

Flood Risk Assessment Addendum

Final report

November 2024

www.jbaconsulting.com



RPS | Consulting UK & Ireland
20 Farringdon Street
London
EC4A 4AB
United Kingdom

JBA Project Manager

Olivier Saillofest
The Library
St Philips Courtyard
Church Hill
Coleshill
Warwickshire
UNITED KINGDOM
B46 3AD

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Contract

This report describes work commissioned by RPS, on behalf of RVG (Retirement Villages Group) by an email instruction dated 18/01/2023. The Client's representative for the contract was Abigail Woods of RPS. Timea Faber and Olivier Saillofest of JBA Consulting carried out this work.

Prepared by Timea Faber BSc MSc
Assistant Analyst

Reviewed by Olivier Saillofest BEng MSc CEng MCIWEM C.WEM
Technical Director

Authorised by Olivier Saillofest BEng MSc CEng MCIWEM C.WEM
Technical Director

Purpose

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Executive summary

JBA Consulting (JBA) were commissioned by RPS to prepare a Flood Risk Assessment Addendum at Thamesfield, Wargrave Road, Henley-On-Thames. This follows and complements the Flood Risk Assessment completed by WSP in October 2022.

Retirement Villages Group (RVG) wish to partially redevelop their Thamesfield site and introduce 17 care home units. The proposal includes:

- To replace existing Block C and part of Block D around a remodelled central courtyard.
- Refurbishing the kitchen and adjacent plant in Block A.
- Refurbishing the laundry and plant behind the office area in Block A.

This addendum report focuses on the main sources of flooding to the site, namely:

- Flooding from the River Thames;
- Flooding from a reservoir breach, and;
- Groundwater flooding.

The proposal is for the regeneration of a Care Home scheme. As such, the development is limited to the site boundary and thus cannot be compared with alternative / more sequential preferable sites. In addition to the above, the proposal follows the sequential approach to flood risk by steering the footprints of the new builds away from the areas the most at risk of flooding. As such, it is considered that the site passes the Sequential Test.

With regards to the Exception Test, the proposal will generate the following wider community benefits:

- Contribution towards identified need for specialist housing for older people in Wokingham Borough Council (WBC).
- Contribution towards WBC's housing land supply.
- The provision of specialist housing and care for older people will free up family housing elsewhere in the Borough Council.
- The proposal will provide a wide range of health and wellbeing benefits to the residents of the scheme.
- The proposal makes efficient use of a previously developed (brownfield) site.
- The proposal will provide biodiversity net gains and landscaping benefits.
- The proposal will provide energy, economic and sustainability benefits.

When considered in conjunction with the flood mitigation measures recommended in this report, it is therefore considered that the proposal passes both parts of the Exception Test.

To assess the risk of fluvial flooding from the River Thames, hydraulic modelling was undertaken by JBA in 2022. Hydraulic modelling results indicated that:

- Water enters the site (from overtopping of the River Thames' banks) for all of the modelled flood scenarios (i.e. 30-year, 100-year, 100-year +31% CC and 1,000-year)
- Flood depths of up to 1.89m are predicted to occur within the site during the 100-year with 31% climate change 'design' flood event.

- During the 100-year with 31% climate change fluvial flood event, the peak water levels will range between 32.24 and 32.29m AOD on site and will exceed the existing floor levels of 2 existing buildings.
- During the 100-year with 31% climate change scenario, the majority of the site falls within the 'low' to 'significant' hazard categories (based on Defra's Hazard-to-People categories).
- The 'design' flood level will increase by 0.77m in the event of a 25% blockage at Henley Bridge.

A review of the Environment Agency's reservoir inundation maps indicates that the site is not at risk of flooding during the 'dry day' reservoir breach scenario (i.e. during the low flow condition within the River Thames channel) and that flood depths of up to 2.32m may occur on site during the 'wet day' reservoir breach scenario (i.e. when combined with a 1,000-year fluvial flood event from the River Thames).

According to the EA's Magic map application groundwater map, the site is considered to be at medium to high and soluble rock risk of groundwater flooding. Furthermore, borehole (SU78SE20) approx. 250m within the site's proximity, highlights that the water is present at approx. 30m below ground. It is important as ground water is likely to flood the site.

To mitigate against flood risk, it is recommended to:

For the new buildings;

- Raise the ground floor levels of the new buildings to a minimum of 600mm above the 'design' flood level.
- Install emergency generators to be used in extreme cases of flooding where the power might be affected to maintain power on site (e.g. to power medical equipment).

For the existing buildings

- Place flood barriers/doors to the doorways of buildings with a floor elevated below the 'design' flood level.
- Install emergency generators to be used in extreme cases of flooding where the power might be affected to maintain power on site (e.g. to power medical equipment).
- The external walls of the building should be inspected for any cracks or gaps, and sealed with silicone sealant or mortar as required.
- The external walls should be treated with water repellent spray.
- Internal walls of the ground floor levels should be made of easily washable materials (e.g. tiles and smooth concrete).

For the existing basement;

- Install sump pumps to the lowest point of the basement and test pumps regularly.
- Ensure that the basement is exclusively used as non-habitable floor space.
- Render the walls impervious (and seek confirmation from a structural engineer that such measures will not detrimentally impact the structural stability of the wall / i.e. that the wall is capable to withstand the increased groundwater pressure on the wet side of the wall).

- Electric wires and sockets should be set as high as possible, if cannot move electric socket and wires, then a small key switch is to be installed to isolate electricity in the basement during flood events and to switch of electricity in the basement when flood water occurs.
- Circulate a copy of the Flood Warning and Evacuation Plan by WSP (Appendix B) to the occupiers of the site and ensure it is updated accordingly.
- Place flood door barrier at the basement doorway.
- Ensure that signage of high flood risk/hazard is placed at the basement access door to notify site occupant of the hazard. Furthermore, a warning sign for not entering the basement when floodwater is present, to avoid for operators to get electric shock.
- Walls to be made of easily washable materials (e.g. tiles, smooth concrete) and appropriate venting is considered to minimise moisture damp in the basement.
- A borehole with a pressure sensor should ideally be set to monitor groundwater level near the basement and trigger alerts or alarms to the occupants of the site.
- As part of the recovery procedure, an electric certificate should be issued after flood events affecting the basement.
- The internal walls and floor of the basement should be tanked in order to prevent groundwater penetration.
- Items stored in the basement should be suitable to be easily removed following receipt of activation of 'be prepared' triggers (flood alert, on site observation). Items that cannot be removed should be suitably flood resilient in their nature to weather continued exposure to floodwater.

In addition to the above, a Flood Response Plan listing all tasks to be carried out by on-site staff and local residents prior to, during and following a flood event should be produced for the site.

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Abbreviations

1D	One Dimensional
2D	Two Dimensional
CC	Climate Change
DTM	Digital Terrain Model
EA	Environment Agency
FFL	Finished Floor Levels
GCS	Grantham Coates Surveyors
Ha	Hectares
JBA	Jeremy Benn Associates
LiDAR	Light Detection and Ranging
m AOD	Metres Above Ordnance Datum
QT	Flow-Time
TUFLOW	2D Hydraulic Modelling Software

1 Introduction

1.1 Terms of reference

JBA Consulting (JBA) were commissioned by RPS to undertake an FRA Addendum study at Thamesfield, Wargrave Road, Henley-On-Thames.

This follows and complements the Flood Risk Assessment completed by WSP in October 2022.

1.2 Context

The FRA Addendum addresses the flood risk requirements received from Wokingham Borough Council in their pre-planning advice letter (dated 29 November 2022) following the work completed by WSP dated 2022 which includes:

- FRA report (see Appendix A)
- Flood Warning and Evacuation Plan (see Appendix B)

It also refers to the latest development proposal for the site (see Appendix C) and to hydraulic modelling work (see Appendix D) undertaken by JBA in 2022 and subsequently approved by the Environment Agency (see Appendix E) in 2023.

This Addendum also expands on reservoir flooding, and on flood risk mitigation required on site. When/if in contradiction, the content of this Addendum supersedes the content of WSP's FRA.

1.3 The Proposal

Retirement Villages Group has identified that there is an opportunity to redevelop the existing site at Thamesfield, Henley-on-Thames to provide several amenity benefits to existing residents, to improve the functioning of the site and to provide new extra care accommodation. This will ensure vitality and viability of the site over the longer term.

The piecemeal development of buildings and extensions on site has resulted in the compromised functionality of the existing site, principally in terms of circulation. The proposed re-development of the buildings and spaces in the northern part of the site therefore seeks to better utilise this area which currently accommodates single storey residential units, inefficient circulation and 'left over' external spaces. The Design and Access statement submitted as part of the planning application contains full details of the existing site constraints and opportunities for improvement through the redevelopment of this part of the site.

Thamesfield is an established and operational Integrated Retirement Community (IRC) providing extra care retirement accommodation and associated communal facilities. The Site currently comprises 37 extra care units (use class C2).

Following the planning application there will be 49 extra-care units on the site (net gain of 14 extra care units).

A copy of the latest site layout plans is provided in Appendix C.

2 Planning Policy and Flood Risk

2.1 National Planning Policy Framework

It is a requirement for development applications to consider the potential risk of flooding from various sources to a proposed development over its expected lifetime and any possible impacts on flood risk elsewhere as a result of the development.

This FRA has been prepared in line with the revised National Planning Policy Framework (NPPF) December 2023.

Where appropriate the following aspects of flood risk should be addressed in all planning applications in flood risk areas:

- The nature and expected lifetime of the development and the extent to which the development is designed to deal with flood risk.
- The area liable to flooding from various sources.
- The probability of the current and future flood risk.
- The extent and standard of existing flood defences and their effectiveness over time.
- The likely depth of flooding.
- The rates of predicted flows.
- The likelihood to impacts on other areas, properties, and habitats.
- The effects of climate change (as per NPPF Chapter 14).
- The proposed development site is over 1ha. Therefore, a site-specific Flood Risk Assessment is required. This document shall consider the risk to the proposal from all sources of flooding including fluvial (river), tidal, coastal, pluvial (Surface Runoff / Surcharging Sewers), flooding from reservoirs and groundwater.
- The NPPF advocates a risk-based approach to flood risk management in terms of appraising, managing and reducing the consequences of flooding both to and from a development site. The primary objectives of this FRA to determine the following:
 - Whether the site is at significant risk from any form of flooding;
 - If the site is at risk of flooding determine if safe access to and from the site can be achieved and maintained;
 - Mitigation measures to alleviate flood risk on site.

2.2 Local Planning Guidance

In addition to the Planning guidance and requirements listed in WSP's reports (which refer to Wokingham Strategic Flood Risk Assessment), the following local policies were reviewed:

- Policy CC09 - Development and Flood Risk (from all sources)
- Policy CC10 - Sustainable Drainage - Wokingham Borough Managing Development Delivery Document (adopted 2014)

This Flood Risk Assessment report was prepared in compliance with the above policies ensuring that:

- 1 All sources of flood risk, including historic flooding, must be taken into account at all stages and to the appropriate degree at all levels in the planning application process to avoid inappropriate development in areas at risk of flooding.

Proposals must be consistent with the guidance in paragraphs 99-104 of the National Planning Policy Framework (NPPF); the Technical Guidance to the NPPF and demonstrate how they have used the Strategic Flood Risk Assessment (SFRA) to determine the suitability of the proposal.

- 2 Development proposals in Flood Zones 2 or 3 must take into account the vulnerability of proposed development.
- 3 Development must be guided to areas of lowest flood risk by applying the sequential approach taking into account flooding from all sources and shall ensure flood risk is not worsened for the application site and elsewhere, and ideally that betterment of existing conditions is achieved. The sequential test will not be required if at least one of the following applies:
 - a. Replacement of an existing single residential property. However, the replacement property should, where possible, be located on the part of the site at lowest risk
 - b. Conversions and change of use unless it involves a change to a more vulnerable class
 - c. Minor development, as defined in footnote 10 of the Technical Guidance Note to the NPPF.
- 4 In exceptional circumstances, new development in areas of flood risk will be supported where it can be demonstrated that:
 - a. The development provides wider sustainability benefits to the community that outweigh flood risk
 - b. The development will:
 - i. Be safe for its lifetime, taking account of the vulnerability of its users
 - ii. Not increase flood risk in any form elsewhere and, where possible, will reduce flood risk overall
 - iii. Incorporate flood resilient and resistant measures into the design
 - c. Appropriate evacuation and flood response procedures are in place to manage the residual risk associated with an extreme flood event.
- 5 Where required, suitable and appropriately detailed flood risk information will need to accompany a planning application. A Flood Risk Assessment (FRA) is required for:
 - a. All proposals in areas of known historic flooding from all sources
 - b. Where there is evidence of a risk from all sources of flooding identified in the Strategic Flood Risk Assessment
 - c. Those proposals set out in footnote 20 to paragraph 103 of the NPPF

In line with Policy CC10, evidence that the “development proposals [will] ensure surface water arising from the proposed development including taking into account climate change is managed in a sustainable manner [will] be demonstrated through a Surface Water Drainage Strategy.” Relevant information confirming compliance with this policy is documented in separate Drainage Strategy report.

2.2.1 Wokingham Borough Council Level 1 Strategic Flood Risk Assessment (2023)

A Strategic Flood Risk Assessment (SFRA) is undertaken by the Local Planning Authority to assess the current and future flood risk within their administrative boundary and, to determine the impact development may have on flood risk. This informs the allocation of land within the Local Plan, through the application of the Sequential Test and, if necessary,

the Exception Test. The current version of the Wokingham Borough Council Level 1 Strategic Flood Risk Assessment was published in May 2023.

The recommendations relating to flood risk are summarised below:

- To locate new development in areas of lowest risk, in line with the sequential test, by steering sites to Flood Zone 1 from the Flood Map for Planning and avoiding where possible areas with a higher risk of surface water flooding. If a sequential test is undertaken and a site at flood risk is identified as the only appropriate site for the development, the exception test shall be undertaken. If development can't be avoided in the higher risk surface water Zone (Zone B), then part "b" of the exception test should be satisfied.
- Planning applications for phased developments should be accompanied by a drainage strategy, which takes a strategic approach to drainage provision across the entire site and incorporates adequate provision for SuDS within each phase.
- Identify opportunities to maintain and enhance permeable surfaces and greenspaces to help reduce surface water runoff whilst promoting other benefits, including biodiversity and wellbeing.
- There should be no built development within 8m from the top of a watercourse or main river for the preservation of the watercourse corridor, wildlife habitat, flood flow conveyance and future watercourse maintenance or improvement.

2.3 Sequential and Exception Tests

The NPPF requires that the Sequential and Exception Test should be applied to identify the location of new development and the layouts of the development site. The Sequential Test aims to promote development in low flood risk areas. The exception test is used where no suitable development areas can be found in low flood risk zones.

The Sequential Test should be applied to identify suitable sites which are at low risk from all sources of flooding, avoiding medium and high-risk areas where possible. If no suitable areas for the development proposal can be identified in low-risk areas, then sites with the lowest flood risk should be considered next. If development is necessary within a medium-high risk zone an exception test may be required to demonstrate the need for the development in that location and how the development will mitigate the flood risk.

The NPPF classifies care home developments as 'More Vulnerable' and, according to Table 2-1:

- Their construction is not incompatible with Flood Zone 2 and 3¹.
- The Exception Test is required.

Table 2-1: Flood risk and flood zone 'incompatibility'

Vulnerability Classification (Table 2)		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatibility
Flood Zone (Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception Test	✓	✓	✓
	Zone 3a	Exception Test	✗	Exception Test	✓	✓
	Zone 3b	Exception Test	✗	✗	✗	✓

1 Flood risk and coastal change - GOV.UK (www.gov.uk)

✓ Exception test not required

X Development should not be permitted

The proposal is for the regeneration of a Care Home scheme. As such, the development is limited to the site boundary and thus cannot be compared with alternative / more sequential preferable sites. In addition to the above, the proposal follows the sequential approach to flood risk by steering the footprints of the new builds away from the areas the most at risk of flooding (as shown in Figure 5-1). As such, it is considered that the site passes the Sequential Test.

With regards to the Exception Test, the proposal will generate the following wider community benefits:

- Contribution towards identified need for specialist housing for older people in Wokingham Borough Council (WBC).
- Contribution towards WBC's housing land supply.
- The provision of specialist housing and care for older people will free up family housing elsewhere in the Borough Council.
- The proposal will provide a wide range of health and wellbeing benefits to the residents of the scheme.
- The proposal makes efficient use of a previously developed (brownfield) site.
- The proposal will provide biodiversity net gains and landscaping benefits.
- The proposal will provide energy, economic and sustainability benefits.

When combined with the flood mitigation measures listed under Section 5 (which will be implemented as part of the proposal), it is therefore considered that the proposal passes both parts of the Exception Test.

3 Fluvial flood risk

3.1 Flood extents

Baseline fluvial flood extents for the 30-year, 100-year and 1,000-year fluvial events are shown in Figure 3-1. This indicates that the site is at risk of fluvial flooding during all modelled return periods.

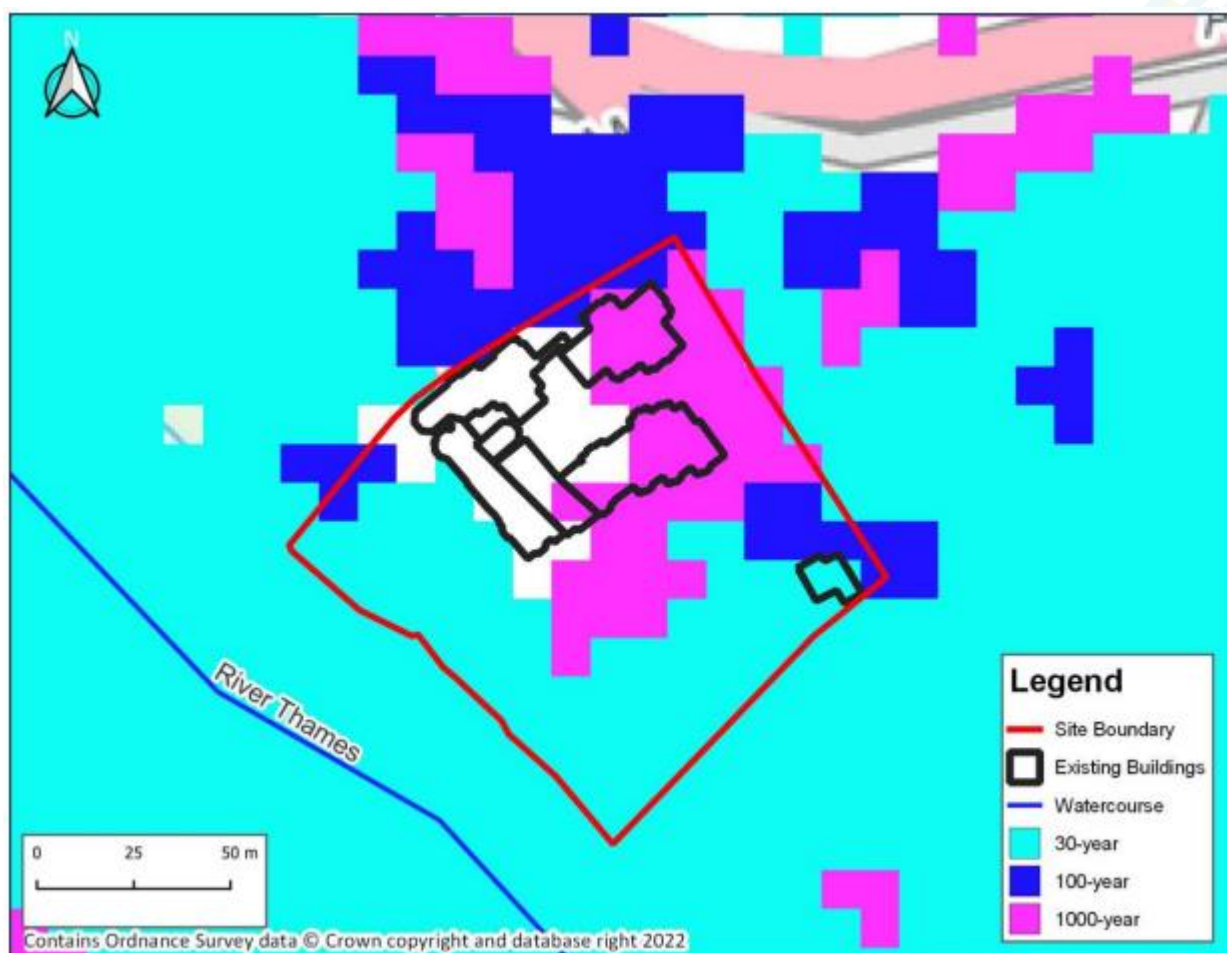


Figure 3-1: Baseline flood extents (30-year, 100-year and 1,000-year)

Figure 3-1 shows that the capacity of River Thames exceeds during all the modelled events. The river water that enters the site for the 30-year return period are significant and mainly affects the south and south-west areas of the site. During the 100-year return period, the flood extents completely surround the site although is unlikely to affect the existing buildings. During the 1,000-year flood event, the existing buildings are likely to flood, including the car parks and private apartments near the car parks.

The proposed building footprint will be steered away from the edge of the 100-year with climate change flood extent.

3.2 Flood levels

The baseline fluvial flood levels during the 100-year plus 31% climate change allowance at the site are shown in Figure 3-2.

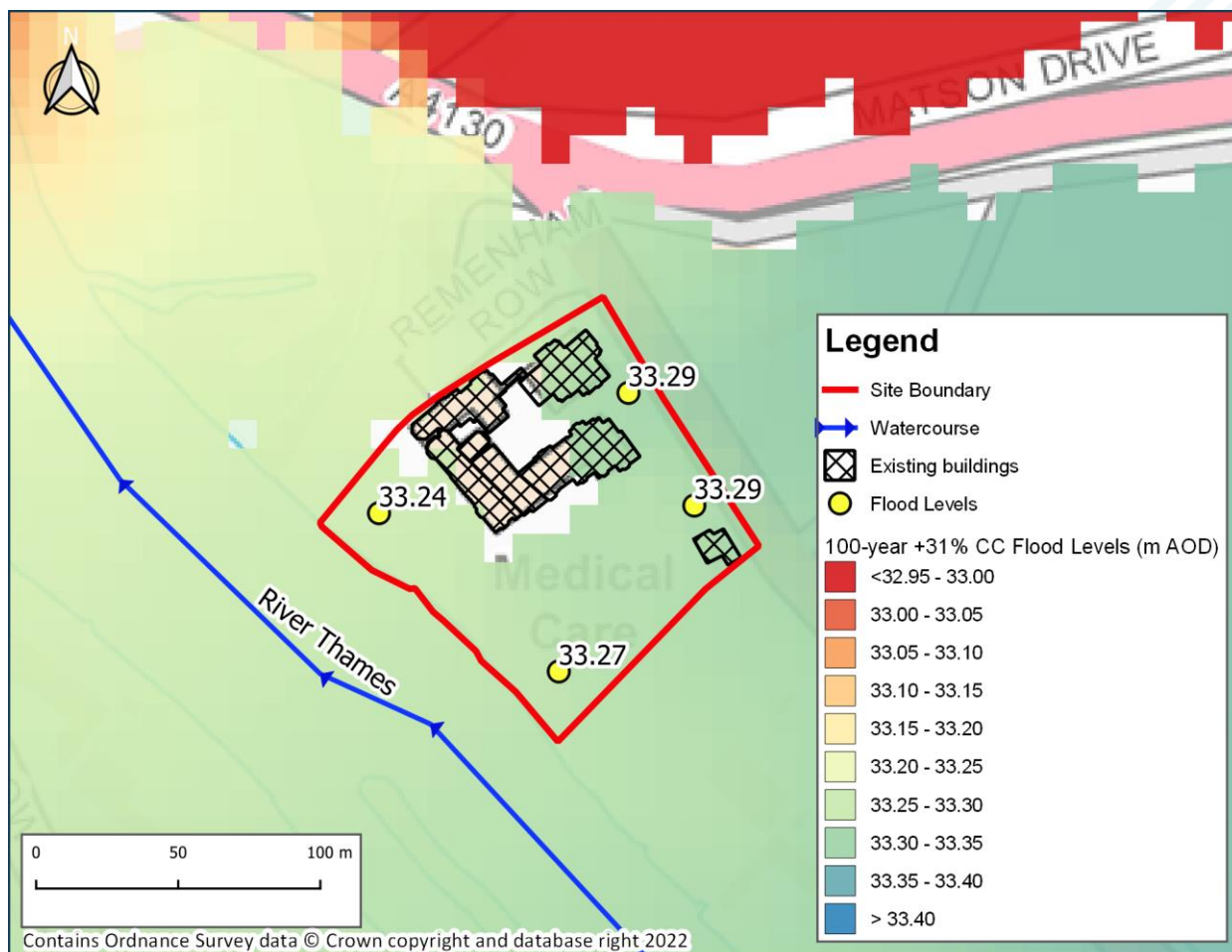


Figure 3-2: Baseline fluvial flood levels during 100-year event plus 31% climate change allowance

Figure 3-2 shows that during the 100-year plus 31% climate change fluvial flood event, the peak water levels will range between 33.24 and 33.29m AOD on site. This will exceed the existing floor levels of two existing buildings on site.

3.3 Flood depths

The baseline flood depths have been reviewed for the design flood event (100-year plus 31% allowance for climate change) and are shown in Figure 3-3.

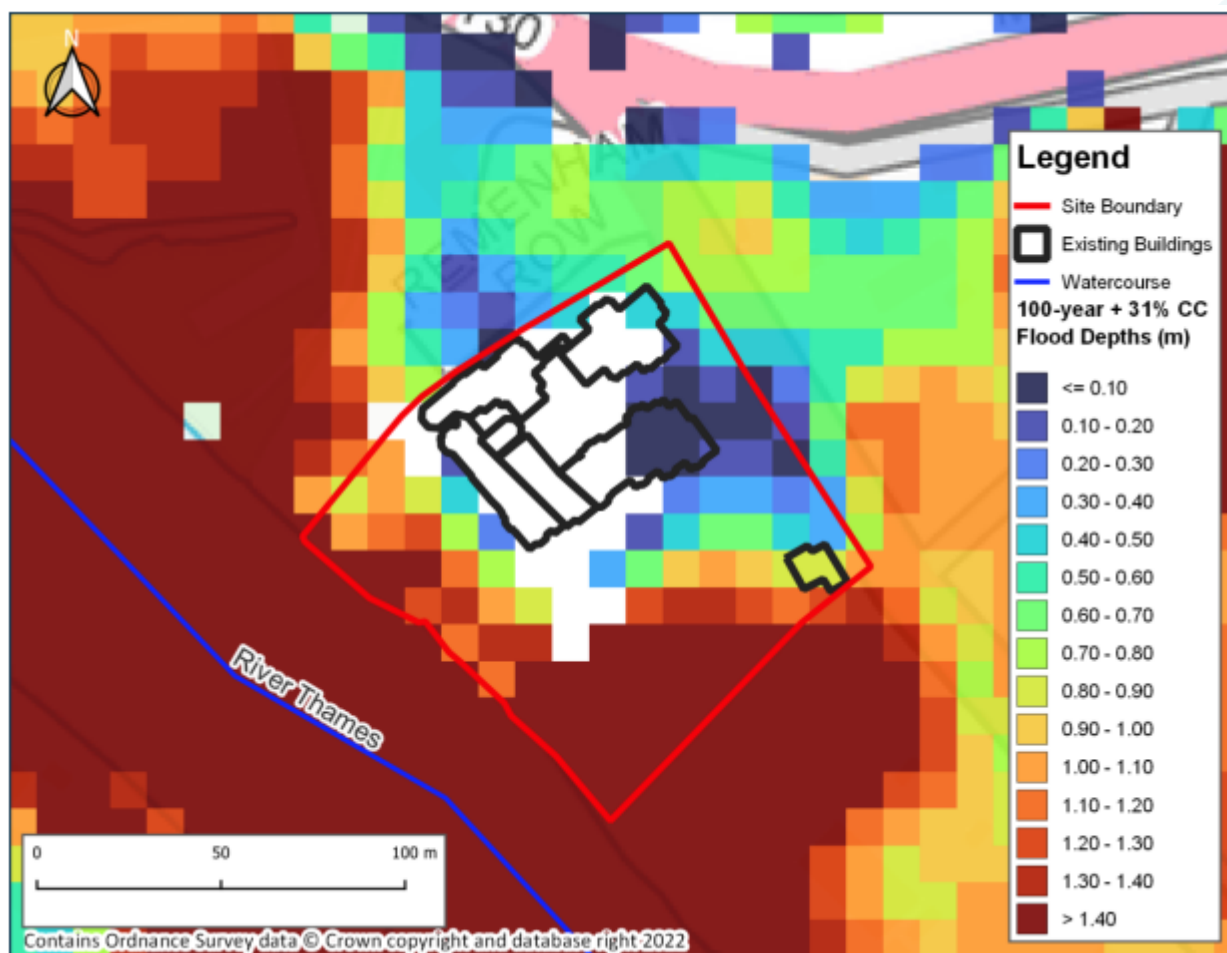


Figure 3-3: Baseline 100-year flood depths with 31% climate change scenario

Figure 3-3 shows the maximum predicted flood depths within the site during the 100-year with 31% climate change event. The flood depths at Block D (See building location in Appendix C) typically range from 0.40 - 0.50m, although this is much lower for Block E with depths of typically ≤ 0.10 m. Flood depths at the site access to the north of the site are most commonly between 0.60 - 0.80m which would likely have implications for access and egress.

3.4 Flood hazard

The 100-year with (+31%) climate change fluvial flood hazard-to-people classifications in relation to the proposed site are represented in Table 3.1. The hazard-to-people classification used in the modelled fluvial flooding maps are based on the formula suggested in Defra's FD2321/TR2 "Flood Risks to People" is shown below. The hazard categories are described in Table 1.

$$HR = d \times (v + 0.5) + DF$$

where,

HR = (flood) hazard rating;

d = depth of flooding (m);

v = velocity of floodwaters (m/sec); and

DF = debris factor (= 1, conservative estimate of DF as largely urban

Table 3.1 Defra's FD2321/TR2 "Flood Risks to People" classifications		
Flood hazard rating depth x (velocity+0.5)+DF	Level of Flood Hazard Description	Description
<0.75	Low	Caution "Flood zone with shallow flowing water or deep standing water"
0.75 - 1.25	Moderate	Dangerous for some (i.e. Children) "Danger: flood zone with deep or fast flowing water"
1.25 - 2.0	Significant	Dangerous for most "Danger: flood zone with deep fast flowing water"
>2.0	Extreme	Dangerous for all "Extreme danger: flood zone with deep fast flowing water"

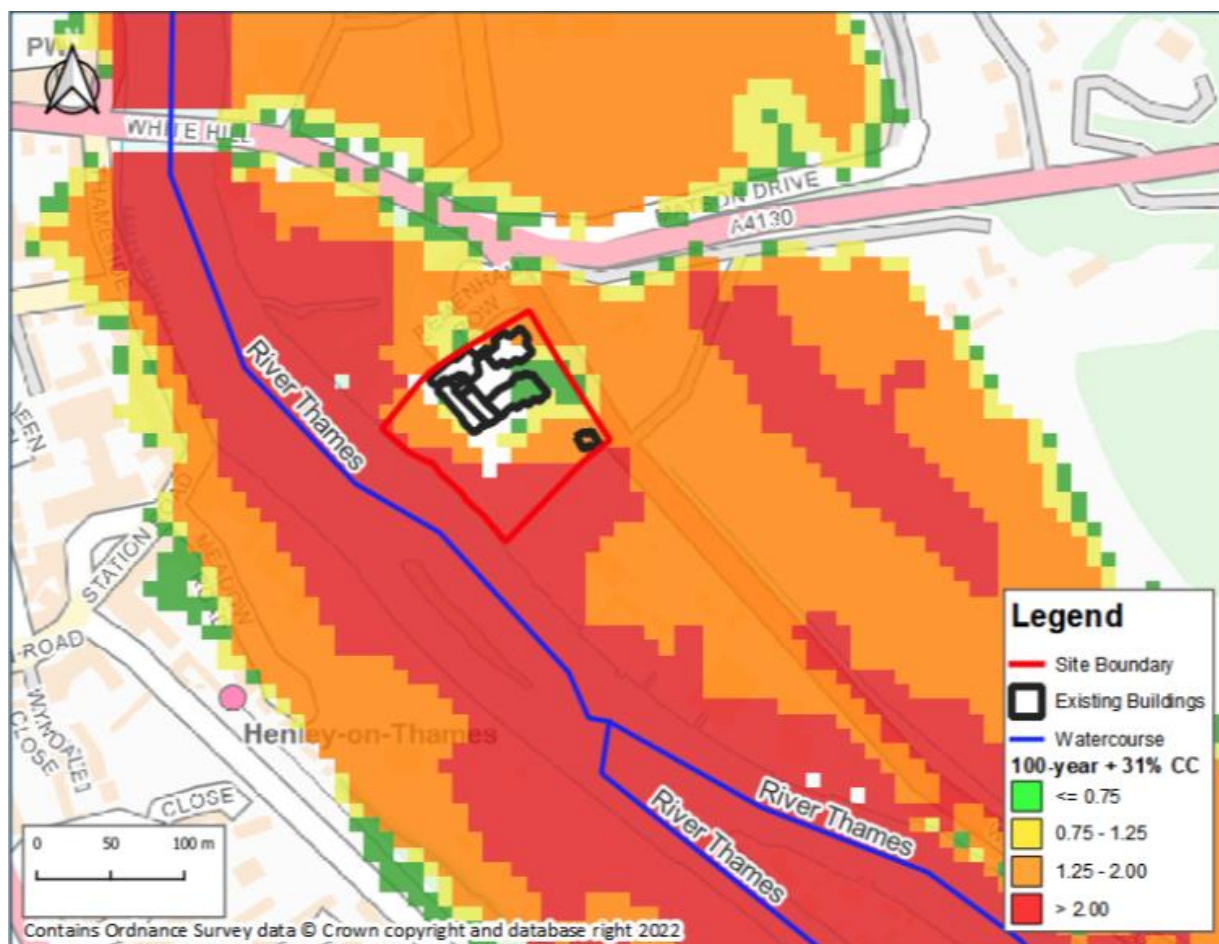


Figure 3-4: Flood Hazard to people

Figure 3-4 shows that the majority of the site and along the A321 falls within the 'very low risk - caution' (≤ 0.75) to 'danger for most' (> 2.00) hazard categories. On the western side along the site the southwest side of the site is classified as 'danger for all' and on the far south corner of the site is in 'danger for all'. Near the main entrance and car park the hazard to people falls under 'very low - caution' and 'danger for some', which could provide safe access for emergency vehicles and those rescuing teams on foot but would be a danger for the elderly to walk past by that flood water.

