Watford Borough Level 2 SFRA

Final Report

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Revision History

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31/03/2020 (v1.0)	Draft Report	Phil Dodshon Jack Green Amy Wolanski
29/06/2020 (v2.0)	Final Report (incorporating edits from Watford BC and the Environment Agency)	Phil Dodshon Jack Green Amy Wolanski

Contract

This report describes work commissioned by Jack Green from Watford Borough Council by an email dated 14 January 2020. Emily Jones and Fiona Hartland of JBA Consulting carried out this work.

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Purpose

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Executive summary

Level 2 SFRA objectives

The objectives of this Level 2 Strategic Flood Risk Assessment (SFRA) update are to:

- Using available data, provide information and maps presenting flood risk from all sources for potential allocation sites in the Watford Local Plan.
- Inform the Sequential Test (whereby new development is steered towards areas at lowest risk of flooding).
- Serve as guidance for developers to complete the Exception Test if applicable i.e. if development has to take place in Flood Zone 2 (medium risk) or Zone 3 (high risk) (See Section 7).
- Provide an assessment of residual flood risk and climate change.
- Where flood risk information is unavailable or limited, conduct appropriate hydraulic modelling where possible to determine the flood risks to potential site allocations.
- Take into account the most recent national and local policy and guidance documents, update information on the requirements for site-specific FRAs, considerations for suitable surface water management methods and opportunities to reduce flood risk to existing communities through new development.

The Level Two assessment includes detailed assessments of the potential site allocations.

These include:

- An assessment of the highest risk flooding mechanism (or way in which flooding occurs) and most likely flooding sources (or type of flooding) for each site.
- An assessment of all sources of flooding including fluvial flooding, surface water flooding, groundwater flooding, reservoir flooding, mapping of the functional floodplain and the potential increase in fluvial and surface water flood risk due to climate change.
- An assessment of existing flood warnings at the sites, including whether there is safe access and egress during an extreme event.
- Advice and recommendations on the likely suitability of Sustainable Drainage Systems (SuDS) for managing surface water runoff.

As part of the Level 2 SFRA, detailed site summary tables have been produced for the potential allocation sites in Watford Borough. To accompany each site summary table, there are a series of maps, containing all of the mapped flood risk outputs.

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Glossary and Abbreviations

Term	Definition
AAP	Area Action Plan
AEP	Annual Exceedance Probability
Blockage scenario	A model scenario used to assess the impact of debris collecting at the entrance of a bridge or culvert (pipe) during a flood event, and prevent water from flowing through the structure. See Section 3.4.1.
Breach scenario	A model scenario used to assess the impact of a river defence (e.g. a flood wall or embankment) failing during a flood event. See Section 3.4.2.
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CIRIA	Construction Industry Research and Information Association
Conveyance feature	A term used to describe a feature of a sustainable drainage system which is designed to convey (move) water through the system (e.g. a swale or rill)
Defence failure	Occurs when a river defence structure (e.g. a flood wall or embankment) in poor condition, collapses during a flood event. This generally causes flooding to areas which were previously defended by the structure. See section 6.1.
Defence overtopping	Occurs when water levels become too high within a river channel, and exceed the height of a defence (e.g. a flood wall or embankment). This generally causes flooding to areas which were previously defended by the structure. See section 6.1.

Term	Definition
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
Exception Test	A planning principle applied to sites at higher flood risk, where lower risk sites cannot be developed. For the Exception Test to be passed, it must be shown the site is safe to develop, and that the sustainability benefits outweigh the flood risk. See Section 7.
Flood risk betterment	A term used to describe a requirement for development to reduce the flood risk to the site itself, and/or the risk to downstream communities. See section 6.1.
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood mechanism	The means by which people or property are affected by a flood source.
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
FSA	Flood Storage Area
Flood source	The type of flooding (e.g. fluvial, surface water, groundwater).
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRA	Flood Risk Assessment - A site specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
Functional floodplain	Areas alongside rivers where water flows onto, and is stored, during times of flood. It is classified as 'Flood Zone 3b', within Strategic Flood Risk Assessments. See Sections 6.1 and 7.5.
Ha	Hectare
Infiltration feature	A term used to describe a feature of a sustainable drainage system which is designed to allow water to soak (infiltrate) into the ground (e.g. a soakaway or infiltration basin)
JBA	Jeremy Benn Associates
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers. However, the Environment

Term	Definition
	Agency are not responsible for all maintenance on Main Rivers, as the Environment Agency have permissive powers, but the riparian owner has the responsibility.
NPPF	National Planning Policy Framework
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
PPG	National Planning Policy Guidance
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
Residual risk	The risk that remains after measures have been taken to alleviate flooding.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
RoFSW	Risk of Flooding from Surface Water map. Environment Agency national map showing risk of flooding from surface water.
Sequential Test	A planning principle which identifies potential development sites at lowest flood risk, before those at higher risk. See Section 7.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection.
SPZ	Source Protection Zone - The Environment Agency have defined Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes and springs used for public drinking water supply. These

Term	Definition
	zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. The maps show three main zones (inner, outer and total catchment) and a fourth zone of special interest, which is occasionally applied, to a groundwater source.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding from surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
Surface water flow path	Rainfall which has been concentrated into a continuous flow of water, by the levels of the ground surface.
Surface water runoff	The flow of rainwater across the ground surface during a storm event.
WFD	Water Framework Directive

1 Introduction

Watford Borough Council (the Council) is currently preparing a New Local Plan, which seeks to set out the vision for Watford, to identify how much development will take place, and to guide where homes and jobs can be sustainably delivered. The plan period will extend from 2020 to 2036. To date, the Council has completed the Issues and Options consultation which identified key issues that face the borough, which have been incorporated into the First Draft Local Plan. Consultation on the First Draft Watford Local Plan ended in November 2019 and adoption is planned for May 2021.

This Level 2 Strategic Flood Risk Assessment (SFRA) follows the South West Hertfordshire Level 1 SFRA, produced in 2018 as a joint study between Dacorum Borough Council, St. Albans City and District Council, Three Rivers District Council and Watford Borough Council in line with the approach set out in the National Planning Policy Framework (2019). The SFRA will also provide input to assist with the consideration of individual proposals for planning decisions, however more detailed investigations will be required to support development of the sites.

This approach is consistent with the National Planning Policy Framework (2019) and in particular Section 14: Meeting the challenge of climate change, flooding and coastal change.

