

# Flood Risk Assessment

28 February 2024

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Land off George Street, Reading, RG4 8DG

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# CONTENTS

## **1. Introduction**

- 1.1 Project Overview
- 1.2 Purpose of Investigation
- 1.3 Scope of Work
- 1.4 Limitations

## **2. Site**

- 2.1 Site Description and Location
- 2.2 Proposed Development
- 2.3 Vulnerability Classification
- 2.4 Sequential Test

## **3. Initial Conceptual Site Model**

- 3.1 Potential Flood Sources
- 3.2 Potential Flood Receptors
- 3.3 Potential Flood Pathways
- 3.4 Risk Assessment Methodology
- 3.5 Conceptual Site Model

## **4. Conclusions**

- 4.1 Risk Evaluation
- 4.2 Existing Flood Mitigation Measures
- 4.3 Proposed Flood Mitigation Measures
- 4.4 Surface Water Management
- 4.5 Safe Access and Egress
- 4.6 Wider Sustainability Benefits
- 4.7 Further Investigation

## **5. References**

## **1. Introduction**

The following document is a Flood Risk Assessment carried out by Oakshire Environmental, and includes details of the site, vulnerability classification, flood linkages and an evaluation of risk.

### **1.1 Project Overview**

The client's proposed project involves the construction of 5 dwellings and associated work on land off George Street, Reading, RG4 8DG. Oakshire Environmental have carried out a Flood Risk Assessment, as described below.

### **1.2 Purpose of Investigation**

The objectives of the Flood Risk Assessment were to:

- Develop a detailed assessment of the site.
- Apply the Sequential Test and Exception Test.
- Identify potential flood sources, receptors and pathways at the site.
- Assess the level of potential flood risk.
- Determine the requirement or scope of further investigations or mitigation measures.

### **1.3 Scope of Work**

- Brief introductory information has been noted to provide context to the report and include an Introduction, Project Overview, Scope of Work and Limitations.
- To develop a detailed assessment of the site and apply the Sequential Test and Exception Test, desk studies have been carried out to collate information obtained from sources including the Environment Agency, Local & National Authorities, Strategic Flood Risk Assessments and Detailed Terrain Model (DTM) LiDAR topographical surveys.
- This information has been used to identify potential flood sources, receptors and pathways at the site, as part of an initial Conceptual Site Model.
- To assess the level of potential flood risk, a Conceptual Site Model have been produced to categorise the potential severity of the impact of the flood linkage on the receptor and the probability of the flood linkage being present.
- Following the assessment of flood linkages, an evaluation of flood risk, mitigation measures, surface water management and safe access and egress has been conducted to determine the requirement or scope of further investigations.
- Supporting appendix include photographs, maps, and plans of the site.

## **1.4 Limitations**

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This report excludes consideration of potential hazards arising from any activities at the site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities. Oakshire Environmental does not warrant or guarantee that the site is free of hazardous or potentially hazardous materials or conditions. It should be noted that this report has been produced for environmental purposes only.

## 2. Site

The following section provides a description of the site, location and proposed development, in addition to, planning and site history, utilising information obtained from the client and publicly available sources.

### 2.1 Site Description and Location

The site is located on the corner of Gosbrook Road and George Street and is approximately 0.09ha. The site is comprised of a plot of grass and a wooden fence with advertisement boards attached. The site is mostly flat with a small slope across the centre and ground level ranging from 36.90mAOD at the south west to 37.82mAOD at the north east.

The site is bordered by Gosbrook Road to the north with residential dwellings beyond, George street to the east with residential dwellings beyond, additional residential dwellings to the south and a recreational field to the west. The surrounding area is predominantly residential with some commercial premises.

Gos Brook is situated 195m south of the site and the River Thames is 390m south east. These are Environment Agency main rivers. The site is situated within Flood Zone 3 of the 'Flood risk map for planning', which means that the land has a high probability of flooding (>1% annual probability of river flooding).

National Grid Reference: SU 71896 74594

### 2.2 Proposed Development

The proposed development involves the construction of five terraced dwellings at the east of the site fronting George Street with private gardens at the south west and open space at the north.

### 2.3 Vulnerability Classification

Table 2 in the NPPF technical guidance (Flood Risk Vulnerability Classification) assesses the flood risk vulnerability of a site based on the site's use. Based on this assessment, the proposed residential development falls within the category of 'more vulnerable'.

The flood risk map for planning indicates that the site falls within Flood Zone 3. Model results show that the 5% AEP flood extent encroaches onto the west and south of the site, therefore, this is designated as Flood Zone 3b (functional floodplain) while the remainder of the site is designated as Flood Zone 3a.

The development will be constructed predominantly within Flood Zone 3a in which more vulnerable developments are permitted provided the Exception Test is passed so this will be carried out. It should be noted that these Flood Zones do not take into account the impact of any flood defences or site-specific mitigation measures.

Table 1: Flood Risk Vulnerability Classification table from National Planning Policy Framework Technical Guidance

| Flood Risk Vulnerability Classification |                          |                         |                         |                 |                  |
|-----------------------------------------|--------------------------|-------------------------|-------------------------|-----------------|------------------|
| Flood Zones                             | Essential Infrastructure | Highly Vulnerable       | More Vulnerable         | Less Vulnerable | Water Compatible |
| Zone 1                                  | ●                        | ●                       | ●                       | ●               | ●                |
| Zone 2                                  | ●                        | Exception Test required | ●                       | ●               | ●                |
| Zone 3a                                 | Exception Test required  | ×                       | Exception Test required | ●               | ●                |
| Zone 3b                                 | Exception Test required  | ×                       | ×                       | ×               | ●                |

Key:      ●      Development is appropriate  
            ×      Development should not be permitted

## 2.4 Sequential Test

An appraisal of the Reading Borough Council Housing and Economic Land Availability Assessment has been conducted and the whole Borough has been selected as the search area. This assessment seeks to identify sites to accommodate at least ten homes, therefore, it is generally unsuitable for carrying out the sequential test for the proposed development. Given the very small scale of the proposed development, it would not be feasible to carry out the development on a large site that is allocated for far more dwellings than the proposed development would provide as this would limit the supply of housing in the Borough. Despite this, there are 9 sites included in the assessment with a capacity of less than 10 dwellings and at least 5 dwellings that are considered to be deliverable (within 5 years) or developable (6-15 years) and these sites will be reviewed with respect to the proposed residential development to determine their suitability.

Table 2: Sequential Assessment of sites outlined in the Reading Housing and Economic Land Availability Assessment

| Reading Housing and Economic Land Availability Assessment |           |                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Site Location                                             | Size (ha) | Comments                                                                                                                                                                                                                                                                                                                                                 |
| 120 Oxford Road                                           | 0.08      | Site is no longer available as an apartment building has recently been constructed on the site                                                                                                                                                                                                                                                           |
| Enterprise House, 89-97 London Street                     | 0.15      | Site can only accommodate a change of use of existing office block, therefore, new build houses would not be suitable or achievable                                                                                                                                                                                                                      |
| Central Club, London Street                               | 0.05      | High risk of surface water flooding on Mill Lane bordering the site to the north west<br><br>There is a Mural on the site and there is likely to be pressure to retain the mural. Unlikely that this could be incorporated into a residential scheme, therefore, the site is not currently considered to be suitable unless this issue can be addressed. |
| Arthur Hill Swimming Pool, 221-225 Kings Road             | 0.11      | Site is no longer available as an apartment building is currently under construction on the site                                                                                                                                                                                                                                                         |
| 131 Wokingham Road                                        | 0.15      | High risk of surface water flooding along St Peter's Road bordering the site to the north east<br><br>Tree Preservation Order impacting a significant portion of the site<br><br>Potential contamination due to existing use as a car garage<br><br>Not known whether the site is currently available                                                    |
| 79 London Road and 34 Eldon Terrace                       | 0.12      | Site is no longer available as an apartment building has recently been constructed on the site                                                                                                                                                                                                                                                           |
| Warwick House, Warwick Road                               | 0.15      | Site preparation works have already been carried out at the site for the development of an apartment building, therefore, it is no longer considered to be available for development                                                                                                                                                                     |
| Rear of 8-26 Redlands Road                                | 0.74      | Access would require upgrading<br><br>University of Reading currently owns the land and the site is surrounded by university sports facilities and student accommodation, therefore, it is not likely to be suitable for the family homes                                                                                                                |
| Rear of 1 & 3 Woodcote Road & 21 St Peter's Hill          | 0.33      | Not clear whether the site is currently available as no contact was made following call for sites nomination so this would need to be confirmed.                                                                                                                                                                                                         |

This assessment identified 1 site (*Rear of 1 & 3 Woodcote Road & 21 St Peter's Hill*) that would be suitable for the proposed development. It is not clear where this site is currently available and it must, therefore, be assumed to be unavailable until it can be shown to be available and capable of accommodating the proposed development. As a result, there are considered to be no reasonably available sites allocated in the Reading Housing and Economic Land Availability Assessment.

The Reading Borough Council Brownfield Land Register was also assessed to identify alternative sites for the proposed development. Sites that are considered to be deliverable with a capacity of less than 10 dwellings and at least 5 dwellings were reviewed with respect to the proposed residential development to determine their suitability.

Table 3: Sequential Assessment of sites outlined in the Reading Borough Council Brownfield Land Register

| Reading Borough Council Brownfield Land Register                     |           |                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Site Location                                                        | Size (ha) | Comments                                                                                                                                                                                                                                                           |
| Bristol and West Arcade, 173-175 Friar Street and 27-32 Market Place | 0.18      | Site can only accommodate a change of use of existing building to flats, therefore, new build houses would not be suitable or achievable                                                                                                                           |
| 175 Friar Street                                                     | 0.02      | Site can only accommodate a change of use of existing building to flats, therefore, new build houses would not be suitable or achievable                                                                                                                           |
| 27-32 Market Place                                                   | 0.05      | Site can only accommodate a change of use of existing building to flats and existing building is listed, therefore, new build houses would not be suitable or achievable                                                                                           |
| 40 Oxford Road                                                       | 0.01      | Site can only accommodate a change of use of existing building to flats, therefore, new build houses would not be suitable or achievable                                                                                                                           |
| Battle Inn PH, 2 Bedford Road                                        | 0.03      | Site has insufficient space to accommodate 5 new build houses                                                                                                                                                                                                      |
| 26-30 Swansea Road and 28-32 Northfield Road                         | 0.29      | Site is no longer available as residential development with 9 dwellings has recently been constructed on the site<br><br>Also situated within Flood Zone 2                                                                                                         |
| 87 Broad Street                                                      | 0.06      | Site can only accommodate a change of use of existing building to flats, therefore, new build houses would not be suitable or achievable                                                                                                                           |
| 165 Oxford Road                                                      | 0.05      | Site can only accommodate a change of use of existing building to flats, therefore, new build houses would not be suitable or achievable                                                                                                                           |
| Mulberry House, 1a Eldon Road                                        | 0.08      | Site's location directly bordering a high-rise serviced apartment building is not likely to be suitable for family houses. Apartment building, for which the site has planning permission, would be far more suitable.                                             |
| Zoar Strict Baptist Chapel, South Street                             | 0.03      | Site has insufficient space to accommodate 5 new build houses                                                                                                                                                                                                      |
| 2 Kings Road                                                         | 0.04      | Site can only accommodate a change of use of existing building to flats, therefore, new build houses would not be suitable or achievable                                                                                                                           |
| Epping House, 55 Russell Street                                      | 0.05      | Site can only accommodate a change of use of existing building to flats, therefore, new build houses would not be suitable or achievable                                                                                                                           |
| 125 Highgrove Street                                                 | 0.13      | Site is no longer available as residential development with 8 dwellings is currently under construction                                                                                                                                                            |
| 40-48 Mount Pleasant                                                 | 0.06      | Potential contamination due to existing use as a car repair garage<br><br>Not likely to be available given the late stage in the planning process (permission has been granted and conditions are being discharged)                                                |
| 85 Pell Street                                                       | 0.03      | Site has insufficient space to accommodate 5 new build houses<br><br>Potential contamination due to existing use as a car repair garage                                                                                                                            |
| 2-6 Water Road and 158 Dee Road                                      | 0.21      | High risk of surface water flooding at the north and medium risk across most the remainder of the site due to topographical flow path along Water Road. Modelled surface water flood depths up to 0.9m at potentially high velocity in a 1% AEP event.             |
| 307-311 Gosbrook Road                                                | 0.05      | Site is no longer available as an apartment building has recently been constructed on the site                                                                                                                                                                     |
| 2 Priory Avenue, Caversham                                           | 0.03      | Site is no longer available as the existing building has recently been converted to flats<br><br>South of the site is in Flood Zone 2 and there is a high risk of surface water flooding on Priory Road and Church Street bordering the site to the west and south |

|                                              |      |                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gardners Arms PH, 48 Surley Row, Emmer Green | 0.33 | Site is no longer available as residential development with 8 dwellings is currently under construction                                                                                                                                                                                                              |
| 2-4 Send Road, Caversham                     | 0.10 | Site and surrounding land is in Flood Zone 3 and Send Road bordering the site to the west is at high risk of surface water flooding<br><br>Potential contamination due to existing use a tyre shop                                                                                                                   |
| 389 Gosbrook Road, Caversham                 | 0.05 | Site and surrounding land is in Flood Zone 3 and there is at high risk of surface water flooding along Send Road and bordering the site to the west and Gosbrook Road bordering the site to the north<br><br>Potential contamination due to previous use for auto refinishing and potential asbestos roofed building |

This assessment identified no sites that would be available or suitable for the proposed development, therefore, there are considered to be no reasonably available sites in the Reading Borough Council Brownfield Land Register.