3.5 Blockage scenario

The site is located near Henley Bridge, which is subject to a potential blockage during a flood event. Therefore, blockage risk analysis was undertaken.

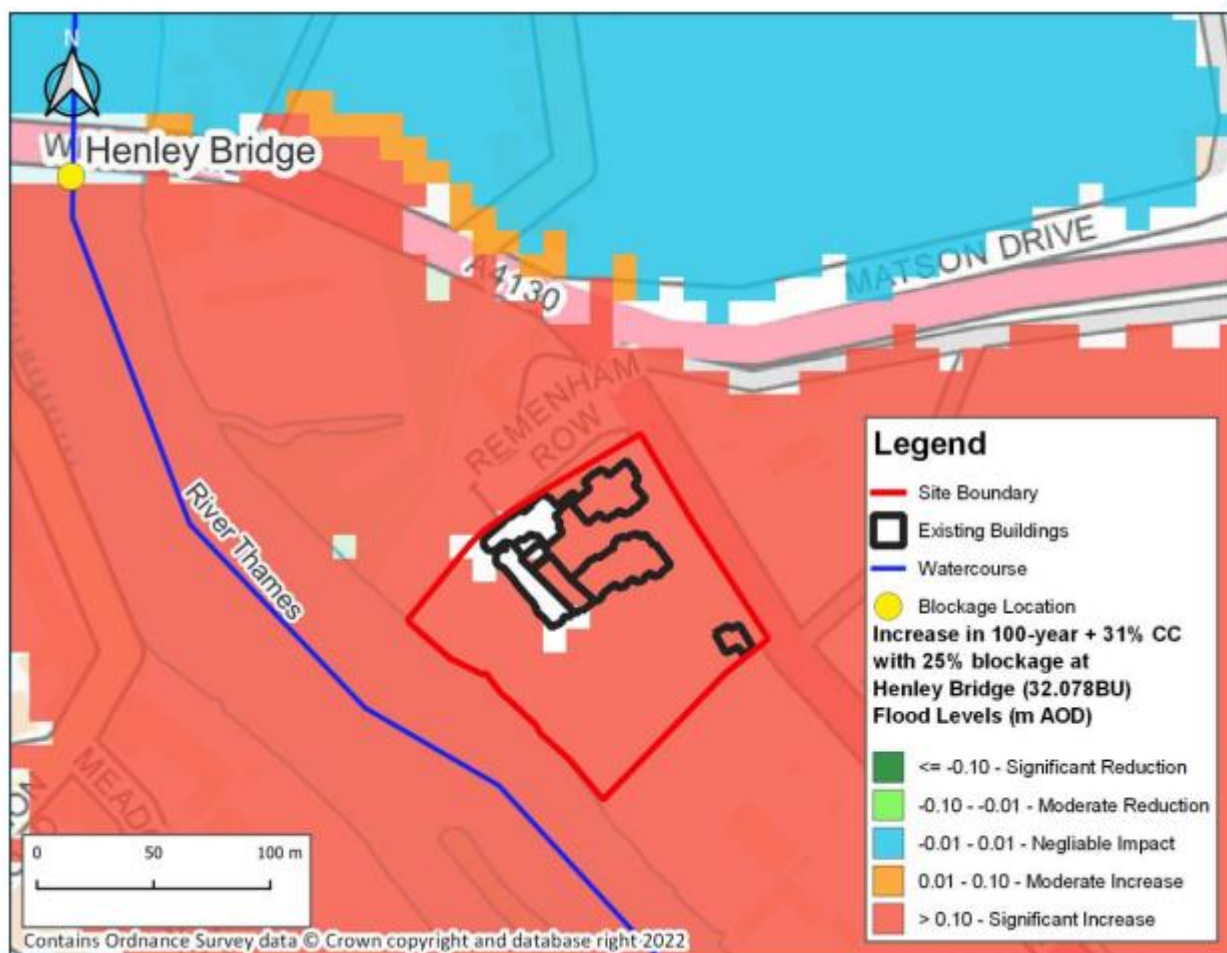


Figure 3-5: Blockage risk analysis in 100-year and 31% climate change with 25% blockage at Henley Bridge

Figure 3-5 shows that during a 1 in 100-year flood event plus 31% climate change allowance, with a 25% blockage at Henley Bridge, flood depths would increase to 0.77m at the site. A blockage of the Henley Bridge would result in a 'significant increase' in flood risk onsite. It is therefore important that the main river beneath the bridge is regularly maintained and cleared to allow the water to flow freely.

4 Other sources of flood risk

4.1 Groundwater flood risk

According to EA's MAGIC map², the geology of the site mainly consists of sedimentary bedrock formations such as chalk, sand and gravel. Based on the borehole record and the geology of the site, it is considered to be in high risk of groundwater flooding. This correlates with anecdotal evidence whereby flood waters were previously observed in the basement by members of the Retirement Village.

Existing basements in the buildings are mainly used for storage and the more vulnerable aspects of the development will not be situated in the basements due to the risk of flooding. There is an approximate of difference in elevation of 2.5m between the floor level of the basement and ground level. There have been instances of flooding in the past within the basements resulting in the installation of sump pumps.

4.2 Reservoir flood risk

Nearby reservoirs need to be considered with regard to flood risk, in the unlikely event a reservoir was to fail. A breach in the reservoir would result in a sudden and large amount of water flowing with high velocity. Two reservoirs, the Farmoor reservoirs, located approximately 25 miles north to site are considered to pose a risk of flooding to the area should they breach during normal river levels and/or during flood conditions.

The Black Swan reservoir, that is located south to the site approximately 10 miles away could also pose a risk of flooding to the site. In the event of a breach, this could lead to flooding downstream along the River Thames.

Figure 3.1 provides an indication of worst-case scenarios of reservoir flooding during a 'dry day' and 'wet day' at the site. The 'fluvial contribution' layer illustrates the baseline flood extents used to generate the 'wet day' breach extents.

² Magic Map Application (defra.gov.uk)

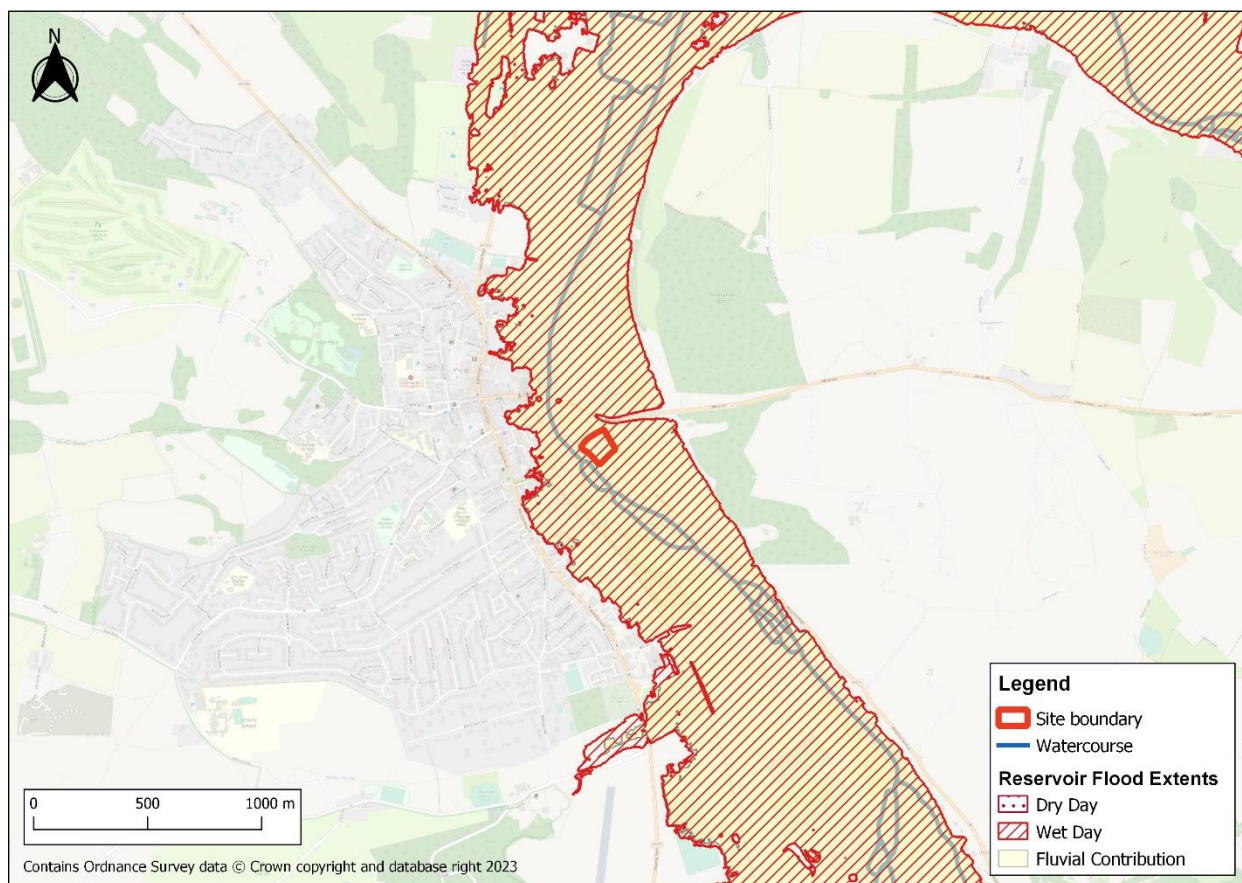


Figure 4-1: Reservoir Flood Extents during 'Wet Day', 'Dry Day' and 'Fluvial Contribution'

Figure 4-1 shows that the site is not affected by reservoir flood extents during the 'dry day' scenario. Flooding may occur during the 'wet day' reservoir breach scenario when i.e. combined with a 1,000-year fluvial flood event from the River Thames. A comparison of the 'wet day' flood extent with LiDAR data indicates flood level of 34.39m AOD could be reached on site during this scenario. This would result in flood depths of up to 2.32m on site.

5 Flood mitigation

5.1 Finished Floor Levels

It is recommended to increase the floor levels of existing buildings, where possible (i.e. subject to headroom constraints) in order to improve their resistance to flooding. With regards to the new building, their finished floor levels will be raised to a minimum of 600mm above the 'design' (100-year with climate change) flood level, i.e. to a minimum of 33.86mAOD.

5.2 Emergency planning

The buildings are at high risk of fluvial flooding due to the proximity to the River Thames, with no permanent safe access and egress route available during the peak of the 'design' 100-year with climate change fluvial flood event. As a result, flood warning and evacuation procedures at this site will be essential.

In 2022, the WSP produced a Flood Warning and Evacuation Plan (see Appendix B) which includes safe exit and access routes during a flood event. The assembly point is located at the courtyard in the centre of the site, where the occupants will need to gather following receipt of a flood warning and make their way out to Wargrave Road if it is safe to do so.

Further to WSP's recommendations, and following consideration of their latest site design, flood boards indicating flood depths along the evacuation route will be provided to confirm when safe access and egress is no longer possible and when confinement/safe refuge on site need to be considered.

5.3 Safe access and egress

Safe egress for the site occupants will be through the main entrance and along Wargrave Road, heading north towards the A4130. The surface water flood risk is lower near the car park and entrance which could be used for safe access and egress. Furthermore, the fluvial flood hazard is lower ('danger for some') at the main entrance, which means emergency vehicles will still be able to access the site. In the event of a flood emergency, the site occupants will be required to evacuate the site. For evacuation plan see Appendix B, Flood Warning and Evacuation Plan by WSP.

As safe access and egress will not be possible during the peak of the 'design' flood event, the Flood Response Plan will be updated accordingly and learnt by staff members. Furthermore, emergency procedure/evacuation plan practices will be regularly undertaken by all site occupants, to learn the process and the muster points of the evacuation plan. Prior to a flood event it is important to plan for the evacuation of the people in the building. The building should only be used as a safe refuge as a last resort.

5.4 Confinement/safe refuge

Given that the whole site is surrounded by flood water during a 100-year with climate change flood event, it is recommended that the residents are evacuated from the building using the safe access/egress routes and following the evacuation plan procedures. In the case of residents are not able to be evacuated, they will have to stay in their rooms if located in upper floor levels (or otherwise in the upper floor levels), for example in Block A, B and E. If the weather conditions are bad during a flood event, it is not recommended for the residents to exit the building (unless instructed by emergency services) as there is no safe access/exit points of the site for the pedestrians.

If the weather conditions are mild and it is safe to leave the buildings, the northern outside area of the site is appropriate for evacuation procedures. For example, the residents can gather to the courtyard in the centre the buildings and move towards the car park where vehicles can enter and exit safely to transport and evacuate the residents.

In extreme cases of flooding when the power can be affected, it is highly recommended to install emergency generators for the buildings. It is also recommended to circulate a copy of the Flood Warning and Evacuation Plan to the residents.

5.5 Basement solutions

The basement is understood to be approximately 2m in depth and by placing new steel beams on the soffit of the ground floor slab, will restrict the headroom locally. The basement height will vary between 1.800m and 2.175m. To mitigate against flood risk in the basement, the space will be used exclusively as non-habitable floor space and for storage only. It is recommended to reinforce the basement and render the walls and floor impervious to ground water (seek confirmation from a structural engineer that such measures will not detrimentally impact the structural stability of the wall / i.e. that the wall is capable to withstand the increased groundwater pressure on the wet side of the wall). Furthermore, the walls should be sprayed with water repellent material and ventilation of the basement should be considered to mitigate damp. The installation of sump pumps at the lowest point in the basement is essential to extract flood water, prevent water pooling in the basement. It is important to ensure that these pumps are tested regularly.

Electrical wires will also be run from the ceiling and electrical appliances will be raised from the floor, if possible. If not, it is recommended that a key switch is installed to isolate electricity in the basement in emergency flooding. A key switch is low cost and will provide efficient solution for electrical mechanisms in the basement. Should it fail to operate and should it require manual interventions, it is highly recommended that operators not to enter in flood water in the basement as there is a high risk of electric shock and switch of main electrical panel. Therefore, it is recommended to place a warning site of the flood water risks/hazards in the basement and to notify site occupant not to enter the basement.

The inspections of the internal walls and floor of the basement is essential to recognise any cracks or gaps which then needs to be fill-in with silicone sealant or mortar to prevent water ingress into the basement.

It is highly recommended that a borehole with sensor is set up to regularly monitor the groundwater levels at the site as permeable bedrock lays beneath the site.

5.6 Flood mitigation against reservoir flooding

Reservoir flooding is considered a residual risk for the site. It will not occur during the 'dry day' scenario and, during a 'wet day' scenario, the site will already be subject to flooding from the River Thames (fluvial contribution).

As a result, no additional flood mitigation measures on top of the flood warning and evacuation procedures already considered against fluvial flood risk are deemed required.

5.7 Floodplain compensation

The proposed building footprint (where demolition and the construction of a new building is required) will be steered away from the 100-year with climate change floodplain, as shown in Figure 5-1.

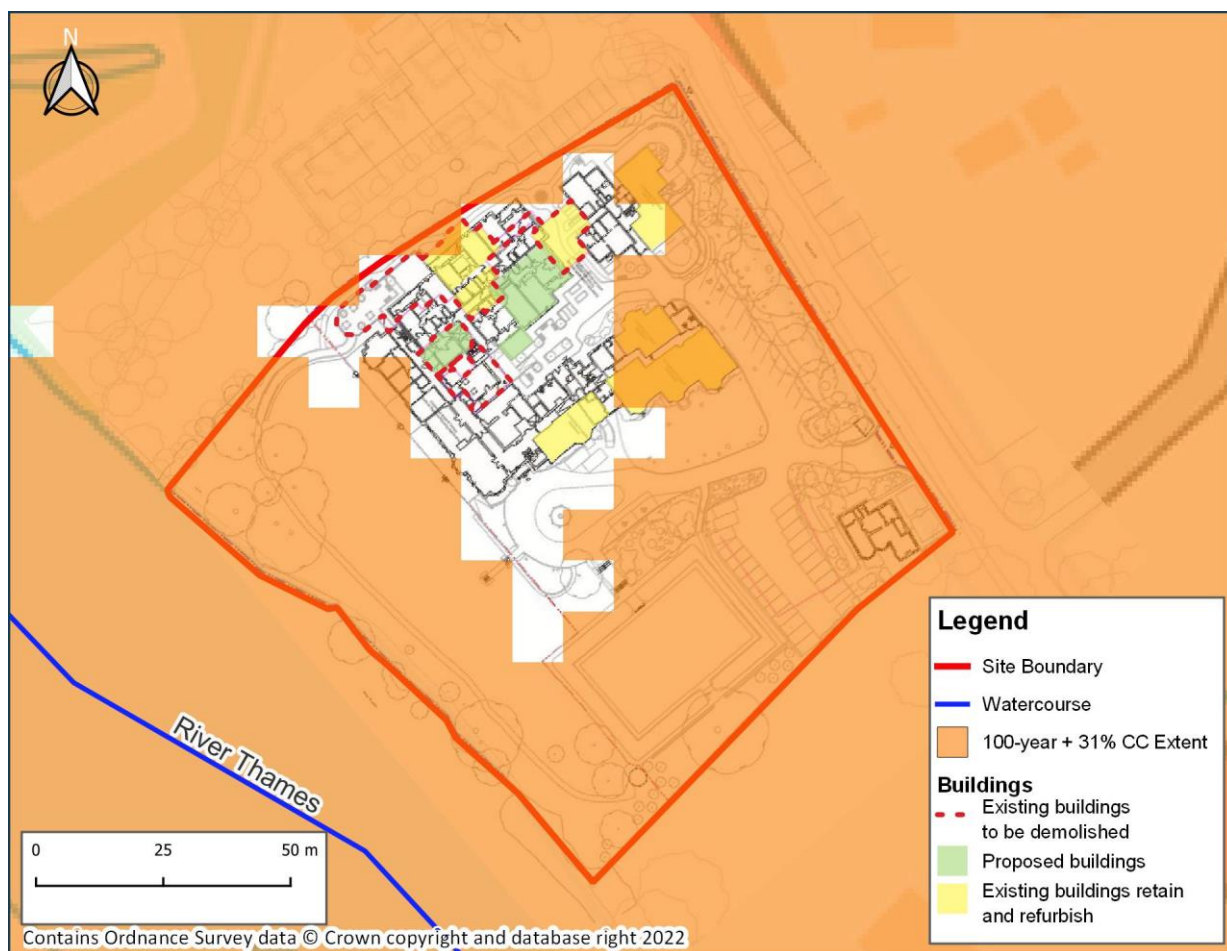


Figure 5-1: Proposed and existing buildings with 100-year plus 31% climate change event

Figure 5-1 shows the existing buildings which will be demolished and the proposed buildings that will be retained and/or refurbished. As a result, floodplain compensation is not required for site.

6 Conclusions

- JBA Consulting were commissioned by RPS to undertake a fluvial hydraulic modelling study.
- This report highlights the risks of flooding to site and the necessary implementations.
- The model has been run for the 30-year, 100-year and 1,000-year with 31% climate change scenarios. It is predicted that the capacity of the River Thames is exceeded during all modelled events and will flood the site.
- Fluvial flood risk is 'high' within the site boundary which is mainly affected by the adjacent River Thames.
- Groundwater flood risk is considered medium to high within the site. It is possible that groundwater floods the basement of the site.
- Reservoir flooding is shown to affect the site should a breach coincide with 'wet day' conditions, however the likelihood of reservoir breach is low. Reservoir flooding does not affect the site during 'dry day' conditions and directly.
- During the modelled fluvial 1 in 100 year plus climate change event, the majority of the site and along the A321 falls within the 'caution' to 'danger for most' hazard categories.
- Blockage at Henley Bridge is projected with the 25% blockage to cause significant increase of flooding the site, with a maximum flood depth of 0.77m.
- A copy of the Flood Warning and Evacuation Plan by WSP (Appendix B) should be provided to the occupiers of the site along with a Flood Response Plan that lists the tasks to undertake should a flood event occur.

To mitigate against flood risk, it is recommended to:

For the new buildings;

- Raise the ground floor levels of the new buildings to a minimum of 600mm above the 'design' flood level.
- Install emergency generators to be used in extreme cases of flooding where the power might be affected to maintain power on site (e.g. to power medical equipment).

For the existing buildings

- Place flood barriers/doors to the doorways of buildings with a floor elevated below the 'design' flood level.
- Install emergency generators to be used in extreme cases of flooding where the power might be affected to maintain power on site (e.g. to power medical equipment).
- The external walls of the building should be inspected for any cracks or gaps, and sealed with silicone sealant or mortar as required.
- The external walls should be treated with water repellent spray.
- Internal walls of the ground floor levels should be made of easily washable materials (e.g. tiles and smooth concrete).
- For the existing basement;
- Install sump pumps to the lowest point of the basement and test pumps regularly.
- Ensure that the basement is exclusively used as non-habitable floor space.
- Render the walls impervious (and seek confirmation from a structural engineer that such measures will not detrimentally impact the structural stability of the

wall / i.e. that the wall is capable to withstand the increased groundwater pressure on the wet side of the wall).

- Electric wires and sockets should be set as high as possible, if cannot move electric socket and wires, then a small key switch is to be installed to isolate electricity in the basement during flood events and to switch of electricity in the basement when flood water occurs.
- Circulate a copy of the Flood Warning and Evacuation Plan by WSP (Appendix B) to the occupiers of the site and ensure it is updated accordingly.
- Place flood door barrier at the basement doorway.
- Ensure that signage of high flood risk/hazard is placed at the basement access door to notify site occupant of the hazard. Furthermore, a warning sign for not entering the basement when floodwater is present, to avoid for operators to get electric shock.
- Walls to be made of easily washable materials (e.g. tiles, smooth concrete) and appropriate venting is considered to minimise moisture damp in the basement.
- A borehole with a pressure sensor should ideally be set to monitor groundwater level near the basement and trigger alerts or alarms to the occupants of the site.
- As part of the recovery procedure, an electric certificate should be issued after flood events affecting the basement.
- The internal walls and floor of the basement should be tanked in order to prevent groundwater penetration.
- Items stored in the basement should be suitable to be easily removed following receipt of activation of 'be prepared' triggers (flood alert, on site observation). Items that cannot be removed should be suitably flood resilient in their nature to weather continued exposure to floodwater.

In addition to the above, a Flood Response Plan listing all tasks to be carried out by on-site staff and local residents prior to, during and following a flood event should be produced for the site.

Appendices

A FRA report (WSP October 2022)



Technical Note – Flood Risk Assessment and Outline Drainage Strategy

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SUBJECT:	Technical Note – Flood Risk Assessment and Outline Drainage Strategy		
PROJECT:	70094722	AUTHOR:	KW
CHECKED:	QW	APPROVED:	TK

INTRODUCTION

This pre-application technical note has been prepared by WSP on behalf of Retirement Village Group, to identify the risks of flooding associated with partial redevelopment of the Thamesfield Retirement Village, which will henceforth be referred to as ‘the Site’. The Site is located on Wargrave Road, Henley-on-Thames, RG9 2LX within Wokingham Borough Council (WBC), Berkshire. A Site location plan is shown in Appendix A.

This initial flood risk investigation has been informed by:

- Data provided by the Environment Agency (EA);
- EA online mapping data (via the GOV.UK website);
- Hydraulic Modelling Study at Thamesfield, Wargrave Road, Henley-On-Thames, (2022), by JBA Consulting.

In addition to the consultation with the above parties, the report has been informed by assessing and reviewing the following available data, local policy documents and policies:

- National Planning Policy Framework (NPPF), 2021
- South Oxfordshire District Council (SODC) Strategic Flood Risk Assessment (SFRA), (2017)
- WBC Draft Local Plan, (2020)
- WBC Preliminary Flood Risk Assessment (PFRA), (2011)
- WBC Local Flood Risk Management Strategy, (2015)
- WBC Strategic Flood Risk Assessment (SFRA), (2019)

Relevant maps from the above documents are attached in Appendix C.

BASELINE INFORMATION

The Site is located at Wargrave Road and bound by the River Thames to the west, the A321 Wargrave Road to the east, Remenham Row to the north and greenspace to the south. The Site is located within the district of Wokingham Borough Council (WBC), and on the border of South Oxfordshire District Council (SODC).

The Site is situated at:

- National Grid Reference: SU 76583 82479
- Easting, Northing: 476583, 182479
- Nearest Postcode: RG9 2LX

Please refer to Figure 1 and Appendix A.

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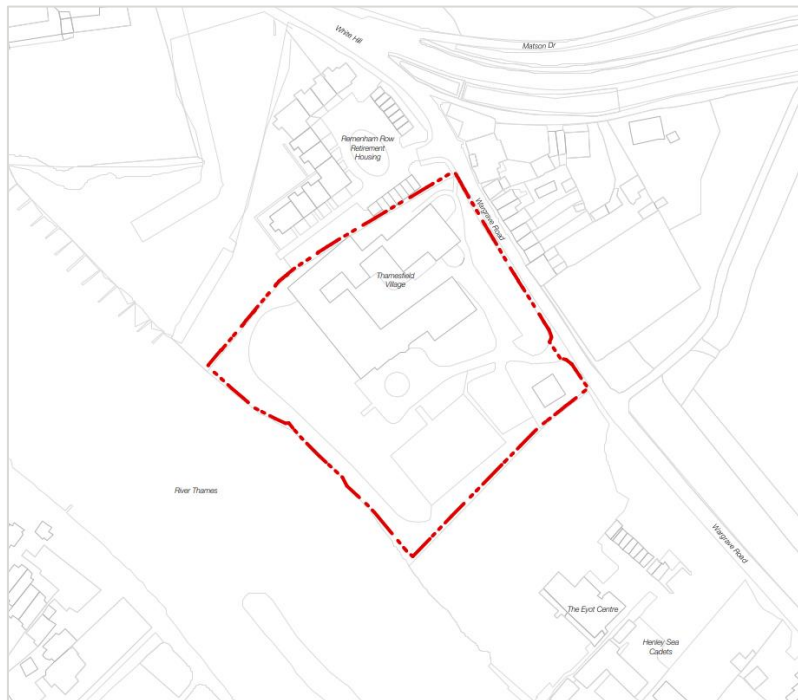


Figure 1 - Indicative Site Location

EXISTING WATERCOURSE

The River Thames, a main river, directly borders the west of the Site. There are no other watercourses in proximity to the Site.

EXISTING DRAINAGE

There is an existing surface water rising main in the northeast corner of the Site travelling north along the A321. There are no other existing on-site connections to the Thames Water network. Please refer to Appendix B for Thames Water Asset Records. There is no existing foul drainage network onsite and a CCTV drainage surveys will be required at a later stage to inform the drainage design.

TOPOGRAPHY AND SITE LEVELS

Based on the topographical survey provided to WSP by Thamesfield Retirement Villages, the levels survey show that the Site slopes down from its eastern boundary to the west, towards the River Thames. The Site fall from approximately +33.50 mAOD to +31.71 mAOD respectively. Please refer to Appendix B for a detailed topographic survey.



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PROPOSED DEVELOPMENT

The development proposals for the Site is comprised of:

The erection of a three-storey extension to provide 14 no. extra-care units, following associated demolition works, along with the potential expansion of the car parking facilities.

POTENTIAL SOURCES OF FLOODING

Reference to gov.uk 'Flood Map for Planning' and 'long term flood risk information' maps (which makes use of EA data) is made where appropriate, along with reference to the WBC documents and SODC documents.

Using the available information, the following assessment has been made:

TIDAL FLOODING

There is no risk of tidal flooding at the Site. Therefore, the risk of tidal flooding is considered **negligible**.

RESERVOIR FLOODING

Based on the online GOV.UK 'Long Term Flood Risk Information', the Site has been identified as within the extent of flooding from reservoirs, however only when there is flooding from rivers. Based on the information available, WSP have deemed this flood risk as **low**.

SURFACE WATER FLOODING

Based on the online GOV.UK 'Long Term Flood Risk Information', the Site is identified to have 'Very Low' risk of flooding from surface water. Therefore, the risk of flooding from surface water is considered **negligible**.

SEWER FLOODING

The SODC SFRA mapping of sewer flooding incidences in the district shows there has been 16-24 incidents of sewer flooding in the vicinity of the Site, however there is no information stating where these sewer floodings have occurred specifically. The WBC PFRA shows there to be no historic incidences of flooding from local flooding incidences at the Site or in the nearby vicinity. Please refer Appendix C.

Based on the available information the risk of flooding from sewers is considered **low**.

GROUNDWATER FLOODING

The 'Susceptibility to Groundwater Flooding Map', Figure 6 of WBC Appendix A.9 SFRA, shows the Site to be in an area described as 'Not considered to be prone to groundwater flooding'. Please refer to Appendix C. Therefore, the risk of groundwater flooding at the Site has been assessed as **low**.

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FLUVIAL FLOODING

Based on the online GOV.UK Flood Map for Planning, majority of the building areas of the Site are located in Flood Zone 2 and external areas has been identified to lie within Flood Zone 3 (please refer to Figure 2).

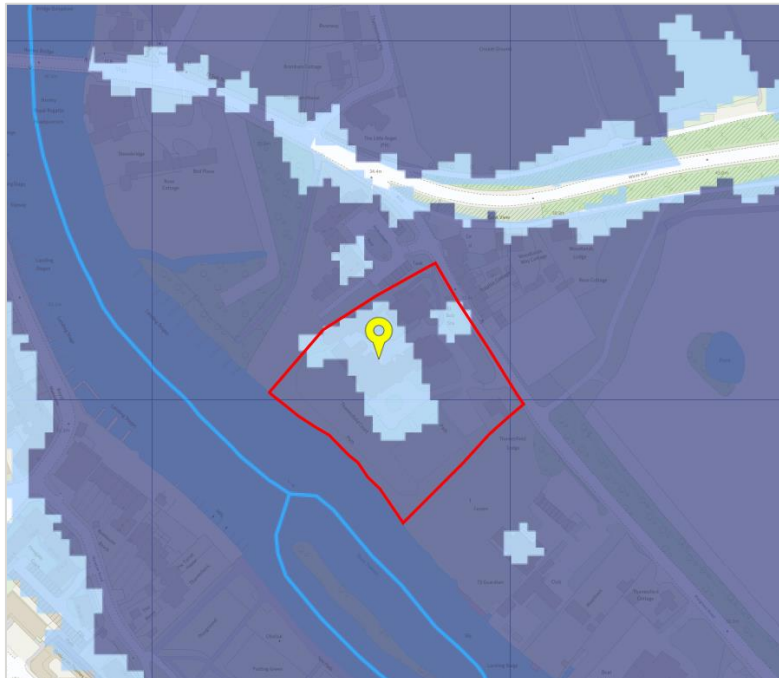


Figure 2 - GOV.UK Flood Map for Planning

Further evidence in the WBC SFRA shows that the Site is located in Flood Zone 3b (Appendix C). According to the EA's definition of flood Zone 3b, the functional floodplain is land where water is required to flow or be stored in times of flooding. As the buildings were built prior to the flood modelling carried out by the EA to determine the flood zone definition, the existing building area should not be deemed as land required to store flood water from the river or sea in a flood event as it would not have been available to provide storage at the time of the modelling. As a result, the whole Site will be deemed to be in Flood Zone 3a and all assessments moving forward will analyse the Site in line with Flood Zone 3a methodology.

Due to the lack of EA product 4 (Detailed Flood Risk Assessment Map, including flood zones, defences and storage areas, areas benefiting from defences, statutory main river designations, historic flood event outlines and more detailed information from the computer river models), JBA Consulting undertook a fluvial water hydraulic modelling study at Thamesfield Retirement Village (Appendix D).

The 'design flood' used for assessment in the JBA report is defined by the EA as river flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year) with an appropriate climate change allowance.

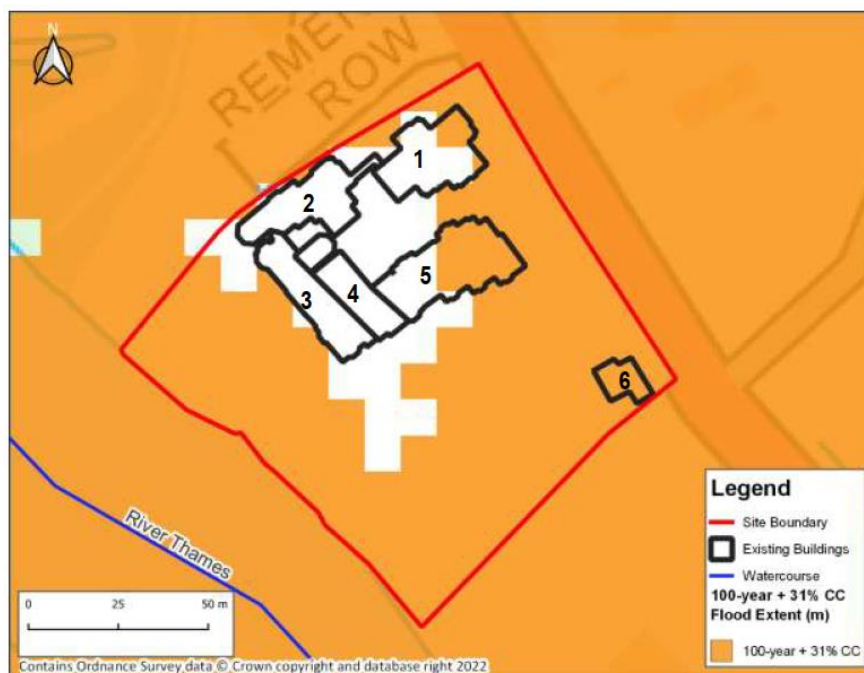
The climate change allowance added is in line with EA guidance that 'More vulnerable' developments in Flood Zone 3a should consider the 'Central' projection. For the 2080s, for the stretch of the River Thames

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the Site sits alongside, the central climate change uplift is 31%. It should be noted that for stretches of the Thames both upstream and downstream, lower climate change uplifts are applied, and therefore it is unlikely a higher value will be requested by the EA. Assessment of the ‘Higher’ or ‘Upper’ projections may be requested as part of a sensitivity analysis.