The SFRA Levels 1 and 2 are prepared in accordance with best practice as set out in the National Planning Practice Guidance "How to prepare a strategic flood risk assessment"[1] (last updated 12 August 2019).

1.1 SFRA Objectives

Planning Practice Guidance advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

- Level One: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- Level Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development, creating the need to apply the Exception Test. In these circumstances, the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

The Level 1 SFRA identified that Level 2 SFRA assessments were required at a number of sites in Watford. Level 2 assessments should be undertaken at all sites which have been identified as 'at risk' and which may be carried forward in the Local Plan. The aim of the Level 2 assessments is to provide evidence to help determine whether or not the Exception Test as set out in Planning Guidance could be passed, i.e. development could be achieved safely, for sites that have been found to be at flood risk by the Level 1 assessment.

[1] Department for Environment, Food and Rural Affairs, Environment Agency (2019) How to prepare a strategic flood risk assessment. Available at: https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment

1.2 How to use the Level 2 SFRA

The Level 2 report gives a short non-technical summary of how the Level 2 sites were selected, the detailed flood risk data that was used to carry out individual site-level assessments for each of the Level 2 sites, and how climate change was assessed. Further technical detail is given in the Appendices.

The following information is contained within the appendices:

- Appendix A – Site screening: a high level screening of flood risks to all sites received as part of the Local Plan process (regardless of their feasibility for allocation within the Local Plan). Provides an update to the site screening carried out as part of South West Hertfordshire Level 1 SFRA (2019) and used to inform application of the Sequential Test.
- Appendix B – Level 2 site summary sheets and maps: assessment and mapping of sites at medium to high flood risk with potential for allocation within the Local Plan. Further details of the content are provided in Section 6.
- Appendix C – Residual Risk Maps – Blockage: maps showing the predicted flood extents, depths and hazards to a site when a critical culvert or bridge becomes blocked.
- Appendix D – Residual Risk Maps – Breach: maps showing the predicted flood extents, depths and hazards to a site when a critical flood defence fails.

The main output of the Level 2 Assessment is the individual site summary sheets (Appendix B), which offer high level flood risk assessments and conclusions for each site.

2 Identification of Level 2 sites

The Level 1 SFRA and subsequent work carried out a screening of 58 sites in Watford Borough, against available flood risk information including:

- Flood Map for Planning (Rivers and Sea) – Flood Zone 2 and 3
- Risk of Flooding from Surface Water (RoFSW)
- Flood Risk from Reservoirs mapping
- JBA Groundwater flood map
- Historic Flood Map

The 58 screened sites were identified from a range of sources, including sites put forward during the Call for Sites process, sites on the Council's Brownfield Register and previously considered sites.

A detailed assessment of flood risk to the 58 identified sites found:

- 51 of these were entirely located within Flood Zone 1 and therefore considered to be at a low risk of fluvial flooding;
- 7 sites contained areas of Flood Zone 2;
- 7 were identified as containing areas of Flood Zone 2 and Flood Zone 3a.
- 22 sites contained greater that 1% of the 100-year RoFSW extent (and five of these sites had an area of greater than 20% at risk.);
- 17 had a total site area of greater than 20% at risk from the 1 in 1,000-year surface water flood map.
- 7 sites were identified as within the Environment Agency's historic flood outline.

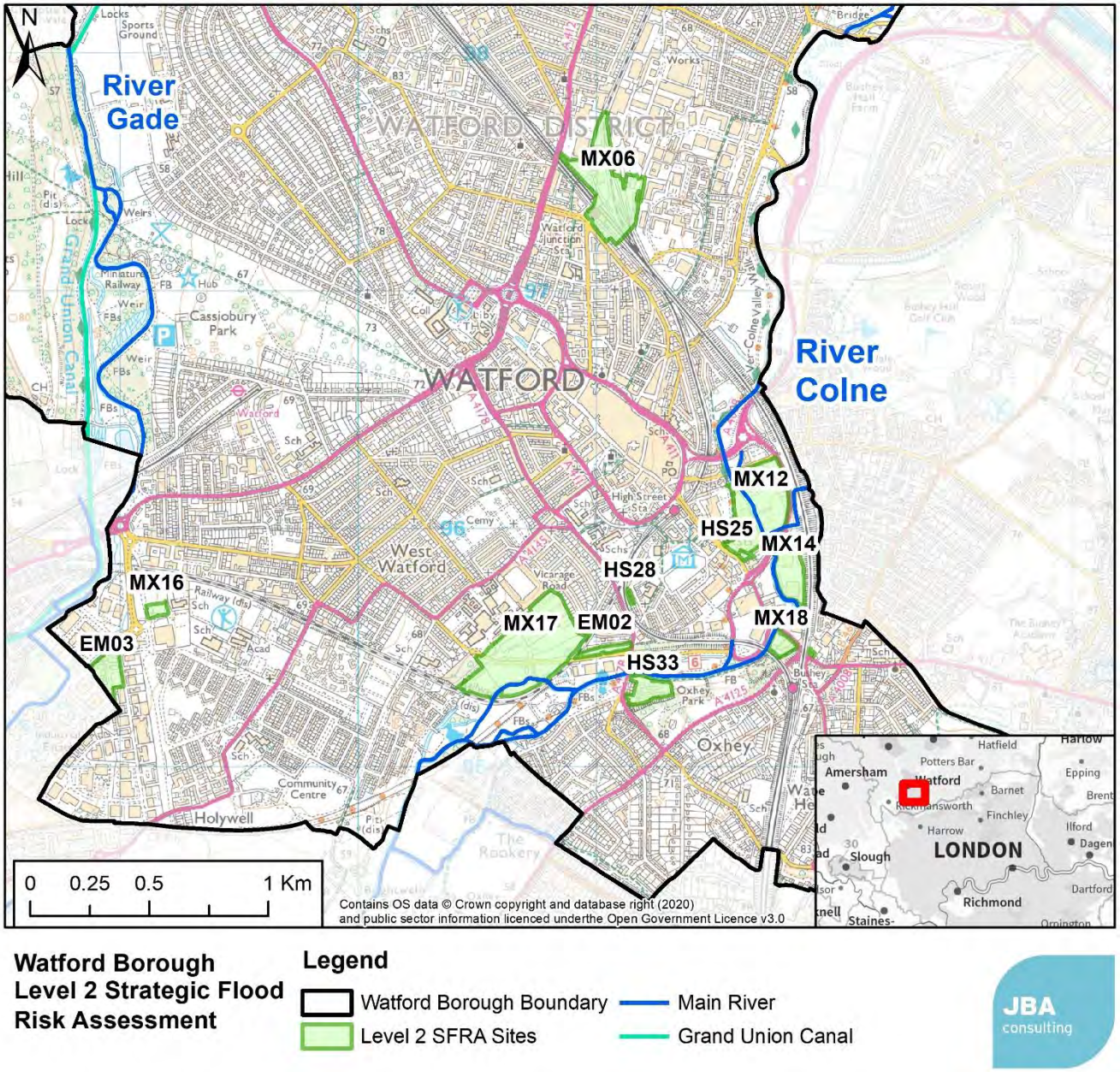
Of the 58 sites screened, 13 sites were taken forward for Level 2 assessment. These sites are shown in