A review of land for sale in the borough was also carried out and 5 plots were identified in the Borough.

Table 4: Sequential Assessment of land available for sale

| Land for Sale              |           |                                                                                                                                                                                                                                                                                       |
|----------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Site Location              | Size (ha) | Comments                                                                                                                                                                                                                                                                              |
| Church Street, Caversham   | 0.04      | Site has insufficient space to accommodate 5 new build houses<br><br>Central location adjacent to retail and commercial units also make this an unsuitable location for houses alone                                                                                                  |
| Land at 362 Oxford Road    | 0.12      | Unreasonably large and expensive for the proposed development                                                                                                                                                                                                                         |
| Tilehurst, Reading         | 0.39      | Site and surrounding land is within Flood Zone 3<br><br>Potential contamination from past use for storage of vehicles and machinery, sale and repair of motor vehicles and the buying and selling of scrap metal<br><br>Unreasonably large and expensive for the proposed development |
| Land beside 37 Chapel Hill | 0.03      | High risk of surface water along Chapel Hill<br><br>Site has insufficient space to accommodate 5 new build houses                                                                                                                                                                     |

None of the land currently available for sale in the Borough is considered to be suitable for the proposed development.

Based on the findings of the above assessments, there are considered to be no other reasonably available sites in the Borough that would be suitable for the proposed development and the Sequential Test is passed.

### **3. Initial Conceptual Site Model**

The following section outlines potential flood sources, pathways and receptors, utilising information gathered in the previous sections, to develop an initial conceptual site model.

#### **3.1 Potential Flood Sources**

The following section outlines potential flood sources, pathways and receptors, utilising information gathered in the previous sections, to develop an initial conceptual site model.

##### **Rivers & Seas**

The site is situated 195m north of Gos Brook and 390m north west of the River Thames. The west of the site is considered to have a high probability of flooding, according to Environment Agency maps that include the impact of flood defences, while the east of the site is at medium risk.

Modelling of the River Thames, carried out by Jacobs in 2021, shows that the whole of the site is at risk of flooding in a 1% AEP event and the maximum flood level at the site is 37.928mAOD. Flood depths could reach up to 0.85m at the south west while flood depths at the east of the site, where the proposed dwellings will be located, are not likely to exceed 0.6m.

There are flood defences along Gos Brook and the River Trent in the form of natural high ground with a design Standard of Protection (SoP) of up to 5 years. These are not considered to offer sufficient protection to the site.

Christchurch Meadow, to the west of the site, is known to provide floodplain storage capacity in major fluvial floods and is drained via Gos Brook.

Environment Agency data shows that the site has previously flooded on two occasions with one event, in 1947, affecting the whole site and another in 2003 that affected only the western boundary. Both of these occurred as a result of the River Thames exceeding its channel capacity.

##### **Surface Water**

Surface water runoff is caused by heavy rainfall that can overwhelm the drainage network. The Environment Agency Risk of Flooding from Surface Water mapping can be used to identify areas at risk of surface water flooding. Map data shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys and can pond in low-lying areas. The risk is most often confined to roads with some run-off flow routes around properties.

Environment Agency maps show that the risk of surface water flooding at the site is very low, however, surface water flooding is anticipated along Gosbrook Road to the north of the site and in the field (Christchurch Meadows) to the west. The site is slightly elevated in relation to Gosbrook Road and Christchurch Meadows, therefore, surface water is likely to follow the topographical flow paths of the roads and collect in the field while the site will remain unaffected in a 1% AEP event.

The underlying bedrock geology at the site is highly permeable Seaford and Newhaven Chalk Formation (undifferentiated), however, the superficial deposits are the impermeable Langley Silt Member. This is likely to limit water infiltration, potentially increasing the risk of surface water flooding.

## **Groundwater**

Flooding from groundwater can occur when the water table rises and reaches ground level allowing water to seep through to the surface. This means that water may rise up through floors or underground rooms such as cellars or basements. Groundwater flooding is much slower to occur than river flooding and will usually happen days, weeks or even months after heavy or prolonged rainfall. And it may last weeks or even months.

The underlying bedrock is a principal aquifer of high productivity, suggesting a potential risk of flooding from groundwater, however, the superficial deposits are impermeable and this will limit the risk of groundwater flooding. Environment Agency mapping outlined in the Reading Borough Council SFRA shows that the site lies within an area considered to be of low susceptibility to groundwater flooding and there are no records of groundwater flooding in the vicinity of the site suggesting a negligible risk of groundwater flooding. It should be noted that this map shows the proportion of each 1km grid square where geological and hydrogeological conditions indicate a susceptibility to groundwater emergence. It does not show the likelihood of groundwater flooding occurring.

## **Sewers**

Sewer flooding occurs when heavy rainfall and flooding overloads sewer capacity or when sewers cannot discharge to watercourses due to high water levels. Sewer flooding can also be caused by blockages, collapses, equipment failure or groundwater leaking into sewer pipes. Sewer flooding is often synonymous with other sources of flooding such as river, surface water and groundwater flooding.

The Reading Borough Council SFRA provides recorded flood incidents from Thames Water's DG5 register and shows that, in the 5 year period before February 2016, there were over 100 recorded flood incidents within the 'RG4 8' postcode area. This suggests that the area is highly susceptible to sewer flooding. There is also a record of flooding affecting a small area of the road and footpath to the north east of the site in 2013-2014 noted to have been caused by 'local drainage' suggesting potential sewer flooding.

## **Reservoirs**

The level and standard of inspection and maintenance required for reservoirs means that the risk of flooding from reservoirs is generally very low. The only reservoir of relevance to Reading Borough is Whiteknights Lake 2.94km south east of the site and the Detailed Reservoir Flood Map shows that the site would be unaffected by a failure or overtopping of this reservoir. Environment Agency mapping also shows that there is only a risk to the site from reservoir flooding when there is also river flooding.

## **Climate Change**

Climate change projections show an increased chance of warmer, wetter winters and hotter, drier summers with a higher likelihood of more frequent and intense rainfall. This is likely to make severe flooding happen more often. It is necessary to ensure that a development will be safe from flooding for its lifetime, which is generally considered to be 100 years for a residential development. Environment Agency guidance recommends that the impacts of climate change on peak river flow are assessed based on management catchments and recommends the use of the 'central' allowances for more vulnerable developments. To assess the impacts of climate change on peak rainfall intensity in large rural catchments the peak river flow allowances should also be used. The central climate change allowance for the 2080s in the Thames and South Chilterns management catchment is 31%.

Modelling of the 1% AEP flood extent, including a range of climate change allowances, has been carried out for the site. The 35% climate change allowance was used to assess the site as this is the closest to the recommended 31% allowance and allows a conservative assessment to be made. Based on this modelling, the whole site is at risk of flooding to a maximum flood level of 38.227mAOD at the south west and up to 38.224mAOD within the footprint of the proposed dwellings.

Climate change modelling of surface water has not been carried out for the site, however, the 0.1% AEP event can be used as a proxy. Based on this, the site is not considered to be at risk of surface water flooding, taking into account climate change.

### **3.2 Potential Flood Receptors**

Given the proposed use of the site, the following receptors are considered:

- Residential end users
- Proposed dwellings

### **3.3 Potential Flood Pathways**

Based on the expected on-site receptors, relevant pathways for the above receptors include:

- Gos Brook
- River Thames
- Surface water along Gosbrook Road and in Christchurch Meadows
- Permeable underlying bedrock
- Local sewers

Pathways between off-site sources and off-site receptors is beyond the scope of this assessment.

### 3.4 Risk Assessment Methodology

The potential level of risk posed by a particular source is determined by assessing the potential severity of the impact of the flood linkage on the receptor, if it is assumed to be present, and the probability of the flood linkage being present.

Severities are categorised from Minor to Severe and probabilities are categorised from Unlikely to High Likelihood to give a potential level of risk output.

Table 5: Risk Matrix

| Probability     | Severity of Consequence |                     |                     |                     |
|-----------------|-------------------------|---------------------|---------------------|---------------------|
|                 | Severe                  | Medium              | Mild                | Minor               |
| High Likelihood | Very High Risk          | High Risk           | Moderate Risk       | Low / Moderate Risk |
| Likely          | High Risk               | Moderate Risk       | Low / Moderate Risk | Low Risk            |
| Low Likelihood  | Moderate Risk           | Low / Moderate Risk | Low Risk            | Very Low Risk       |
| Unlikely        | Low / Moderate Risk     | Low Risk            | Very Low Risk       | Very Low Risk       |

#### *Very High Risk*

There is a high probability that severe harm could arise to a designated receptor from an identified source; or there is evidence that severe harm to a designated receptor is currently happening.

#### *High Risk*

Harm is likely to arise to a designated receptor from an identified source.

#### *Moderate Risk*

It is possible that harm could arise to a designated receptor from an identified source. It is relatively unlikely that any such harm would be severe or if any harm were to occur it is more likely that the harm would be relatively mild.

#### *Low Risk*

It is possible that harm could arise to a designated receptor from an identified source, however, it is likely that this harm, if realised, would normally be mild.

#### *Very Low Risk*

There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

### 3.5 Conceptual Site Model

The information in this section has been compiled to produce an initial conceptual site model outlining the potential sources, pathways and receptors to consider at the site. The level of risk was categorised by considering the severity and probability, as outlined in the previous section.

Table 6: Conceptual site model

| Sources                | Pathways                                                      | Receptors                                             | Severity | Probability    | Potential Level of Risk |                                                                                                                                                                                                                                                        |
|------------------------|---------------------------------------------------------------|-------------------------------------------------------|----------|----------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fluvial Flooding       | Gos Brook<br>River Thames                                     | Residential<br>end users<br><br>Proposed<br>dwellings | Medium   | Likely         | Moderate                | The site is partly within the functional floodplain and the whole site is at risk of flooding in a 1% AEP event with the west of the site at higher risk than the east. Flood defences are not considered to offer sufficient protection to the site.  |
| Surface Water Flooding | Surface water along Gosbrook Road and in Christchurch Meadows |                                                       | Mild     | Unlikely       | Very Low                | Surface water flooding is likely along Gosbrook Road to the north of the site and in Christchurch Meadows to the west, however, this is not likely to impact the site, due to the site's slight elevation.                                             |
| Groundwater Flooding   | Permeable underlying bedrock                                  |                                                       | Mild     | Low Likelihood | Low                     | Despite the high permeability of the underlying bedrock, groundwater flooding is mitigated by the impermeable superficial deposits underlying the site. Environment Agency mapping suggests a low susceptibility to groundwater flooding in the area.  |
| Sewer Flooding         | Local sewers                                                  |                                                       | Mild     | Low Likelihood | Low                     | Extensive sewer flooding has occurred in the postcode area suggesting that the site is particularly susceptible to sewer flooding, however, the very low risk of surface water flooding suggests that sewer flooding at the site itself is not likely. |
| Climate Change         | Gos Brook<br>River Thames                                     |                                                       | Medium   | Likely         | Moderate                | Climate change modelling shows that the whole site is at risk of flooding to a maximum flood level of 38.227mAOD at the south west and up to 38.224mAOD within the footprint of the proposed dwellings.                                                |
|                        | Surface water along Gosbrook Road and in Christchurch Meadows |                                                       | Medium   | Unlikely       | Low                     | Using the 0.1% AEP flood event as a proxy for climate change modelling, the site is not considered to be at risk of surface water flooding, taking into account climate change.                                                                        |

## 4. Conclusions

### 4.1 Risk Evaluation

The initial conceptual site model identified the following potential flood linkages present at the site and the following conclusions have been drawn:

- There is a **moderate risk** to residential end users and the proposed dwellings from river flooding from Gos Brook and the River Thames.
- There is a **very low risk** to residential end users and the proposed dwellings from surface water flooding along Gosbrook Road and in Christchurch Meadows.
- There is a **low risk** to residential end users and the proposed dwellings from groundwater flooding through the permeable underlying bedrock.
- There is a **low risk** to residential end users and the proposed dwellings from sewer flooding in local sewers.
- There is a **moderate risk** to residential end users and the proposed dwellings from river flooding, taking into account climate change.
- There is a **low risk** to residential end users and the proposed dwellings from surface water flooding, taking into account climate change.

### 4.2 Existing Flood Mitigation Measures

Flood defences along Gos Brook and the River Thames are not considered to offer sufficient protection and there are no formal flood mitigation measures at the site.

### 4.3 Proposed Flood Mitigation Measures

In order to mitigate the risk to the development from river flooding, the finished floor level of proposed dwellings will be set no lower than 38.524mAOD to provide a 300mm freeboard above the maximum modelled flood level within the building footprint in a 1% AEP event, including a 35% allowance for climate change.

The entire site is situated within the 1% AEP (+35%CC) floodplain, therefore, it will not be possible to provide flood compensation on a level for level, volume for volume basis on the site. Where it is not possible to provide level for level floodplain compensation then other forms of mitigation may be considered including the use of voids.