Figure 3 generated by the JBA hydraulic model shows that only a small part of existing Building 1, Building 5 and the whole of Building 6 are located within the flooding extents when subjected to the design flood (1 in 100-year rainfall event, with a 31% climate change allowance).



*Figure 3 Baseline 100- Year flood extents with 31% climate change scenario
(Source: Hydraulic Modelling Study at Thamesfield, Wargrave Road, Henley-On-Thames, (2022), by JBA Consulting.)*

Figure 4, along with Table 1, indicates that for the 100-year event with a 31% climate change allowance, peak flood levels are not expected to exceed the existing floor level in any of the main buildings where redevelopment is proposed, with the exception of Building 1 which will undergo a partial demolition of a unit outside the footprint and in a higher flood zone. For Building 1 flood levels exceed existing floor level by 0.01m. The only other existing building where flood levels exceed existing floor level is Building 6, where an exceedance of 0.66m is predicted.

There are however no proposed demolition or re-development works for Buildings 5 & 6, areas within the modelled flood extents and therefore, no increased risk is associated with these buildings. For the areas where the development is proposed, fluvial flooding will not materially affect building areas and central courtyard / gardens as shown by the modelled flooding extents below.

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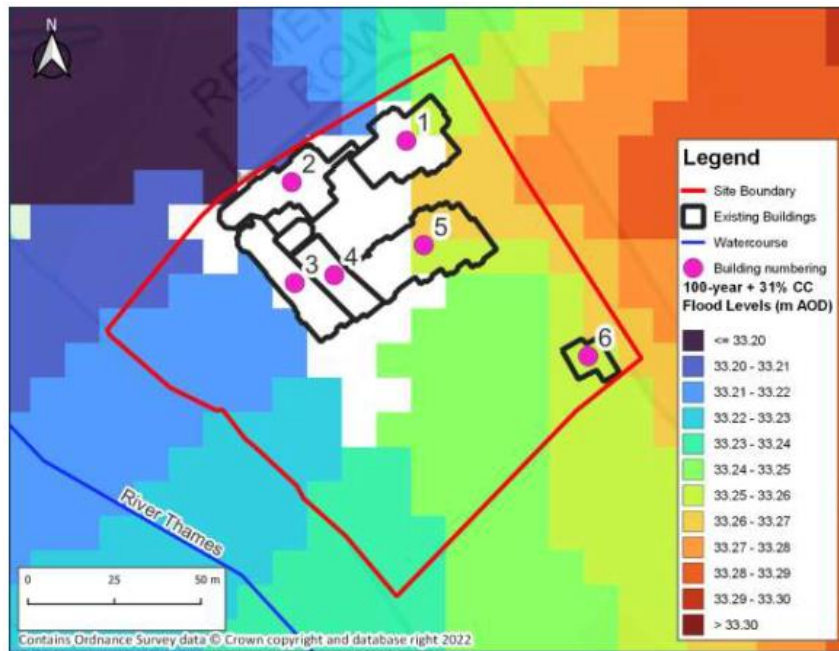


Figure 4 Baseline 100-year water levels with 31% climate change
(Source: Hydraulic Modelling Study at Thamesfield, Wargrave Road, Henley-On-Thames, (2022), by JBA Consulting.)

Table 1: Peak Water Levels Related to Buildings Floor Levels

Building No.	Existing Floor Levels (mAOD)*	Peak water level within existing building(mAOD)
1	33.26	33.27
2	33.83	33.20
3	33.84	33.22
4	33.48	No flooding
5	33.26	33.26
6	32.60	33.26

*: Estimated from Point 2 Surveyors Limited topographical survey dated June 2021

(Source: Hydraulic Modelling Study at Thamesfield, Wargrave Road, Henley-On-Thames, (2022), by JBA Consulting.)

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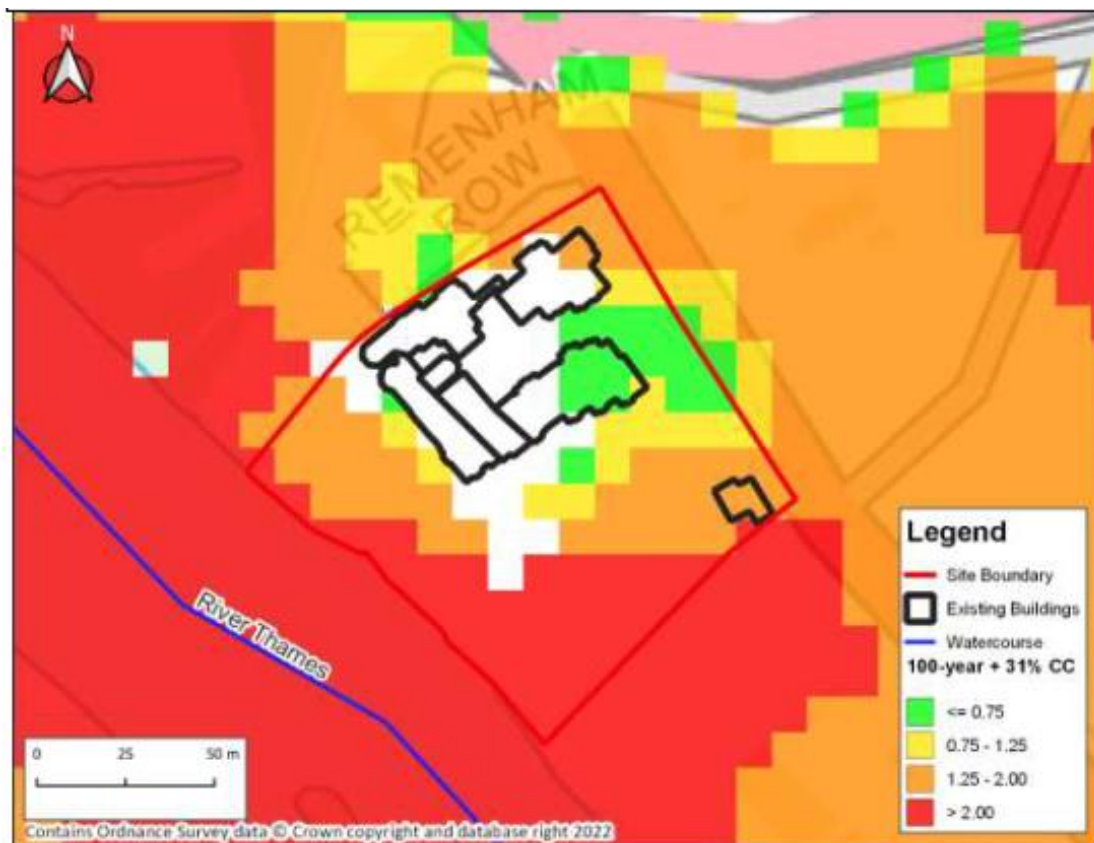


Figure 5: Hazard to People

(Source: Hydraulic Modelling Study at Thamesfield, Wargrave Road, Henley-On-Thames, (2022), by JBA Consulting.)

The fluvial hazard-to-people rating during a 100-year with 31% climate change flood scenario has been mapped by JBA consulting using the formula as suggested in Defra’s FE2321/TR2 “Flood Risk to People”.

As shown in Figure 5, the Hazard to People rating for the majority of the building and central garden area (more vulnerable areas) falls within the “no risk” to “low” (≤ 0.75) hazard categories. Only the external areas (water compatible areas) south and east of the Site, where there are no proposals for development fall within significant (1.25-2) and extreme (> 2).

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SEQUENTIAL AND EXCEPTION TEST

VULNERABILITY CLASSIFICATION

As stated in the NPPF, a sequential risk-based approach to determine the suitability of land for development in flood risk areas should be applied at all stages of the planning process giving precedence to low flood risk areas wherever possible.

Table 2 - Flood Risk Vulnerability and Flood Zone 'Compatibility'

FLOOD RISK VULNERABILITY CLASSIFICATION		ESSENTIAL INFRASTRUCTURE	WATER COMPATIBLE	HIGHLY VULNERABLE	MORE VULNERABLE	LESS VULNERABLE
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	✗	Exception Test Required	✓
	Zone 3b	Exception Test Required	✓	✗	✗	✗

- ✓ Development is appropriate
- ✗ Development should not be permitted

As discussed in the previous section, the building areas are located in Flood Zone 2 and the external areas are located in Flood Zone 3a. In accordance with the NPPF, the sequential and exception test must be applied.

SEQUENTIAL TEST

The Sequential Test should be applied to major developments located in areas at risk of flooding. However, a pragmatic approach needs to be taken where proposals involve comparatively small extensions to existing premises (relative to their existing size), where it may be impractical to accommodate the additional space in an alternative location (PPG paragraph 027 Reference ID: 7-027-20220825). We note that the proposal's size, scale and footprint would be modest when seen on the context of the existing building form on site. Furthermore, the proposal seeks to increase the existing provision of extra-care units on site. As such, it would not be practical or reasonable to accommodate the proposed units elsewhere. For these reasons, we consider it would not be necessary to undertake a Sequential Test.

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EXCEPTION TEST

To pass the exception test two criteria must be satisfied:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh the flood risk; and
- Demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and which possible, reduce flood risk overall.

The WBC Local Plan policy TB09 states the following:

“The council will in principal support proposals which provide for the following types of accommodation to provide people’ need over a lifetime:

- *Extra care homes [...]*

Proposals that allow the elderly and those with disability to remain in their own homes or purpose-built accommodation.”

With reference to the first point, the Site will provide 14 no. extra-care units to ensure appropriate support is available to the elderly and therefore makes a significant contribution to the community, aligning with the WBC Local Plan Policy TB09. In addition, the proposed development will reduce the existing impermeable areas and the proposed drainage strategy will introduce a sustainable drainage system to improve the current surface water management and enhance the biodiversity and amenity values.

With reference to the second point, the redevelopments will include the residential apartments on the first floor. Based on the Hydraulic Modelling Study 2022, the proposed redevelopment is located outside the Hazard to People areas (Figure 5). The modelled flood level during the 1 in 100 years with 31% climate change in Building 2, where the proposed redevelopment is located, is below the existing floor level. The proposed development will ensure the residential area (more vulnerable) is situated above the estimated flood levels. A dry route of escape and safe access and egress will be provided above the estimated flood levels for occupants so that occupants can escape to a place of safe refuge. It is worth mentioning that only the proposed potential car park extension is located in Flood Zone 3. Car park areas are less sensitive and can be usually used to manage the exceedance flows. In addition, a Flood Warning and Evacuation Plan will be put in place. It is recommended that the Site signs up to receive Flood Alerts issued by the EA to aid with the early evaluation, helping to reduce the consequence of flooding by removing the receptor before flood waters from fluvial sources surround the Site. Any residual risk will be safely managed as part of the Flood Evacuation Plan.

Furthermore, the proposed redevelopment will not increase the impervious area at the Site. It will instead provide a reduction in the permeable area by replacing the vehicle access area with a new green courtyard and introducing Sustainable Urban Drainage Systems (SuDS) features. These will also improve biodiversity

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and sustainability at the Site. Additional measures outlined as part of the FRA and Outline Drainage Strategy (ODS) detailed below further demonstrate how the development satisfies the second point of the Exception Test.

OUTLINE DRAINAGE STRATEGY

The proposed drainage strategy at the Site is to include the following measures:

- The proposed drainage arrangement for the Site will comprise of appropriate SuDS system to deliver source control, water quality treatment and biodiversity enhancement and attenuation. The attenuation will be sized to hold the critical 1 in 100 year rainfall event plus 40% Climate change;
- Proposals for the application include the replacement of the existing impermeable driveway with a green courtyard. This will naturally provide a reduction of surface water runoff by increasing the permeability of the construction surfaces on the Site. This can be further developed at later design stages to be incorporated into the Sustainable Drainage System;
- A permeable paving system without infiltration will be proposed in the potential car park extension areas to manage surface water runoff close to its source and prevent groundwater contamination. The permeable paving cleans the surface water runoffs through filtration, absorption, biodegradation and sedimentation processes that occurs within the surface structure, subsurface matrix and geotextile layer. Overflow will be connected to the surface water drainage network.
- To ensure the effectiveness of the drainage strategy, a drainage maintenance schedule will be in place to ensure the future permeance of all the SuDS and drainage devices for its lifetime;
- Provision of additional flood protection design safety measures such as setting finished floor levels to provide established freeboard for the buildings above the flood levels; and
- Managing any residual risk by providing a safe access and escape route as detailed within an agreed Flood Evacuation Plan.

CONCLUSION

The above FRA & ODS report has been put together by WSP in support of the application for the erection of a three-storey extension to provide 14 no. extra-care units, following associated demolition works, along with the potential expansion of the car parking facilities.

All flood sources in the vicinity of the Site have been reviewed in line with the NPPF guidelines. The most significant source of flooding has been identified as fluvial flooding.

Based on the EA Flood Map for Planning, the building areas of the Site are located in Flood Zone 2 and the external areas of the Site are located in Flood Zone 3. However, according to the Hydraulic Modelling study 2022, the proposed redevelopment of the existing buildings is located outside the Hazard to People areas

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(Figure 5) and the modelled flood level during the 1 in 100 year with 31% climate change is lower than the existing floor levels, in all the areas where redevelopment are proposed.

The proposed redevelopment does not increase the building footprint and instead reduces the existing impervious area through the introduction of a new green courtyard. The proposed drainage strategy will introduce a sustainable drainage system to improve the current surface water management and enhance the biodiversity and amenity values. Because of this, the redevelopment will not increase the flood risk at the Site. Any residual risk will be mitigated by design measures introduced to ensure no impact on third-party land and vulnerable users are protected.

For the reasons mentioned above, the current flood risk at the Site will be mainly unaltered by the proposed development.

NEXT STEPS

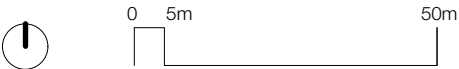
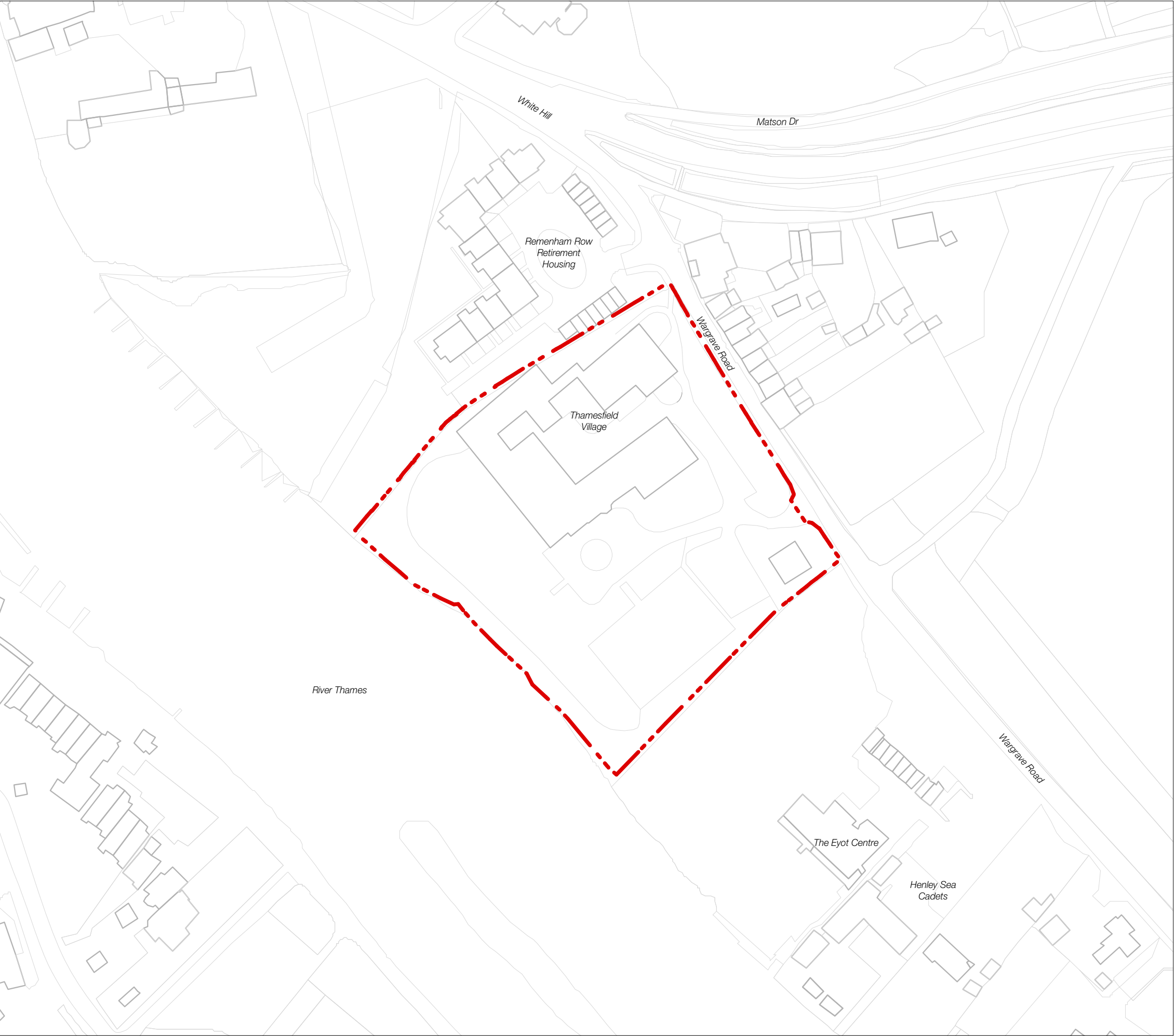
A detailed Flood Risk Assessment and Drainage Strategy should be devised for further assessment of the Site.



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APPENDIX A -SITE LOCATION PLAN



Notes

Do not scale for this drawing. Use written levels and dimensions only.

This drawing is to be read in conjunction with all other relevant documentation produced by Design Engine Architects Consultants and Sub-Contractors drawings, schedules and Specifications.

Key:

Site Boundary - - -

00	28/09/22	Preliminary Issue	TTr	RE
rev	date	notes	drawn	chkd

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ARCHITECTS

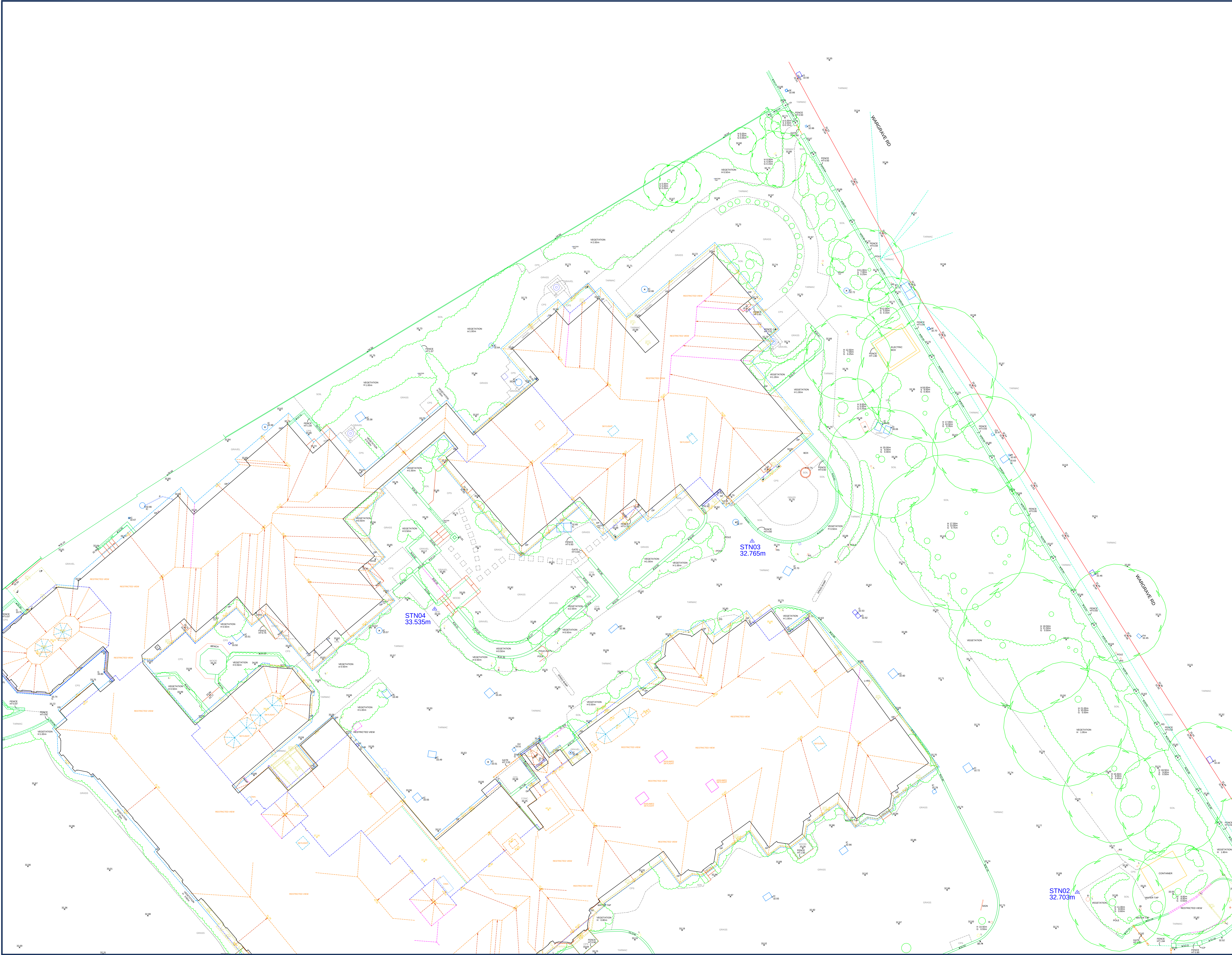
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Thamesfield	September 2022	1:1250 @A3
client	drawing title	
Retirement Villages Group	Site Location Plan	
status	drawing reference	revision
PRELIMINARY	2212-001	00



Technical Note – Flood Risk Assessment and Outline Drainage Strategy

DATE:	12 October 2022	CONFIDENTIALITY:	Confidential
SUBJECT:	Technical Note – Flood Risk Assessment and Outline Drainage Strategy		
PROJECT:	70094722	AUTHOR:	KW
CHECKED:	QW	APPROVED:	TK

APPENDIX B – TOPOGRAPHICAL SURVEY AND ASSET MAP



100%

A/C	Air Conditioning Unit	IC	Inspection Cover
B	Bollard	JB	Junction Box
BP	Back Sowing	LP	Lamp Post
BT	BT Inspection Cover	MH	Man Hole Cover
CAV	Cable Television Inspection Cover	PS	Post Box
CH	Coal Hole	PL	Pavement Light
CPS	Concrete Paving Slab	PO	Post
CK	Concrete Kerb	RL	Ridge Level
CP	Down Pipe	SC	Smoke Outlet
DK	Dropped Kerb	SLO	Smoke Outlet
EL	Eaves Level	SPC	Surface Change
EV	Fire Hydrant	SV	Stop Valve
FL	Foot Light	TBS	Telephone Call Box
GP	Gully	TV	Television
GR	Gravel	W	Water
IR	Illuminated Road Sign	WM	Water Meter

Sheet Layout

S1

S2

S3

S4

Control Stations

STN01, 476580.281, 182423.656, 33.270
STN02, 476533.690, 182453.941, 32.703
STN03, 476606.079, 182483.662, 32.765
STN04, 476579.108, 182477.894, 33.535

Notes:

Levels are related to Ordnance Survey
Datum via GPS Observations
Survey location is related to Ordnance
Survey Grid via GPS Observations

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(including digital data) should be checked and
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Project: Thamesfield Retirement Village
Warrgrave Road
Henley-on-Thames
RG9 2LX

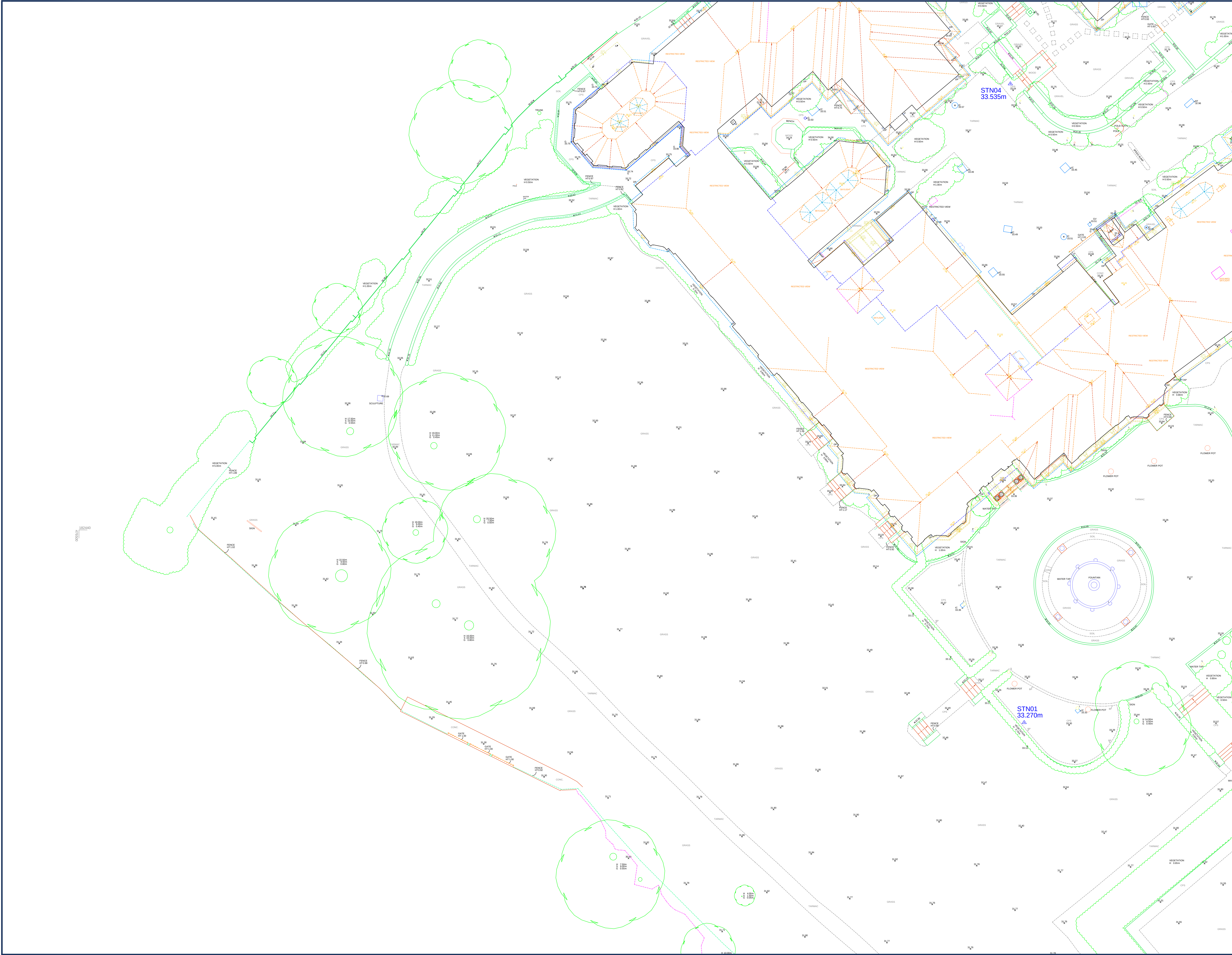
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Sheet 1

Drawn By: SB	Scale: 1:100	Date: June 2021
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Dwg No: LS2498/T

Point 2 Surveys Limited
17 Stimpby Place
London
WC2E 9AB
0207 836 5828
point2.co.uk

POINT



Legend

A/C	Air Conditioning Unit	IC	Inspection Cover
B	Bollard	JB	Junction Box
BP	Back Sawing	LP	Lamp Post
BT	BT Inspection Cover	MH	Man Hole Cover
CAV	Cable Television Inspection Cover	PO	Post Box
CH	Coal Hole	PL	Pavement Light
CPS	Concrete Paving Slab	PS	Smoke Outlet
CK	Dropped Kerb	RL	Ridge Level
CP	Down Pipe	S/D	Smoke Casing
EL	Eaves Level	SFC	Surface Change
EV	Fire Hydrant	SV	Stop Valve
GL	Gully	TLS	Telephone Call Box
GP	Gate Post	TV	Television
IR	Illuminated Bollard	W	Water Inspection Cover
IRS	Illuminated Road Sign	WM	Water Meter

Sheet Layout

S1

S2

S3

S4

Notes

Levels are related to Ordnance Survey Datum via GPS Observations.

Survey location is related to Ordnance Survey Grid via GPS Observations.

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Control Stations

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STN02, 476633.690, 182453.841, 32.702

STN03, 476606.079, 182483.662, 32.765

STN04, 476579.108, 182477.894, 33.535

Project: Thamesfield Retirement Village

Warrgrave Road

Henley-on-Thames

RG9 2LX

Title: Topographic Survey

Sheet 2

Drawn By: SB

Scale: 1:100

Date: June 2021

Dwg No: LS2498/T

A0

Point 2 Surveyors Limited

17 Stingsby Place

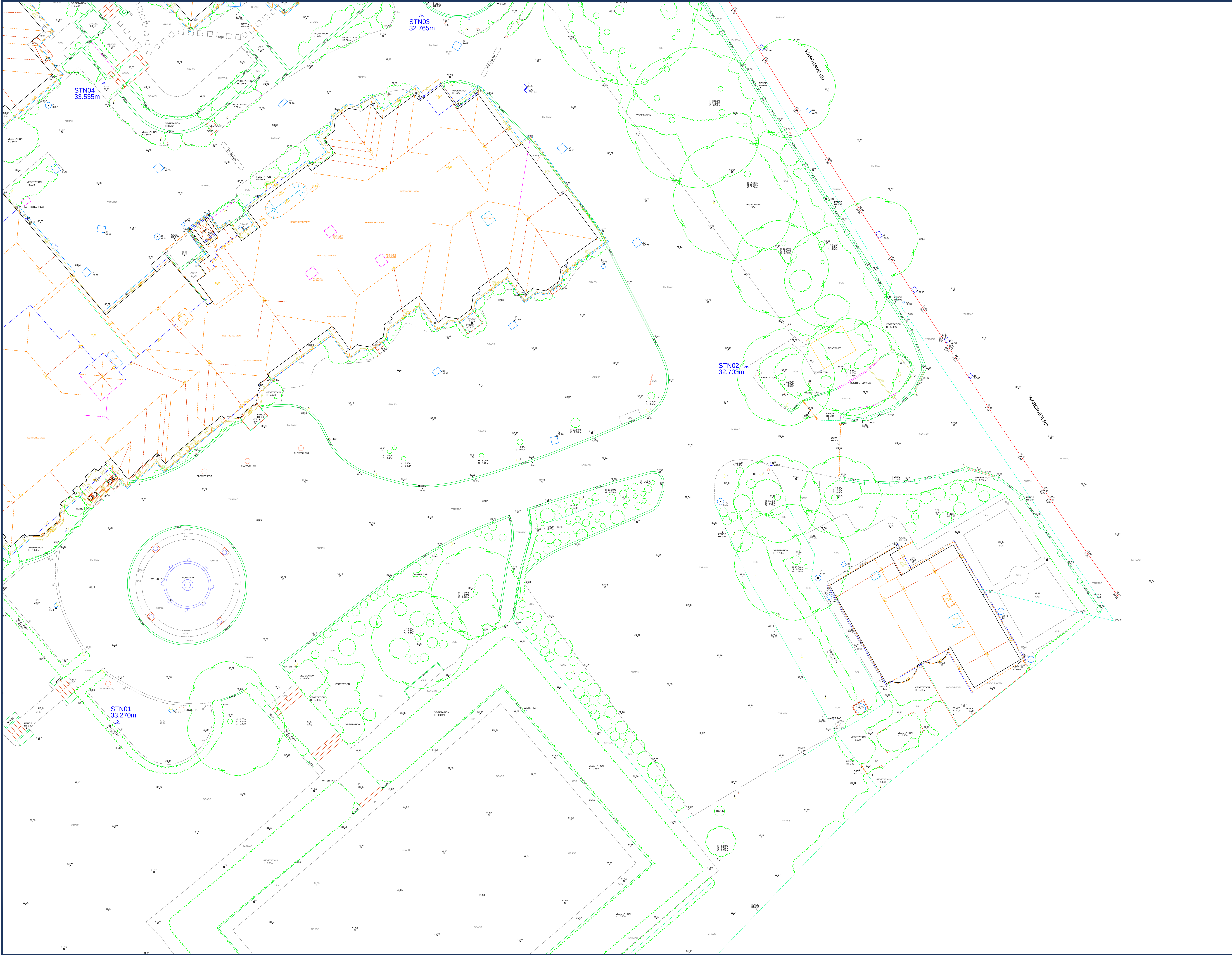
London

WC2E 9AB

0207 836 5828

point2.co.uk

POINT



A/C Air Conditioning Unit
B Bollard
BT Back-sawing
BT Inspection Cover
CATV Cable Television Inspection Cover
CH Coal Hole
CPS Concrete Paving Slab
DK Drilled Kerb
DN Down Pipe
EL Eaves Level
FI Fire Hydrant
G Gully
GP Illuminated Bollard
IRS Illuminated Road Sign

IC Inspection Cover
JB Junction Box
LP Lamp Post
MH Man Hole Cover
PB Post Box
PL Pavement Light
PO Pole
R Ridge Level
S/D Smoke Outlet
SLO Surface Change
SV Stop Valve
TBS Telephone Call Box
TP Tackle Tower
W Water Inspection Cover
WM Water Meter

Sheet Layout

S1

S2

S3

S4

Control Stations

STN01, 476580.281, 182423.656, 33.270
STN02, 476533.690, 182453.841, 32.703
STN03, 476606.079, 182483.662, 32.765
STN04, 476579.108, 182477.894, 33.535

Notes

Levels are related to Ordnance Survey
Datum via GPS Observations
Survey location is related to Ordnance
Survey Grid via GPS Observations
All information contained in this drawing
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Project

Thamesfield Retirement Village
Warrgrave Road
Henley-on-Thames
RG9 2LX

Title

Topographic Survey
Sheet 3

Drawn By

SB

Scale

1:100

Date

June 2021

Dwg No:

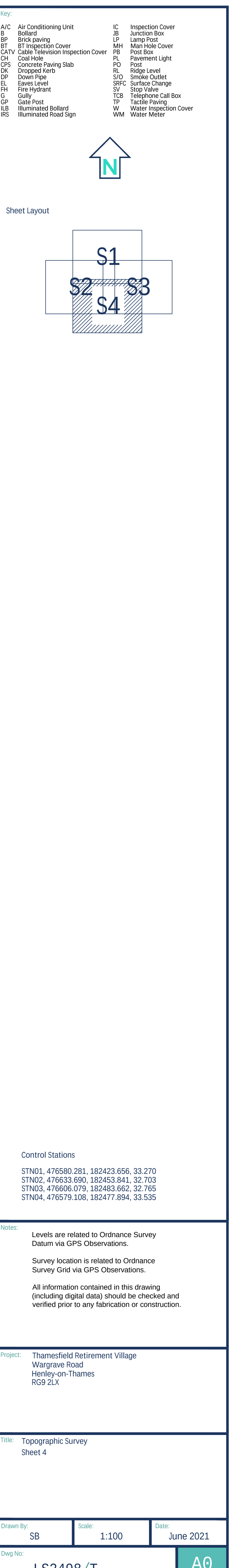
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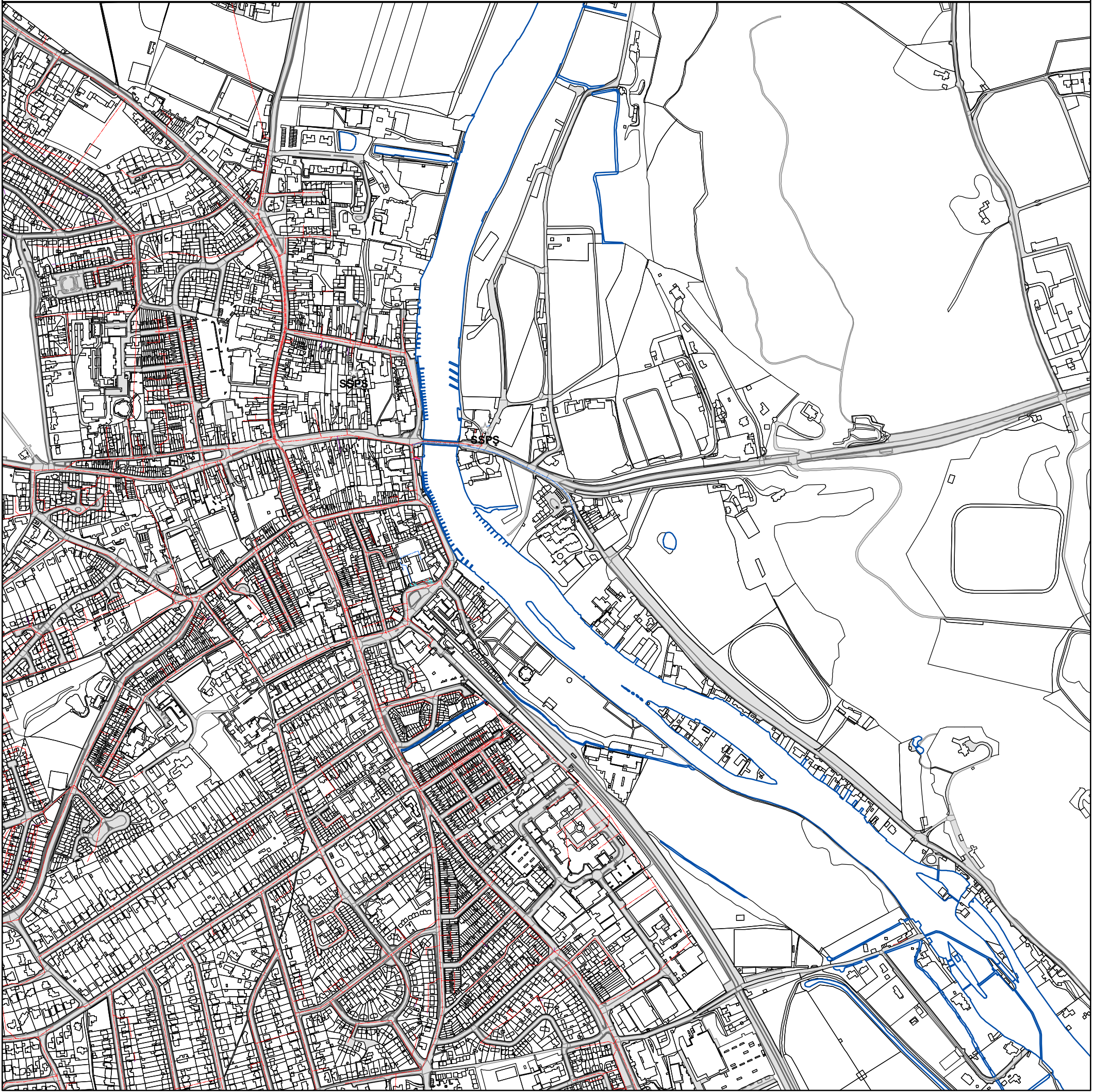
POINT

2



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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
3601	34.1	31.72
361H	32.71	31.46
361I	n/a	n/a
361F	32.42	31.8
3503	32.43	31.06
361E	32.31	31.72
361G	n/a	n/a
3501	32.55	30.41
361D	31.97	29.4
341A	n/a	n/a
331B	n/a	n/a
341B	32.17	31.67
341E	32.17	31.03
341C	32.17	31.33
341Q	n/a	n/a
341G	32.17	31.47
331F	n/a	n/a
331C	n/a	n/a
331H	n/a	n/a
331A	n/a	n/a
341H	n/a	31.47
341P	n/a	31.53
341D	34.1	30.6
341F	32.17	31.35
331E	n/a	n/a
341R	n/a	n/a
331I	n/a	n/a
331J	n/a	n/a
3502	32.33	30.46
331D	n/a	n/a
321A	n/a	n/a
321C	n/a	n/a
3304	32.91	31.4
3305	32.73	31.33
3306	32.64	31.6
3401	32.2	31.2
331K	n/a	n/a
431F	n/a	n/a
461B	n/a	n/a
461C	n/a	n/a
461D	n/a	n/a
431E	n/a	n/a
461E	n/a	n/a
431D	n/a	n/a
431C	n/a	n/a
431B	n/a	n/a
431A	n/a	n/a
461A	n/a	n/a
321B	n/a	n/a
321D	n/a	n/a
321E	n/a	n/a
321F	n/a	n/a
321G	n/a	n/a
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.		



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

Scale: 1:7161
Width: 2000m
Printed By: Rveldhur
Print Date: 06/10/2021
Map Centre: 476560,182453
Grid Reference: SU7682SE

Comments:



ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

	Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
	Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
	Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
	Trunk Surface Water
	Trunk Foul
	Storm Relief
	Trunk Combined
	Bio-solids (Sludge)
	Vent Pipe
	Proposed Thames Surface Water Sewer
	Proposed Thames Water Foul Sewer
	Gallery
	Foul Rising Main
	Surface Water Rising Main
	Combined Rising Main
	Sludge Rising Main
	Proposed Thames Water Rising Main
	Vacuum

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plans are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
- 5) 'na' or 'D' on a manhole level indicates that data is unavailable.

Sewer Fittings

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

	Air Valve
	Dam Chase
	Fitting
	Meter
	Vent Column

Operational Controls

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

	Control Valve
	Drop Pipe
	Ancillary
	Weir

End Items

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

	Outfall
	Undefined End
	Inlet

Other Symbols

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

	Public/Private Pumping Station
	Change of characteristic indicator (C.O.C.I.)
	Invert Level
	Summit

Areas

Lines denoting areas of underground surveys, etc.

	Agreement
	Operational Site
	Chamber
	Tunnel
	Conduit Bridge

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

	Foul Sewer		Surface Water Sewer
	Combined Sewer		Gully
	Culverted Watercourse		Proposed
			Abandoned Sewer

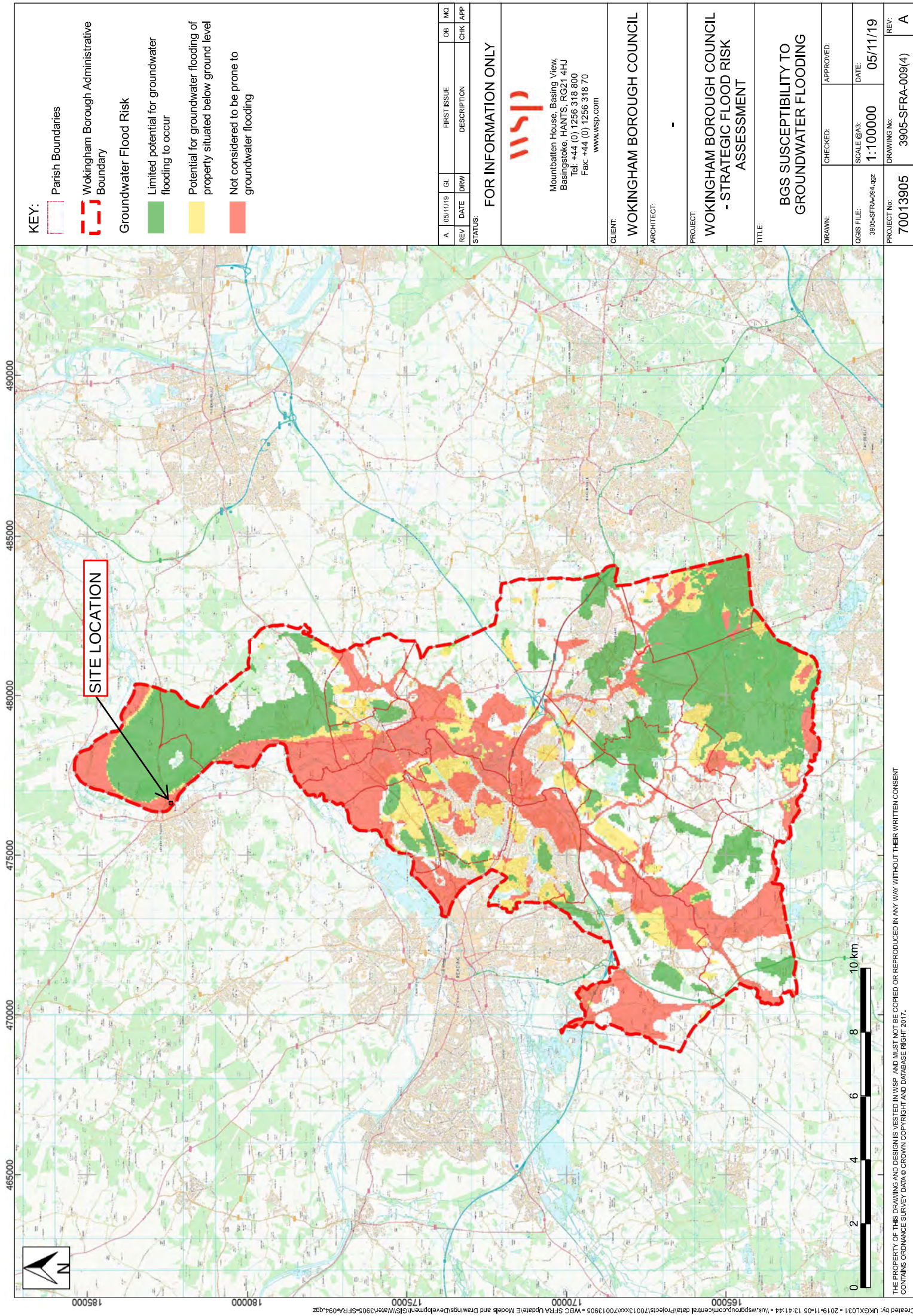
- 6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0800 009 4540.



Technical Note – Flood Risk Assessment and Outline Drainage Strategy

DATE:	12 October 2022	CONFIDENTIALITY:	Confidential
SUBJECT:	Technical Note – Flood Risk Assessment and Outline Drainage Strategy		
PROJECT:	70094722	AUTHOR:	KW
CHECKED:	QW	APPROVED:	TK

APPENDIX C – FLOOD MAPPING



KEY:

- Parish Boundaries
- Wokingham Borough Administrative Boundary
- Groundwater Flood Risk
 - Limited potential for groundwater flooding to occur
 - Potential for groundwater flooding of property situated below ground level
 - Not considered to be prone to groundwater flooding

REV		GL	DATE	DRW	FIRST ISSUE	OB	NO
STATUS		DESCRIPTION		CHK		APP	
A		05/11/19					

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WSP

Mountbatten House, Basing View,
Basingstoke, HANTS, RG21 4HU
Tel: +44 (0) 1256 318 800
Fax: +44 (0) 1256 318 70
www.wsp.com

CLIENT:
WOKINGHAM BOROUGH COUNCIL

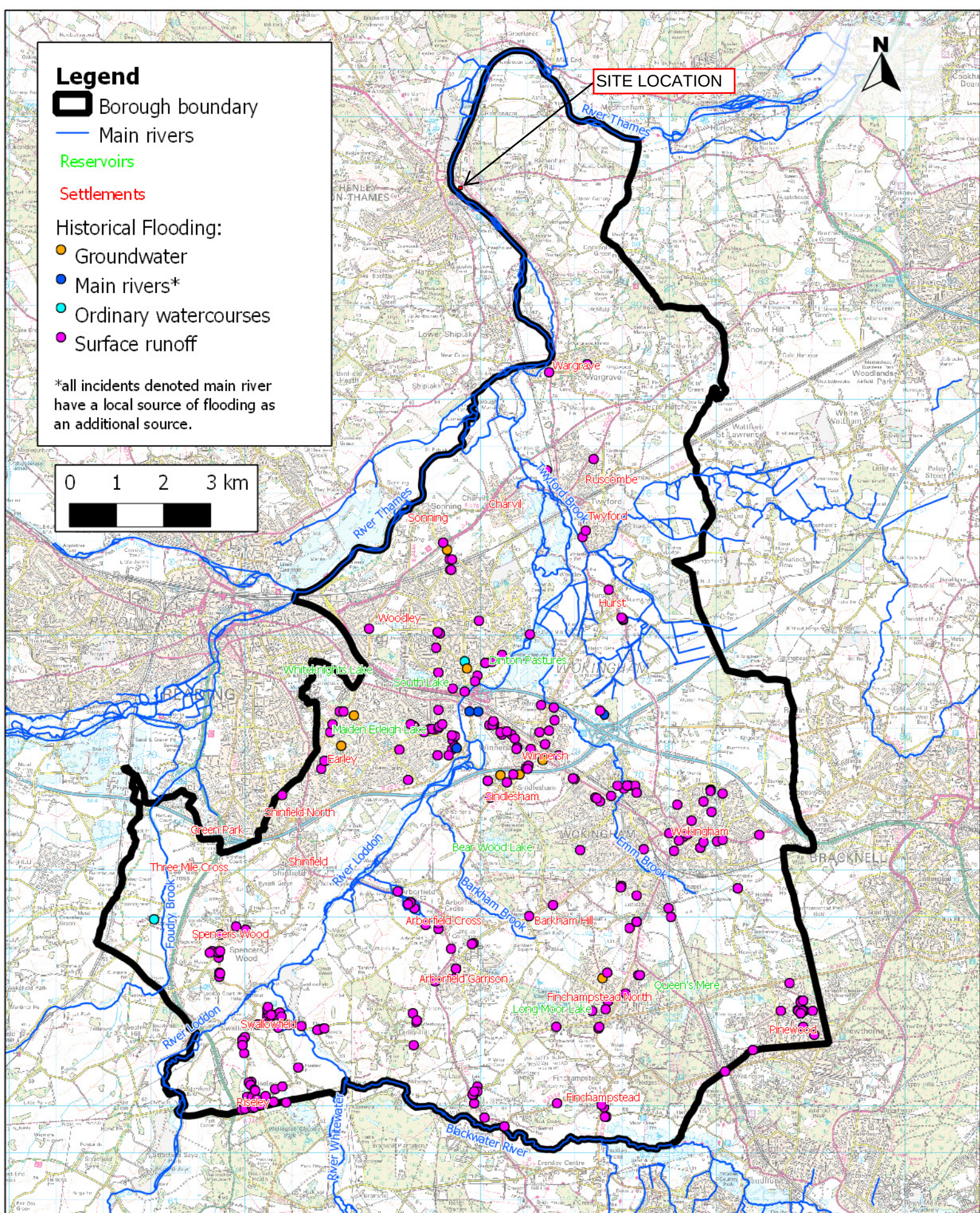
ARCHITECT:
-

PROJECT:

**WOKINGHAM BOROUGH COUNCIL
- STRATEGIC FLOOD RISK
ASSESSMENT**

TITLE:
**BGS SUSCEPTIBILITY TO
GROUNDWATER FLOODING**

DRAWN:	CHECKED:	APPROVED:
OGIS FILE: 3905-SFRA-094-qbz	SCALE @A3: 1:100000	DATE: 05/11/19
PROJECT No: 70013905	DRAWING No: 3905-SFRA-009(4)	REV: A



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Wokingham Preliminary Flood Risk Assessment

Figure 5-1: Historical flooding incidents from local sources of flooding

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Checked by: BV

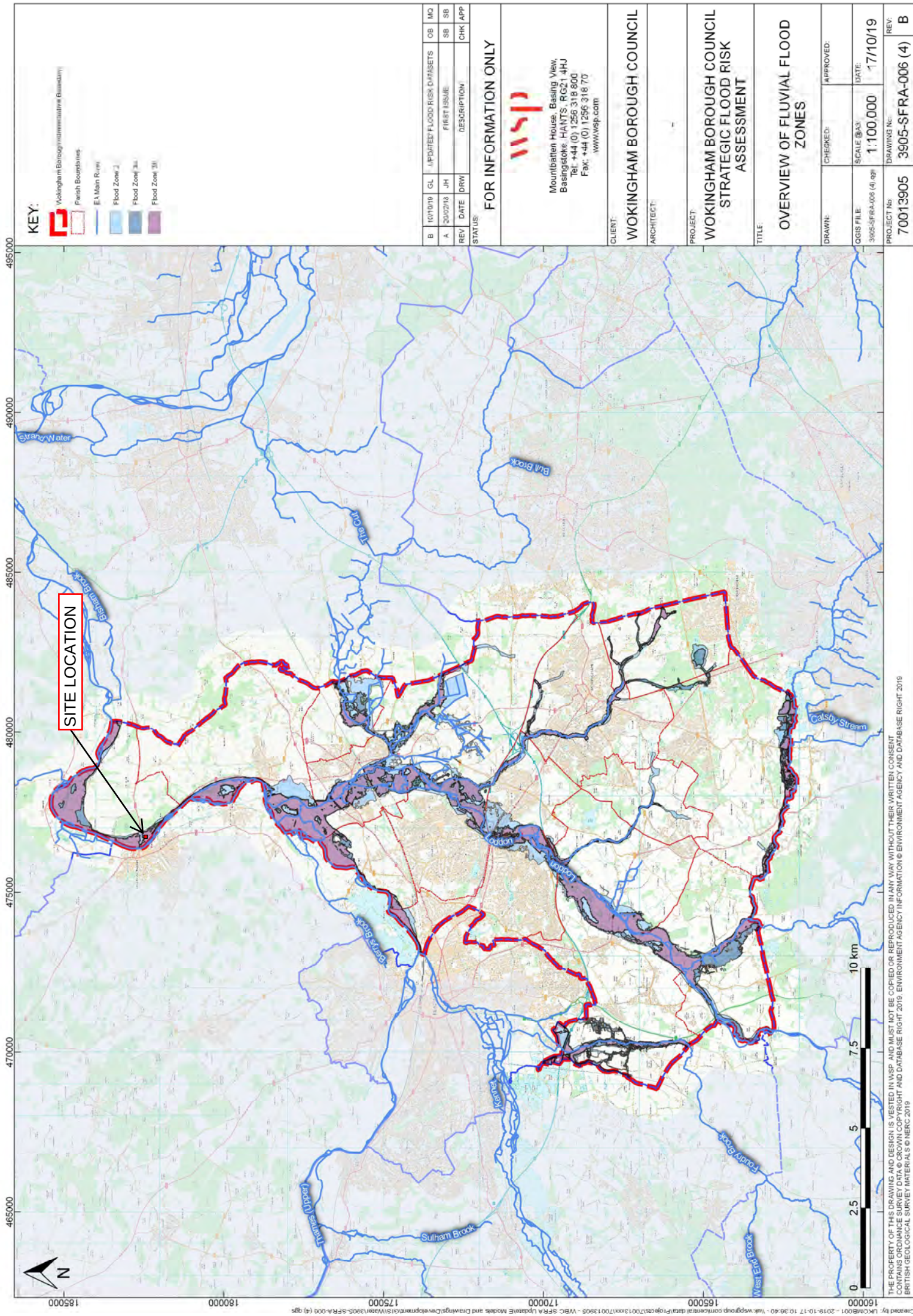
Revision: 3
Date: 10/06/11



Wokingham Borough Council
Civic Offices
Shute End
Wokingham RG40 1BN



Halcrow Group Ltd
Griffin House, 135 High Street
Crawley
West Sussex RH10 1DQ
www.halcrow.com



KEY:

- Wokingham Borough (Administrative Boundary)
- Parish Boundaries
- EA Main River
- Flood Zone 1
- Flood Zone 2
- Flood Zone 3
- Flood Zone 4

REV	DATE	DRW	DESCRIPTION	CHK	APP
B	10/10/19	GL	UPDATED FLOOD RISK DATASETS	OB	MQ
A	20/02/18	JH	FIRST ISSUE	SB	SB

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Mountbatten House, Basing View,
Basingstoke HANTS, RG21 4HJ
Tel: +44 (0) 1256 318 800
Fax: +44 (0) 1256 318 70
www.wsp.com

CLIENT	WOKINGHAM BOROUGH COUNCIL				
ARCHITECT					
PROJECT	WOKINGHAM BOROUGH COUNCIL STRATEGIC FLOOD RISK ASSESSMENT				
TITLE	OVERVIEW OF FLUVIAL FLOOD ZONES				
DRAWN:	CHECKED:	APPROVED:	SCALE @ A3	DATE:	REV:
3905-SFRA-006 (4) 09			1:100,000	17/10/19	B
PROJECT No	DRAWING No				
70013905	3905-SFRA-006 (4)				



Technical Note – Flood Risk Assessment and Outline Drainage Strategy

DATE:	12 October 2022	CONFIDENTIALITY:	Confidential
SUBJECT:	Technical Note – Flood Risk Assessment and Outline Drainage Strategy		
PROJECT:	70094722	AUTHOR:	KW
CHECKED:	QW	APPROVED:	TK

APPENDIX D HYDRAULIC MODELLING STUDY

Hydraulic Modelling Study at Thamesfield, Wargrave Road, Henley-On-Thames

Draft report

May 2022

www.jbaconsulting.com



RV Services Limited
3rd Floor
123 Victoria Street
London
SW1E 6RA

JBA Project Manager

Olivier Saillofest
The Library
St Philips Courtyard
Church Hill
Coleshill
Warwickshire
UNITED KINGDOM
B46 3AD

Revision History

Revision Ref/Date	Amendments	Issued to
S03-P01 / May 2022	Draft Report	Caroline Keiller (RV Services Limited)

Contract

JBA were contacted on 8/12/2021 by Niall Greenan of WSP on behalf of RV Services Limited to commission this report. This report describes work commissioned by RV Services Limited. RV Services Limited representative for the contract was Caroline Keiller. Emelie Persson and Olivier Saillofest of JBA Consulting carried out this work.

Prepared by Emelie Persson BSc PgCert

Assistant Analyst

Reviewed by Olivier Saillofest BEng MSc CEng MCIWEM
C.WEM

Technical Director

Purpose

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Executive summary

JBA Consulting were commissioned by RV Services Limited to undertake a fluvial water hydraulic modelling study at Thamesfield, Wargrave Road, Henley-On-Thames.

The proposed development located off Wargrave Road, Henley-On-Thames. The surrounding area is a mix of residential and greenfield land. The site is located adjacent to the River Thames (which flows in a northerly direction southwest of the site).

To assess the risk of fluvial flooding at the site, a license has been obtained from the Environment Agency (EA) to re-use the existing 1D-2D Thames Mapledurham to Hurley hydraulic model (2019) of the River Thames. The existing model has been re-run with an updated version of Flood Modeller – TUFLOW, site-specific topographic survey data and cross-sectional data of Henley Bridge.

The model has been run for the baseline scenario for 20-year, 100-year, 100-year with 31% climate change and 1,000-year events in order to determine the existing fluvial flood risk to the site.

In line with the new guidance on Climate Change issued by the Environment Agency in July 2021¹, the effect of climate change was assessed by increasing 100-year peak flows by 31% for the fluvial model (higher central climate change allowance for essential infrastructure developments within the Thames and Chilterns South management catchment).

Results from the hydraulic model were tested for their sensitivity to changes in Manning's roughness, downstream boundary conditions, and flows. A blockage risk scenario was undertaken for Henley Bridge during the 100-year with climate change flood event. Results from the sensitivity analysis indicate that the model results within the site are relatively insensitive to changes in roughness, downstream boundary or changed flow conditions.

Results from the updated model runs show that:

- Water enters the site from overtopping of the River Thames from all of the modelled 20-year, 100-year, 100-year +31% CC and 100-year fluvial flood events, as illustrated in Figure 0-1.
- The peak flood depth predicted within the site during the 100-year with 31% climate change event is 1.89m.
- During the 100-year with 31% climate change event, peak water levels are predicted exceed the existing flood levels in 2 off the existing buildings within the site boundary.
- During the 100-year with 31% climate change scenario the majority of the site falls 'low' to 'significant' hazard categories on the Defra Hazard to People map.
- The blockage risk analysis undertaken at Henley Bridge (node 32.078BU) during the 100-year with climate change flood event indicates that when a 25% blockage is applied, a significant increase in maximum flood depths of up to 0.77m is predicted within the site.

1 <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>



Figure 0-1: Baseline fluvial flood extents

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Abbreviations

1D	One Dimensional
2D	Two Dimensional
CC	Climate Change
DTM	Digital Terrain Model
EA	Environment Agency
ESTRY	Primary 1D engine used by TUFLOW
FEH	Flood Estimation Handbook
FFL	Finished Floor Levels
GCS	Grantham Coates Surveyors
Ha	Hectares
HQ	Head-Flow
JBA	Jeremy Benn Associates
LiDAR	Light Detection and Ranging
m AOD	Metres Above Ordnance Datum
QT	Flow-Time
ReFH	Revitalised Flood Hydrograph
RoFSW	Risk of Flooding from Surface Water
TUFLOW	2D Hydraulic Modelling Software

1 Introduction

1.1 Terms of reference

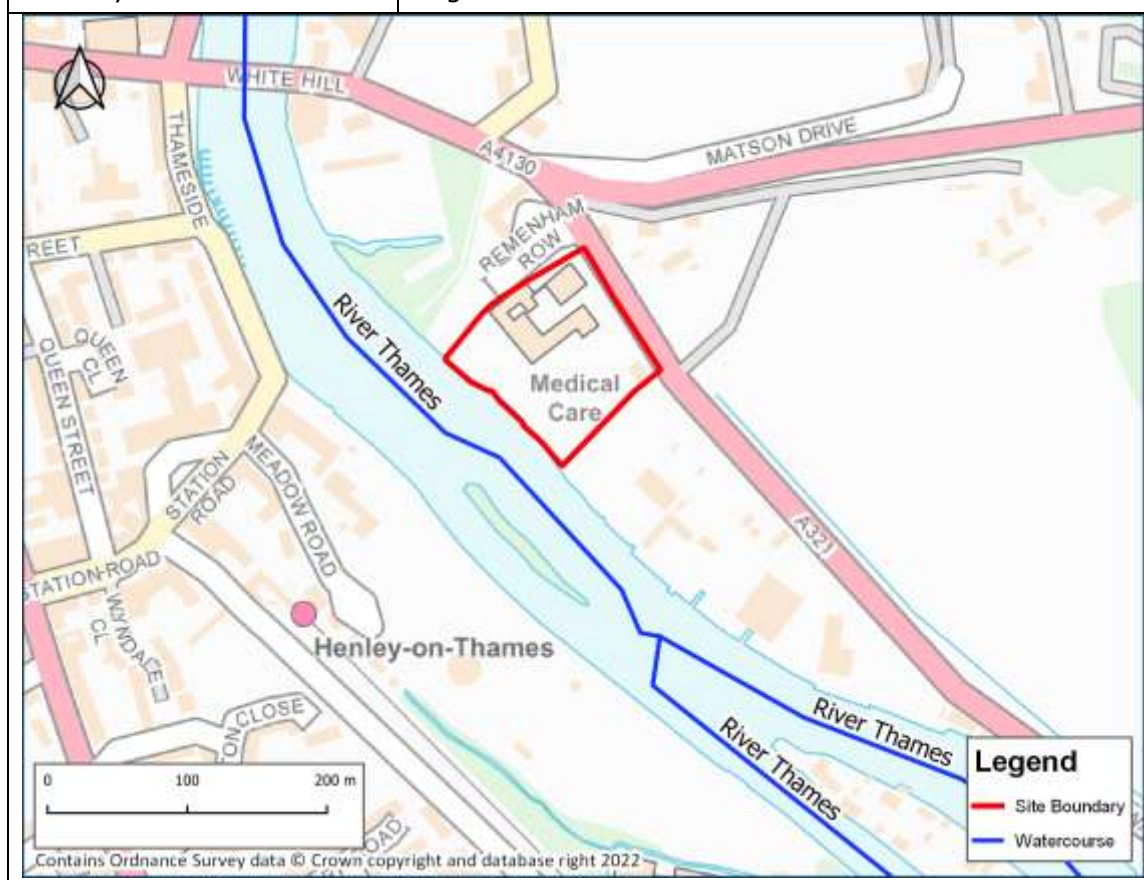
JBA Consulting (JBA) were commissioned by RV Services Limited to undertake a fluvial hydraulic modelling study at Thamesfield, Wargrave Road, Henley-On-Thames.

To support this assessment, the 2019 Thames Mapledurham to Hurley 1D-2D hydraulic model was re-used and re-run with the latest versions of Flood Modeller – TUFLOW and with inclusion of new site-specific topographic survey data to allow accurate representation of the fluvial flood levels, extents and hazards within the site boundary.

1.2 Site details

Table 1-1: Site details

Site name	Thamesfield, Wargrave Road, Henley-On-Thames, RG9 2LX
Site area	1.24ha
Existing land-use	Residential (retirement living accommodations)
OS NGR	SU765824
County	Oxfordshire
Country	England



1.3 Site description

The proposed development site is located off Wargrave Road, Henley-On-Thames. The surrounding area is a mix of residential and greenfield land. The site is currently occupied by an existing retirement village with 35 apartments and a 12-bed care home. The proposal is looking at potential redevelopment opportunities for the site to deliver additional homes and improved facilities.

The River Thames is located immediately adjacent to the site and flows in a northerly direction.

1.4 Existing flood data

It is understood that the Environment Agency's fluvial flood zones currently represents the best source of flood risk information in relation to the site.

To refine flood risk in relation to the site, JBA Consulting was commissioned to carry out an updated version of the detailed fluvial hydraulic modelling study in relation to the proposed development site.

1.5 General approach

The existing 1D-2D Thames Mapledurham to Hurley Hydraulic model was obtained from the EA and re-used as part of this project.

The existing model has been updated with new survey data of Henley Bridge and the flood relief culverts located approximately 100 m east of the bridge / 120m northwest of the site. The model is using LiDAR data from the Defra website (flown in 2018 with a 1m grid resolution) and site topographic survey data collected in June 2021 by Point 2 Surveyors Limited, provided in Appendix A.

Given the age of the latest EA model update, flow estimates are deemed representative of current conditions and thus do not need updating. The model has been run for the baseline defended scenario for the 20-year, 100-year, 100-year with 31% climate change and 1000-year flood events in order to determine the existing flood risk to the site.

1.6 Limitations

The 1D-2D Thames Mapledurham uses a 2D grid cell size of 20m within the site area. Given the model run times (i.e. between 1 day and 20hrs) and the prominent location of the site in the Thames floodplain, no attempts were made to refine the model grid cell size. Where results show partial flooding of a building in the model, a comparison of the modelled peak water level with the building floor level was carried and, when relevant, the building was filtered away from the mapped flood extent.

2 Model build phase

2.1 Model geometry

2.1.1 Data availability

The LiDAR used to represent the ground levels within the floodplain has a grid resolution 1m and was last flown in 2018.

Site topographic survey collected by Point 2 Surveyors Limited in June 2021 was provided by the client and used to represent ground levels within the site (see Appendix A). Survey of Henley bridge and the 6 flood relief culverts located approximately 100 m east of the bridge was collected by Grantham Coates Surveys Ltd in March 2022 (see Appendix B).

2.1.2 Model extent and build

2.1.2.1 Fluvial model

To understand fluvial flood risk to the site, the 1D-2D Mapledurham to Hurley 2019 model was obtained from the Environment Agency and re-used as part of this study. The hydraulic model represents the River Thames, and the floodplain in the vicinity of the proposed site. The extent of the fluvial model developed for this study is shown in Figure 2-1.

The channels were represented as 1-dimensional (1D) features using Flood Modeller (version 4.6.0). The 1D model begins approximately 24.6km upstream of the proposed development site and the model extends approximately 7.3km downstream of the site.

The 2D domain was represented using TUFLOW (2020-01-AB-iSP-w64) with floodplain topography represented using LiDAR data. The 2D domain for the fluvial model has an area of 8.27km² and a 5m grid resolution.

The orientation of the grid is southeast to northwest, representing the main direction of floodplain flows. The 1D and 2D domains can be seen in Figure 2-1.