Figure 2-1.

The primary flood sources for the sites (and reason they have been assessed at Level 2) are as follows:

- 7 sites are partly located within the current Flood Zones 3b, 3a and 2;
- 3 sites are located entirely in Flood Zone 1, however have greater than 10% of their area within the RoFSW 1 in 100-year (1%) flood risk extent;
- 6 of the sites are located entirely in Flood Zone 1, however have greater than 10% of their area within an area of high groundwater flood risk; and
- 7 sites have greater than 10% of their area at risk of flooding from reservoirs.

Figure 2-1: Location of 13 sites assessed within Level 2 SFRA.



3 What flood risk information has been used?

3.1 Data sources

The Level 2 SFRA draws upon all the information and data sources that were compiled as part of the Level 1 assessment, examining them in more detail on a site-by-site basis. These sources include:

- EA Main Rivers GIS layer and OS OpenRivers GIS layer;
- EA Risk of Flooding from Surface Water Map (RoFSW);
- Surface water flood modelling of 1 in 100-year + 40% climate change event;
- EA detailed hydraulic models (summarised in Table 3-1);
- EA Recorded Flood Outline;
- EA Spatial Flood Defences layer;
- EA Risk of Flooding from Reservoirs map; and
- JBA Groundwater Flood Map.

3.2 Flood Zones

The Flood Zones defined within the South West Hertfordshire Level 1 SFRA have been used for assessment within the Level 2 SFRA.

3.3 Environment Agency detailed hydraulic models

The Environment Agency flood risk mapping programme has produced detailed hydraulic models covering the following watercourses:

- Upper Colne
- River Gade and Bulbourne

Their outputs are incorporated into the existing Flood Zones, but they also provide additional information on flood probability, rates of onset, depths, velocities and hazards.

The scope of the SFRA does not allow for re-survey and re-modelling of these river catchments. However, models for the watercourses were obtained and re-run for the latest climate change scenarios.

Table 3-1: Hydraulic models in Watford Borough used within Level 2 SFRA

Model	Year created	Model Type	Data source used in Flood Zone 3b	Data source used in Flood Zone 3a + CC	Comments	Confidence in modelled results
Upper Colne	2010	1D-2D	1 in 20 modelled outline	Flood Zone 2	Model was unstable during re-runs for larger climate change allowances. Results not used and FZ2 to act as conservative replacement.	Moderate – both channel and floodplain represented. Higher confidence in lower return periods, but unstable at higher flows
River Gade River Bulbourne	2016	1D-2D	1 in 20 modelled outline	1 in 100 + 70% modelled outline	Flood extents include the Grand Union Canal. Flood walls at Nash Mill represented.	Higher – recent model with both channel and floodplain represented

3.4 Residual Risk from Breach and Blockages

'Residual risk' refers to the risks that remain in circumstances after measures have been taken to alleviate flooding. It is important that these risks are quantified to confirm that the consequences can be safely managed. It is the responsibility of the site developer to fully assess flood risk to an individual site, to propose measures to mitigate the flood risk and demonstrate that any residual risks can be safely managed.

This Level 2 SFRA does not assess the probability of failure, other than noting that such events are very rare. However, in accordance with NPPF, all sources of flooding need to be considered. If a breach or blockage event were to occur, then the consequences to people and property could be high.

For two of the 13 sites assessed as part of the Level 2 SFRA, structures have been identified which may pose a residual risk in the event of blockage to a culvert or breach of a defence. The culvert or defence may not be located directly within the site, but may be within close proximity. The identified sites are:

- MX12 – Land at Tesco Lower High Street
- MX14 – Colne Valley Retail Park

To fully assess the potential risk to the proposed development site, additional model runs were completed. These ran for the 1 in 100-year return period. Once complete, flood outlines were compared to Flood Zone 3a to understand if there is an increase in flood risk.

The methodology for breach and blockage scenarios is outlined in the following sections.

3.4.1 Culvert blockage

Culverts and structures susceptible to blockage, located within or close to the allocated sites, were identified using Ordnance Survey mapping, the Environment Agency Culverts and Spatial Defences layers, and available hydraulic models.

As part of the Level 2 SFRA, medium (50%) medium-high (75%) and high (90%) blockages were applied to the identified structure on Site MX12, and the scenarios were run for a 1% AEP (1 in 100-year) event, to assess the impact of bridge blockage on flood risk to the potential allocation site. A 100% blockage scenario was tested, but did not complete due to instability issues in the model.

The results are described within the Site Summary Sheets in Appendix B, with maps of the blockage results provided in Appendix C.

A summary of the scenarios and results is shown in Table 3-2, with a location plan shown in Figure 3-1.