The proposed dwellings will, therefore, be constructed with underfloor voids. In line with Environment Agency guidance, the voids will be open on all sides, with the underside of the void no lower than 38.224mAOD. The openings will be at least 1 metre wide and there will be one opening in every 5-metre length of wall. 10mm diameter vertical bars set at 100mm centres will also be incorporated into the void openings. Voids will be maintained as designed and remain open for the lifetime of the development.

#### **4.4 Surface Water Management**

Generally, it is desirable to discharge surface water runoff into the ground before allowing discharge to a surface water body, surface water sewer, highway drain, or a combined sewer. Surface water currently discharges directly into the ground and excess surface runoff discharges into the highway drains along Gosbrook Road and George Street.

The proposed development will significantly increase the impermeable surface cover across the site and, as a result, the rate and volume of runoff will be greater than the existing run-off rate and volume. To ensure that the flood risk off-site is not increased, Sustainable Drainage Systems will be incorporated including the installation of soakaways in the rear gardens.

#### **4.5 Safe Access and Egress**

There is a significant risk of river flooding at the site and safe access and egress will not be possible to and from the proposed building during design conditions, without the intervention of emergency services.

Residents should sign up to receive Environment Agency Flood Alerts and Warnings.

Given the absence of parking at the site, a pedestrian evacuation route to an area at low risk of flooding (i.e. Flood Zone 1) will be necessary.

The preferred evacuation route is to exit the site onto Gosbrook Road and travel west 275m after which there are multiple areas in Flood Zone 1 to the north. This evacuation route is short and easily navigable for site users with mobility issues. The evacuation route is shown in the Appendix.

Finished floor levels will be raised above the modelled 1% AEP flood level, with an allowance for climate change, and the 0.1% AEP flood level, therefore, safe refuge will be possible within the dwellings if absolutely necessary. There will also be no sleeping accommodation on the ground floor.

#### **4.6 Wider Sustainability Benefits**

Reading Borough Council's latest Housing Trajectory as published in the Annual Monitoring Review 2021 shows that the need for family housing (3 beds or more) makes up over half the identified need, while the supply falls well short based on current figures, therefore, the provision of five 3-bed family houses is considered to be a significant sustainability benefit to the local community.

The proposed development will also include an area for native shrub and tree planting at the north of the site which will improve biodiversity.

## 4.7 Further Investigation

The site lies within Flood Zone 3, based on the Environment Agency's Flood Map for Planning. Assessment of the risk to the site from all sources of flooding, including consultation of the Reading and Caversham Flood Alleviation Scheme - Baseline Modelling Report and the Reading Borough Council SFRA, shows that the site is considered to be at moderate risk from river flooding, low risk from groundwater and sewer flooding and a very low risk from surface water flooding. The risk from reservoir flooding is considered to be negligible.

There is also considered to be a moderate risk to the site from river flooding and a low risk from surface water flooding when taking into account climate change.

In order to mitigate the risk to the development from river flooding, the finished floor level of proposed dwellings will be set no lower than 38.524mAOD. The proposed dwellings will also be constructed with underfloor voids with the underside of the void no lower than 38.224mAOD.

The proposed development will significantly increase the impermeable surface cover across the site and, as a result, the rate and volume of runoff will be greater than the existing run-off rate and volume. To ensure that the flood risk off-site is not increased, Sustainable Drainage Systems will be incorporated including the installation of soakaways in the rear gardens.

The preferred evacuation route is to exit the site onto Gosbrook Road and travel west 275m after which there are multiple areas in Flood Zone 1 to the north. This evacuation route is short and easily navigable for site users with mobility issues. Finished floor levels will be raised above the modelled 1% AEP flood level, with an allowance for climate change, and the 0.1% AEP flood level, therefore, safe refuge will be possible within the dwellings if absolutely necessary.

It should be noted that these conclusions are based on the currently proposed development plan, therefore, flood risk at the site should be re-assessed if material changes are made to the proposed development.

## 5. References

**British Geological Survey.** *British Geological Survey (BGS)* [online] Available at: <bgs.ac.uk/>.

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**Department for Environment Food & Rural Affairs, 2022.** *Climate Change Allowances.* [online] Available at: <environment.data.gov.uk>.

**Environment Agency, 2023.** *Flood map for planning.* [online] Available at: <flood-map-for-planning.service.gov.uk>.

**Environment Agency, 2022.** *Flood risk and coastal change.* [online] Available at: <gov.uk/guidance/flood-risk-and-coastal-change>.

**Environment Agency, 2022.** *Flood risk assessments: climate change allowances.* [online] Available at: <gov.uk/guidance/flood-risk-assessments-climate-change-allowances>.

**Jacobs U.K. Limited, 2021.** *Reading and Caversham Flood Alleviation Scheme - Baseline Modelling Report.*

**Peter Brett Associated LLP, 2017.** *Reading Borough Council Strategic Flood Risk Assessment.* [online] Available at: <reading.gov.uk>.

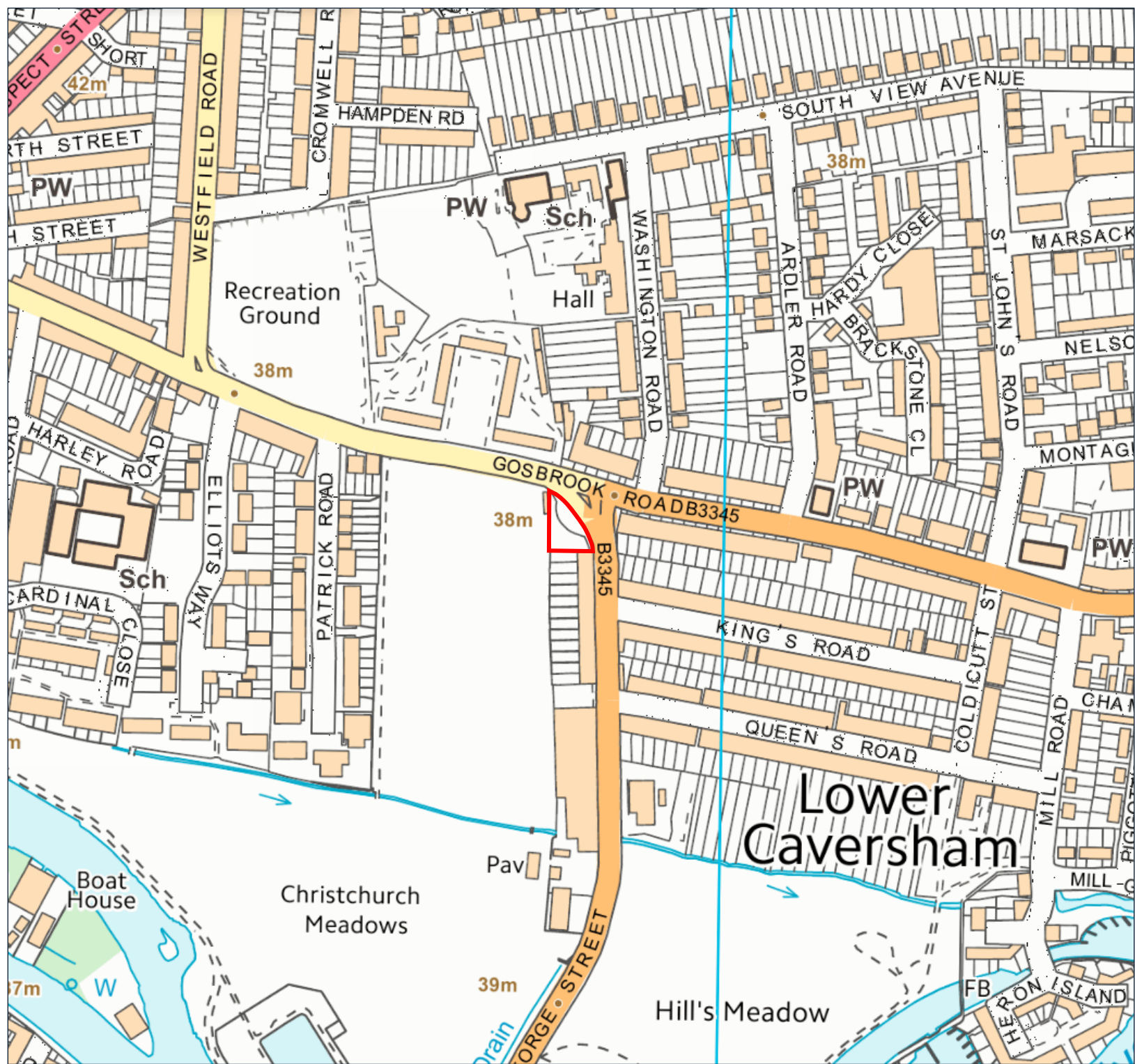
**Reading Borough Council, 2017.** *Reading Housing and Economic Land Availability Assessment.* [online] Available at: <reading.gov.uk>.

**Reading Borough Council, 2023.** *Brownfield Land Register.* [online] Available at: <reading.gov.uk>.

**Rightmove.** *Property for sale - Find flats and houses for sale in the UK.* [online] Available at: <rightmove.co.uk/property-for-sale>.

**Ordnance Survey.** [online] Available at: <ordnancesurvey.co.uk/>.

**Oakshire Environmental.** Available at: <oakshireenvironmental.co.uk>



| Appendix - Site Maps & Plans                           |               |
|--------------------------------------------------------|---------------|
| Description                                            |               |
| Site location plan                                     |               |
| Sources                                                |               |
| Contains OS data © Crown copyright and database rights |               |
| Key                                                    |               |
| <div></div>                                            | Site boundary |
| <div></div>                                            | North         |





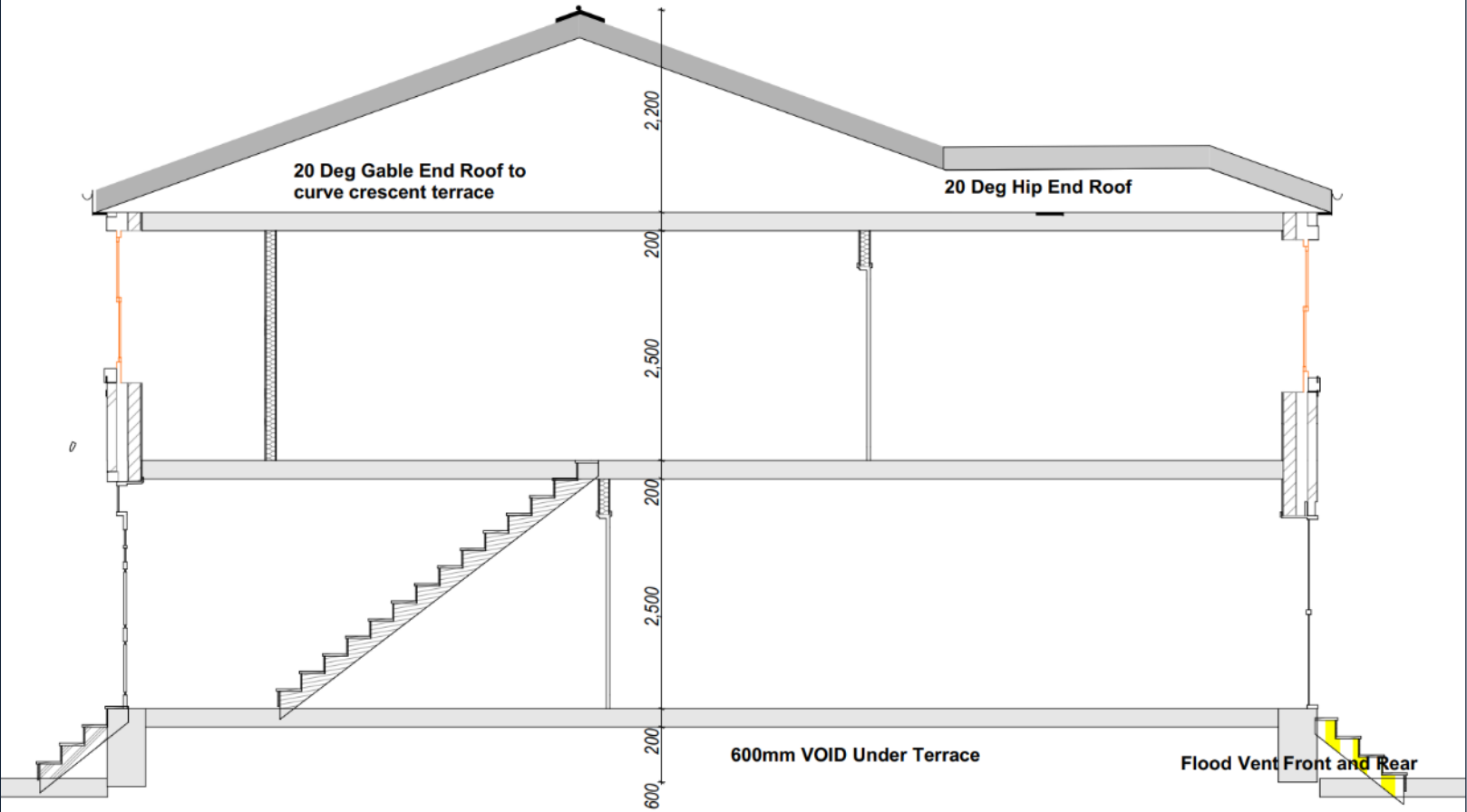


| Appendix - Site Maps & Plans                                                        |               |
|-------------------------------------------------------------------------------------|---------------|
| Description                                                                         |               |
| Proposed ground floor plan                                                          |               |
| Key                                                                                 |               |
|  | Site boundary |
|  | North         |

