will be no detrimental impact on third parties. The proposal complies with the National Planning Policy Framework (NPPF) and local planning policy with respect to flood risk and is an appropriate development at this location.

Appendix A OpenData Flood Maps

- Site Location Plan
- Site Location (Aerial Photography)
- Area Topography (LiDAR)
- EA Flood Zone Map
- EA Surface Water Flood Risk
- Reservoir Flood Map
- EA Historic Flood Map

Appendix B Topographic Survey

Topographic Survey by Warner Land Surveys, Drawing No. RT/319/0558/P0001,
March 2019

Appendix C Development Proposals

Development Proposals by Allford Hall Monaghan Morris Architects

Appendix D EA P4 Data

EA Product 4 data reference THM_124288, May 2019

- Flood Zone Map
- Defence information
- Hydraulic model information
- Modelled flood extents
- Modelled in channel flood levels
- Historic flood map
- Historic flood data
- Hazard mapping

Appendix E Stantec Drawings

Drawing 48968/4001/001 – Modelled Flood Extents – Present Day 1 in 100 Annual Probability

Drawing 48968/4001/001 – Modelled Flood Extents – 1 in 100 Annual Probability
+35% Climate Change