Table 3-2: Summary of blockage scenarios modelled as part of Level 2 SFRA

Site	MX12	
Site Address	Land at Tesco, Lower High Street	
Hydraulic Model	Upper Colne	
Structure	Bridge	
Structure Location (and model nodes)	Bridge on A411, at south of site (UCL68_2825u, UCL68_2825d)	
Impact to site? (1% AEP event)	Medium (50%) blockage	Flooding is predicted to increase beyond the 1% AEP extent in the north of the site, particularly in the north east and north western corners of the site. Peak flood depths ranging from 0.06 – 0.38m in the north west corner of the site, and 0.03 – 0.64m across the majority of the flooded area in the north of the site. The highest flood depths of 2.1 - 2.5m are expected on the northern access road for the site, as well as the area of ponding in the north east corner of the site.
	Medium-high (75%) blockage	Flooding is predicted to increase significantly across the central and southern areas of the site, to cover the majority of the site. A significant increase in flood extent also occurs downstream, at site MX14. Peak flood depths for the 1% AEP event across the south and centre of the site range from 0.02 – 0.44m, with the shallowest depths predicted in the south west of the site. In the north of the site, peak flood depths largely range between 0.2 – 1.15m, reaching a high of 3.0m on the northern access roads for the site.
	High (90%) blockage	A further increase in flood extent is seen in the centre and south west of the site. An additional increase in flood extent is seen downstream of the site. Peak flood depths range between 0.02 – 0.6m across the south and centre of the site. In the north of the site, flood depths largely range between 0.3 – 1.48m, with the greatest depths of up to 3.2m predicted on the access road at the north of the site.

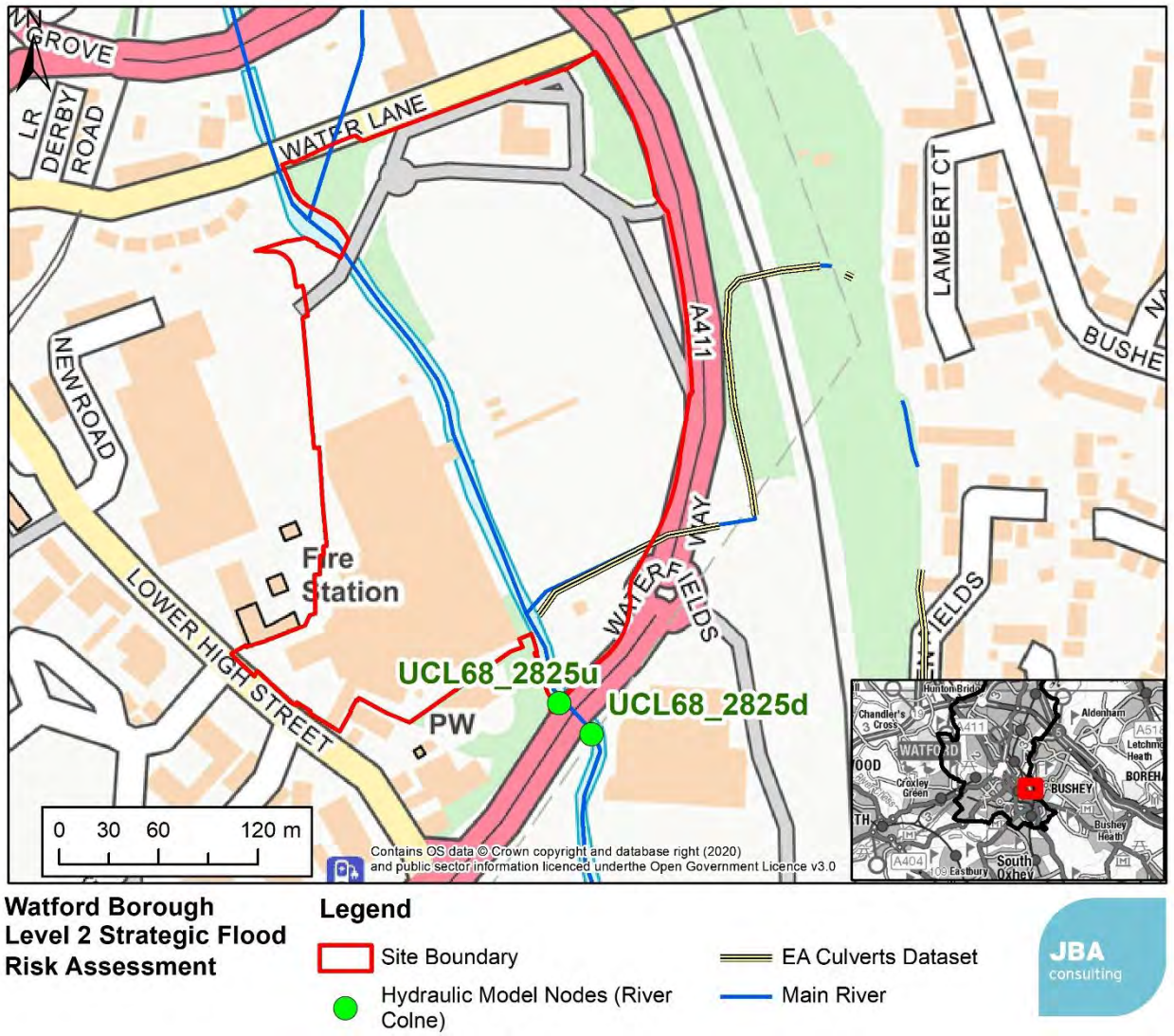


Figure 3-1: Location of blockage modelled at site MX12.

3.4.2 Fluvial defence breach

The Environment Agency's 'Breach of Defences Guidance'[2] document was used to inform the width of the breaches represented within the hydraulic model.

An overview of where the breach was represented at Site MX14 is shown in Table 3-3, with a location plan shown in Figure 3-2.

For the MX14 site, the breach locations for both models are situated next to a reinforced concrete defence, and so the width of the breach was set to 20m. To trigger the defence breach within the model, a 'variable Z-Shape layer' was applied, to define the shape of the breach. Variable Z-Shapes allow the ground levels within the model to transition over time, from the defended ground level, to the final ground levels, after the defence has been breached. This transition is set to begin at peak flow in the watercourse, to simulate a worst-case scenario for the volumes of water flowing through the breached defence. Therefore, breach levels are lowered to ground levels behind the defence.

2 Environment Agency (2017) Modelling and Forecasting Technical Guidance Note: Breach of Defences Technical Guidance (Inland and Coastal). Available on request from Environment Agency.

The results of the breach modelling are described within the Site Summary Sheets in Appendix B, with maps of the breach results provided in Appendix D.