Appendix - Site Maps & Plans

Description

Proposed section showing underfloor void

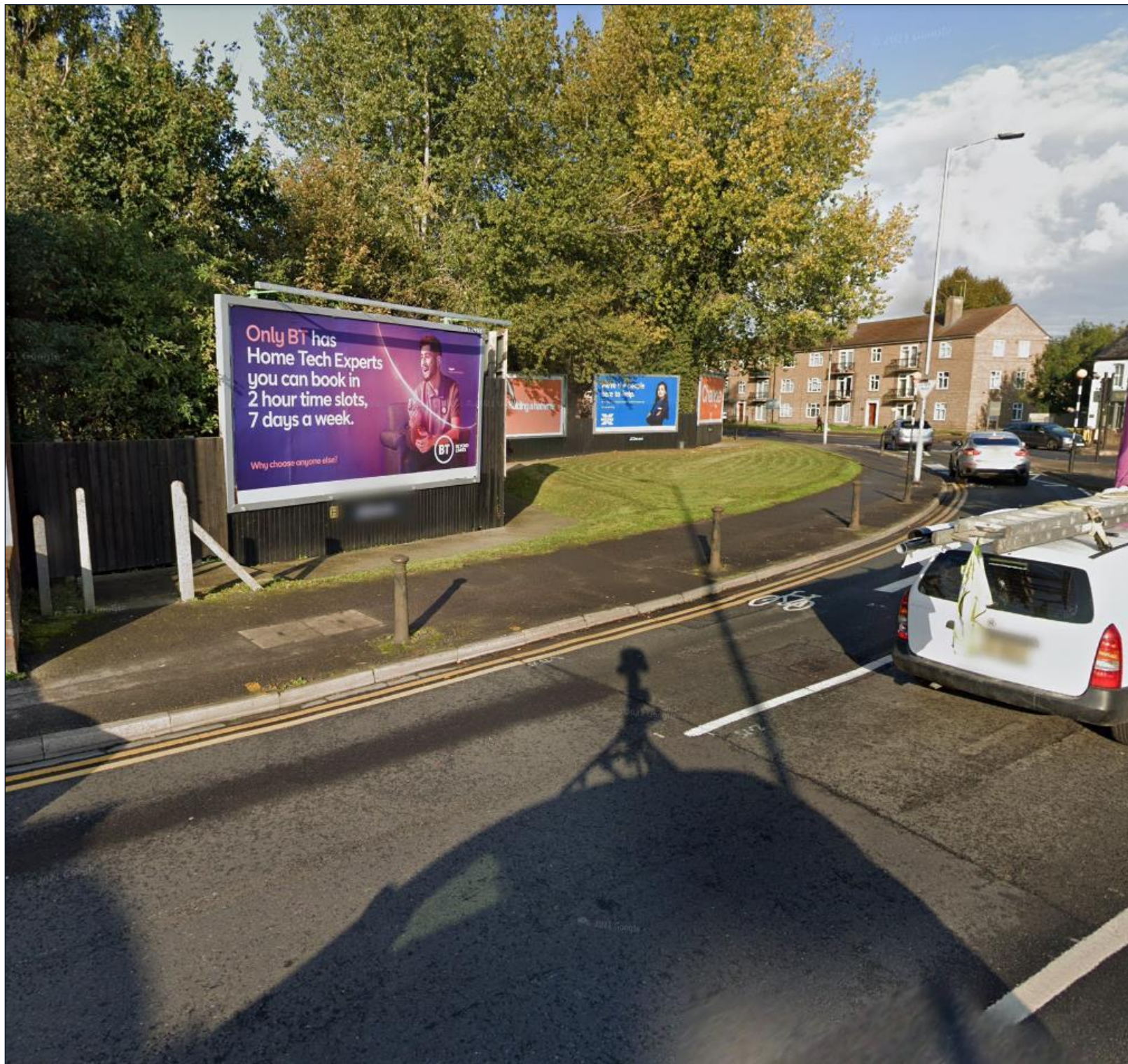


## Appendix - Site Maps & Plans

Description

Proposed front and rear elevations





| Appendix - Site Photos                                   |
|----------------------------------------------------------|
| Description                                              |
| Photo of the site from the south east, facing north west |
| Sources                                                  |
| Google, 2021                                             |



## Appendix - Site Photos

### Description

Photo of the site from the north east, facing south west

### Sources

Google, 2021



## Appendix - Site Photos

### Description

Photo of the site from the north west, facing south east

### Sources

Google, 2021



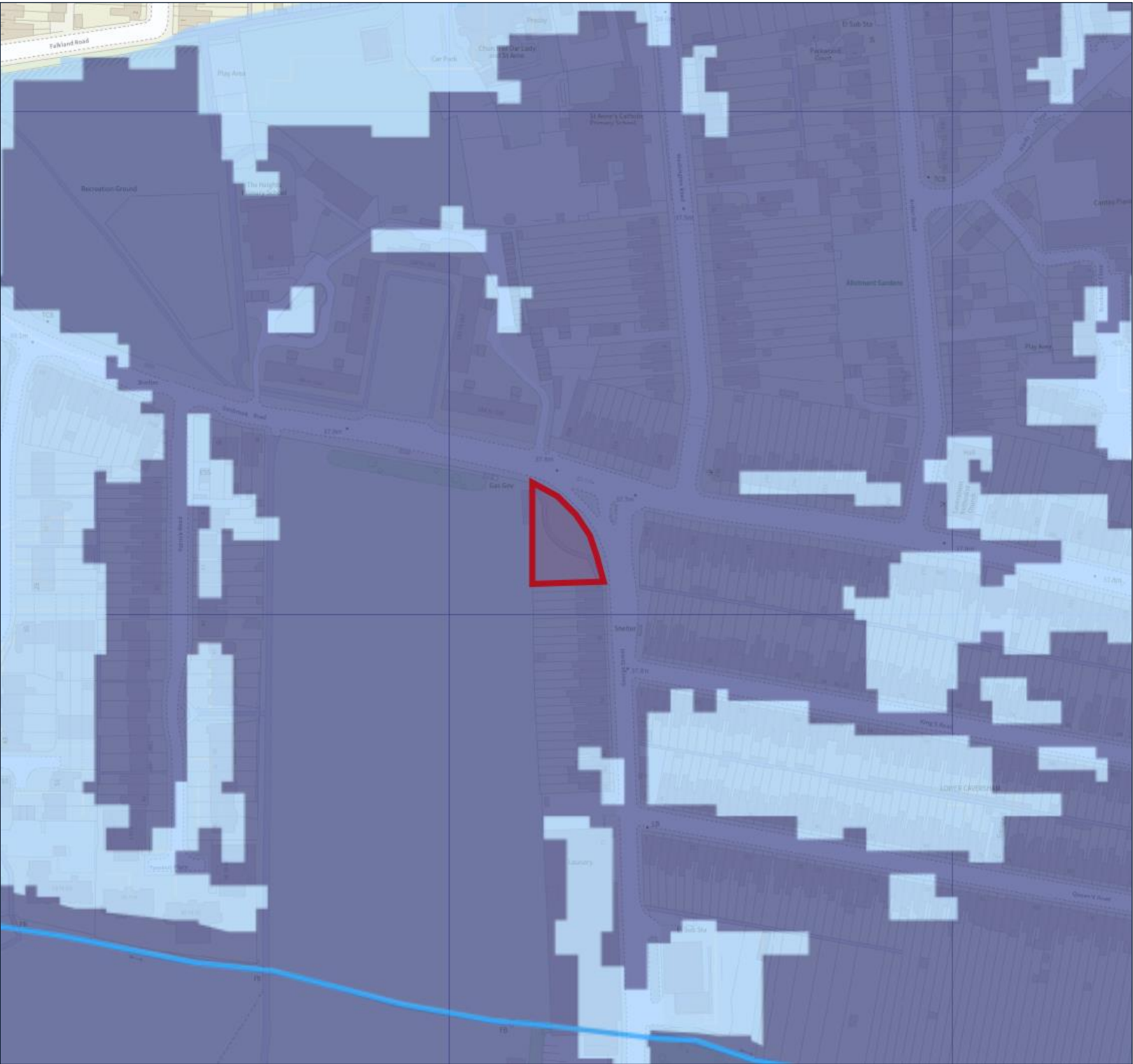
# Appendix - Site Photos

## Description

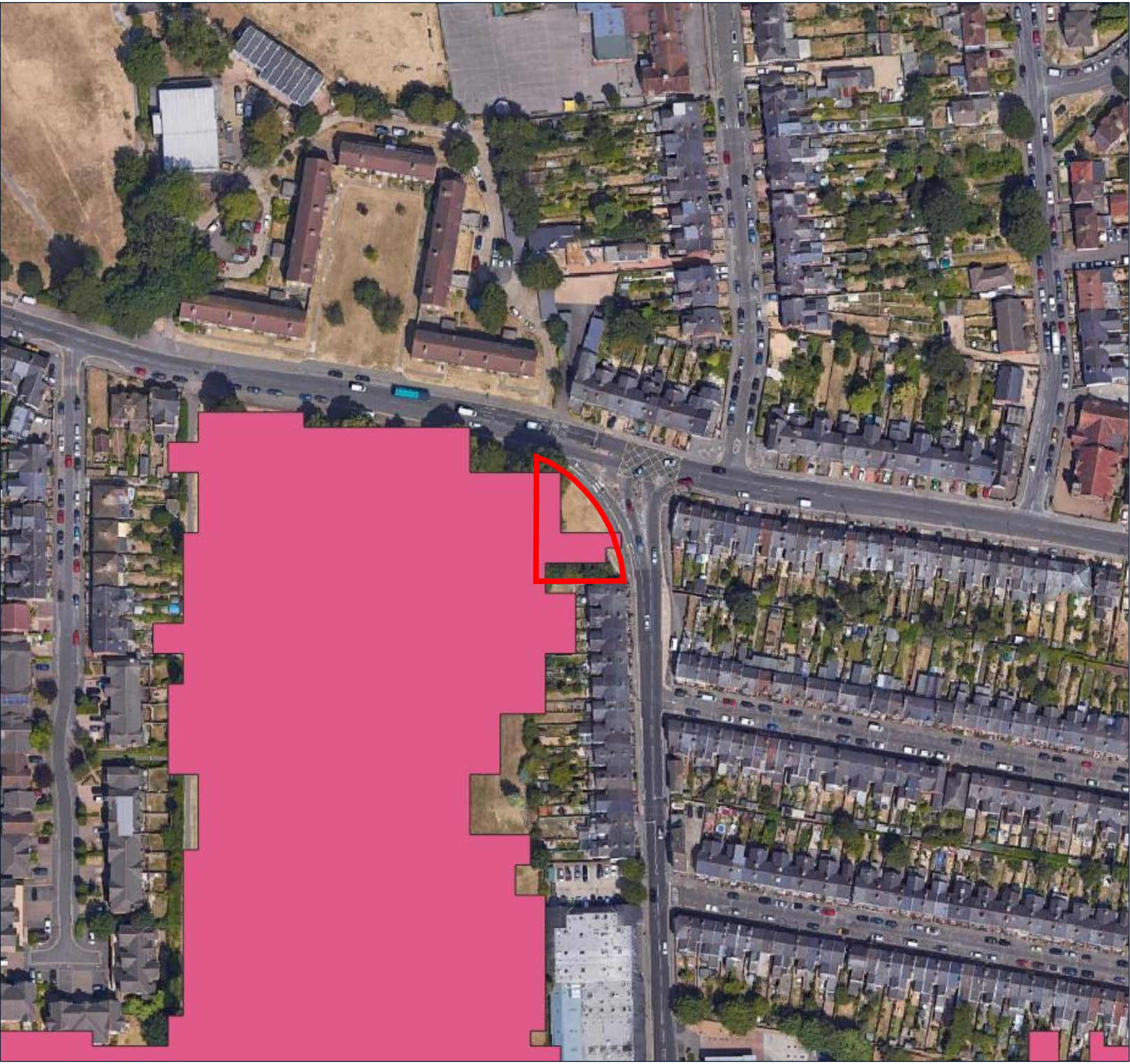
Photo of field bordering the site to the south west, facing south