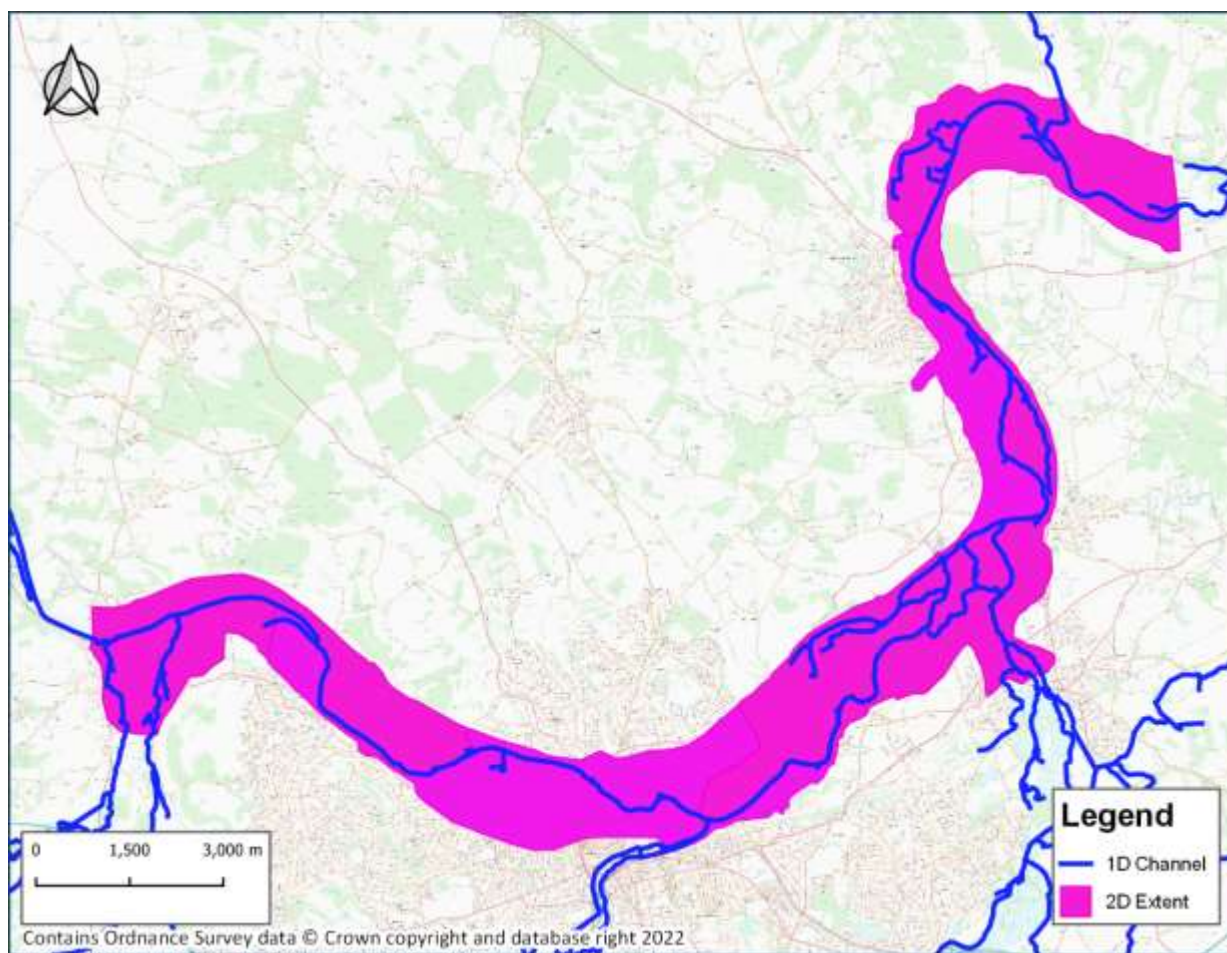


Figure 2-1: Model extent

2.1.3 Model roughness parameters

Manning's n values from the 2019 Thames Mapledurham to Hurley model was re-used to represent roughness values for the channel and floodplain. Table 2-1 gives the range of Manning's n values used in the 1D and 2D domains.

Table 2-1: Manning's n range within the hydraulic model	
1D Channel	0.025 – 0.05 (in channel) 0.075 (banks)
Buildings	0.300
General surface	0.050 – 0.060
Glasshouse	0.200
Inland water	0.045
Landform	0.060
Boulders	0.065
Trees	0.012 – 0.060
Rail	0.045
Roads	0.035

2.2 Model boundary conditions

2.2.1 Model inflows

Flow estimates from 2019 Thames to Mapledurham to Hurley hydraulic model was updated in line with the new guidance on Climate Change issued by the Environment Agency in July 2021², the effect of climate change was assessed by increasing 100-year peak flows by 31% for the model (higher central climate change allowance for essential infrastructure developments within the Thames and Chilterns South management catchment).

2.2.2 Downstream boundary conditions

The original downstream boundary conditions used in the 2019 Thames to Mapledurham to Hurley hydraulic model was kept in this study. *A rating curve extracted from the Lower Thames modelling was used to derive boundary conditions the model. This characterises the flow vs stage relationship upstream of Hurley Lock for both the channel and the floodplain. The downstream boundary condition was informed by plotting stage vs discharge pairings for the rising limb from each of the design events simulated for the Lower Thames flood risk modelling (20%, 10%, 5%, 3.33%, 4%, 2%, 1.33%, 1%, 0.5% and 0.1% AEP events). Given the close proximity of the downstream boundary location to the Lower Thames model inflow (at Hambleden Lock) the flow data informing the stage vs discharge pairings is based on the Lower Thames model inflow to remove complexity of extracting 1D channel and 2D floodplain flows from the Lower Thames model³.*

² <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

³ JBA Consulting for Environment Agency. Thames Mapledurham – Final Model Report (v2 Mar 2019)

2.3 Calibration

The 2019 Thames Mapledurham to Hurley hydraulic model was calibrated to historic flood events. As a result, new calibration has not been carried out on the model results, however sensitivity testing has been carried out to provide confidence in the model parameters, see Appendix C.

2.4 Model Runs

2.4.1 Modelled scenarios

The following flood scenarios were simulated by the model:

Baseline scenarios

- 20-year (5% AEP) fluvial flood event;
- 100-year (1% AEP) fluvial flood event;
- 100-year (1% AEP) plus Climate Change (31%) fluvial flood event;
- 1000-year (0.1% AEP) fluvial flood event.

Blockage scenario

- 100-year (1% AEP) plus Climate Change (31%) fluvial flood event – Henley Bridge (32.078BU) downstream of the site blocked by 25%.

Sensitivity analysis

- 100-year (1% AEP) flood event with +20% increase in peak flows;
- 100-year (1% AEP) flood event with +20% increase in roughness value;
- 100-year (1% AEP) flood event with -20% decrease in roughness value;
- 100-year (1% AEP) flood event with +250mm increase in peak water level at the downstream model boundary.

The results of the baseline and blockage scenarios are discussed in the following section with sensitivity analysis included in Appendix C of this report.

3 Hydraulic model results

3.1 Baseline flood extents

Flood extents for the 20-year, 100-year and 1,000-year fluvial flood events are shown in Figure 3-1.



Figure 3-1: Baseline flood extents (20-year, 100-year and 1,000-year)

Figure 3-1 shows that the capacity of the River Thames is exceeded during all of the modelled events and flooding occurs on the site for all of the three modelled events. Flood extent for the 100-year with (+31%) climate change is represented in Figure 3-2.

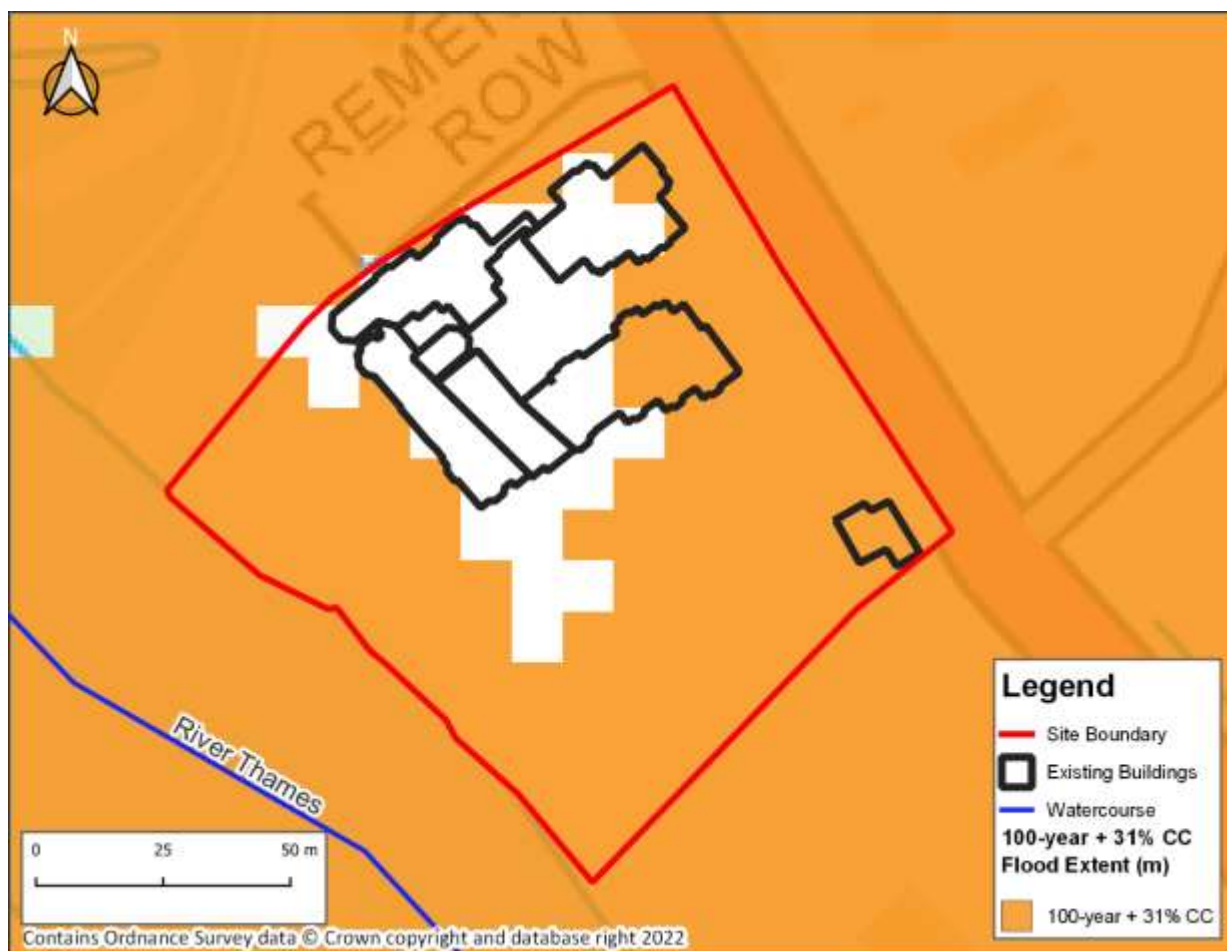


Figure 3-2: Baseline 100-Year flood extents with 31% climate change scenario

Figure 3-2 shows that the extent of flooding during the 100-year with 31% climate change scenario.

3.2 Baseline flood depths

The baseline flood depths during the 100-year with 31% climate change event in the vicinity of the site are shown in Figure 3-3.

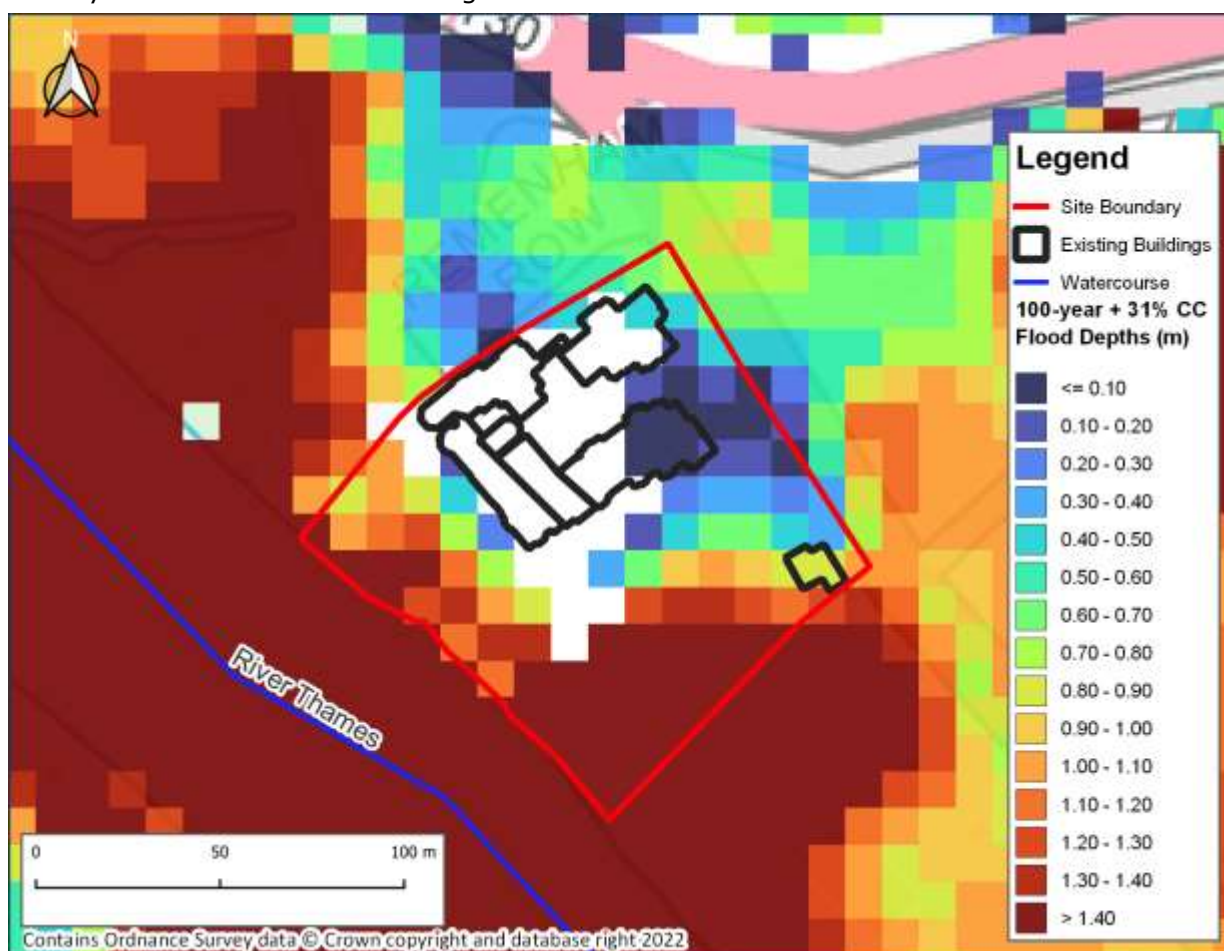


Figure 3-3: Baseline 100-year flood depths with 31% climate change scenario

Figure 3-3 shows the maximum predicted flood depths within the site during the 100-year with 31% climate change event. An approximate maximum depth of 1.89m is predicted within the southern part of the site.

3.3 Baseline flood levels

The baseline flood levels during the 100-year with 31% climate change return period are shown within Figure 3-4 below.

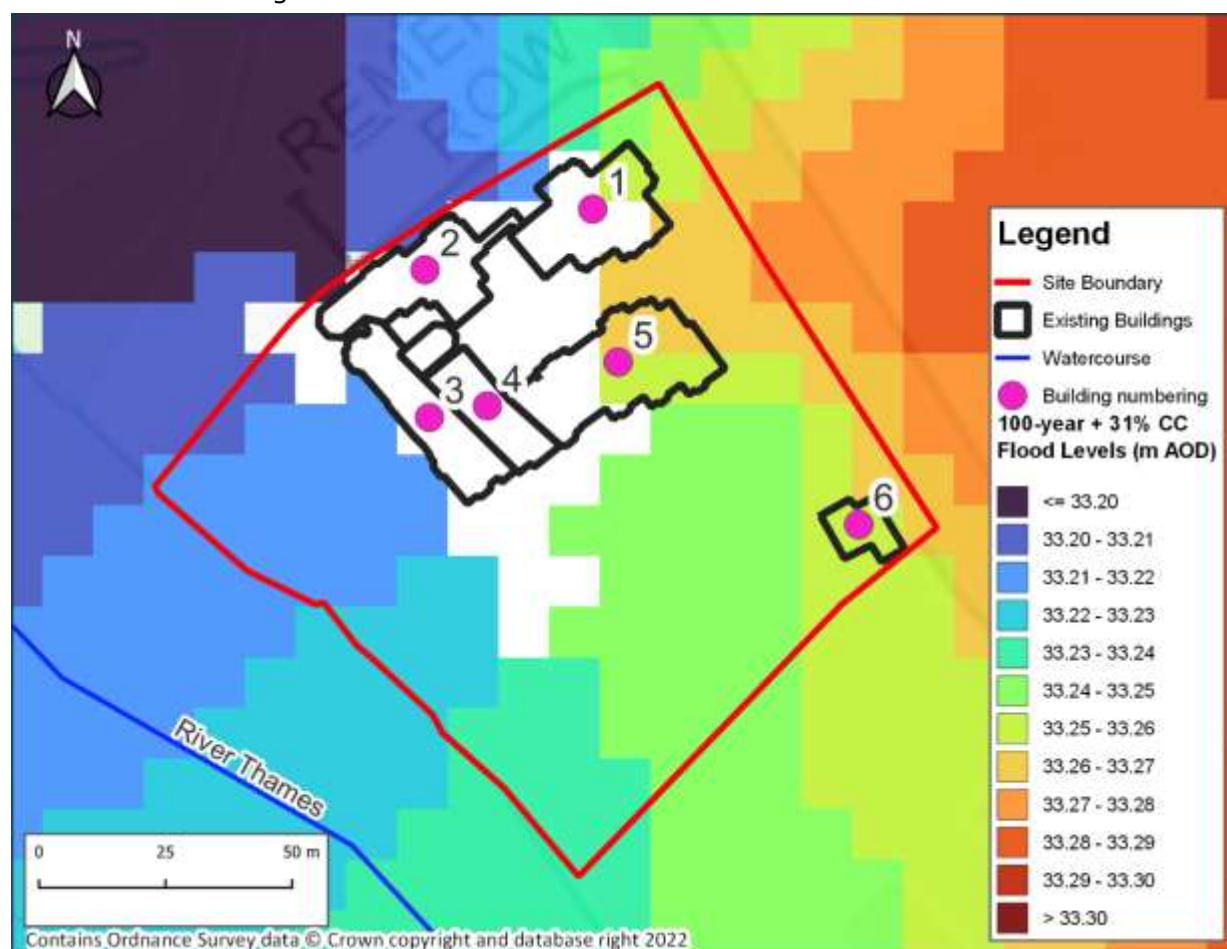


Figure 3-4: Baseline 100-year water levels with 31% climate change scenario

Figure 3-4 shows peak water levels during the 100-year with 31% climate change event. Peak water levels related to each existing building are displayed in Table 3-1.

Table 3-1: Peak Water Levels		
Building	Existing floor levels (m AOD)*	Peak water levels within existing building (m AOD)
1	33.26	33.27
2	33.83	33.20
3	33.84	33.22
4	33.48	No flooding
5	33.26	33.26
6	32.60	33.26

*: Estimated from Point 2 Surveyors Limited topographic survey dated June 2021

Table 3-1 shows that, during the 100-year with 31% climate change event, peak water levels are expected to exceed the existing floor levels for building 1 by 0.01m and by 0.66m for building 6.

3.4 Blockage risk analysis

Given the site's location in relation to Henley Bridge, a blockage risk analysis was undertaken. Figure 3-5 shows the location of the node 32.078BU in the model, where a 25% blockage was considered.

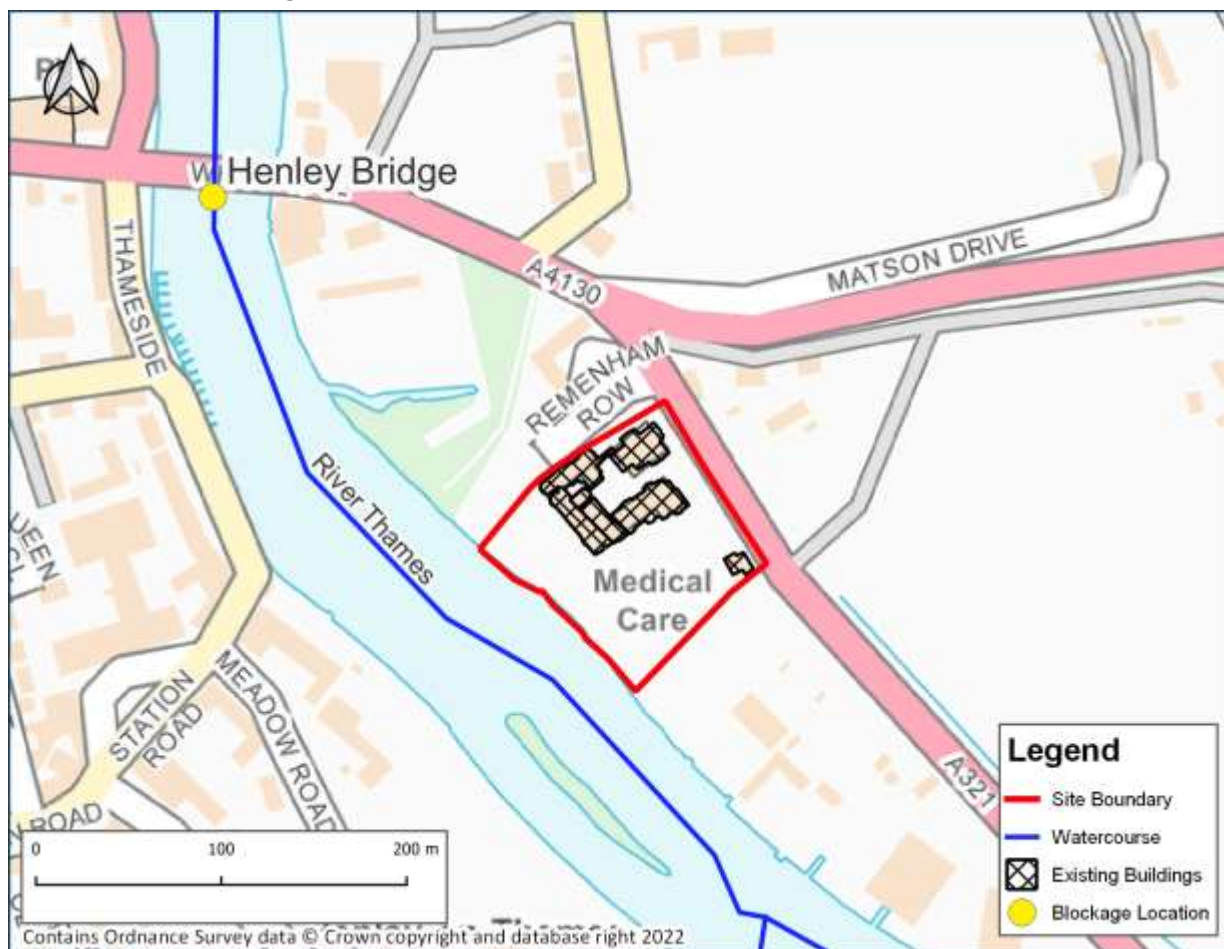


Figure 3-5: Baseline Blockage Risk Analysis location

Figure 3-6: Baseline Blockage Analysis (100-year + 31% climate change) shows the peak flood elevation during 100-year plus 31% climate change flood event when a 25% blockage is applied to Henley Bridge (node 32.078BU).



Figure 3-6: Baseline Blockage Analysis (100-year + 31% climate change)

When compared with Figure 3-4, Figure 3-6 shows that a 25% blockage at Henley Bridge during a 100-year plus 31% climate change flood event will generate an increase of up to 0.77m (approximately) in flood level at the site.

3.5 Hazard-to-people classification

The fluvial hazard-to-people rating during a 100-year with (31%) climate change flood scenario has been mapped using the formula as suggested in Defra's FD2321/TR2 "Flood Risk to People". The different hazard categories are shown in Table 3-2 and the hazard classification to the site during the 100-year with (31%) climate change scenario is shown in Figure 3-7.

Table 3-2: Defra's FD2321/TR2 "Flood Risks to People" classifications

Flood hazard rating depth (velocity+0.5) + DF	Level of Flood Hazard Description	Class label
<0.75	Low	Caution "Flood zone with shallow flowing water or deep standing water"
0.75 to 1.25	Moderate	Dangerous for some (i.e. Children) "Danger: flood zone with deep or fast flowing water"
1.25 to 2.00	Significant	Dangerous for most "Danger: flood zone with deep fast flowing water"
>2.00	Extreme	Dangerous for all "Extreme danger: flood zone with deep fast flowing water"

Using the hazard equation $HR = d(v+0.5) + DF$
Where d = depth of flooding (m) v = velocity of floodwaters (m/sec) DF = debris factor

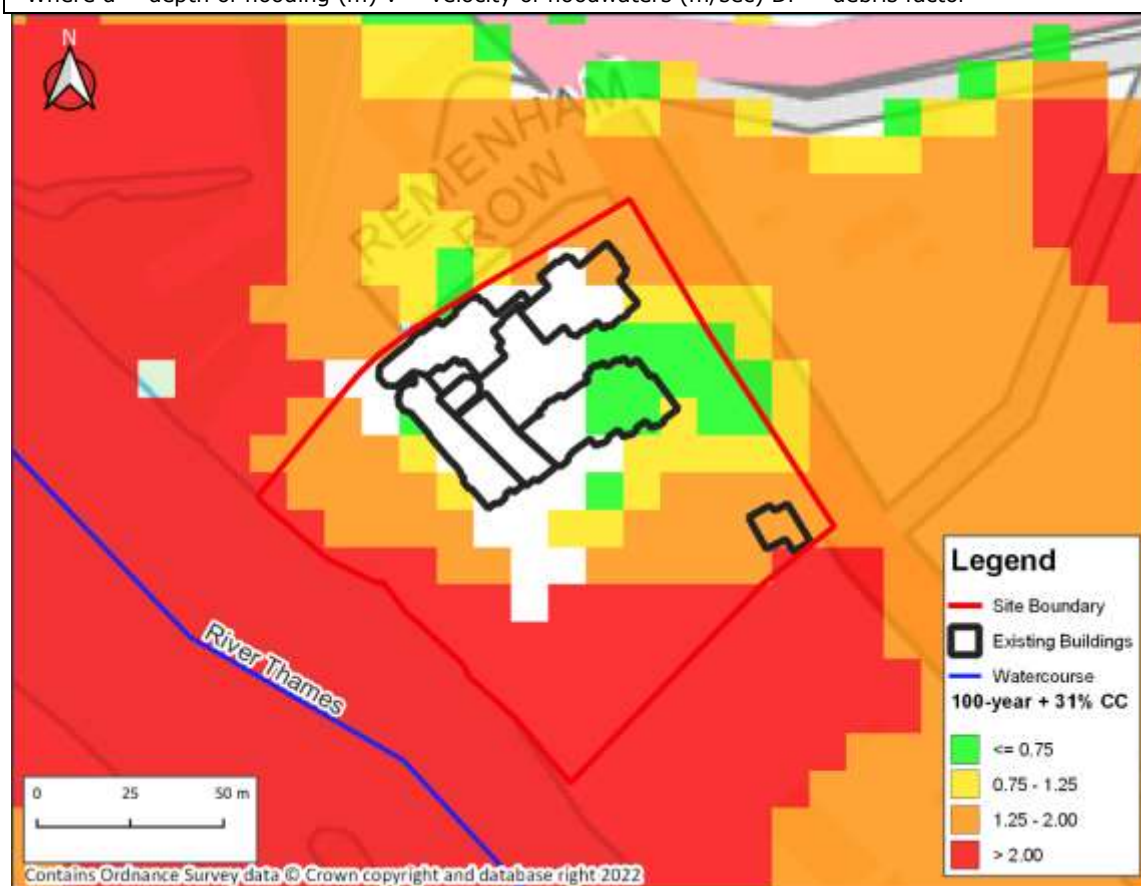


Figure 3-7: Baseline Hazard to People

Figure 3-7: Baseline Hazard to People shows that the Hazard to People rating for the majority of the site and along the A321 (which runs alongside the north-eastern site boundary) fall within the 'low' to 'significant' hazard categories.

4 Conclusions and Recommendations

- JBA Consulting were commissioned by RV Services Limited to undertake a fluvial water hydraulic modelling study at Thamesfield, Wargrave Road, Henley-On-Thames.
- The model has been run for the baseline scenario for 20-year, 100-year, 100-year with 31% climate change and 1,000-year events in order to determine the existing fluvial flood risk to the site.
- Results from the hydraulic model were tested for their sensitivity to changes in Manning's roughness, downstream boundary conditions, and flows. A blockage risk scenario was undertaken for Henley Bridge during the 100-year with climate change flood event. Results from the sensitivity analysis indicate that the model results within the site are relatively insensitive to changes in roughness, downstream boundary or changed flow conditions.
- Results from the updated model runs show that:
 - Water enters the site from overtopping of the River Thames from all of the modelled 20-year, 100-year, 100-year +31% CC and 100-year fluvial flood events, as illustrated in Figure 0-1.
 - The peak flood depth predicted within the site during the 100-year with 31% climate change event is 1.89m.
 - During the 100-year with 31% climate change event, peak water levels are predicted exceed the existing flood levels in 2 off the existing buildings within the site boundary.
 - During the 100-year with 31% climate change scenario the majority of the site falls 'low' to 'significant' hazard categories on the Defra Hazard to People map.
 - The blockage risk analysis undertaken at Henley Bridge (node 32.078BU) during the 100-year with climate change flood event indicates that when a 25% blockage is applied, a significant increase in maximum flood depths of up to 0.77m is predicted within the site.

Appendices

A Appendix A – Site topographic survey

B Appendix B – Survey of Henley Bridge

C Appendix C – Sensitivity analysis

The hydraulic model was tested for sensitivity to key model parameters which might impact flood risk at the proposed development site. This included the following scenarios:

- Increasing flows by 20%
- Increasing the Manning's n values by 20%. This both in the Flood Modeller 1D channel and in the 2D TUFLOW domain.
- Increasing the downstream boundary water levels by 250mm

The following sections discuss the impacts of these sensitivity scenarios.

C.1 Sensitivity to flow

Figure E-4-1 shows the changes in peak water level compared to the baseline 100-year event when an increase of 20% is applied to all inflows.

Figure E-4-1: Sensitivity analysis for +20% inflows



Figure E-4-1 indicates there that there are minimal changes in the peak water level results when increasing the flow with 20%. As a result, the model is considered to be insensitive to increases in flow.

C.2 Sensitivity to roughness

Figure E-4-2 shows the changes in peak water level compared to the baseline 100-year event when a change of +20% is applied Manning's 'n' in both the 1D and 2D domains.

Figure E-4-2: Sensitivity to changes of +20% in roughness

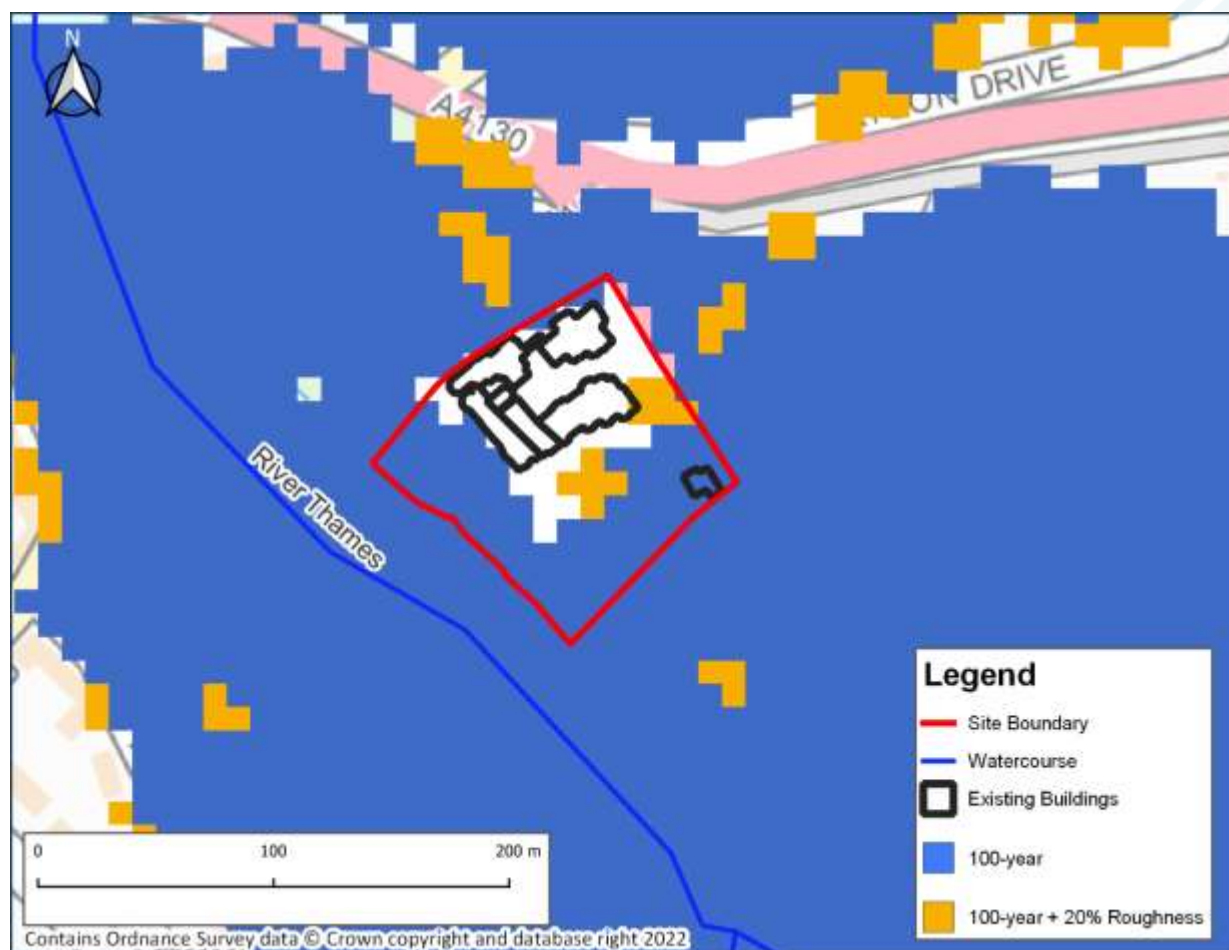


Figure E-4-2 indicates that, the model is relatively insensitive to the roughness values applied to the 1D and 2D domains within the site boundary, with minor changes in the peak flood extents predicted to occur within the south-eastern edge of the site boundary when roughness is increased by +20%.