Table 3-3: Summary of breach scenarios modelled as part of Level 2 SFRA

Site	MX14
Site Address	Colne Valley Retail Park
Hydraulic Model	Upper Colne
Defence Type (EA Spatial Defences Layer)	Raised poured concrete bank protection, filled in with brickwork where there are gaps. Defended height varies from 0.4m to 1.5m along the defence.
Defence Location (and model nodes)	Western boundary of site - left bank of River Colne (UCL68_2702)
Defence Crest at site	54.78mAOD
Impact to site? (1% AEP event)	A breach of the bank protection results in a significant increase in flood extent within the site during the 1% AEP event, extending to cover the majority of the site. The northern and south western borders of the site remain at low risk of fluvial flooding. Maximum flood depths within the site are predicted to range between 0.05 – 0.57m during the 1% AEP event, with the deepest flood waters predicted to form in the lowest-lying central and northern areas of the site.

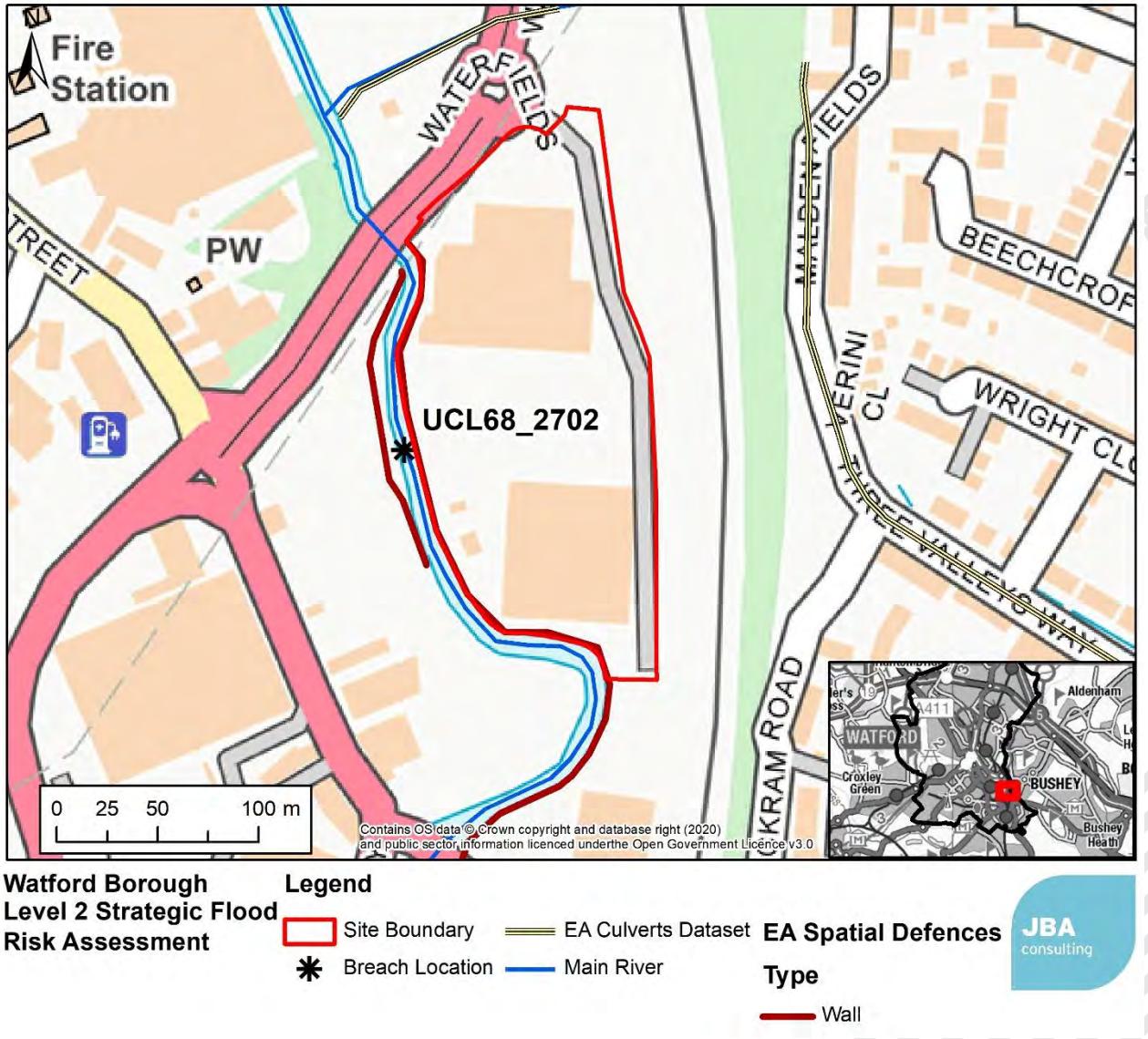


Figure 3-2: Location of modelled defence breach at site MX14

4 Assessment of climate change

4.1 Government guidance on climate change

Updated government guidance on assessing the impact of climate change on flooding in line with the UKCP09 Climate Change Projections was released in February 2016 and updated in 2017[3].

The guidance sets out a range of climate change allowances that should be considered when assessing the future risk to a proposed development. The climate change allowances are dependent on location in the country (by river basin) and lifetime and vulnerability classification of the development (epoch). It also provides several bands (termed 'central', 'higher central' and 'upper end') to test depending on the vulnerability of the development and the Flood Zone within which it is located.

The UKCP18 Climate Change Projections were released in December 2018. However, current Environment Agency guidance[4] is still based on the UKCP09 (February 2016) climate change allowances for peak river flow. Therefore, the recommended UKCP09 projections have been used to represent climate change within the Level 2 SFRA.

4.2 Climate change and fluvial modelling

Following the government guidance (Section 5.1), the key epoch considered is 2070-2115 as this reflects the lifetime of residential development; and the key vulnerability is 'more vulnerable' as this represents a conservative classification incorporating all vulnerabilities. The key allowances to consider for Flood Zone 3a are therefore the Higher Central and Upper End (35% and 70% in Thames river basin) as shown in Table 4-1.

Table 4-1: Climate change allowances

River basin district	Allowance category	Total potential change anticipated for the **'2020s' (2015** to 2039)	Total potential change anticipated for **the '2050s'** (2040 to 2069)	Total potential change anticipated for the **'2080s' (2070** to 2115)
Thames	Upper end	25%	35%	70%
	Higher central	15%	25%	35%
	Central	10%	15%	25%

In order to assess the impact of these climate change scenarios on the 1 in 100-year flood risk (Flood Zone 3a) at development sites, in accordance with the NPPF, we used the following hierarchy of modelling information as agreed with the Council and the Environment Agency:

- Re-run of existing detailed models with the Higher Central and Upper End climate change flows scenarios.
- Flood Zone 2 as a proxy.