## Sources

Google, 2021

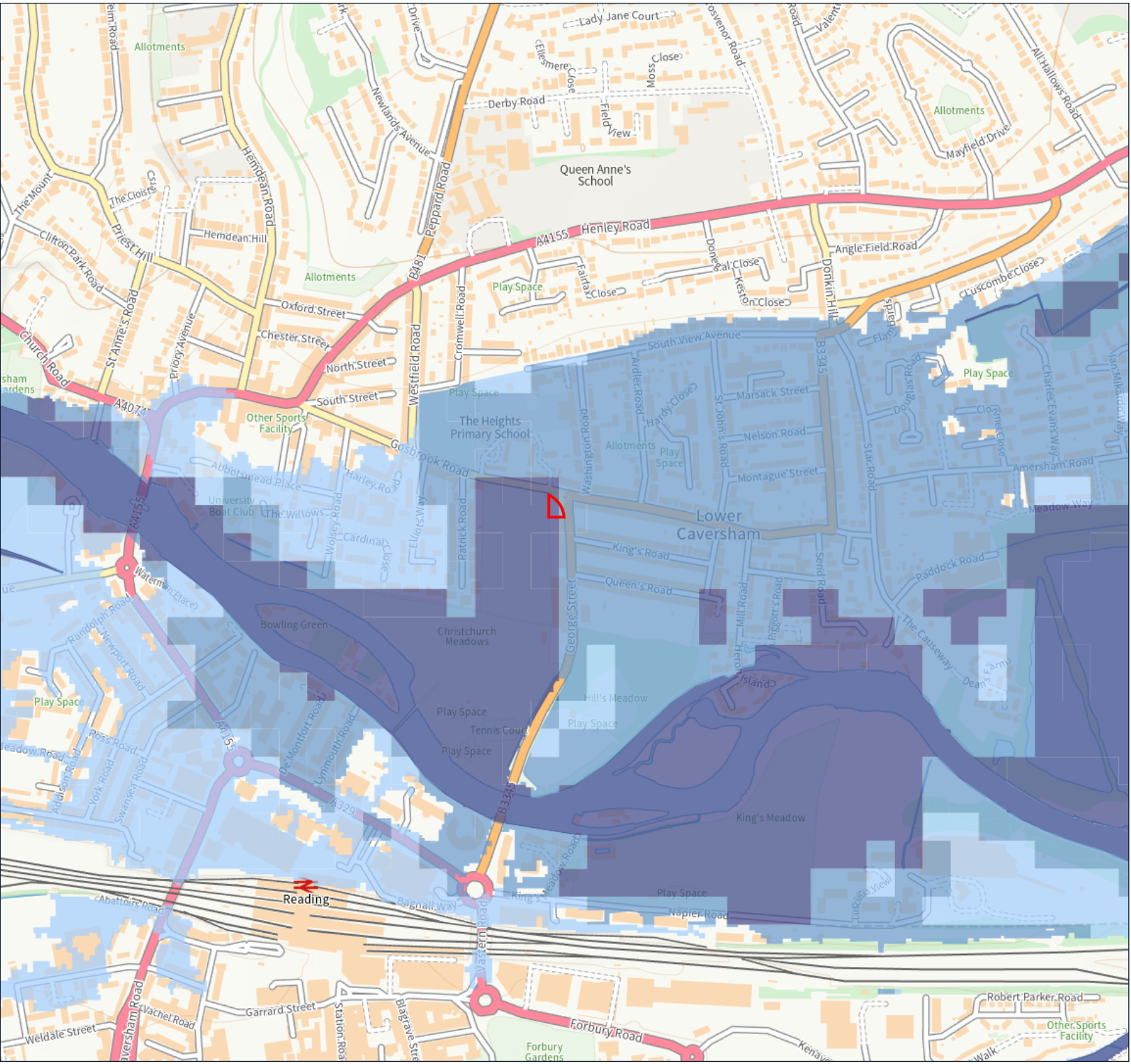


| Appendix – Flood Risk Maps                                                          |                                       |
|-------------------------------------------------------------------------------------|---------------------------------------|
| Description                                                                         |                                       |
| Flood zone map for planning                                                         |                                       |
| Sources                                                                             |                                       |
| Environment Agency<br>OS data © Crown copyright and database rights                 |                                       |
| Key                                                                                 |                                       |
|  | Site boundary                         |
|  | Flood Zone 1                          |
|  | Flood Zone 2                          |
|  | Flood Zone 3                          |
|  | Areas benefitting from flood defences |
|  | Main river                            |
|  | Flood defence                         |
|  | North                                 |



**Appendix - Flood Risk Maps**

| Description                                                                           |                               |
|---------------------------------------------------------------------------------------|-------------------------------|
| Modelled extent of the 5% AEP event, denoted as functional floodplain (Flood Zone 3b) |                               |
| Sources                                                                               |                               |
| Jacobs<br>Google                                                                      |                               |
| Key                                                                                   |                               |
|    | Site boundary                 |
|    | 5% AEP extent (Flood Zone 3b) |
|    | North                         |



Appendix - Flood Risk Maps

Description

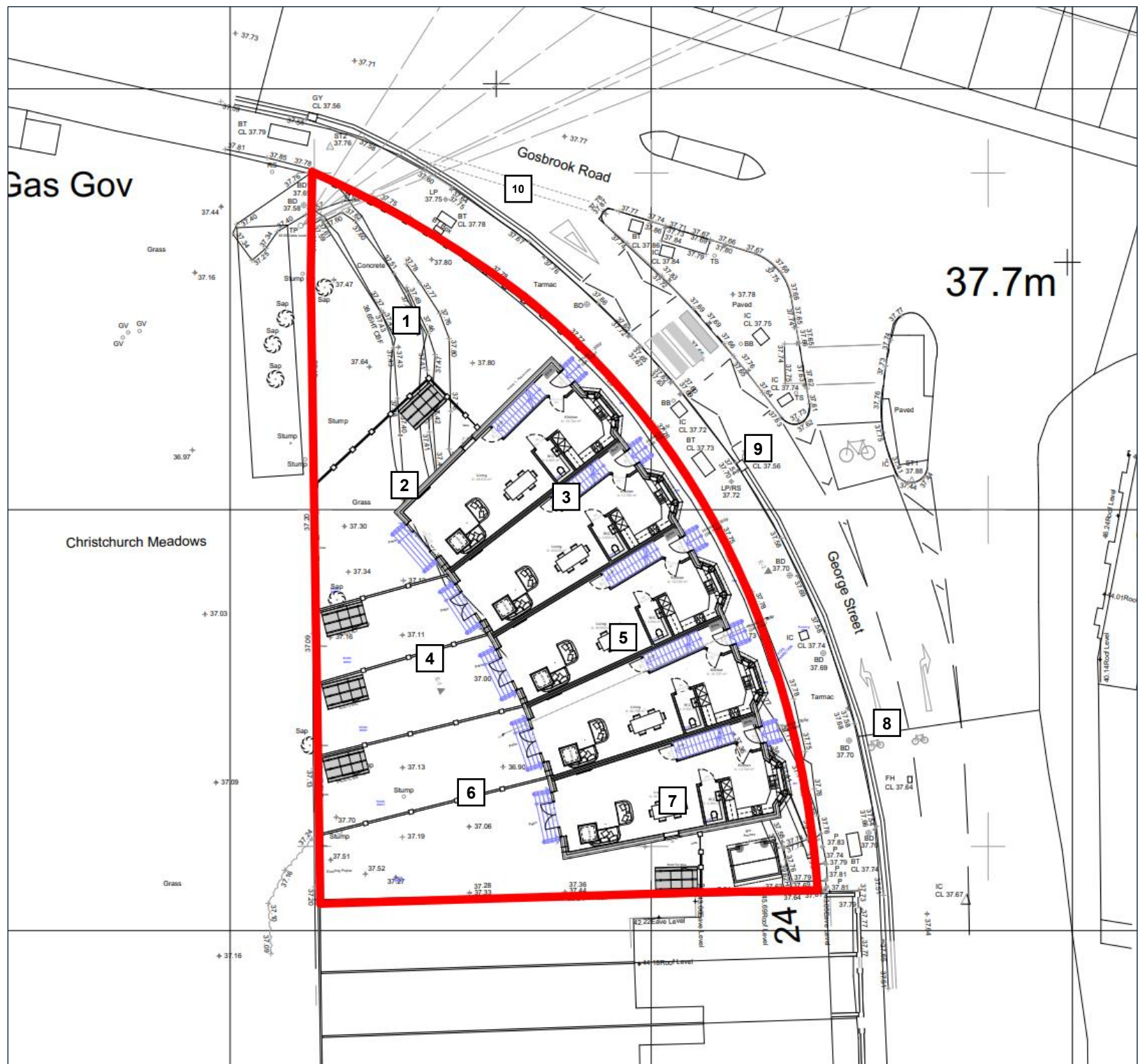
Environment Agency map showing the extent of flooding from rivers or the sea

Sources

Environment Agency  
OS data © Crown copyright and database rights

Key

|  |               |
|--|---------------|
|  | Site boundary |
|  | Very Low      |
|  | Low           |
|  | Medium        |
|  | High          |
|  | North         |



## Appendix - Flood Risk Maps

### Description

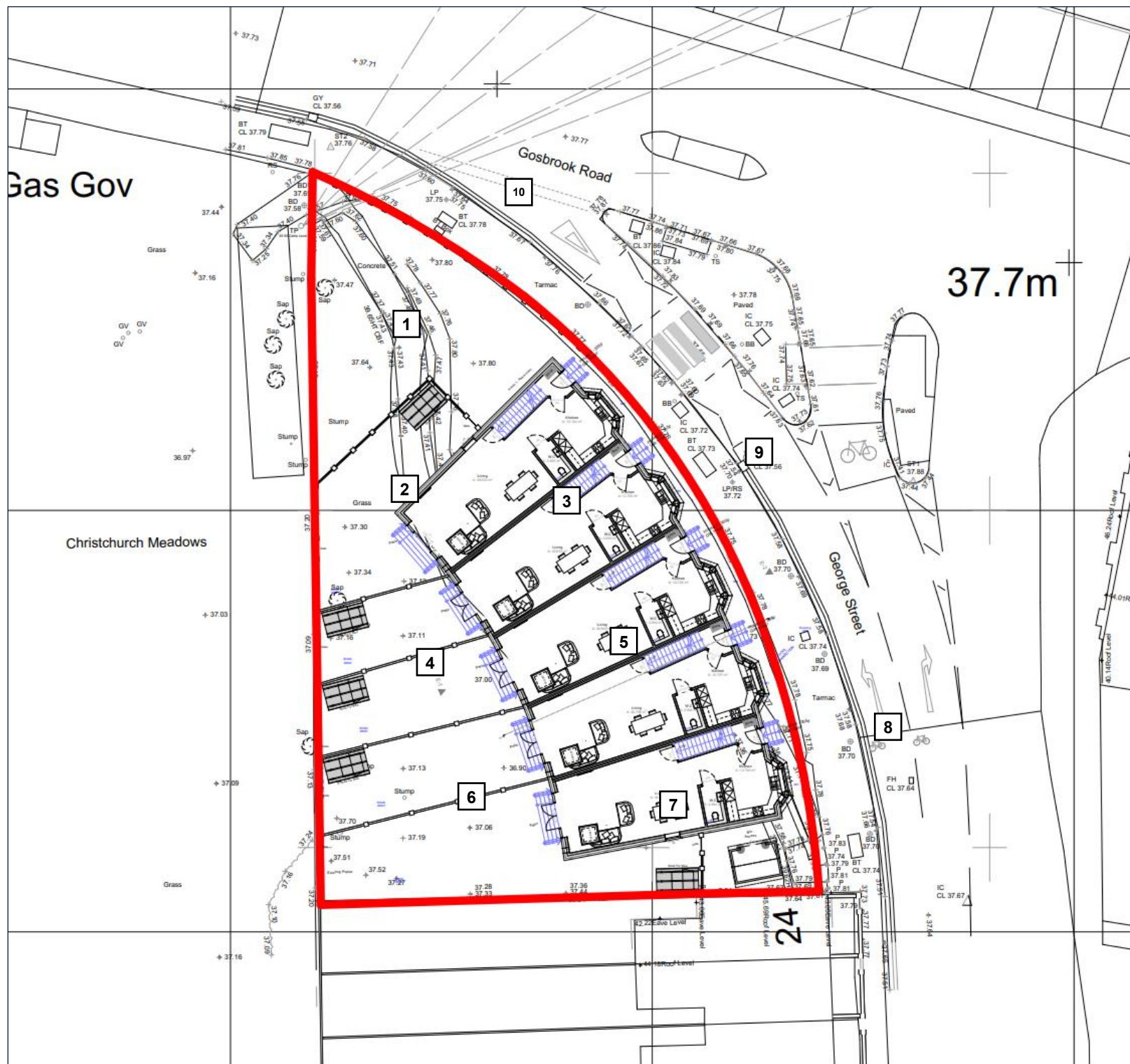
Node map showing maximum modelled river flood levels in a 1% AEP event