C.3 Sensitivity to downstream boundary conditions

Figure E-4-3 shows the changes in peak water levels compared to the baseline 100-year event when an increase of 250mm in water level is applied to the downstream model boundary condition.

Figure E-4-3: Sensitivity analysis for +250mm in water level at downstream boundary

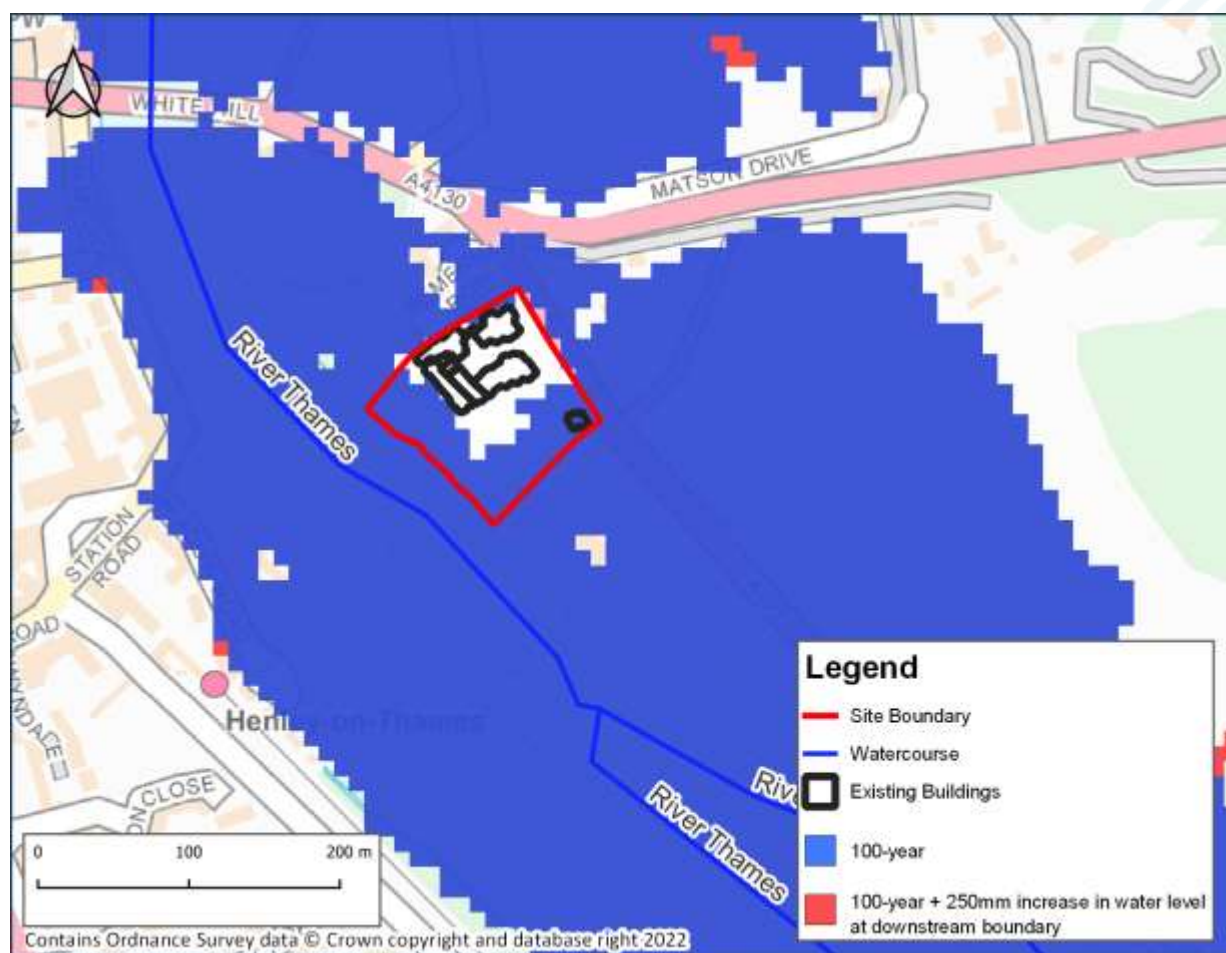


Figure E-4-3 indicates that minimal change can be seen due to the increase in water level at the downstream boundary. As a result, the model is insensitive to changes in downstream boundary condition within the site.

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North Yorkshire
BD23 3FD
United Kingdom

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B Flood Warning and Evacuation Plan (WSP)



RETIREMENT VILLAGES

THAMESFIELD

FLOOD WARNING AND EVACUATION PLAN





RETIREMENT VILLAGES

THAMESFIELD

FLOOD WARNING AND EVACUATION PLAN

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70089182

OUR REF. NO. TRV-WSP-RP-001

DATE: JULY 2022

RETIREMENT VILLAGES

THAMESFIELD

FLOOD WARNING AND EVACUATION PLAN

WSP

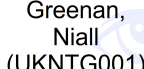
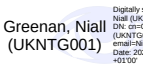
WSP House
70 Chancery Lane
London
WC2A 1AF

Phone: +44 20 7314 5000

Fax: +44 20 7314 5111

WSP.com

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APPENDICES

APPENDIX A

COMMUNITY & PERSONAL FLOOD PLAN TEMPLATES

APPENDIX B

FLOOD EVACUATION ROUTE



EXECUTIVE SUMMARY

This Flood Warning and Evacuation Plan (FWEP) was commissioned by Retirement Villages for the existing independent living residents at Thamesfield Villages, Henley-On-Thames, RG9 2LX. This FWEP outlines the flood risk associated with the Site alongside the measures and procedures to be followed in the event of a Flood Warning and necessary evacuation.

Contact Details

Niall Greenan – Associate Director | Niall.Greenan@wsp.com

Qianqian Wu – Senior Engineer | Qianqian.Wu@wsp.com

Kyra Wilson – Graduate Engineer | Kyra.Wilson@wsp.com

1. INTRODUCTION, SCOPE & OBJECTIVES

1.1. OVERVIEW

- 1.1.1. This Flood Warning and Evacuation Plan (FWEP) has been prepared by WSP to advise residents of the Thamesfield Village on awareness and preparation for a flood event so that they can evacuate from the site safely.
- 1.1.2. Thamesfield Village is located on Wargrave Road, Henley-on-Thames, RG9 2LX within Wokingham Borough Council, Berkshire. The site is bound by Wargrave Road (A321) to the North-East and by the River Thames to the South-West as shown in the Site Location plan below. The approximate Easting and Northing for the centre of the Site is 476583, 182479 respectively.

Figure 1 - Indicative Site Location Plan



- 1.1.3. Thamesfield Villages is a part of the Retirement Villages Group providing a selection of independent living solutions suitable for elderly residents, alongside Care & Support Facilities available for the residents 24/7. Thamesfield Village is comprised of 36 units, accommodating up to a total capacity of 45 people at any given time.
- 1.1.4. The Site is situated within Wokingham Borough Council (WBC) & within the South Oxfordshire District Council (SODC).

1.2. SCOPE

- 1.2.1. This FWEP has been prepared because the Site is located within Flood Zone 3b, an area of high probability of flooding from Fluvial & Tidal sources.
- 1.2.2. This FWEP has been produced with reference to the Environment Agency's website, which contains up to date guidance on flooding issues. Relevant flood related planning documents have been used from WBC & SODC including their Strategic Flood Risk Assessments (SFRA) and Local Flood Risk Management Strategies (LFRMS).

- 1.2.3. The Environment Agency's 'Community Flood Plan' & 'Personal Flood Plan' templates are included as **Appendix A**. This should be copied and completed for the residents prior to occupation and kept on file.
- 1.2.4. These documents should be reviewed and updated regularly (annually) to ensure that all information contained within is relevant and up to date. Consideration may need to be given to the following:
 - Do the residents understand their responsibilities in the event of a flood?
 - Does the plan demonstrate any changes in the physical layout of the site?
 - Are the photographs and/or other records of possessions up to date?
 - Are the names, titles and telephone numbers in the plan current?
 - Are the residents being briefed on any changes to the plan?
- 1.2.5. A thorough evaluation has been conducted to ensure that the advice provided within this FWEP is wholly accurate and sufficient in detail at the date of issue. It is the responsibility of the owner and future residents to ensure that any additional risks specific to the property are fully considered. WSP accepts no responsibility for any errors, omissions or misleading statements in this guidance or for any loss, damage or inconvenience caused as a result of relying on this guidance document.

1.3. AIMS AND OBJECTIVES

- 1.3.1. The main aim of this FWEP is to ensure the safest possible evacuation for the residents of Thamesfield Villages in Henley-On-Thames before a major flood event and only in exceptional circumstances during a major flood event.
- 1.3.2. The main objectives of the Flood Warning and Evacuation Plan are to:
 - raise awareness of the risk of flooding at the village.
 - ensure safe evacuation of the residents at Thamesfield Villages before a major flood event and only in exceptional circumstances during a major event.
 - define the areas of responsibility for those partaking in the plan.
 - provide details on flood warning & how to act on them.
 - create procedures for implementing the plan.
 - define an escape route from the village and a dry meeting point.
 - advise on minimising financial loss during a flood event.
 - advise on security procedures during a flood event.

2. SUMMARY OF FLOOD RISK

2.1.1. Reference to GOV.UK's 'Flood Map for Planning' and 'long term flood risk information' maps (which makes use of Environmental Agency's data) is made where appropriate, along with reference to the WBC documents and SODC documents.

2.2. TIDAL FLOODING

2.2.1. Tidal flooding is caused by elevated sea levels or overtopping by wave action.

2.2.2. There is no risk of tidal flooding at the Site.

2.3. FLUVIAL FLOODING

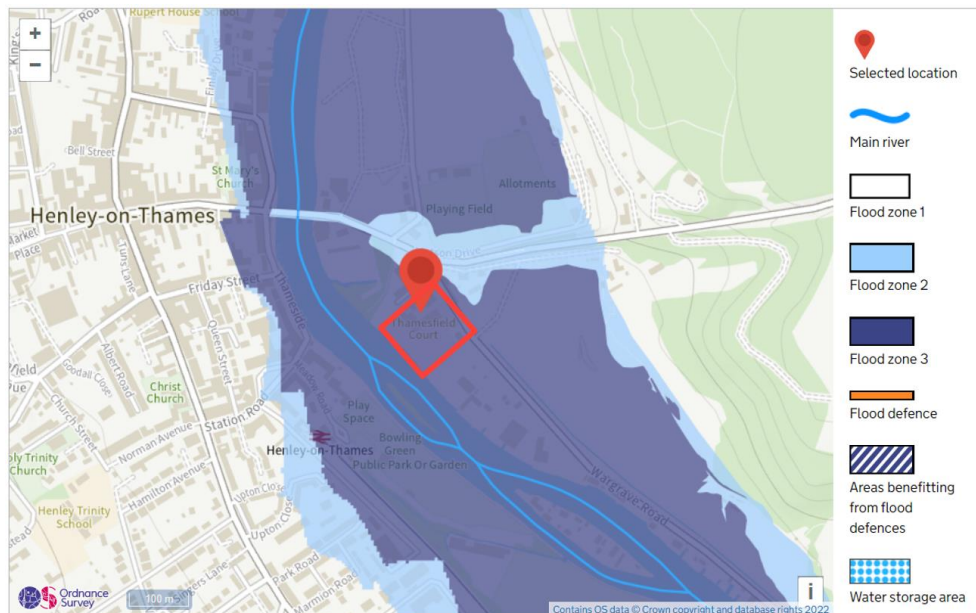
2.3.1. Fluvial flooding is caused by rivers, watercourses or ditches overflowing.

2.3.2. Based on the online GOV.UK Flood Map for Planning, the Site has been identified to lie within Flood Zone 3b - Functional Floodplain i.e. *this zone comprises land where water has to flow or be stored in times of flood*. Please refer to Figure 2.

2.3.3. The WBC SFRA defines Flood Zone 3b - Function Floodplain as:

- Land subject to flooding in the 5% AEP fluvial flood event (1:20 chance), excluding building footprints; and,
- Land which provides a function of flood conveyance (i.e. free flow) or flood storage, either through natural processes, or by design (e.g. washlands and flood storage areas).

Figure 2 - GOV.UK Flood Map for Planning



2.3.4. Based on Hydraulic Modelling undertaken by JBA Consulting, the maximum depth of flooding to occur within the site boundary is 1.89m.

2.3.5. Therefore, the risk of fluvial flooding at the site has been assessed as **high**.

2.4. SURFACE WATER FLOODING

- 2.4.1. Surface water flooding occurs when intense rainfall or overland flow is unable to drain away by traditional means such as into drainage systems or infiltrating into the ground. This excess water could run off quickly off land and result in localised flooding.
- 2.4.2. Based on the online GOV.UK 'Long Term Flood Risk Information', the Site is identified to have 'Very Low' risk of flooding from Surface Water. Please refer to Figure 3.

Figure 3 - GOV.UK Surface Water Flooding Extent



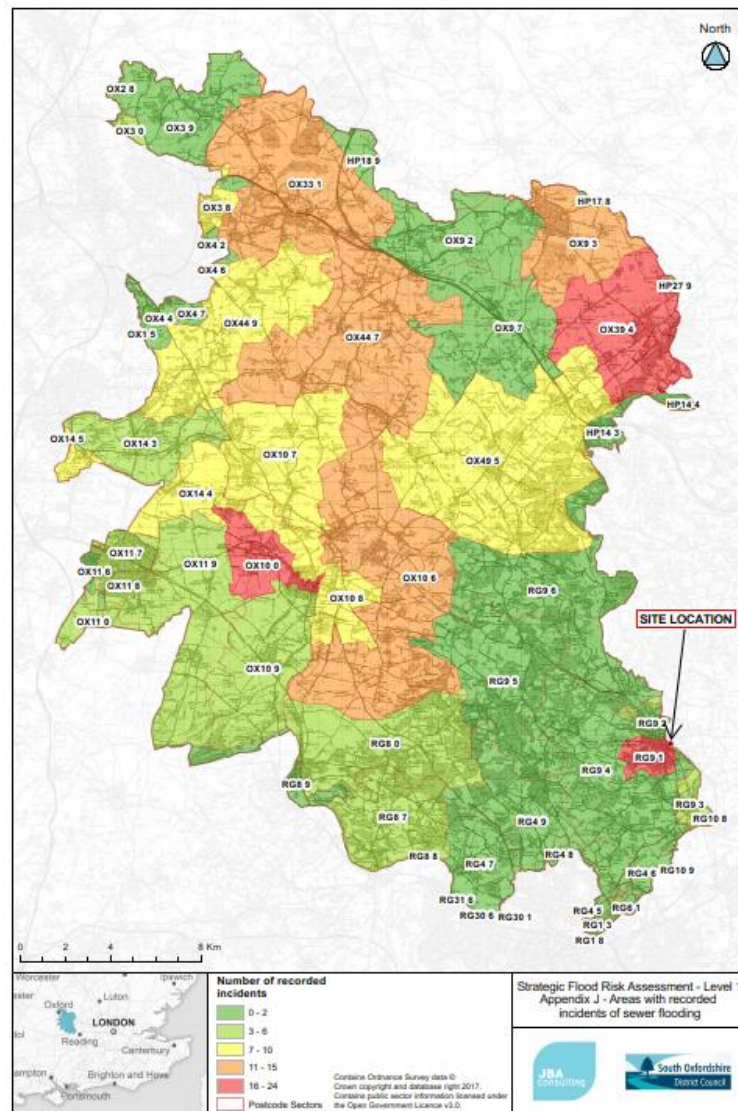
- 2.4.3. Based on the available information the risk of flooding from sewers is considered **negligible**.

2.5. SEWER FLOODING

- 2.5.1. Sewer flooding arises when the drainage system is unable to cope with the volumes of rainfall during an event, causing pipes to back up and surcharge, which may lead to flood flows out of chambers. Flooding can also occur due to the ingress of groundwater into the sewer network, leading to overloading of the sewer system and subsequent flooding.

The SODC SFRA mapping of sewer flooding incidences in the district shows there has been 16-24 incidents of sewer flooding in the vicinity of the Site, however there is no information to state where these sewer floods have occurred specifically. Please refer to Figure 4 below.

Figure 4 - South Oxfordshire District Council Incidence of Sewer Flooding Map



2.5.2. WBC SFRA notes Thames Water maintains records of flooding from their sewers, however due to the Thames Water confidentiality requirements information could only be supplied as the number of flooding incidents by the first part of the post code.

2.5.3. Based on the available information the risk of flooding from sewers is considered **medium**.

2.6. GROUNDWATER FLOODING

2.6.1. Groundwater flooding occurs as a result of water rising up from underlying rocks, typically after long periods of sustained rainfall. It is most likely to occur in low-lying areas underlain by aquifers.

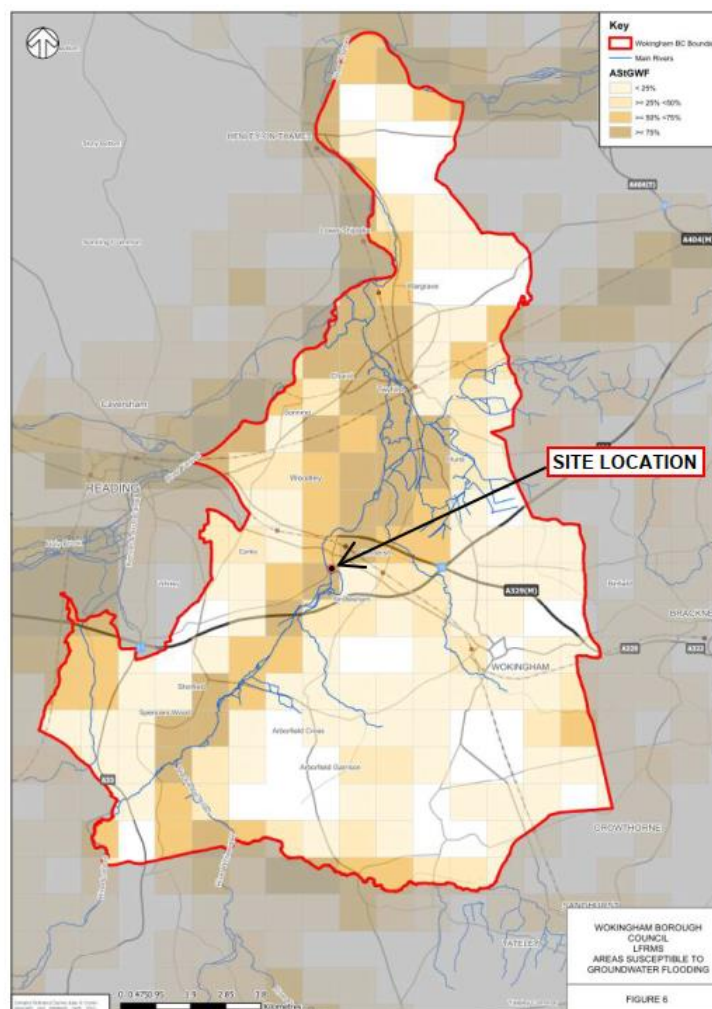
2.6.2. The WBC highlights the high risk of groundwater flooding within their district stating the following:

‘There is a known risk of groundwater flooding within the River Thames floodplain due to the presence of ‘Thames Gravels’. This is a term commonly used to describe the highly permeable soils beneath the historical floodplain of the River Thames. During periods of high-water levels in the river, the local

water table within this gravel layer rises, often resulting in localised groundwater flooding to properties situated away from the direct influence of the river.'

- 2.6.3. The Susceptibility to Groundwater Flooding Map from WBC's LFRMS, confirms this assessment, as an area with greater than 75% susceptibility to groundwater flooding. Please refer to below.

Figure 5 - WBC Groundwater Flooding Areas Susceptible to Groundwater Flooding

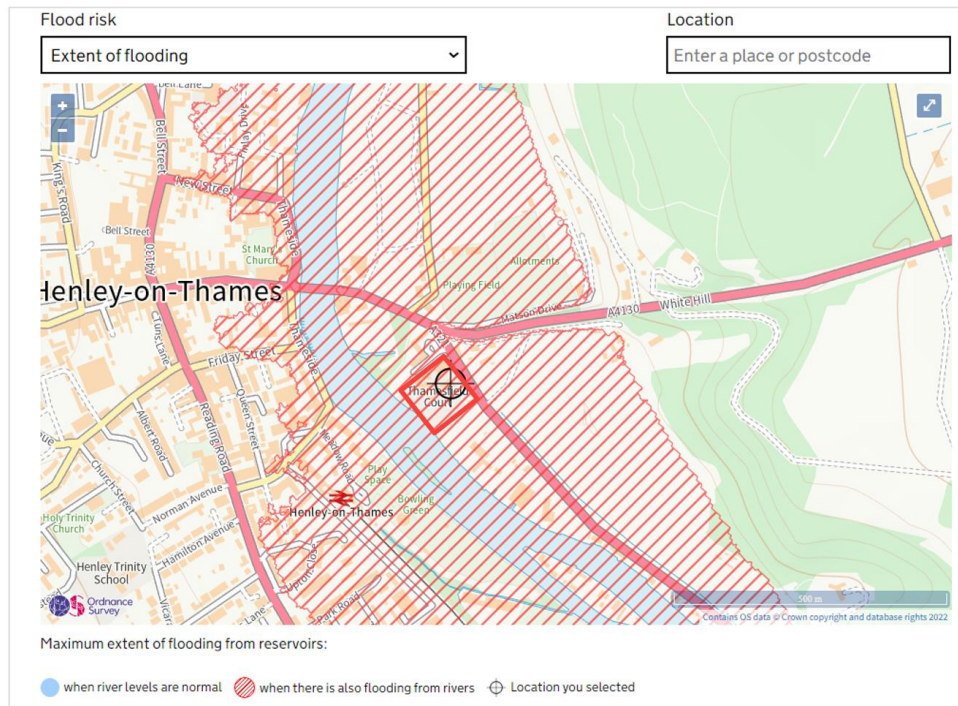


- 2.6.4. Therefore, the risk of groundwater flooding at the site has been assessed to be **high**.

2.7. ARTIFICIAL SOURCES OF FLOODING

- 2.7.1. Areas which lie within the maximum extent of flooding by an uncontrolled release of water from a reservoir are considered to be areas where lives could be threatened.
- 2.7.2. Based on the online GOV.UK's 'Long Term Flood Risk Information', the site has been identified as within the extent of flooding from reservoirs, however only when there is flooding from rivers.
- 2.7.3. Based on the available information, WSP have deemed this flood risk as **low**.

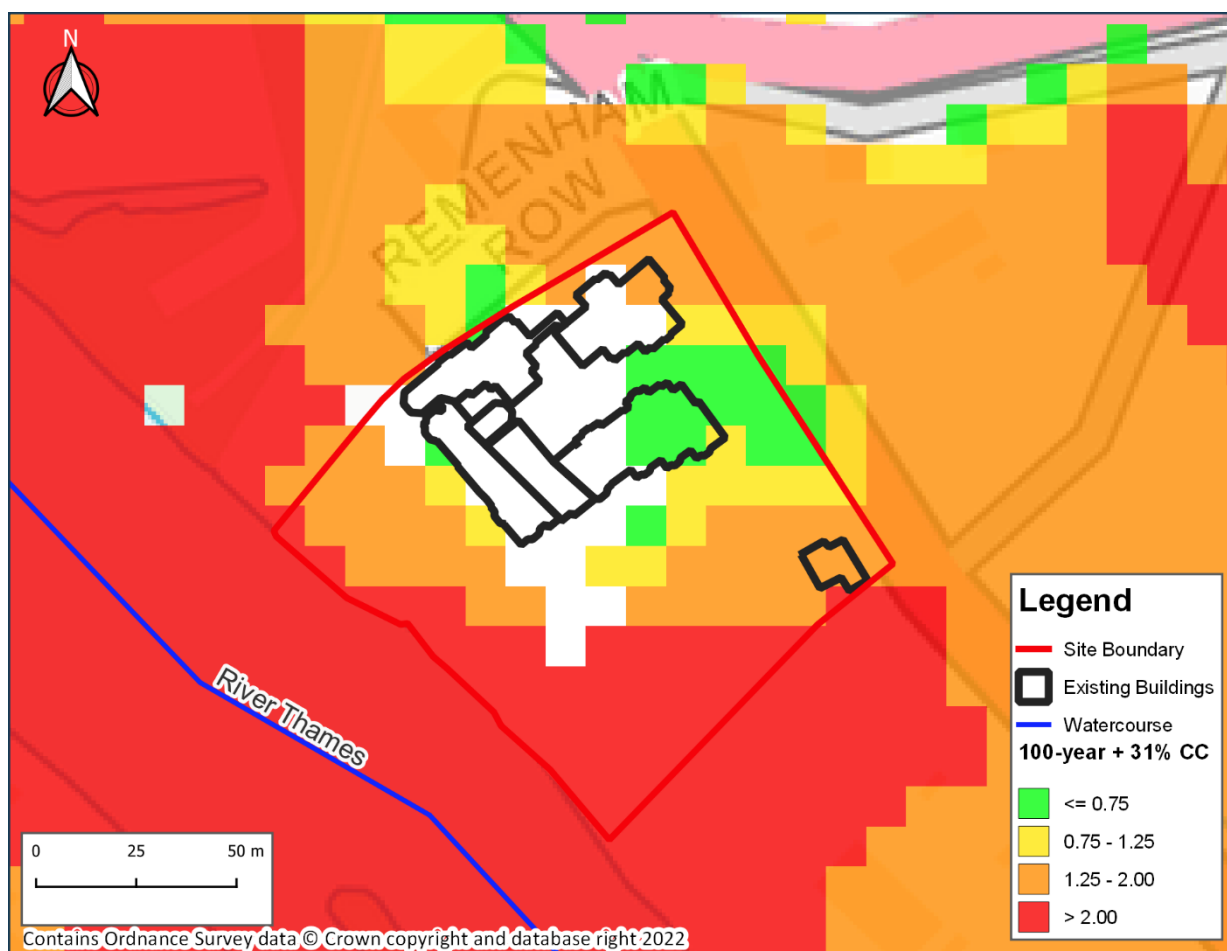
Figure 6 - GOV.UK Reservoir Flooding Extent



3. FLOOD WARNING & ASSOCIATED ACTIONS

- 3.1.1. The Environment Agency are the competent warning authority and operate a flood warning service covering all areas at risk of flooding from tidal and fluvial sources.
- 3.1.2. For more information on the Environmental Agency, their work and their responsibilities please visit www.environment-agency.gov.uk.

Figure 7 – Baseline Hazard To People



Source: JBA Consulting, Hydraulic Modelling Study at Thamesfield, Wargrave Road, Henley-On-Thames

- 3.1.3. Figure 7 above highlights the potential Hazard to People in the event of flooding. This shows that the Site is surrounded by flood risk and during a flood event residents should be evacuated from the premises, escorted to the designated assembly point and onwards to safe locations away from the Flood Hazard.

3.2. FLOOD WARNING SERVICES

ENVIRONMENTAL AGENCY DIRECT SERVICE

- 3.2.1. The Village Manager, along with all residents of the Retirement Village should directly register with the Environment Agency's Floodline Warnings Direct Service. This is a free service that provides flood warnings to those registered, by telephone, SMS text message or email. To register for this either:

- Register online at www.gov.uk/sign-up-for-flood-warnings
- Call Floodline on 0345 988 1188
- SMS Text Floodline on 0345 602 6340

3.2.2. It is recommended that when occupants of the retirement village observe high rainfall and/or stormy river conditions, they should consult the Village Manager and/or the Environment Agency. The Environment Agency can be contacted via the website online (www.environment-agency.gov.uk/flood) and/or phone Floodline on 0345 988 1188 entering the following quick-dial codes, which gives faster access to information for the area:

- **415006** – Marsh to Boveney Lock

NATIONAL UPDATES

3.2.3. The Met Office issues weather forecasts for the UK, including severe weather warnings and information can be found online as follows:

- <https://www.metoffice.gov.uk/weather/warnings-and-advice/uk-warnings>

LOCAL UPDATES

3.2.4. Updates and news on flooding for the local area can be obtained from local television news reports and from local radio stations, including the following sources:

Radio Stations

- BBC Radio Berkshire – 94.6 FM
- River Radio – online at <https://river.radio/>

Television stations

- BBC South
- ITV Meridian

3.2.5. During times of heavy rainfall and/or stormy river conditions, residents of the retirement village should check the TV/radio stations for information regarding flood risk. This may allow for extra preparation time, enabling the properties, contents and people to be better protected against the effects of flooding.

3.2.6. It is the Village Manager's responsibility to advise the occupants of the retirement village home regarding evacuation.

3.3. ENVIRONMENTAL AGENCY FLOOD WARNING AREAS

Flood Warning Codes	Meaning	When is it used	General Advice
ONLINE FLOOD RISK FORECAST	Be aware – keep an eye on the weather situation		- Check weather conditions - Check for updated flood forecasts on the Environmental Agency's Website
 FLOOD ALERT	Flooding is Possible – be prepared	2 hours – 2 days in advance of flooding	- Be prepared to act on your flood plan - Prepare a flood kit of essential items - Monitor local weather levels and the flood forecast on the Environmental Agency's website
 FLOOD WARNING	Flooding is Expected – immediate action required	30 minutes – 1 day in advance of flooding	- Move family, pets and valuables to a safe place - Turn off gas, electricity and water supplies is safe to do so - Move vehicles parked at ground level to a higher level or area outside of the flood zone - Put flood protection equipment in place
 SEVERE FLOOD WARNING	Severe Flooding – danger to life	When flooding poses a significant threat to life	- Stay in a safe place with means of escape - Be ready should you need to evacuate - Co-operate with the emergency services - Call 999 if you are in immediate danger
WARNING NO LONGER IN FORCE 	No further flooding is currently expected in your area.	When river or sea conditions begin to return to normal	- Be careful. Flood water may still be around for several days - If you've been flooded, ring your insurance company as soon as possible

4. PREPARATION & EVACUATION PROCEDURE

- 4.1.1. A Village Manager is responsible for management and operation of the Retirement Village. The Village Manager will be on call 24 hours a day, 365 days per year. In the event of pre-planned leave or any other absence a prior appointed deputy will be available.
- 4.1.2. All residents are to be notified of the flood risk associated with the Retirement Village with Flood Safety Procedures and will be provided with the contact details of the Village Manager. Information will also be made available via notices on communal notice boards and within welcome packs. This information will include a summary of the Flood Evacuation Plan listing the actions to be taken in the event or likelihood of flooding.

4.2. PREPARATION FOR FLOOD EVENT (PRIOR TO OCCUPATION OF NEW RESIDENTS)

- 4.2.1. The Village Manager should undertake the following prior to first occupation:
- Assemble a Personal Flood Plan – a template can be found in **Appendix A**. Copies of the Personal Flood Plan should be kept on site and a copy kept separately by the Village Manager.
 - Assemble the Community Flood Plan – a template can be found in **Appendix A**. Copies of the Community Flood Plan should be kept on site and a copy kept separately by the Village Manager.
 - Forward a copy of this Flood Evacuation Plan, the Personal Flood Plan and the Community Flood Plan to the Emergency Management Service at Wokingham Borough Council.
 - Subscribe to the Environment Agency Floodline service.
 - Fill in the relevant contact details within Section 5 of this FWEP.
 - Activate procedures for residents to receive flood warnings, and train residents in the procedures to be followed in response to receipt of the flood warning.
 - Ensure that future occupants of Thamesfield Villages are made aware of the flood risk associated with the retirement village prior to rental and purchase contracts.
 - Ensure that all occupants of Thamesfield Village are trained in flood evacuation procedures upon arrival with a defined meeting point clearly located.
 - Assemble a flood tool kit for use by residents in an emergency – including a whistle, water resistant high visibility jackets, food and water, hard hats and head lamps (with spares for visitors), key documents, flash lamp, first aid kit and blankets.
 - Compile a list of useful contacts for residents, emergency services, Floodline quick dial numbers, contact details of staff and occupants.
 - Ensure that all residents have been shown how to turn off the electricity, gas and water in an emergency, and how to close shutters.
 - Acquire any flood protection items listed in Personal Flood Plan.
 - Confirm that the insurance policy is adequate.

4.3. PERSONAL SAFETY IN A FLOOD EVENT

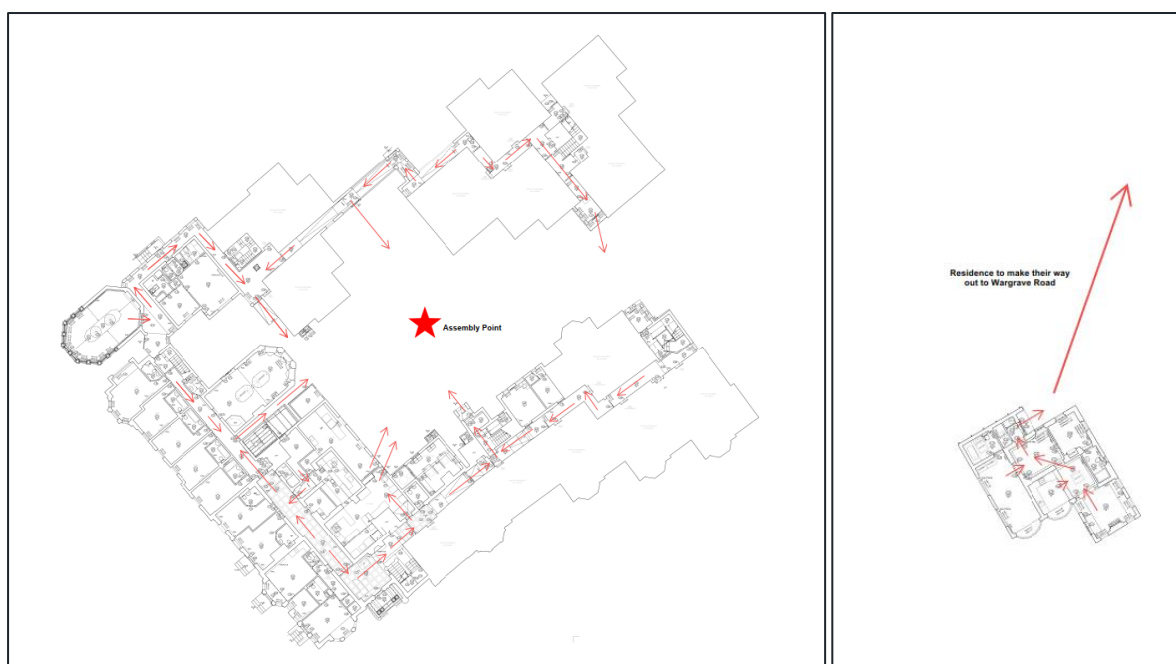
- 4.3.1. The following actions are of great importance and should be considered carefully.
- Stay safe in a flood event.
 - Do not put yourself at risk in the event of a flood, personal safety is paramount. Be aware that floods bring their own unique hazards, the majority of which will be hidden from view.