3 Environment Agency (2016) Flood risk assessments: climate change allowances. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

4 Environment Agency (2019) Using 'Flood risk assessments: climate change allowances' following publication of new climate projections in UKCP18.

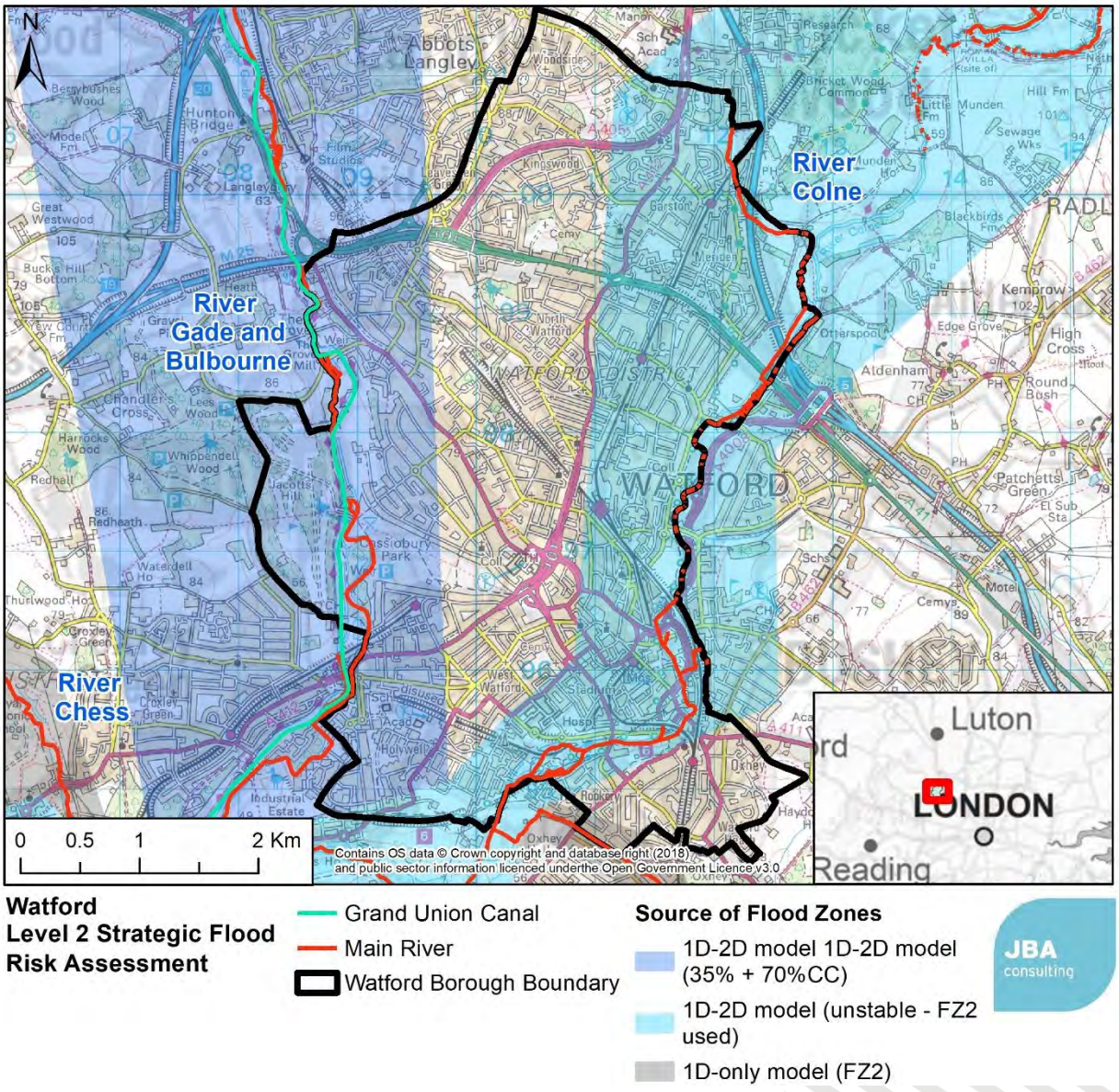
Applying additional flows into hydraulic models above what they were originally optimised for can cause instability and adding 35% or 70% onto the 1 in 100-year flow often causes the model to fail before it can output full results for a flood event. This means that maximum flood extents cannot be generated from the model results.

Flood extents for the 35% and 70% climate change scenarios were available for the Gade and Bulbourne model. The Upper Colne model was run for the 25% climate change allowance, however failed to run for the 35% and 70% allowances, due to model instabilities. It was considered to be beyond the scope of the SFRA to stabilise the model, and therefore Flood Zone 2 was used as a proxy for climate change.

Figure 4-1 shows the coverage of hydraulic models in Watford Borough and the source of information used to generate climate change extents.

The source of climate change information and the impact on flood risk to the individual sites, is also noted on the summary sheets under 'Climate Change – Implications for the Site'.

Figure 4-1: Source of Flood Zone 3a plus climate change extents in the Level 2 SFRA



4.3 Climate change and surface water

Peak rainfall intensity allowance is used to understand the risk posed by increased rainfall on land and urban drainage systems.

Climate change is predicted to increase rainfall intensity in the future by a range of between 20% and 40% (the recommended national precautionary sensitivity range for 2070 to 2115).

Table 4-2 shows the climate change allowances for the various epochs. The same allowances are applied across all of England. For the purpose of strategic planning, the 'Upper End' band is considered for the 2050s and 2080s epoch, as this reflects the timeline of development.

Table 4-2: Climate change allowances for peak intensity rainfall

	Total potential change anticipated for the 2020s (2015 – 2039)	Total potential change anticipated for the 2050s (2040 - 2069)	Total potential change anticipated for the 2080s (2070 - 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

The Level 2 assessment of present-day surface water flood risk is based on the Risk of Flooding from Surface Water (RoFSW) map. The impact of climate change on surface water flood risk has been assessed by applying a 40% uplift ('Upper End' for 2070 to 2115) to the 1 in 100-year Risk of Flooding from Surface Water mapping.

The climate change uplift extended and connected existing surface water flow paths generated during a 1 in 100-year event, and expanded areas of surface water ponding on low-lying ground, particularly against railway embankments and on the fluvial floodplain.

The latest climate change allowances should be considered as part of any site-specific assessment.