### Sources

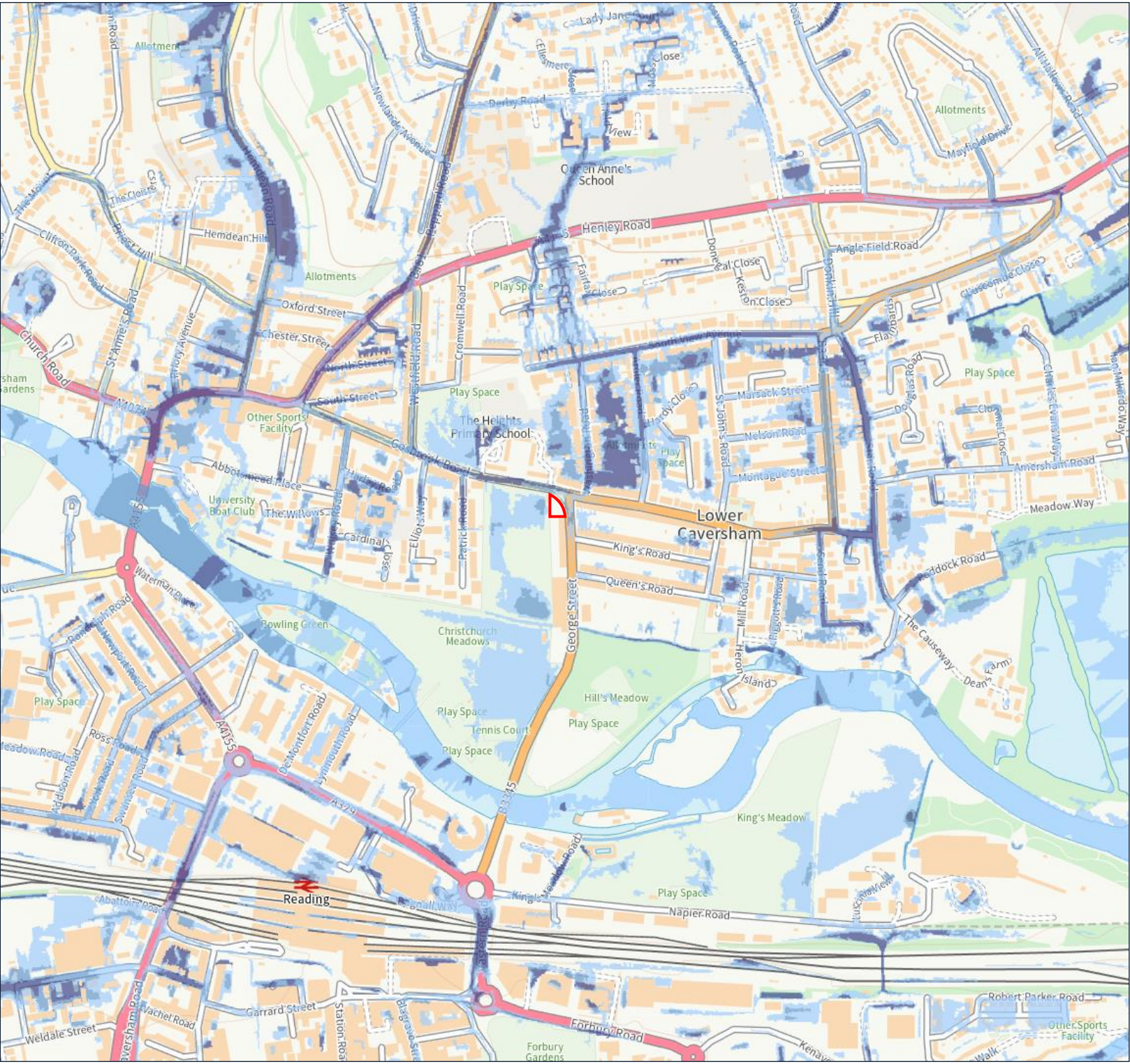
Jacobs  
The KEEN Partnership

### Key

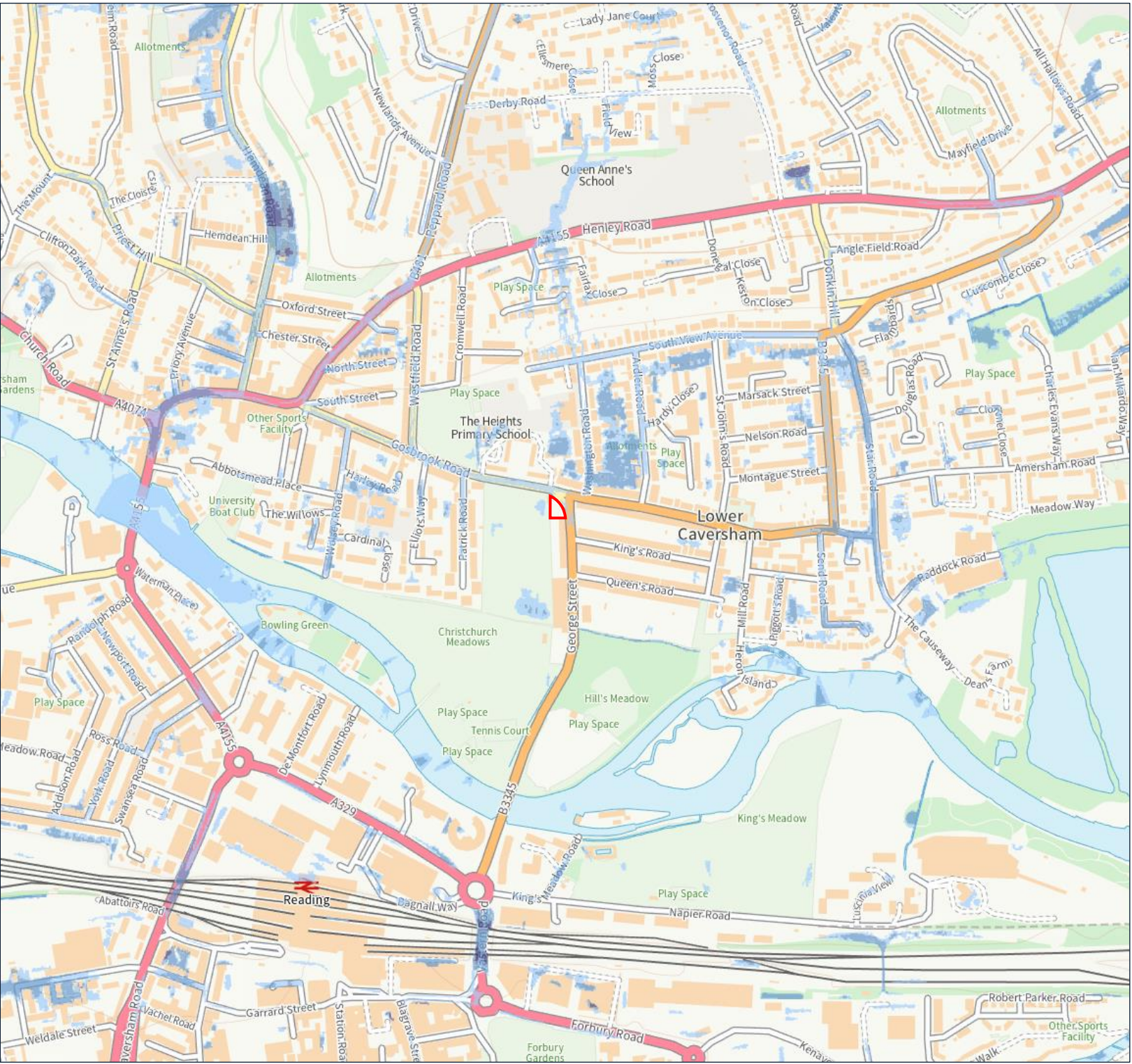
|    |               |
|----|---------------|
|    | Site boundary |
| 1  | 37.924mAOD    |
| 2  | 37.926mAOD    |
| 3  | 37.916mAOD    |
| 4  | 37.928mAOD    |
| 5  | 37.921mAOD    |
| 6  | 37.927mAOD    |
| 7  | 37.922mAOD    |
| 8  | 37.902mAOD    |
| 9  | 37.904mAOD    |
| 10 | 37.918mAOD    |
| ▲  | North         |



| Appendix - Flood Risk Maps                                                          |               |
|-------------------------------------------------------------------------------------|---------------|
| Description                                                                         |               |
| Node map showing maximum modelled river flood levels in a 0.1% AEP event            |               |
| Sources                                                                             |               |
| Jacobs<br>The KEEN Partnership                                                      |               |
| Key                                                                                 |               |
|  | Site boundary |
| 1                                                                                   | 38.266mAOD    |
| 2                                                                                   | 38.269mAOD    |
| 3                                                                                   | 38.253mAOD    |
| 4                                                                                   | 38.272mAOD    |
| 5                                                                                   | 38.253mAOD    |
| 6                                                                                   | 38.276mAOD    |
| 7                                                                                   | 38.248mAOD    |
| 8                                                                                   | 38.227mAOD    |
| 9                                                                                   | 38.238mAOD    |
| 10                                                                                  | 38.258mAOD    |
| ▲                                                                                   | North         |



| Appendix - Flood Risk Maps                                               |               |
|--------------------------------------------------------------------------|---------------|
| Description                                                              |               |
| Environment Agency map showing the extent of flooding from surface water |               |
| Sources                                                                  |               |
| Environment Agency<br>OS data © Crown copyright and database rights      |               |
| Key                                                                      |               |
|                                                                          | Site boundary |
|                                                                          | Very Low      |
|                                                                          | Low           |
|                                                                          | Medium        |
|                                                                          | High          |
|                                                                          | North         |



Appendix - Flood Risk Maps

Description

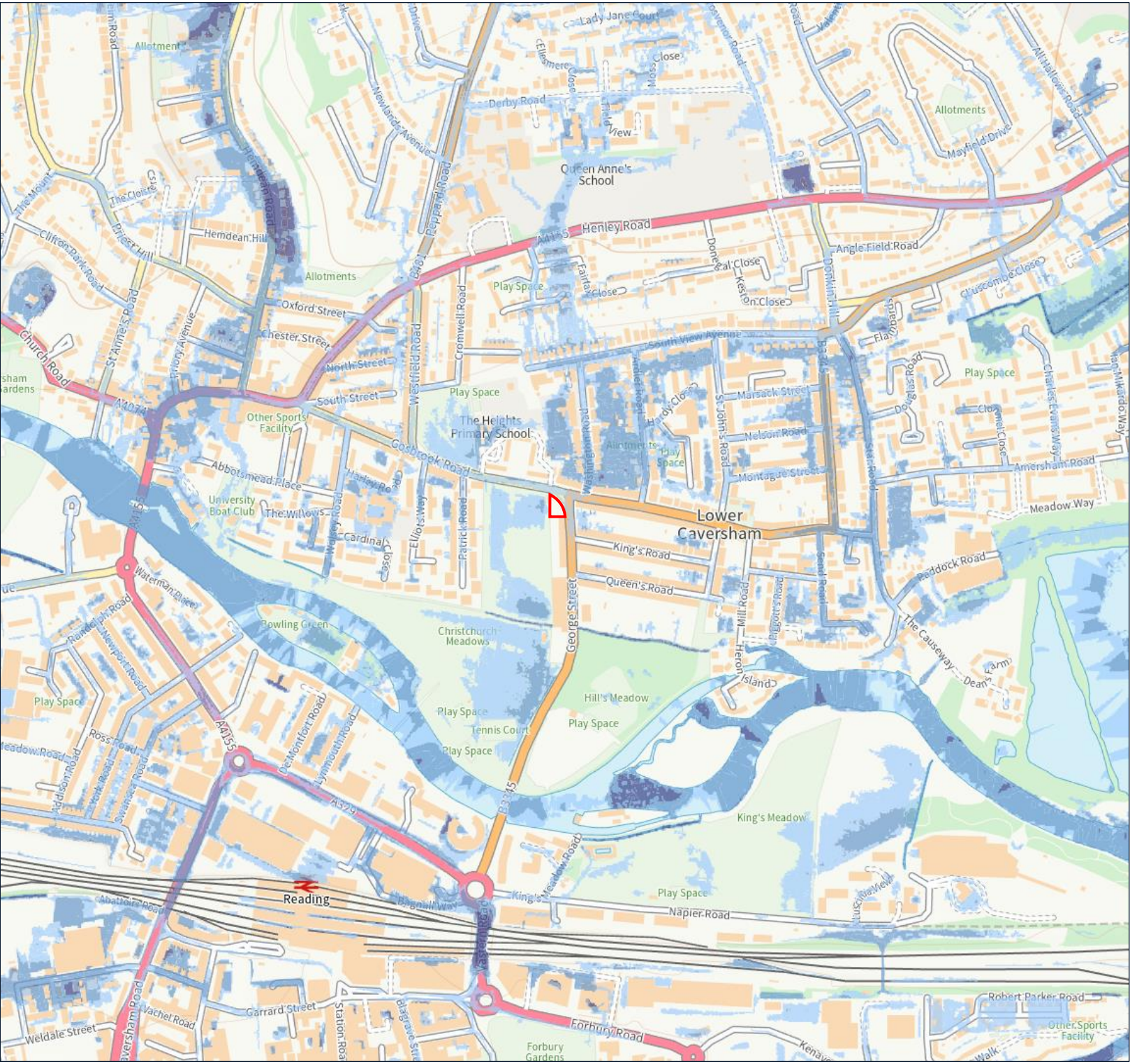
Environment Agency map showing the modelled depth of flooding from surface water in a medium risk scenario (1% - 3.3% chance each year)