- Never try swim through fast flowing water as you will be swept away or struck with an object from the flood water.
- Avoid wading through flood water as this is likely to be contaminated with raw sewage as drains and sewers overflow.

4.4. RESPONDING TO FLOOD WARNINGS

- 4.4.1. This FWEP will be overridden by any advice given by competent authorised staff including the Emergency Services or Local Authority responders on the ground in the event of a serious flood event.
- 4.4.2. The Village Manager should immediately contact the occupants of the Retirement Village once receiving a flood warning to ensure all residents are aware of the flood warning currently in place and alert them to prepare for a potential evacuation.
- 4.4.3. Any advice provided by the local Emergency Services, Environment Agency, Local Authority and the Village Manager regarding whether, and where to evacuate should be adhered to. In the absence of advice to the contrary, it is recommended that the internal courtyard is used as a pre-defined meeting point.
- 4.4.4. According to Hydraulic Modelling undertaken by JBA Consulting, the courtyard is not within the extreme (1 in 100 year +31% Climate Change) flood outline. The internal evacuation route to the courtyard is indicated in Figure 8 below and in **Appendix B**.

Figure 8 - Evacuation Route from Retirement Village



- 4.4.5. Subscription to the Flood Warning Service is important to provide another source of flood warning. The Village Manager and occupants should call Floodline on 0345 988 1188, select option 1 and enter quick-dial number 415006 to subscribe. Once subscribed no further action is required.
- 4.4.6. Under '**Flood Alert**' conditions:

- the Village Manager should contact all residents, establish their current location and prepare them for the potential need to evacuate and gather belongings.
- Temporary flood proofing measures such as shutters and flood boards should be fitted if it is safe to do so and there is sufficient time prior to evacuation.
- The Village Manager should be on site following a Flood Alert & monitor the Flood Warning situation. They should advise residents on evacuation procedures should this become necessary.

4.4.7. On receipt of the **'Flood Warning'** status:

- the Village Manager should evacuate the residents immediately.

4.4.8. In the unlikely event that a **'Flood Alert'** and **'Flood Warning'** have been missed, or the Environment Agency Floodline issues an immediate **'Severe Flood Alert'**:

- the retirement village should be immediately evacuated provided it is still safe to do so, and without hesitating to close shutters or collecting belongings.
- If it is not safe to evacuate and floodwater is encroaching on the property, residents should seek safety at the upper level of the residence, call emergency services and await assistance.

4.4.9. If it is safe to do so, vehicles should be driven to higher ground. If there is any doubt about the safety of moving vehicles, they should be abandoned. Do not try to walk, drive or swim through deep floodwater. Avoid contact with floodwater – it may be contaminated with sewage.

4.4.10. The Village Manager should ensure that all residents and occupants have evacuated the retirement village successfully and close (and lock) the main entrances until it safe to return.

4.4.11. It is advised that an emergency 2-way communication between the residents and Village Manager is implemented.

4.5. EVACUATION PROCEDURE

4.5.1. In the event an evacuation is required the following evacuation procedure should be implemented throughout the Retirement Village:

1. The Village Manager should contact all residents of the retirement village alerting them that an evacuation of the premises is taking place.
2. Residents should make their way to the nearest exit as shown in the Evacuation Plan and make their way to the Safe Refuge Spot in the internal courtyard.
3. The Village Manager should check all accommodation units to ensure that everyone has left the premises safely and grab the emergency flood kit on their way out.
4. Once all residents are accounted for, the Village Manager is responsible for directing each individual resident onto a safe location, off site and outside the flood zone. Final destinations of the residents needs to be away from the flood zone, in a safe dry location with access to basic human needs.
5. Once residents are in their safe locations off site, they need to contact the Village Manager, informing them of their safe arrival at their destination.

4.6. AFTER FLOOD EVENT

- 4.6.1. Only return to the property once it is safe to do so and following confirmation from the Village Manager and/or emergency services.
- 4.6.2. The Village Manager should commission immediate emergency pumping/repair work if necessary to prevent further damage.
- 4.6.3. Open doors and windows to ventilate properties.
- 4.6.4. The Village Manager will advise on where you can get help to clean up including contacting the local authority or health service for assistance.
- 4.6.5. Contact your utility providers (electricity and water) to have them check services before re-use.
- 4.6.6. Dispose of all food which may have been in contact with floodwater as contamination could have occurred. For further assistance contact your local authority Environmental Health department for advice.
- 4.6.7. Keep a comprehensive record of flood damage (photographs, videos, etc) and retain correspondence with insurance broker after the flood.
- 4.6.8. Contact your insurance broker (24hour) Emergency Helpline. They will be able to provide information on dealing with your compensation claim and provide assistance.
- 4.6.9. Floodline (0345 988 1188), provides an advice guide to repairing flood damaged property.

5. ROLE OF GOVERNING BODIES & CONTACT INFORMATION

- 5.1.1. The response to a major flood event will involve several organisations working together at a local level, including the emergency services, local authority (the council), the Environment Agency and utility companies.
- 5.1.2. The general roles of the main bodies in relation to a major flood event in Wokingham are summarised below. It should be noted that this is a general list, and specific duties may vary between different bodies.

5.2. VILLAGE MANAGER

- 5.2.1. The Village Manager will be responsible for ensuring evacuation of the retirement village is carried out according to this plan and relevant advice from emergency services. The Village Manager should also sign up to the Environmental Agency's Floodline flood warning service.

Village Manager
Name: Address: Telephone (Office Hours): Telephone (Out of Office Hours):

5.3. POLICE DEPARTMENT

- 5.3.1. The police are responsible for the for the overall coordination of the multi-agency response at a major flood event. They will coordinate any multi-agency decision to evacuate & save lives of residents in partnership with key partner agencies.
- 5.3.2. The nearest police station to Thamesfield Village is the Maidenhead Police Station.

999 – Emergencies

5.4. FIRE & RESCUE DEPARTMENT

- 5.4.1. The Fire and Rescue department will be there to assist with the evacuation and search and rescue operations. They will be able to provide and/or obtain specialist advice and assist where hazardous materials are involved.
- 5.4.2. The Fire and Rescue department also assist other relevant agencies, particularly the local authority, to minimise the effects of major flooding to the community.

999 – Emergencies	
Royal Berkshire Fire & Rescue Services (Non-Emergencies):	
	0118 938 4452
	07500 108627
	Centralhubfiresafety@rbfrs.co.uk
	oxboroughn@RBFRS.co.uk
Fire Safety Inspection Officer:	Nick Oxborough

5.5. ENVIRONMENTAL AGENCY

- 5.5.1. Floodline Warnings Direct is a free service which sends you a direct message when flooding is expected and may affect your property. Flood warnings will give you time to prepare for flooding which could save you time, money and heartache. You can receive warnings by telephone, SMS text message & email.

Floodline on 0345 988 1188 SMS Text Floodline on 0345 602 6340
--

5.6. LOCAL AUTHORITIES

- 5.6.1. The local authorities work closely with the police, fire services, rescue services and co-ordinate the response during severe flooding.
- 5.6.2. The Council's Emergency Management Service is concerned with the well-being of the community and environment during and after emergency situations.

Telephone (Emergencies) on 0800 212 111 (Ask for the Emergency management Duty Officer) Telephone (Office Hours) on 0118 974 6000
--

5.7. AMBULANCE SERVICE

- 5.7.1. In the event of a serious medical emergency to one or more residents, it is advised that an ambulance be brought to the site.

999 – Emergencies

5.8. LOCAL PUBLIC TRANSPORT, BUS & TRAIN COMPANIES, TAXI SERVICES

5.8.1. Henley-on-Thames railway station operates regular services going south to Twyford. From there trains can be caught south towards Reading or north to Maidenhead and onto London. Train times can be found on the National Rail and Trainline websites listed below.

- <https://www.nationalrail.co.uk/>
- <https://www.thetrainline.com/>

5.8.2. There are 3 main local bus services running through Henley-On-Thames, information on which can be found below.

Arriva Services:

1. **800** running from Reading to High Wycombe via Henley-On-Thames
2. **850** running from High Wycombe to Reading via Henley-On-Thames

Thames Travel Services:

1. **X38** running between Wallingford & Henley-on-Thames

5.8.3. For residents without a means of self-transportation away from the site, it is recommended that taxi services are called to the assembly point and residents taken to destinations as specified by the Village Manager.

Henley Taxis Ltd – 01491 574 222 Henley Taxi Services – 01491 526566 Maidenhead Taxi Services – 01628 200189 Reading Station Taxis – 07475 661060

5.9. ADDITIONAL CONTACTS

5.9.1. The below contact information is to be provided by the Village Manager.

ELECTRICITY, GAS, WATER & TELEPHONE SERVICE PROVIDERS

Electricity Company Company Name: Contact Number:

Gas Company Company Name: Contact Number:

Telephone Provider

Company Name:

Contact Number:

INSURANCE COMPANY OR PROVIDER**Insurance Company**

Company Name:

Contact Number:

6. MONITORING AND REVIEW OF THE PLAN

- 6.1.1. This FWEP should be reviewed every 3-5 years to ensure that the Flood Plan is keep up to date and in line with new policies and modelling results.
- 6.1.2. The FWEP should also be reviewed & updated if:
 - There are changes to the contact information & details listed in Section 5.
 - Works (internal & external) have taken place within the development causing the structural layout or landscaping to have changed.
 - Modelled Flood extents have significantly changed since the last issue of the FWEP.

Appendix A

COMMUNITY & PERSONAL FLOOD PLAN TEMPLATES



community flood plan

Parishes and communities working together

Community or group		Address	
Floodline Quickdial Number		Which Environment Agency flood warnings are you registered to receive?	
Local flood warning trigger <i>i.e. when water reaches bottom of the bridge</i>			
Date			

Contents

1. Actions to be taken before a flood

- A - Locations at risk of flooding: flood warnings
- B - Locations at risk of flooding: locations at risk of flooding / sources of flooding
- C - Locations at risk of flooding: map showing direction of flooding

2. Actions to be taken during a flood

- A - Local flood actions
- B - Local volunteers / flood wardens
- C - Important telephone numbers
- D - Available resources
- E - Arrangements between authorities
- F - Vulnerable residents, properties and locations

3. After a flood

- A - Reputable contractors

1A – Locations at risk of flooding: Flood warnings

From the information you have available, make a list of areas liable to flood and the level of warning which would affect them.

Area number	Location of risk	Trigger level	Actions
Area 1			
Area 2			
Area 3			
Area 4			
Area 5			
Area 6			
Area 7			
Area 8			

1B – Actions to be taken before a flood: Locations at risk of flooding / source of flooding

Insert details of areas at risk from flooding and the direction of flooding. Include maps and if possible, details of existing defences.

Area number	Location at risk	Source of flooding	Direction of flooding
Area 1			
Area 2			
Area 3			
Area 4			
Area 5			
Area 6			
Area 7			
Area 8			

1C – Actions to be taken before a flood: Map showing direction of flooding

Include a map in the flood plan showing the flood risk area and direction of flooding.



2A – Actions to be taken during a flood: local flood actions

Identify local flood actions.

Area number	Location at risk	Action / trigger	Local action	Equipment required	Time required
Area 1					
Area 2					
Area 3					
Area 4					
Area 5					
Area 6					
Area 7					
Area 8					

2B – Actions to be taken during a flood: local volunteers / flood wardens

List local volunteers/flood wardens that could be contacted in an incident. They may be required to lift heavy sandbags so should be reasonably active or fit. Consider using other volunteers such as communicators, administrators or minders of vulnerable people during an incident. These volunteers could be registered on the Environment Agency's Floodline Warnings Direct service so they receive the flood warnings. **Volunteers must not put their own life at risk.**

Name	Address	Telephone Day	Telephone Evening	Mobile

2C – Actions to be taken during a flood: Important telephone numbers

Make a list of important telephone numbers so all the information you require during an incident is readily available.

Organisation	Telephone (office hours)	Telephone (out of hours)	Fax
Floodline			
Environment Agency			
District Council			
County Council			
County Contracting			
Fire & Rescue Service			
Police			
Ambulance Service			
Housing Unit			
Environment Unit			
Water Company			
Electricity Company			
Gas Company			
Telecommunications Company			
Adjacent Town/Parish Councils			

2D – Actions to be taken during a flood: Available resources

Identify available resources.

Organisation	Resource	Number	Location	Notes

2E – Actions to be taken during a flood: Arrangements between authorities

Details of specific arrangements between the various authorities to be included here.

Organisation(s)	Agreed arrangement

2F – Actions to be taken during a flood: Vulnerable residents, properties and locations

List vulnerable people, properties and locations where early assistance may be required.

Name	Address	Daytime telephone	Evening telephone	Assistance required

3A – After a flood: Reputable contractors

List companies/reputable contractors whose help you may need after a flood. Get contracts in place, or know who to call for assistance. If help is not needed, you can leave this section blank. If you plan to do the work yourself, leave this section blank.

Company name	Business (e.g. builder)	Telephone	Fax

Personal flood plan

Name



Are you signed up to receive flood warnings?

If not call Floodline on 0345 988 1188 to see if your area receives free flood warnings.

☐

Let us know when you've completed your flood plan by calling Floodline on **0345 988 1188**. This will help us learn more about how people are preparing for flooding.

General contact list	Company name	Contact name	Telephone
Floodline	Environment Agency		0345 988 1188
Electricity provider			
Gas provider			
Water company			
Telephone provider			
Insurance company and policy number			
Local council			
Local radio station			
Travel/weather info			

Key locations

Service cut-off	Description of location
Electricity	
Gas	
Water	

Who can help/who can you help?

Relationship	Name	Contact details	How can they/you help?
Relative			
Friend or neighbour			

Be prepared for flooding. Act now

Personal flood plan

What can I do NOW?



Put important documents out of flood risk and protect in polythene

☐

Look at the best way of stopping floodwater entering your property

☐

Find out where you can get sandbags

☐

Identify what you would need to take with you if you had to leave your home

☐

Check your insurance covers you for flooding

☐

Make a flood plan and prepare a flood kit

☐

Identify who can help you/ who you can help

☐

Understand the flood warning codes

☐

What can you do if a flood is expected in your area?

Actions	Location
Home	
• Move furniture and electrical items to safety	
• Put flood boards, polythene and sandbags in place	
• Make a list now of what you can move away from the risk	
• Turn off electricity, water and gas supplies	
• Roll up carpets and rugs	
• Unless you have time to remove them hang curtains over rods	
• Move sentimental items to safety	
• Put important documents in polythene bags and move to safety	
Garden and outside	
• Move your car out of the flood risk area	
• Move any large or loose items or weigh them down	
Business	
• Move important documents, computers and stock	
• Alert staff and request their help	
• Farmers move animals and livestock to safety	
Evacuation - Prepare a flood kit in advance	
• Inform your family or friends that you may need to leave your home	
• Get your flood kit together and include a torch, warm and waterproof clothing, water, food, medication, toys for children and pets, rubber gloves and wellingtons	

There are a range of flood protection products on the market to help you protect your property from flood damage. A directory of these is available from the **National Flood Forum** at www.bluepages.org.uk

Be prepared for flooding. Act now

Appendix B

FLOOD EVACUATION ROUTE







WSP House
70 Chancery Lane
London
WC2A 1AF

wsp.com

C Development proposal

D Hydraulic modelling report

Hydraulic Modelling Study at Thamesfield, Wargrave Road, Henley-On-Thames

Final report

April 2023

www.jbaconsulting.com



RPS | Consulting UK & Ireland
20 Farringdon Street
London
EC4A 4AB
United Kingdom

JBA Project Manager

Olivier Saillofest
The Library
St Philips Courtyard
Church Hill
Coleshill
Warwickshire
UNITED KINGDOM
B46 3AD

Revision History

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S03-P01 / May 2022	Draft Report	Caroline Keiller (Retirement Villages Development Ltd)
A01-C01 / July 2022	Final Report	Caroline Keiller (Retirement Villages Development Ltd)
A01-C02 / October 2022	Final Report (following EA review)	Caroline Keiller (Retirement Villages Development Ltd)
A01-C03 / March 2023	Final Report (updated with 30-year event)	Abigail Woods (RPS)
A01-C04 / April 2023	Final Report (Typos)	Abigail Woods (RPS)

Contract

This report describes work commissioned by RPS, on behalf of RVG (Retirement Villages Group) by an email instruction dated 8/12/2021. RPS representative for the contract was Abigail Woods. Emelie Persson and Olivier Saillofest of JBA Consulting carried out this work.

Prepared by Emelie Persson BSc PgCert

Assistant Analyst

Reviewed by Olivier Saillofest BEng MSc CEng MCIWEM
C.WEM

Technical Director

Purpose

This document has been prepared as a Final Report for RPS. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the client for the purposes for which it was originally commissioned and prepared. JBA Consulting has no liability regarding the use of this report except to RPS.

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Executive summary

JBA Consulting were commissioned by RPS, to undertake a fluvial water hydraulic modelling study at Thamesfield, Wargrave Road, Henley-On-Thames.

The proposed development located off Wargrave Road, Henley-On-Thames. The surrounding area is a mix of residential and greenfield land. The site is located adjacent to the River Thames (which flows in a northerly direction southwest of the site).

To assess the risk of fluvial flooding at the site, a license has been obtained from the Environment Agency (EA) to re-use the existing 1D-2D Thames Mapledurham to Hurley hydraulic model (2019) of the River Thames. The existing model has been re-run with an updated version of Flood Modeller – TUFLOW, site-specific topographic survey data and cross-sectional data of Henley Bridge.

The model has been run for the baseline scenario for 30-year, 100-year, 100-year with 31% climate change and 1,000-year events in order to determine the existing fluvial flood risk to the site.

In line with the new guidance on Climate Change issued by the Environment Agency in July 2021¹, the effect of climate change was assessed by increasing 100-year peak flows by 31% for the fluvial model (higher central climate change allowance for essential infrastructure developments within the Thames and Chilterns South management catchment).

Results from the hydraulic model were tested for their sensitivity to changes in Manning's roughness, downstream boundary conditions, and flows. A blockage risk scenario was undertaken for Henley Bridge during the 100-year with climate change flood event. Results from the sensitivity analysis indicate that the model results within the site are relatively insensitive to changes in roughness, downstream boundary or changed flow conditions.

Results from the updated model runs show that:

- Water overtops the River Thames' banks and flood the site for all of the modelled flood scenarios (i.e. 30-year, 100-year, 100-year +31% CC and 1,000-year fluvial), as illustrated in Figure 0-1.
- Flood depths of up to 1.89m are predicted to occur within the site during the 100-year with 31% climate change 'design' flood event.
- During the 100-year with 31% climate change fluvial flood event, the peak water levels will exceed the existing floor levels of 2 existing buildings within the site boundary.
- During the 100-year with 31% climate change scenario, the majority of the site falls within the 'low' to 'significant' hazard categories (based on Defra's Hazard-to-People).
- The blockage risk analysis undertaken at Henley Bridge (node 32.078BU) during the 100-year with climate change flood event indicates that when a 25% blockage is applied, a significant increase in maximum flood depths of up to 0.77m is predicted within the site.

1 <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

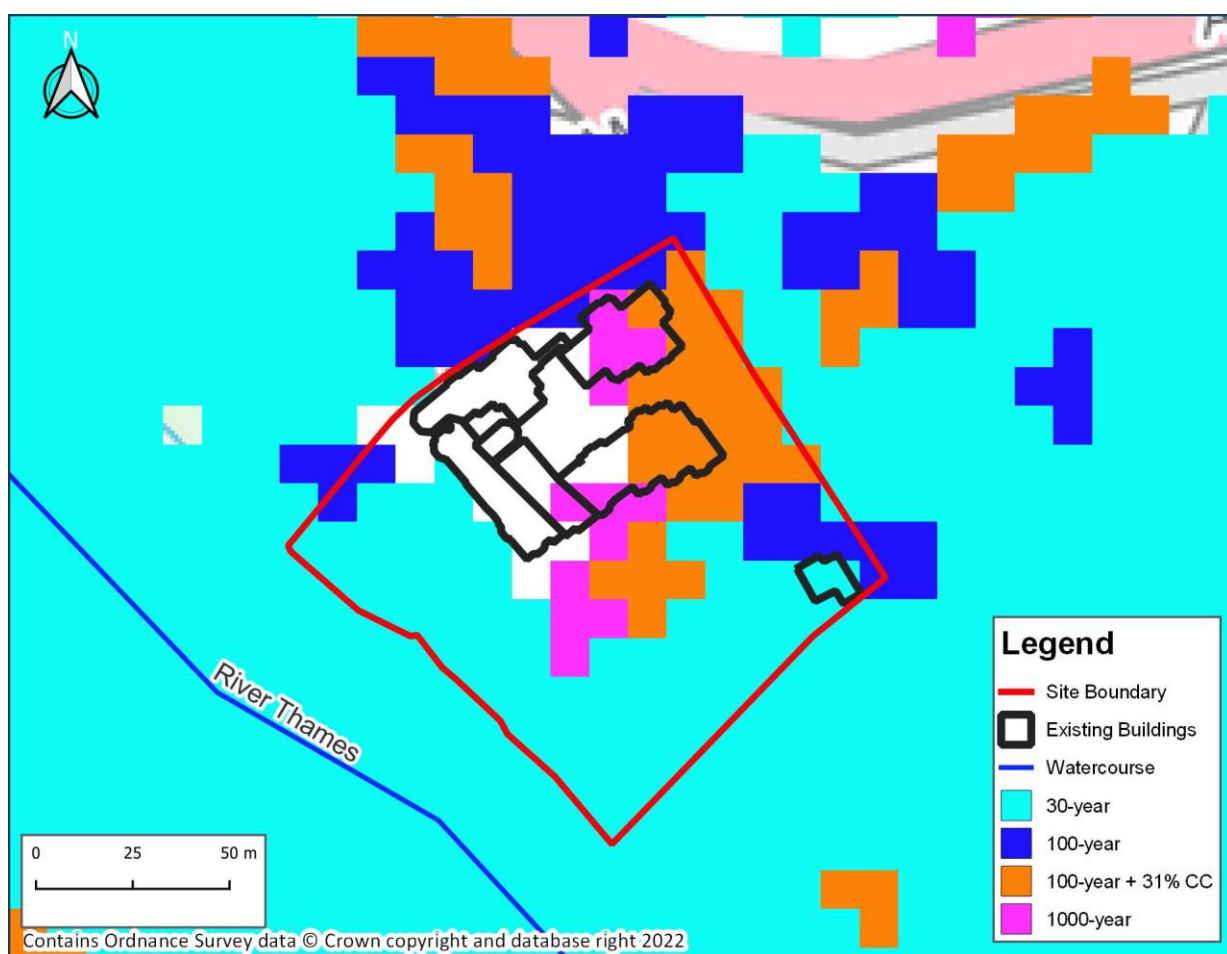


Figure 0-1: Baseline fluvial flood extents

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Abbreviations

1D	One Dimensional
2D	Two Dimensional
CC	Climate Change
DTM	Digital Terrain Model
EA	Environment Agency
ESTRY	Primary 1D engine used by TUFLOW
FEH	Flood Estimation Handbook
FFL	Finished Floor Levels
GCS	Grantham Coates Surveyors
Ha	Hectares
HQ	Head-Flow
JBA	Jeremy Benn Associates
LiDAR	Light Detection and Ranging
m AOD	Metres Above Ordnance Datum
QT	Flow-Time
ReFH	Revitalised Flood Hydrograph
RoFSW	Risk of Flooding from Surface Water
TUFLOW	2D Hydraulic Modelling Software

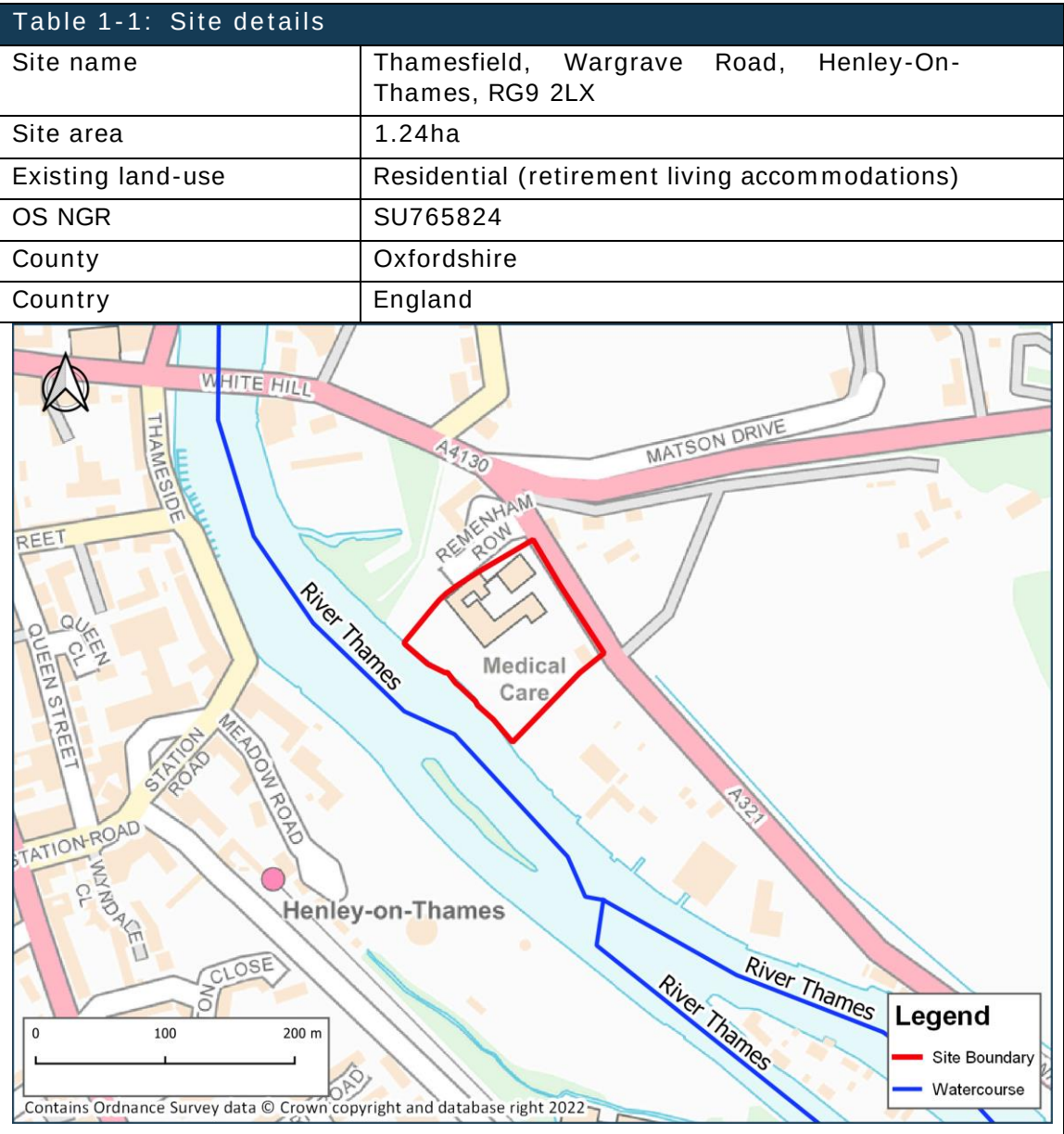
1 Introduction

1.1 Terms of reference

JBA Consulting (JBA) were commissioned by RPS Ltd to undertake a fluvial hydraulic modelling study at Thamesfield, Wargrave Road, Henley-On-Thames.

To support this assessment, the 2019 Thames Mapledurham to Hurley 1D-2D hydraulic model was re-used and re-run with the latest versions of Flood Modeller – TUFLOW and with inclusion of new site-specific topographic survey data to allow accurate representation of the fluvial flood levels, extents and hazards within the site boundary.

1.2 Site details



1.3 Site description

The proposed development site is located off Wargrave Road, Henley-On-Thames. The surrounding area is a mix of residential and greenfield land. The site is currently occupied by an existing retirement village with 35 apartments and a 12-bed care home. The proposal is looking at potential redevelopment opportunities for the site to deliver additional homes and improved facilities.

The River Thames is located immediately adjacent to the site and flows in a northerly direction.

1.4 Existing flood data

It is understood that the Environment Agency's fluvial flood zones currently represents the best source of flood risk information in relation to the site.

To refine flood risk in relation to the site, JBA Consulting was commissioned to carry out an updated version of the detailed fluvial hydraulic modelling study in relation to the proposed development site.

1.5 General approach

The existing 1D-2D Thames Mapledurham to Hurley hydraulic model was obtained from the EA and re-used as part of this project.

The existing model has been updated with new survey data of Henley Bridge and the flood relief culverts located approximately 100 m east of the bridge / 120m northwest of the site. The model is using LiDAR data from the Defra website (flown in 2018 with a 1m grid resolution) and site topographic survey data collected in June 2021 by Point 2 Surveyors Limited, provided in Appendix A.

Given the age of the latest EA model update, flow estimates are deemed representative of current conditions and thus do not need updating. The model has been run for the baseline defended scenario for the 30-year, 100-year, 100-year with 31% climate change and 1000-year flood events in order to determine the existing flood risk to the site.

1.6 Limitations

The 1D-2D Thames Mapledurham to Hurley model uses a 2D grid cell size of 20m within the site area. Given the model run times (i.e. between 1 day and 20hrs) and the prominent location of the site in the Thames floodplain, no attempts were made to refine the model grid cell size. Where results show partial flooding of a building in the model, a comparison of the modelled peak water level with the building floor level was carried and, when relevant, the building was filtered away from the mapped flood extent.

2 Model build phase

2.1 Model geometry

2.1.1 Data availability

The LiDAR used to represent the ground levels within the floodplain has a grid resolution 1m and was last flown in 2018.

Site topographic survey collected by Point 2 Surveyors Limited in June 2021 was provided by the client and used to represent ground levels within the site (see Appendix A). Survey of Henley bridge and the 6 flood relief culverts located approximately 100 m east of the bridge was collected by Grantham Coates Surveys Ltd in March 2022 (see Appendix B).

2.1.2 Model extent and build

2.1.2.1 Fluvial model

To understand fluvial flood risk to the site, the 1D-2D Mapledurham to Hurley 2019 model was obtained from the Environment Agency and re-used as part of this study. The hydraulic model represents the River Thames, and the floodplain in the vicinity of the proposed site. The extent of the fluvial model developed for this study is shown in Figure 2-1.

The channels were represented as 1-dimensional (1D) features using Flood Modeller (version 4.6.0). The 1D model begins approximately 24.6km upstream of the proposed development site and the model extends approximately 7.3km downstream of the site.

The 2D domain was represented using TUFLOW (2020-01-AB-iSP-w64) with floodplain topography represented using LiDAR data. The 2D domain for the fluvial model has an area of 8.27km² and a 5m grid resolution.

The orientation of the grid is southeast to northwest, representing the main direction of floodplain flows. The 1D and 2D domains can be seen in Figure 2-1.

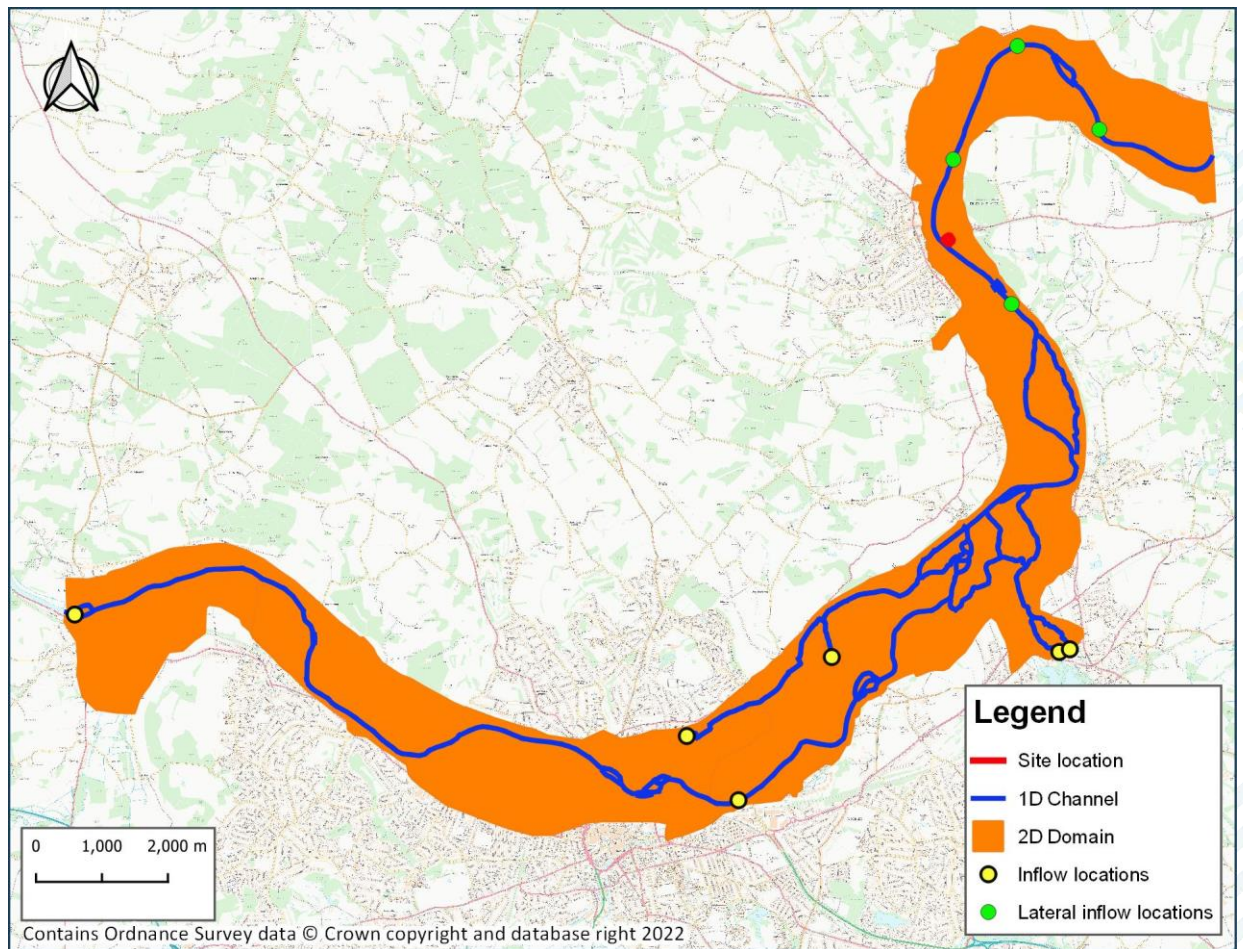


Figure 2-1: Model extent

2.1.3 Model roughness parameters

Manning's n values from the 2019 Thames Mapledurham to Hurley model was re-used to represent roughness values for the channel and floodplain. Table 2-1 gives the range of Manning's n values used in the 1D and 2D domains.