5 How have cumulative impacts been assessed?

5.1 Principle

Cumulative impacts are defined as the effects of past, current and future activities on the environment. Under the 2019 NPPF, strategic policies and their supporting Strategic Flood Risk Assessments (SFRAs), are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para. 156).

When allocating land for development, consideration should be given to the potential cumulative impact on flood risk within a catchment. Development increases the impermeable area within a catchment, which if not properly managed, can cause loss of floodplain storage, increased volumes and velocities of surface water runoff, and result in heightened downstream flood risk. Whilst individual developments should only have a minimal impact on the hydrology and flood risk of an area, the cumulative effect of multiple developments may be more severe.

The cumulative impact should be considered throughout the planning process, from the allocation of sites within the Local Plan, to the planning application and development design stages. Once preferred options are identified, their cumulative impact can be considered in more detail within a Level 2 SFRA, where necessary. In addition, site-specific FRAs must consider the cumulative impact of the proposed development on flood risk within the wider catchment area.

In consultation with the Environment Agency, conditions set by the Council should support the implementation of SuDS and appropriate flood mitigation measures. As a minimum, development should have a neutral impact on flood risk, and lead to no net loss in functional floodplain. Where possible it should improve existing issues, to ensure that flood risk is not exacerbated either within, or outside of, the Council's administrative area.

5.2 Methodology

The impacts of cumulative development on flood risk were assessed as part of the South West Hertfordshire Level 1 SFRA.

A series of inputs, including recorded flood history, predicted flood risk, existing development commitments and potential future development pressures, were used to calculate impact of any future development on areas susceptible to flooding.

Where catchments were identified as sensitive to the cumulative impact of development, the assessment concluded with potential strategic planning policy suggestions to manage the risk.

Full details of the methodology used can be found in Appendix D of the South West Hertfordshire Level 1 SFRA, 'Catchment-level Assessment of Cumulative Impacts of Flood risk'.

5.3 Planning Policy Considerations for Catchments

As part of the South West Hertfordshire Level 1 SFRA, planning policy considerations have been identified for the following catchments where cumulative development is likely to have the greatest impact on flood risk to communities:

- Colne (from Confluence with Ver to Gade)
- Gade (from confluence with Bulbourne to Chess)

The policy considerations for each of these catchments have been reviewed within the Level 2 SFRA, in the context of potential development pressures within Watford Borough.

Within the Level 2 SFRA Site Summary Sheets in Appendix A, recommendations are provided for sites within catchments identified as at medium and high sensitivity to the cumulative impacts of development.

5.3.1 Colne (from Confluence with Ver to Gade)

Key Flood Risk Issues

- Significant fluvial flood risk from the River Colne, Hartsbourne Stream and Oxhey Brook.
- Surface water flow paths which follow the topography and are impeded by embankments for major transport infrastructure.
- Groundwater flood risk.

Planning Policy Considerations

- As Hertfordshire County Council, the Lead Local Flood Authority (LLFA) may not be consulted on minor development sites, planning policy should ensure that these sites limit discharge rates and volumes to greenfield rates, in line with Hertfordshire County Council's policy for major development sites.
- To provide wider flood risk benefits to the mid-Colne catchment, development sites in the upper catchment, such as north of Watford and around Abbots Langley, should include the provision of long-term storage. This would control the release of surface water volumes from the site during and immediately after storm events, help to reduce and delay the peak flows on the River Colne reaching South Watford and Oxhey.

5.3.2 Gade (from confluence with Bulbourne to Chess)

Key Flood Risk Issues

- Significant surface water flow paths flow towards the River Gade, following the natural topography. High number of surface water flooding incidents reported in Croxley Green.

Planning Policy Considerations

- Opportunities should be taken to implement SuDS schemes which reduce runoff to greenfield runoff rates or less, and hold back surface water for longer periods during storm events.
- A strategic, catchment-based approach to managing surface water should also be taken, particularly in the northwest of the catchment, by interrupting known surface water flow paths and creating ponds or basins to store water.

6 Level 2 flood risk summaries

6.1 Site level assessments

The flood risk summary sheets in Appendix A give flood risk information for each Level 2 site in order to determine whether the Exception Test will be required and/or the development will be viable. These include:

- Basic site information (area, type of site, % of site in each Flood Zone).
- Description of sources and mechanisms of flooding.
- Flood Zone (1% and 0.1% annual probability events) and functional floodplain extent maps, flood hazard map, flood depth map, flood velocity map, climate change impact maps. Where a site is not covered by detailed modelling, information on flood hazard, depth and velocity will not be available.
- Information on rate of onset and duration of flooding.
- Risk of Flooding from Surface Water (RoFSW) map.
- Assessment of flood defences.
- A high-level assessment of how sites might be affected during events where there is failure of flood risk management measures (breach or failure), or they are overwhelmed by events that exceed their envisaged design capacity (overtopping).
- An assessment of flood warning coverage.
- An assessment of emergency planning procedures and how safe access and egress will be managed.
- An assessment of the effect of land use and structures on flood risk both within the potential local plan site and for other development nearby.
- Recommendations on the requirements for drainage control and impact mitigation, including an assessment of likely SuDS suitability and flood betterment opportunities.
- Site-specific development control advice (including for example sequential site design, access and egress, requirements for SuDS, recommendations for drainage control and impact mitigation).
- Sensitivity of the wider catchment to the cumulative impact of development on flood risk, as assessed within the South West Hertfordshire Level 1 SFRA.
- Information on the requirements for the Exception Test, flood risk assessments and site design.

These summary sheets form the main output of the Level 2 SFRA.

7 Implications for development and requirements for the Exception Test

7.1 Sites within Flood Zone 2 and 3 and the Exception Test

It should be noted that the 'Sequential Test' refers to the procedure of sequentially selecting sites with the lowest possible flood risk, as part of the Local Plan process. Once sites have been selected for inclusion within the Local Plan, and plans to develop the site take shape, the 'Sequential Approach' should also be applied to the site design, to ensure that vulnerable land uses are located in areas of lower flood risk.

Guidance is clear that the Sequential Test must be applied first and only if passed should the site consideration extend to Level 2. Only once the Sequential Test is passed should the Exception Test be applied.