Sources

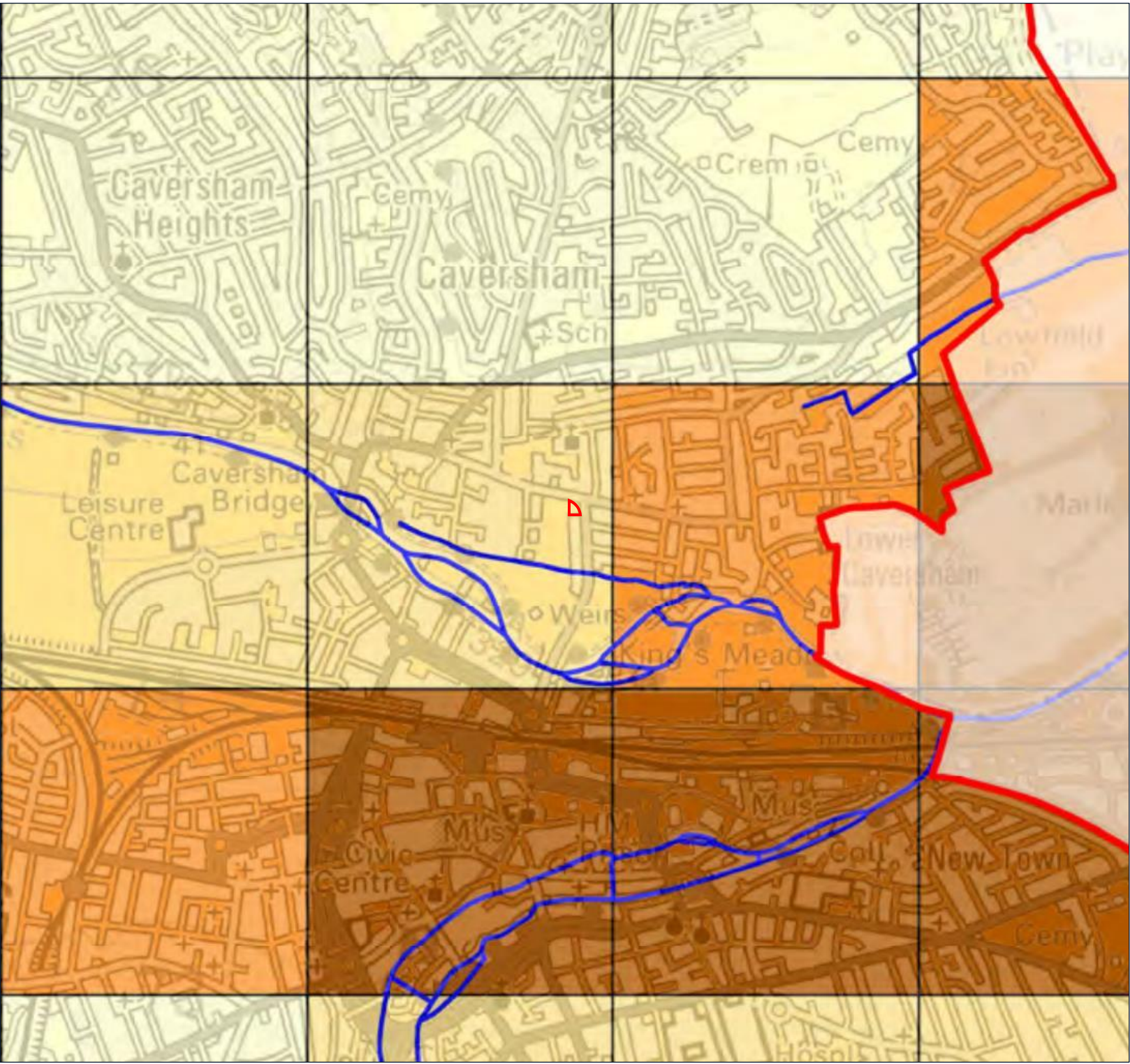
Environment Agency  
OS data © Crown copyright and database rights

Key

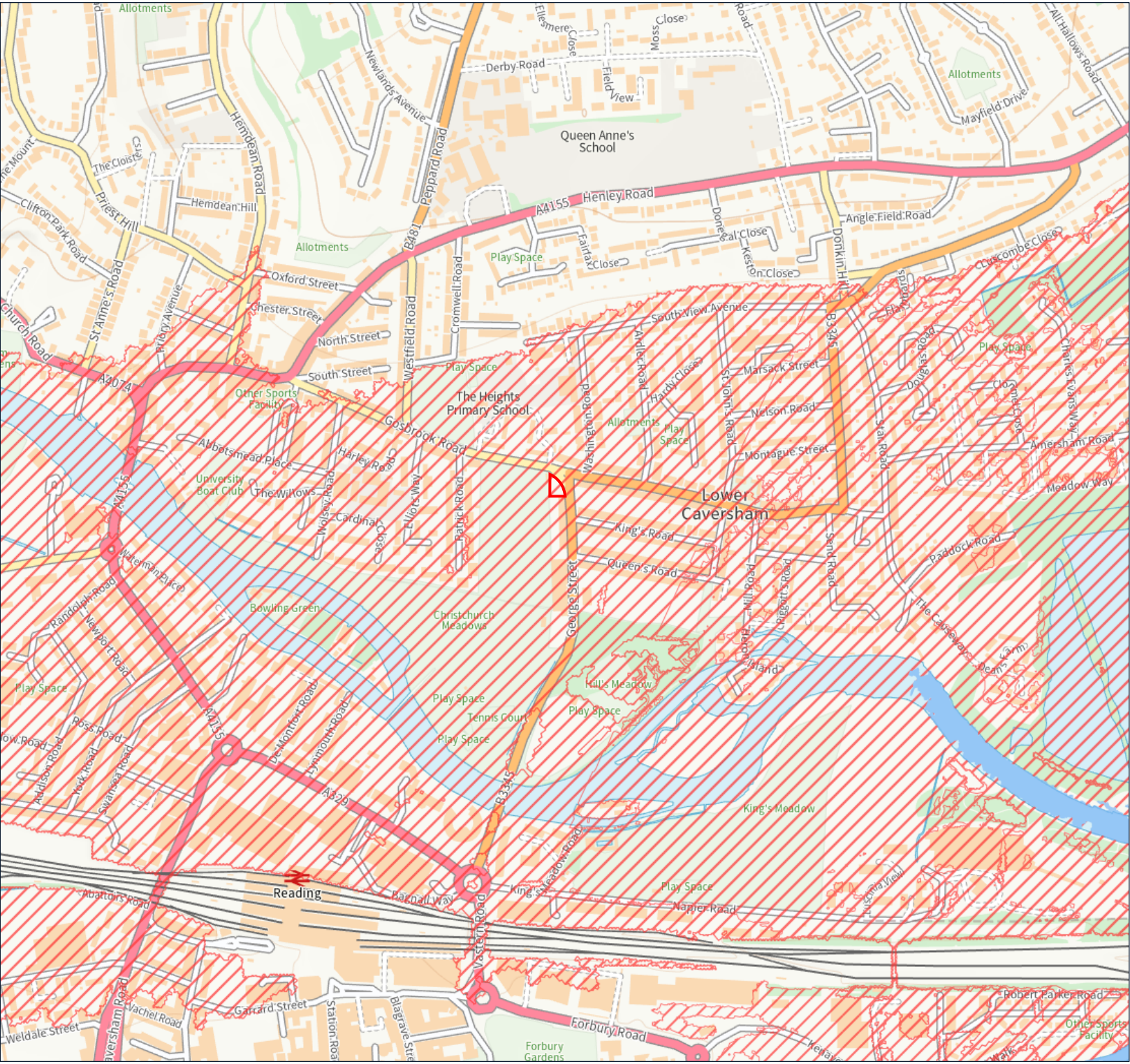
|  |               |
|--|---------------|
|  | Site boundary |
|  | Below 0.3m    |
|  | 0.3m to 0.9m  |
|  | Over 0.9m     |
|  | North         |



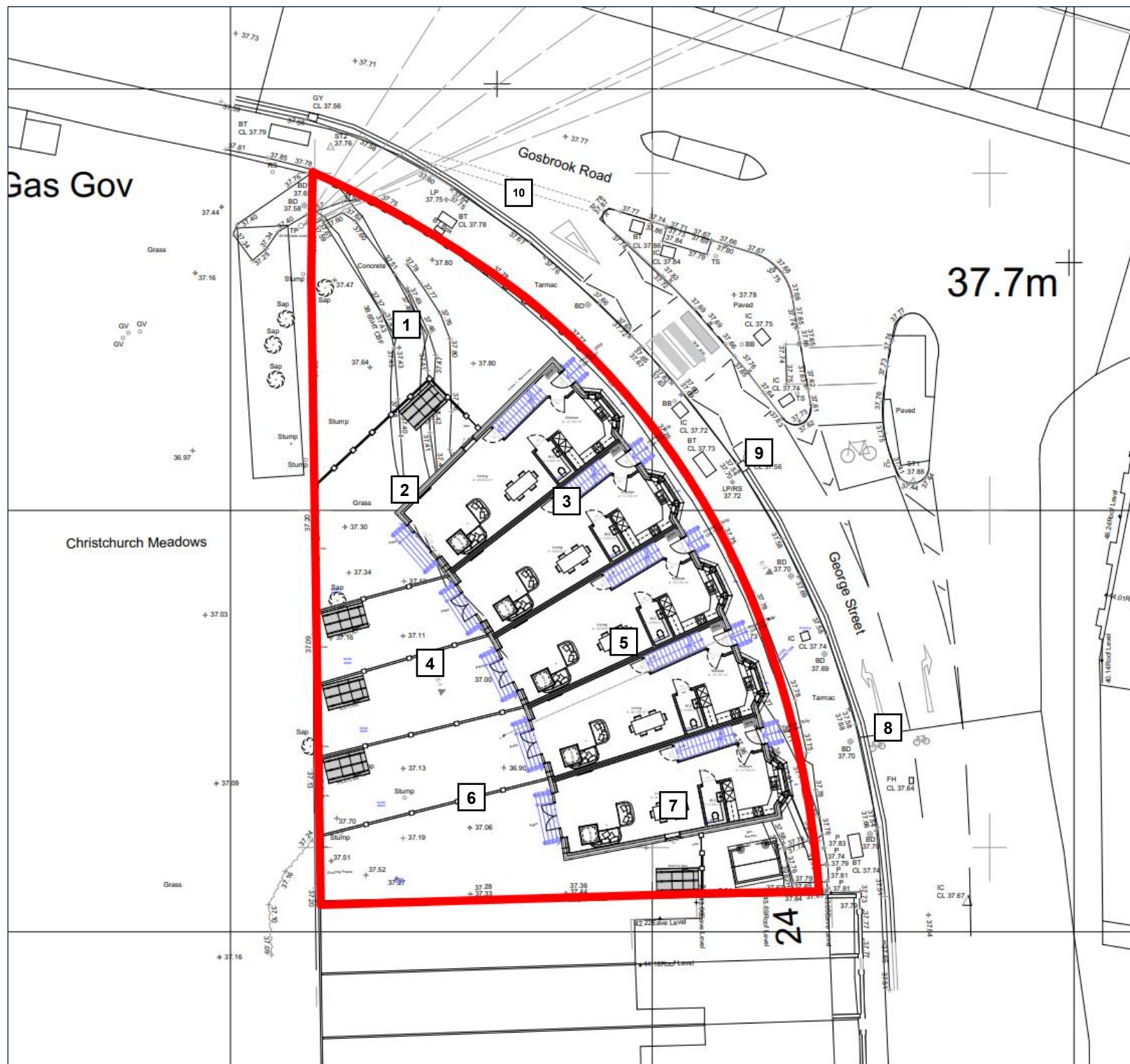
| Appendix - Flood Risk Maps                                                                                                           |               |
|--------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Description                                                                                                                          |               |
| Environment Agency map showing the modelled depth of flooding from surface water in a low risk scenario (0.1% - 1% chance each year) |               |
| Sources                                                                                                                              |               |
| Environment Agency<br>OS data © Crown copyright and database rights                                                                  |               |
| Key                                                                                                                                  |               |
|                                                                                                                                      | Site boundary |
|                                                                                                                                      | Below 0.3m    |
|                                                                                                                                      | 0.3m to 0.9m  |
|                                                                                                                                      | Over 0.9m     |
|                                                                                                                                      | North         |