Table 2-1: Manning's n range within the hydraulic model	
1D Channel	0.025 – 0.05 (in channel) 0.075 (banks)
Buildings	0.300
General surface	0.050 – 0.060
Glasshouse	0.200
Inland water	0.045
Landform	0.060
Boulders	0.065
Trees	0.012 – 0.060
Rail	0.045
Roads	0.035

2.2 Model boundary conditions

2.2.1 Model inflows

Flow estimates from 2019 Thames Mapledurham to Hurley hydraulic model was re-used (see Appendix D) and updated in line with the new guidance on Climate Change issued by the Environment Agency in July 2021², the effect of climate change was assessed by increasing 100-year peak flows by 31% for the model (higher central climate change allowance for essential infrastructure developments within the Thames and Chilterns South management catchment).

2.2.2 Downstream boundary conditions

The original downstream boundary conditions used in the 2019 Thames Mapledurham to Hurley hydraulic model was kept in this study. *A rating curve extracted from the Lower Thames modelling was used to derive boundary conditions the model. This characterises the flow vs stage relationship upstream of Hurley Lock for both the channel and the floodplain. The downstream boundary condition was informed by plotting stage vs discharge pairings for the rising limb from each of the design events simulated for the Lower Thames flood risk modelling (20%, 10%, 5%, 3.33%, 4%, 2%, 1.33%, 1%, 0.5% and 0.1% AEP events). Given the close proximity of the downstream boundary location to the Lower Thames model inflow (at Hambleden Lock) the flow data informing the stage vs discharge pairings is based on the Lower Thames model inflow to remove complexity of extracting 1D channel and 2D floodplain flows from the Lower Thames model³.*

² <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

³ JBA Consulting for Environment Agency. Thames Mapledurham – Final Model Report (v2 Mar 2019)

2.3 Calibration

The 2019 Thames Mapledurham to Hurley hydraulic model was calibrated to historic flood events. As a result, new calibration has not been carried out on the model results, however sensitivity testing has been carried out to provide confidence in the model parameters, see Appendix C.

2.4 Model Runs

2.4.1 Modelled scenarios

The following flood scenarios were simulated by the model:

Baseline scenarios

- 30-year (3.33% AEP) fluvial flood event;
- 100-year (1% AEP) fluvial flood event;
- 100-year (1% AEP) plus Climate Change (31%) fluvial flood event;
- 1000-year (0.1% AEP) fluvial flood event.

Blockage scenario

- 100-year (1% AEP) plus Climate Change (31%) fluvial flood event – Henley Bridge (32.078BU) downstream of the site blocked by 25%.

Sensitivity analysis

- 100-year (1% AEP) flood event with +20% increase in peak flows;
- 100-year (1% AEP) flood event with +20% increase in roughness value;
- 100-year (1% AEP) flood event with -20% decrease in roughness value;
- 100-year (1% AEP) flood event with +250mm increase in peak water level at the downstream model boundary.

The results of the baseline and blockage scenarios are discussed in the following section with sensitivity analysis included in Appendix C of this report.

3 Hydraulic model results

3.1 Baseline flood extents

Flood extents for the 30-year, 100-year and 1,000-year fluvial flood events are shown in Figure 3-1.

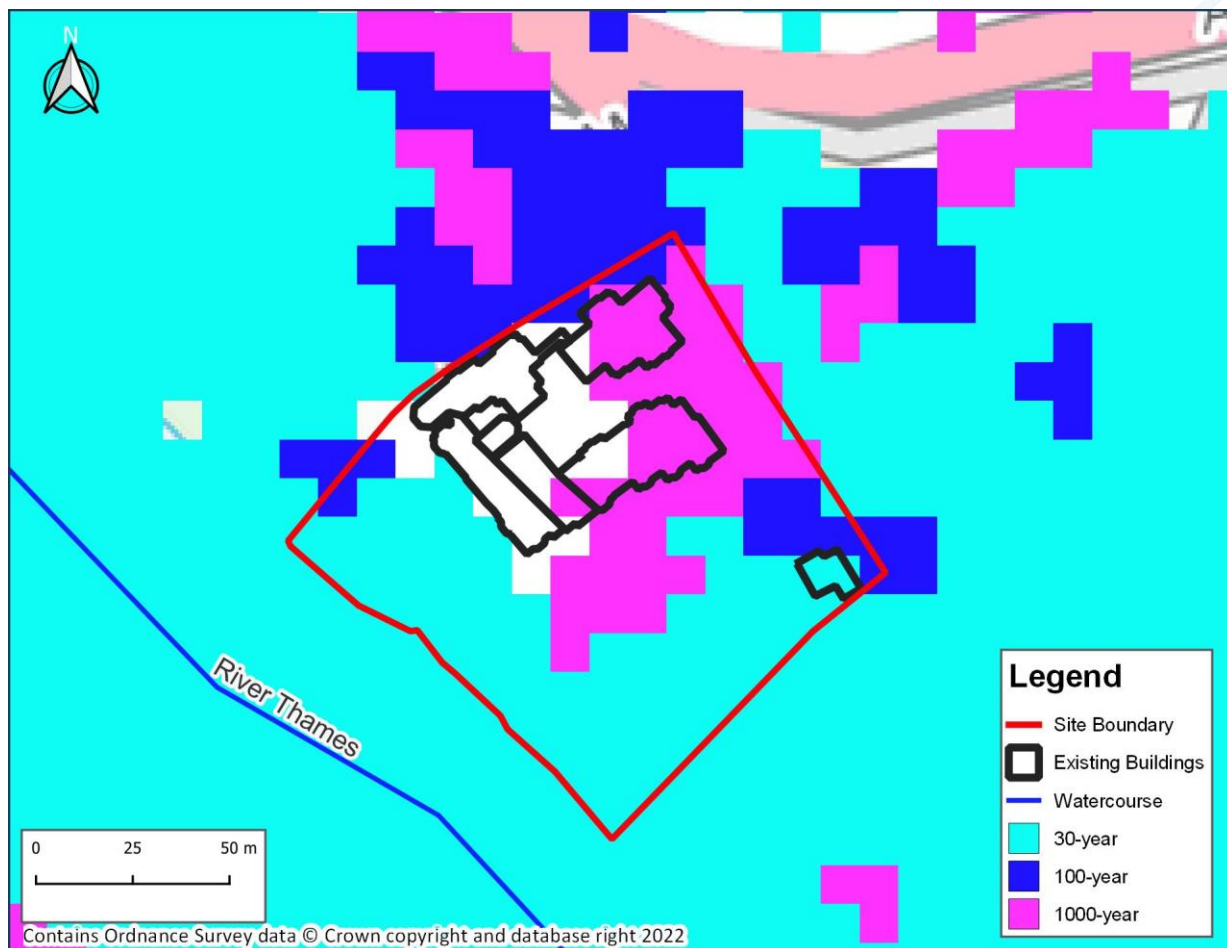


Figure 3-1: Baseline flood extents (30-year, 100-year and 1,000-year)

Figure 3-1 shows that the capacity of the River Thames is exceeded during all of the modelled events and flooding occurs on the site for all of the three modelled events. Flood extent for the 100-year with (+31%) climate change is represented in Figure 3-2.

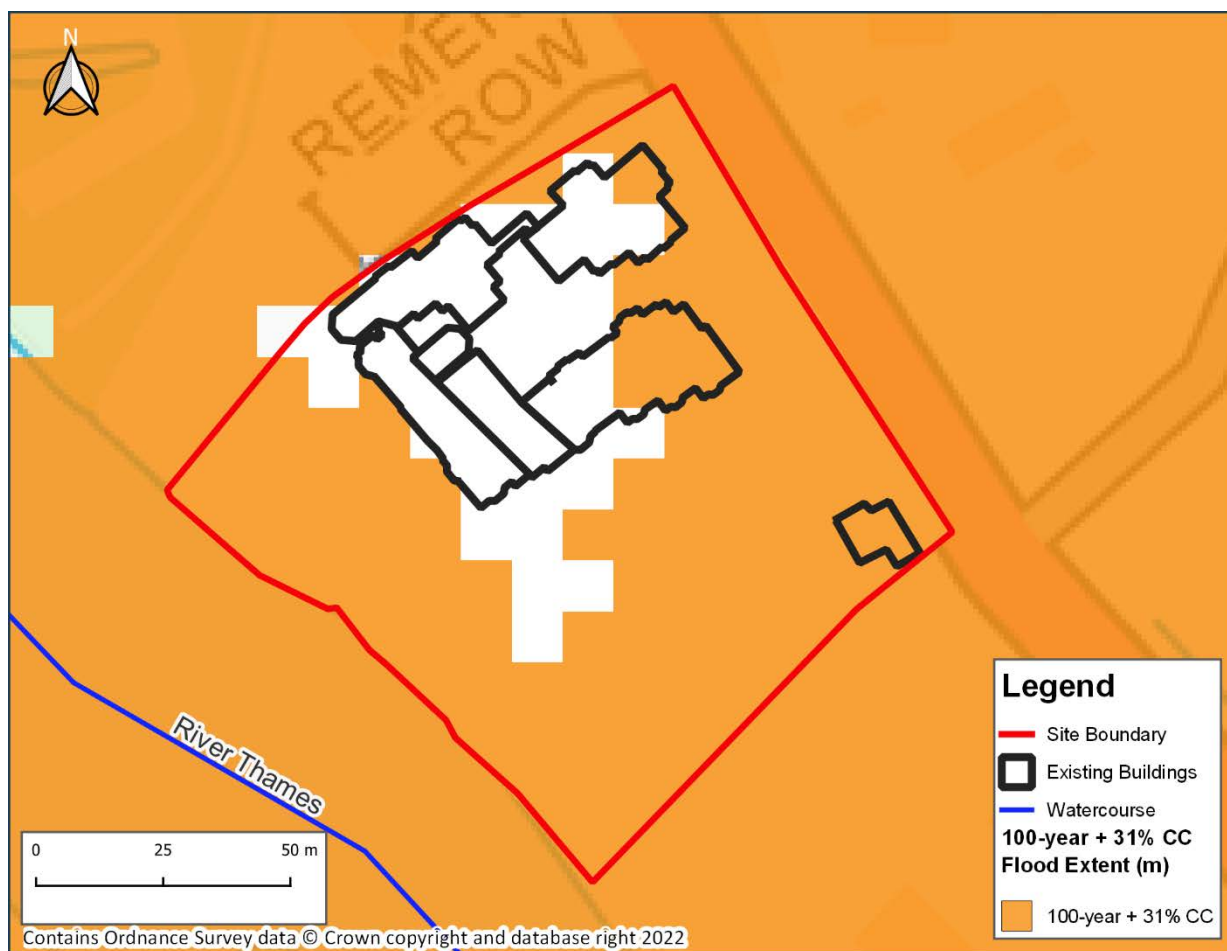


Figure 3-2: Baseline 100-Year flood extents with 31 % climate change scenario

Figure 3-2 shows the extent of flooding during the 100-year with 31% climate change scenario.

3.2 Baseline flood depths

The baseline flood depths during the 100-year with 31% climate change event in the vicinity of the site are shown in Figure 3-3.

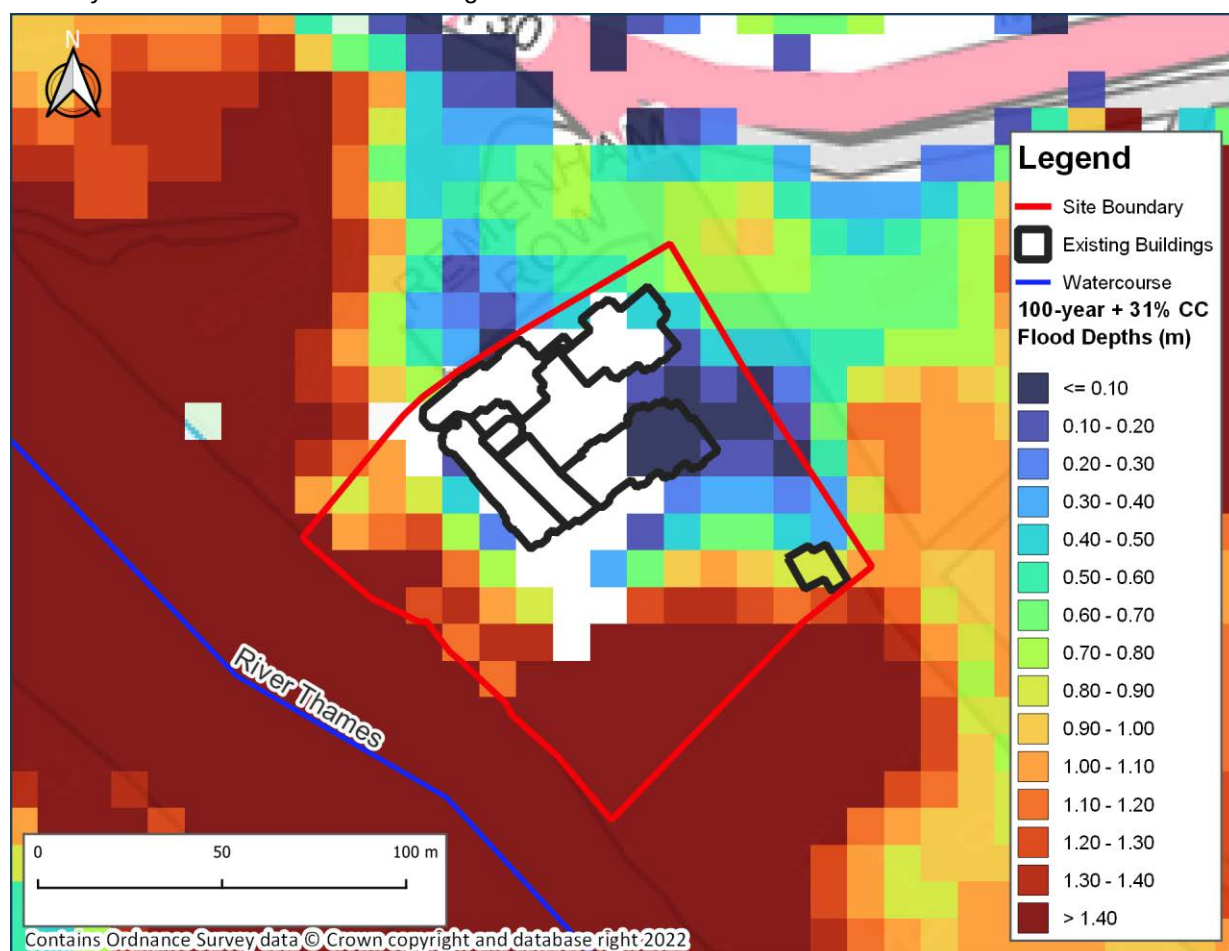


Figure 3-3: Baseline 100-year flood depths with 31% climate change scenario

Figure 3-3 shows the maximum predicted flood depths within the site during the 100-year with 31% climate change event. An approximate maximum depth of 1.89m is predicted within the southern part of the site.

3.3 Baseline flood levels

The baseline flood levels during the 100-year with 31% climate change return period are shown within Figure 3-4 below.

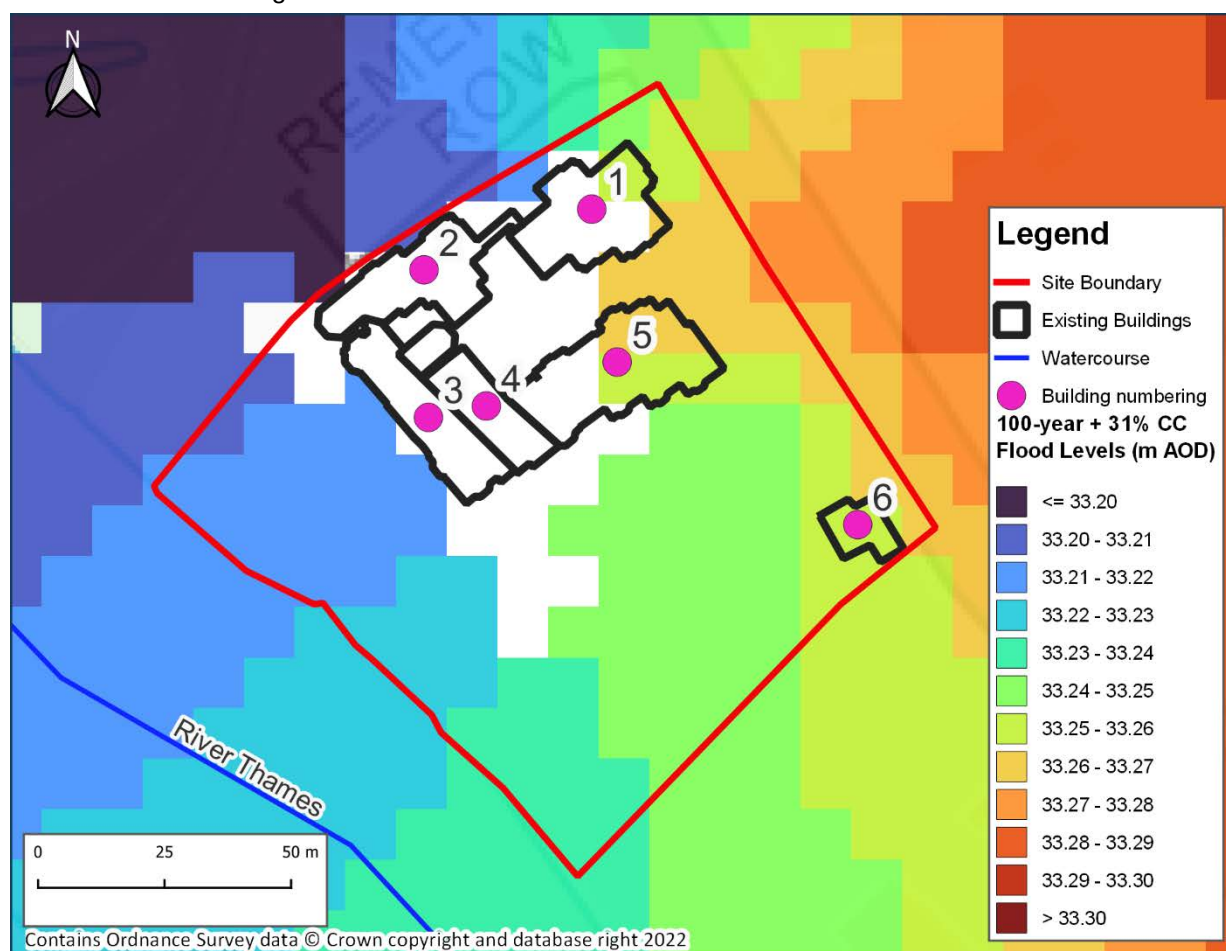


Figure 3-4: Baseline 100-year water levels with 31 % climate change scenario

Figure 3-4 shows peak water levels during the 100-year with 31% climate change event. Peak water levels related to each existing building are displayed in Table 3-1.

Building	Existing floor levels (m AOD) *	Peak water levels within existing building (m AOD)
1	33.26	33.27
2	33.83	33.20
3	33.84	33.22
4	33.48	No flooding
5	33.26	33.26
6	32.60	33.26

*: Estimated from Point 2 Surveyors Limited topographic survey dated June 2021

Table 3-1 shows that, during the 100-year with 31% climate change event, peak water levels are expected to exceed the existing floor levels for building 1 by 0.01m and by 0.66m for building 6.

3.4 Blockage risk analysis

Given the site's location in relation to Henley Bridge, a blockage risk analysis was undertaken. Figure 3-5 shows the location of the node 32.078BU in the model, where a 25% blockage was considered.

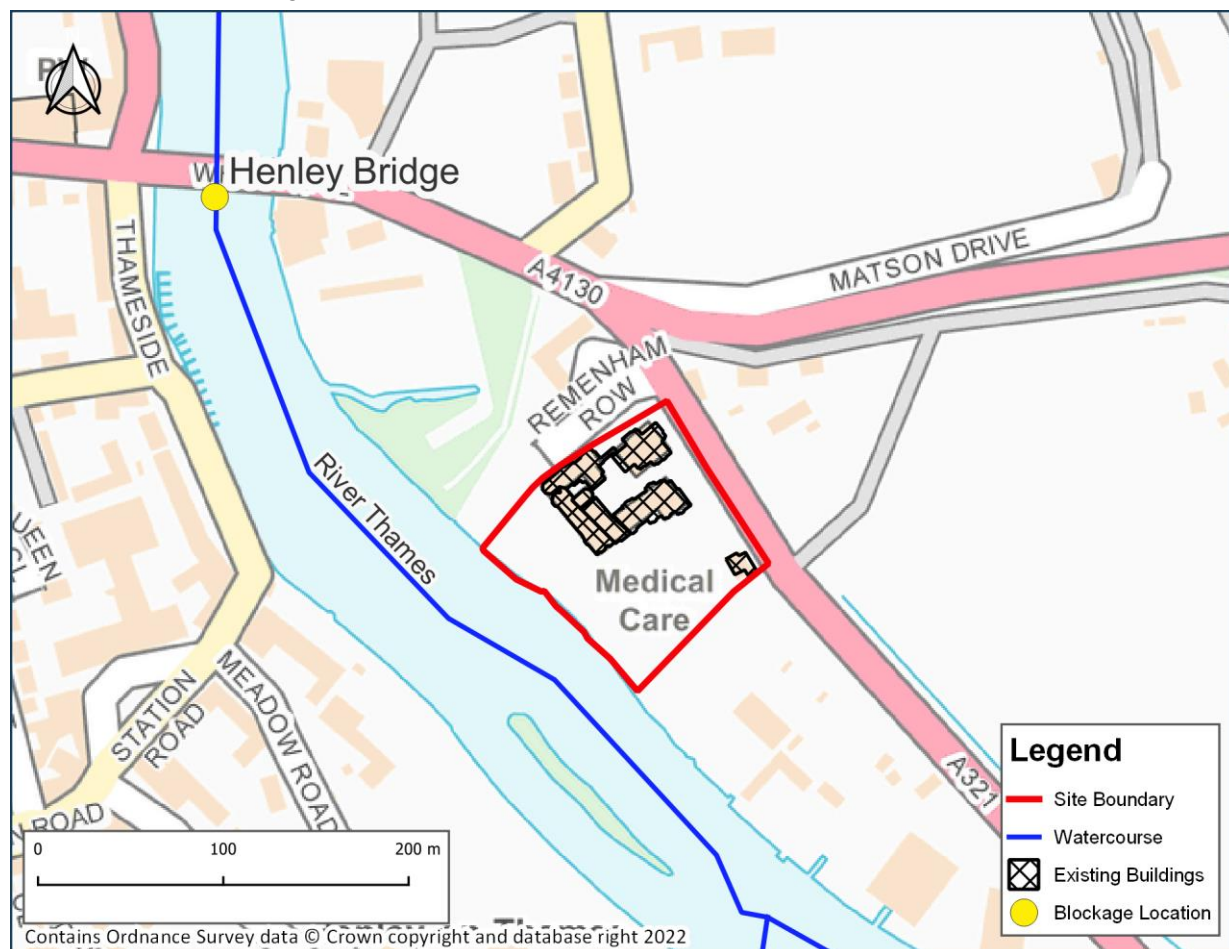


Figure 3-5: Baseline Blockage Risk Analysis location

Figure 3-6: Baseline Blockage Analysis (100-year + 31% climate change) shows the peak flood elevation during 100-year plus 31% climate change flood event when a 25% blockage is applied to Henley Bridge (node 32.078BU).

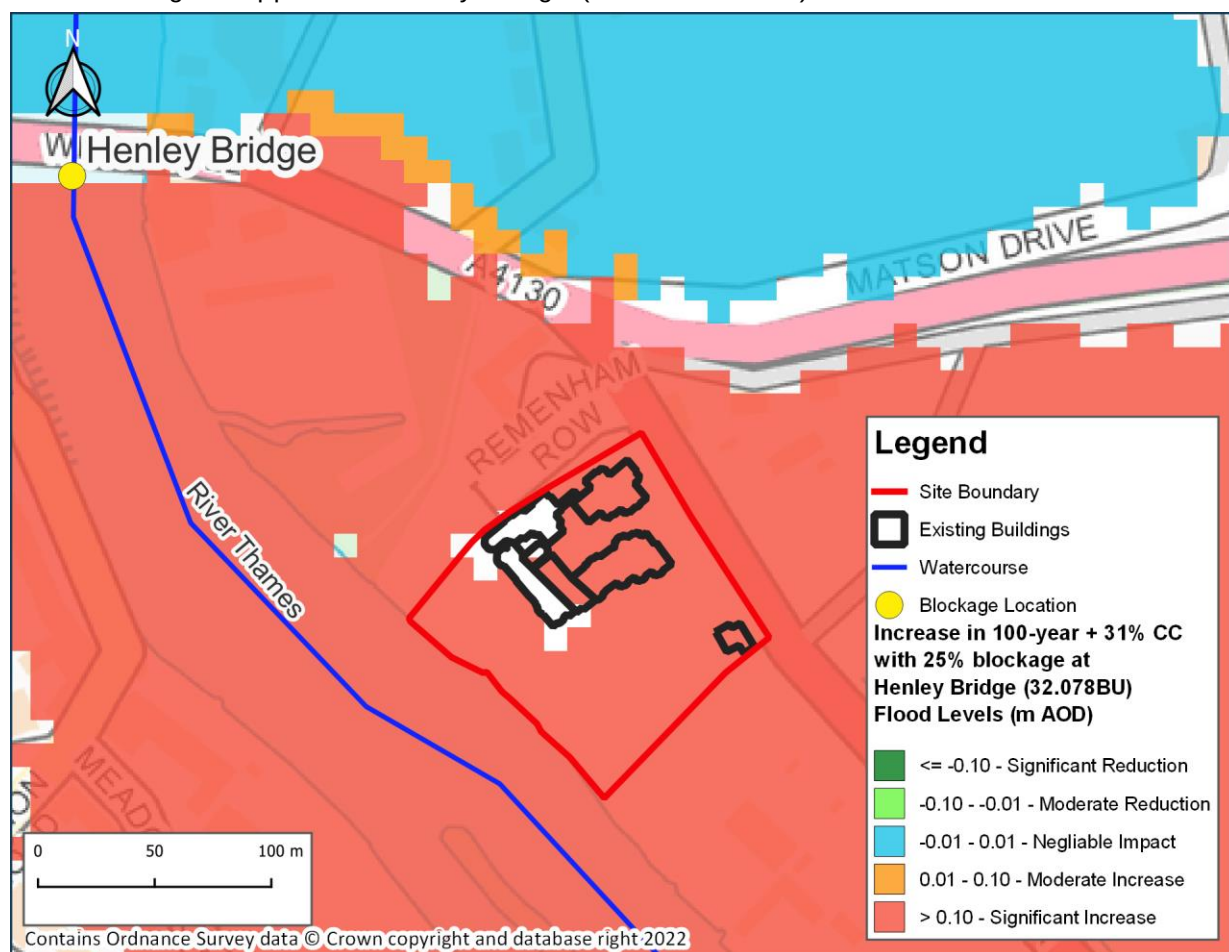


Figure 3-6: Baseline Blockage Analysis (100-year + 31% climate change)

When compared with Figure 3-4, Figure 3-6 shows that a 25% blockage at Henley Bridge during a 100-year plus 31% climate change flood event will generate an increase of up to 0.77m (approximately) in flood level at the site.

3.5 Hazard-to-people classification

The fluvial hazard-to-people rating during a 100-year with (31%) climate change flood scenario has been mapped using the formula as suggested in Defra's FD2321/TR2 "Flood Risk to People". The different hazard categories are shown in Table 3-2 and the hazard classification to the site during the 100-year with (31%) climate change scenario is shown in Figure 3-7.

Table 3-2: **Defra's FD2321/TR2 "Flood Risks to People" classifications**

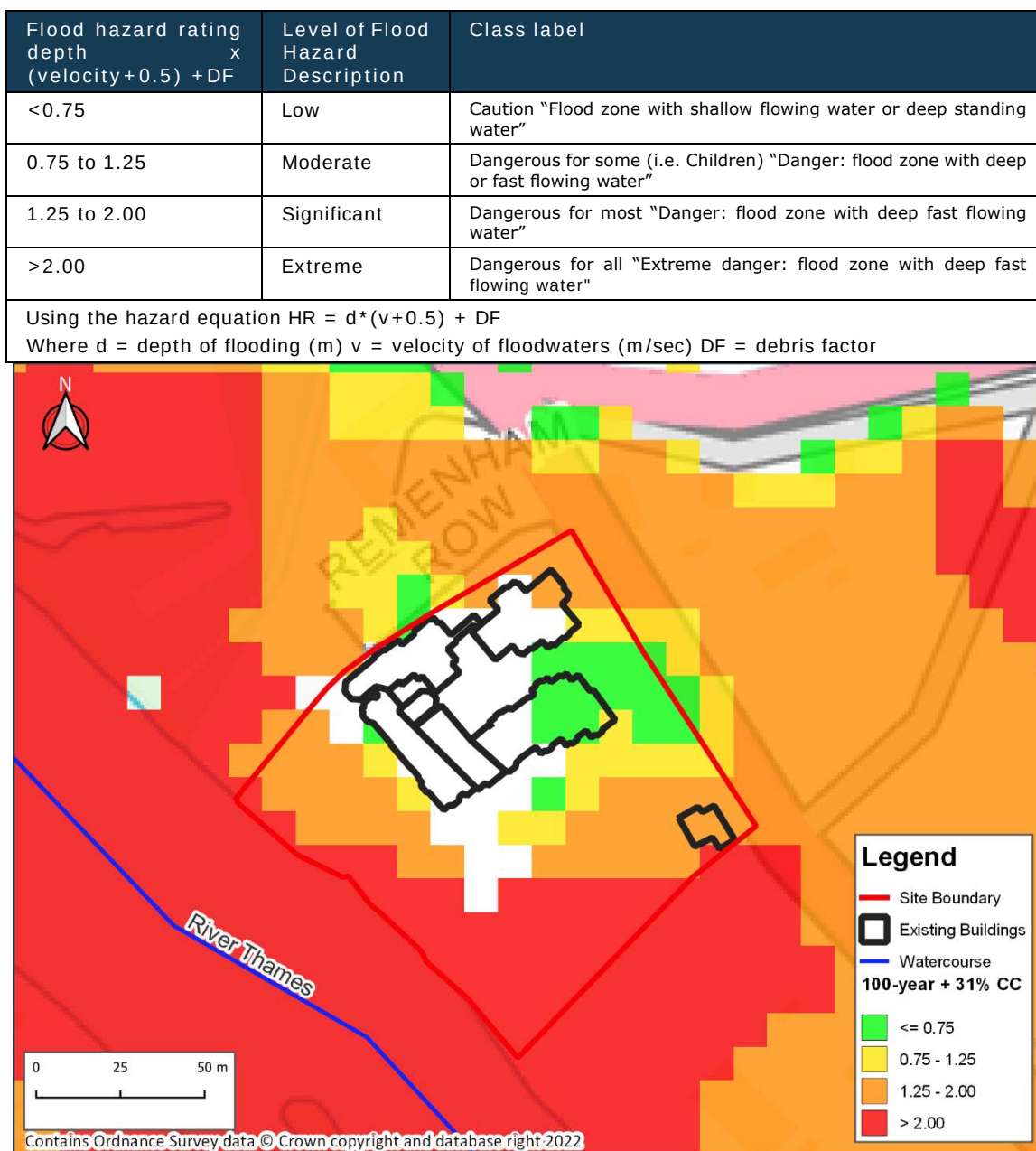


Figure 3-7: Baseline Hazard to People

Figure 3-7: Baseline Hazard to People shows that the Hazard to People rating for the majority of the site and along the A321 (which runs alongside the north-eastern site boundary) fall within the 'low' to 'significant' hazard categories.

3.6 Model result comparison

An 80mm decrease in peak water levels at the proposed site was noted when comparing the 100-year peak water levels at the proposed site from the 2019 Thames Mapledurham to Hurley with the updated model results produced by this hydraulic modelling study. This difference in peak water levels at the proposed site is considered negligible.

4 Conclusions and Recommendations

- JBA Consulting were commissioned by RPS to undertake a fluvial water hydraulic modelling study at Thamesfield, Wargrave Road, Henley-On-Thames.
- The model has been run for the baseline scenario for 30-year, 100-year, 100-year with 31% climate change and 1,000-year events in order to determine the existing fluvial flood risk to the site.
- Results from the hydraulic model were tested for their sensitivity to changes in Manning's roughness, downstream boundary conditions, and flows. A blockage risk scenario was undertaken for Henley Bridge during the 100-year with climate change flood event. Results from the sensitivity analysis indicate that the model results within the site are relatively insensitive to changes in roughness, downstream boundary or changed flow conditions.
- Results from the updated model runs show that:
 - o Water enters the site from overtopping of the River Thames' banks from all of the modelled 30-year, 100-year, 100-year +31% CC and 100-year fluvial flood events, as illustrated in Figure 0-1.
 - o The peak flood depth predicted within the site during the 100-year with 31% climate change event is 1.89m.
 - o During the 100-year with 31% climate change event, peak water levels are predicted exceed the existing flood levels in 2 off the existing buildings within the site boundary.
 - o During the 100-year with 31% climate change scenario the majority of the site falls 'low' to 'significant' hazard categories on the Defra Hazard to People map.
 - o The blockage risk analysis undertaken at Henley Bridge (node 32.078BU) during the 100-year with climate change flood event indicates that when a 25% blockage is applied, a significant increase in maximum flood depths of up to 0.77m is predicted within the site.

Appendices

A Appendix A – Site topographic survey