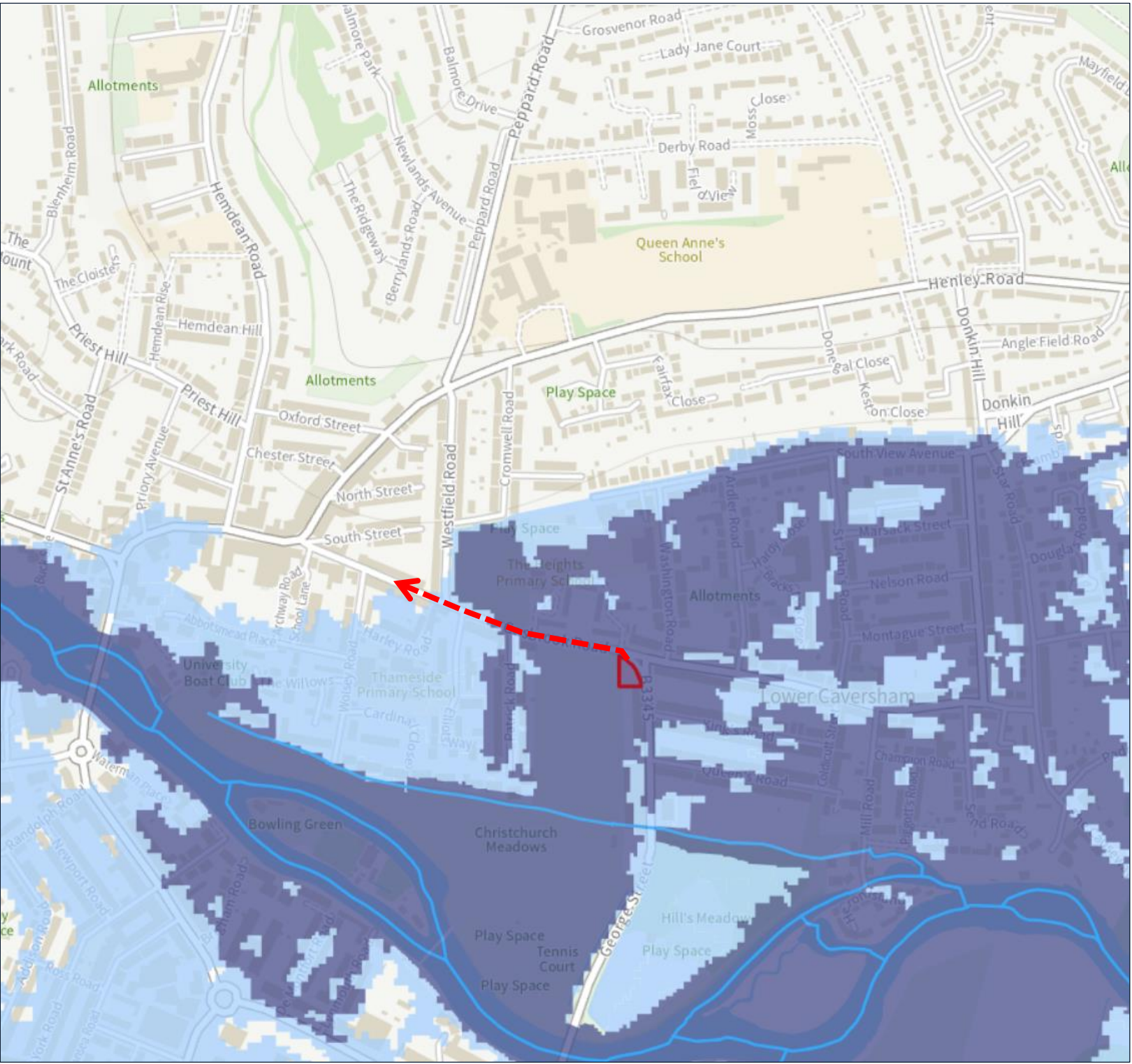
| Appendix - Flood Risk Maps                                                      |               |
|---------------------------------------------------------------------------------|---------------|
| Description                                                                     |               |
| Areas Susceptible to Groundwater Flooding map from Reading Borough Council SFRA |               |
| Sources                                                                         |               |
| Peter Brett Associates<br>OS data © Crown copyright and database rights         |               |
| Key                                                                             |               |
|                                                                                 | Site boundary |
|                                                                                 | < 25%         |
|                                                                                 | ≥ 25% < 50%   |
|                                                                                 | ≥ 50% < 75%   |
|                                                                                 | ≥ 75%         |
|                                                                                 | North         |



| Appendix - Flood Risk Maps                                                     |                              |
|--------------------------------------------------------------------------------|------------------------------|
| Description                                                                    |                              |
| Environment Agency map showing the modelled extent of flooding from reservoirs |                              |
| Sources                                                                        |                              |
| Environment Agency<br>OS data © Crown copyright and database rights            |                              |
| Key                                                                            |                              |
|                                                                                | Site boundary                |
|                                                                                | When river levels normal     |
|                                                                                | When there is river flooding |
|                                                                                | North                        |



| Appendix - Flood Risk Maps                                                                                           |               |
|----------------------------------------------------------------------------------------------------------------------|---------------|
| Description                                                                                                          |               |
| Node map showing maximum modelled river flood levels in a 1% AEP event, including a 35% allowance for climate change |               |
| Sources                                                                                                              |               |
| Jacobs<br>The KEEN Partnership                                                                                       |               |
| Key                                                                                                                  |               |
|                                                                                                                      | Site boundary |
| 1                                                                                                                    | 38.22mAOD     |
| 2                                                                                                                    | 38.224mAOD    |
| 3                                                                                                                    | 38.219mAOD    |
| 4                                                                                                                    | 38.226mAOD    |
| 5                                                                                                                    | 38.211mAOD    |
| 6                                                                                                                    | 38.227mAOD    |
| 7                                                                                                                    | 38.208mAOD    |
| 8                                                                                                                    | 38.187mAOD    |
| 9                                                                                                                    | 38.196mAOD    |
| 10                                                                                                                   | 38.212mAOD    |
| ▲                                                                                                                    | North         |



## Appendix – Evacuation Plan

### Description

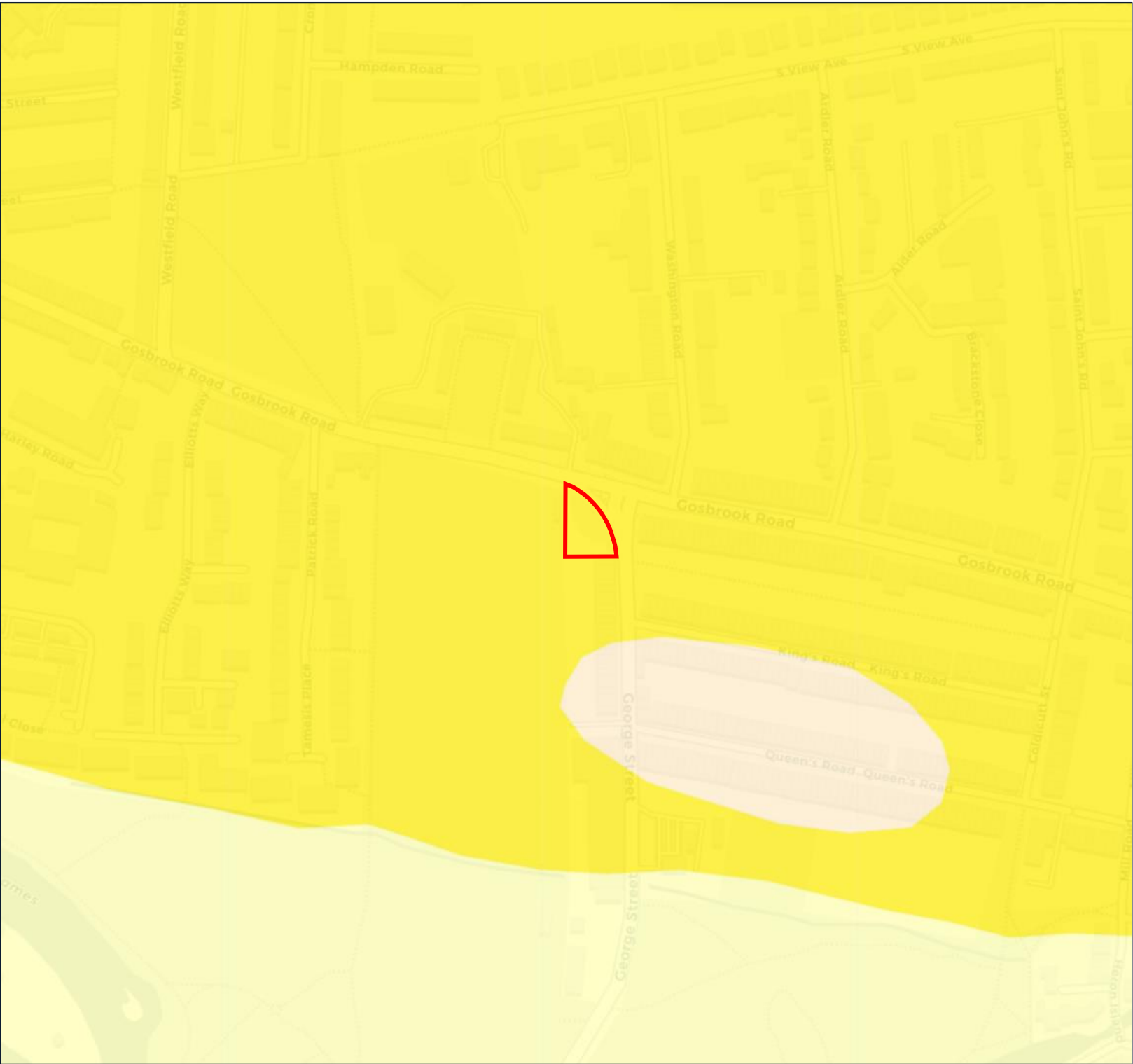
Flood zone map for planning showing proposed evacuation route

### Sources

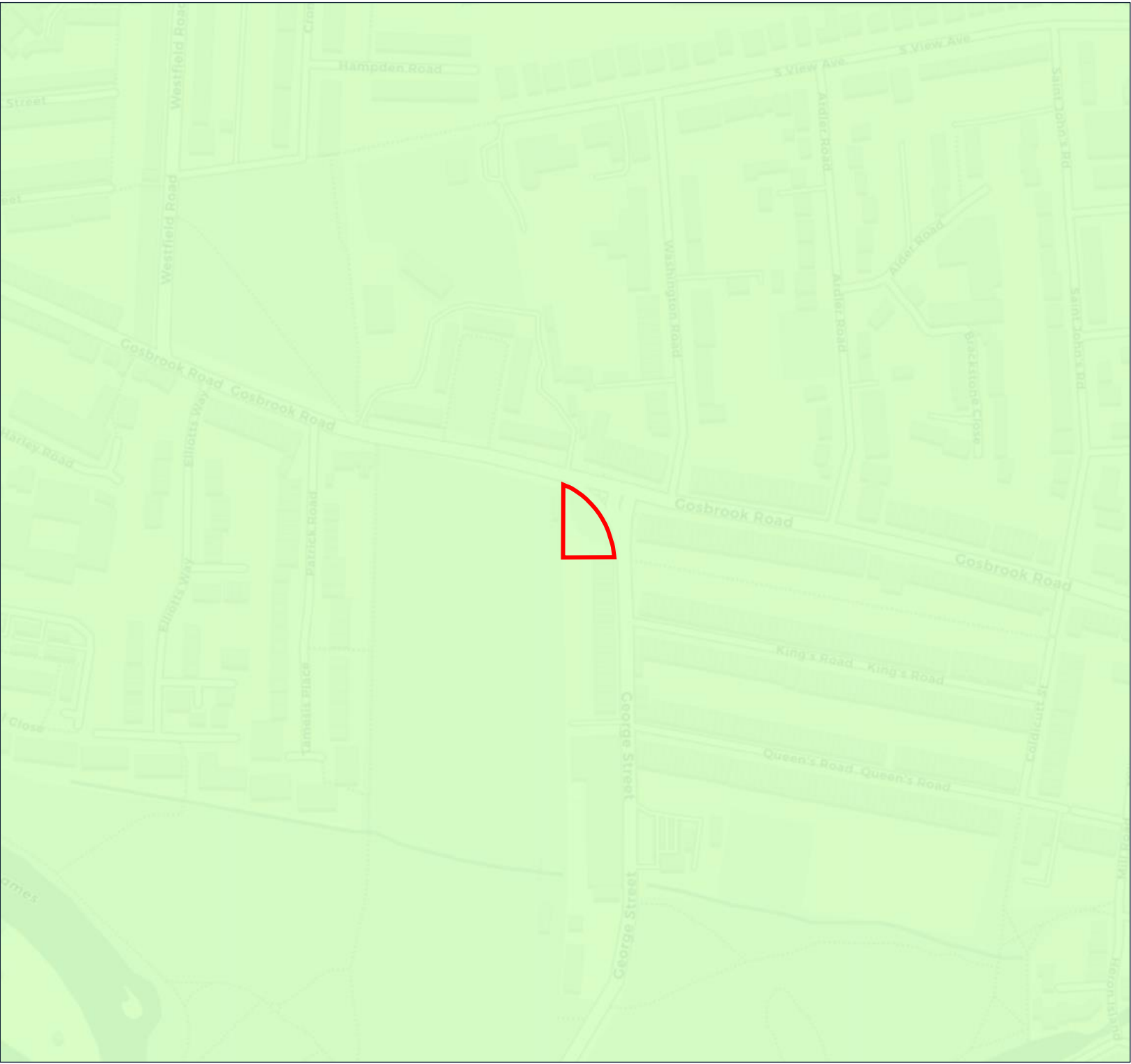
Environment Agency  
OS data © Crown copyright and database rights

### Key

|                                                                                     |                  |
|-------------------------------------------------------------------------------------|------------------|
|  | Site boundary    |
|  | Flood Zone 1     |
|  | Flood Zone 2     |
|  | Flood Zone 3     |
|  | Main river       |
|  | Evacuation route |
|  | North            |



| Appendix - Geological Maps                                                          |                                        |
|-------------------------------------------------------------------------------------|----------------------------------------|
| Description                                                                         |                                        |
| Superficial deposits at the site                                                    |                                        |
| Sources                                                                             |                                        |
| British Geological Survey (2022)                                                    |                                        |
| Key                                                                                 |                                        |
|  | Site boundary                          |
|  | Langley Silt Member – Clay and Silt    |
|  | Kempton Park Gravel – Sand and Gravel  |
|  | Alluvium – Clay, Silt, Sand and Gravel |
|  | North                                  |



| Appendix - Geological Maps       |                                      |
|----------------------------------|--------------------------------------|
| Description                      |                                      |
| Bedrock geology at the site      |                                      |
| Sources                          |                                      |
| British Geological Survey (2022) |                                      |
| Key                              |                                      |
| <div></div>                      | Site location                        |
| <div></div>                      | Seaford and Newhaven Chalk Formation |
| <div></div>                      | North                                |