Of the 13 sites considered in the Level 2 assessment, there are seven sites where part of the site falls within Flood Zones 2 and 3. For two of the sites examined, less than 50% of the site area is located within Flood Zones 2. Therefore, it is expected that it will be possible to preserve Flood Zones 2 and 3 (subject to a detailed flood risk assessment) as public green space or other open land category, with built development restricted to Flood Zone 1.

For these sites, the Exception Test will only be required if built development is proposed in Flood Zone 2 or 3 and will be dependent upon their vulnerability.

Table 7-1: Sites in Flood Zones 2 and 3, where >50% of the site area is in Flood Zone 1.

Site Code	Site Name	% of site in Flood Zone 1
HS33	Wiggenhall Road Depot	88%
EM02	Land to the south of Wiggenhall	70%

Flood risk assessments must carry out detailed assessments where appropriate to define the Flood Zones and model the effect of climate change. Climate change assessments should be undertaken using the relevant allowances[5] for the type of development and level of risk and in discussion with the EA. The requirements for flood risk assessments are set out in the Level 1 SFRA. Further detail is given on the relevant summary sheets.

The remaining five sites were found to have significant proportions (greater than 50%) of the site at fluvial flood risk, meaning that built development may need to be located within Flood Zone 2 and/or 3, if the Council wishes to take these sites forward. The sites are shown in Table 7-2.

Table 7-2: Sites with significant proportions of the site at fluvial flood risk

Site Code	Site Name	% of site in Flood Zone 2 and 3
HS25	Land and buildings at 247 Lower High Street	100%
MX17	Land at Riverwell	54%
MX12	Land at Tesco Lower High Street	90%
MX14	Colne Valley Retail Park	96%

5 Environment Agency (2016) Flood risk assessments: climate change allowances. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Site Code	Site Name	% of site in Flood Zone 2 and 3
MX18	Colne Bridge Retail Park	90%

In this case the above sites will require application of the Exception Test depending on the vulnerability of the development[6]:

- If More Vulnerable and Essential Infrastructure is located in FZ3a.
- If Highly Vulnerable development is located in FZ2.
- If Essential Infrastructure is located in FZ3b

Development will not be permitted in the following scenarios:

- Highly Vulnerable infrastructure within FZ3a and FZ3b.
- More Vulnerable and Less Vulnerable Infrastructure within FZ3b.

The site and building design will need to ensure that the development is safe and resilient to the modelled flood risk, and any residual risk in defended areas. A flood mitigation and adaptation approach is likely to be required. Development should be designed using a sequential approach, with built development / higher vulnerabilities located towards areas of lower risk and hazard. Areas of the sites within the functional floodplain, Flood Zone 3b, and areas of higher hazard should be preserved for appropriate uses, such as public open space or essential infrastructure (subject to the Sequential and Exception Tests). Further detail is given on the relevant summary sheets.

7.2 Sites at risk from flooding from ordinary watercourses

There are several sites which fall entirely in Flood Zone 1, but which contain an ordinary watercourse or drainage feature.

These sites must still pass the Sequential Test, taking account of the non-fluvial source of flooding, but will not require the Exception Test. In this case, the area at risk is likely to be limited and as long as it is taken into account in the site design, it should not affect the viability of development. Flood risk assessments must carry out detailed modelling where appropriate to define the Flood Zones and model the effect of climate change. The requirements for flood risk assessments are set out in the Level 1 SFRA. Further detail is given on the relevant summary sheets.

Liaison with Hertfordshire County Council is advised for sites within Flood Zone 1 that contain an ordinary watercourse.

7.3 Sites at risk of significant surface water flooding

All developments over 1ha must carry out a flood risk assessment to assess surface water drainage and other sources of flooding. There are five sites where greater than 10% of the site area is within the RoFSW 1% AEP (1 in 100-year) risk area. The sites are shown in Table 7-3.

6 Ministry of Housing, Communities & Local Government (2014) Planning Practice Guidance. Table 2: Flood risk vulnerability classification. Paragraph: 066 Reference ID: 7-066-20140306. Available at: https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification

Table 7-3: Sites with significant proportions of the site at surface water flood risk

Site Code	Site Name	% of site in 1% AEP (1 in 100-year) surface water flood risk
MX06	Land at Watford Junction Station	21%
MX17	Land at Riverwell	12%
HS11	Land at 420-420a St Albans Road	46%
MX14	Colne Valley Retail Park	12%
MX18	Colne Bridge Retail Park	37%

These sites will still need to pass the Sequential Test, taking account of the non-fluvial sources of flooding. The Exception Test is not required under the NPPF, but it must be shown that the development will be safe for its lifetime and the risk can be managed through a sequential approach to design.

Flood risk assessments should consider carrying out surface water modelling to define the level of surface water risk, and the risk areas / flow paths, including the effects of climate change. Drainage designs should 'design for exceedance' and accommodate existing surface water flow routes. Building design (threshold levels etc.) should ensure that development is safe from flooding. The requirements for surface water strategies and flood risk assessment are set out in the Level 1 SFRA. Further detail is given on the relevant summary sheets.

Liaison with the Hertfordshire County Council is advised for sites within Flood Zone 1 that contain significant surface water flood risk.

7.4 Sites at risk of significant groundwater flooding

There are 10 sites where greater than 10% of the site area is within Zone 4 of the JBA Groundwater Flood Map. The higher risk categories are defined as:

- Zone 3 - Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
- Zone 4 - Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.

The sites are shown in Table 7-4.

Table 7-4: Sites with significant proportions of the site at groundwater flood risk

Site Code	Site Name	% of site in JBA Groundwater Map Zone 4
HS25	Land and buildings at 247 Lower High Street	100%
HS31	Chalk Hill Car Park	15%
MX17	Land at Riverwell	23%
MX12	Land at Tesco Lower High Street	27%
HS33	Wiggenhall Road Depot	48%

Site Code	Site Name	% of site in JBA Groundwater Map Zone 4
EM03	Gateway Zone	100%
MX14	Colne Valley Retail Park	98%
MX18	Colne Bridge Retail Park	100%
MX16	Land East of Ascot Road	28%

These sites will still need to pass the Sequential Test, taking into account the non-fluvial source of flooding, but will not require the Exception Test.

Flood risk assessments should consider conducting further analysis of groundwater within the site to define the level of groundwater flood risk. Site design, including any SuDS features, should be resilient to groundwater flooding and building design (threshold levels etc.) should ensure the development is safe from flooding. Liaison with Hertfordshire County Council (LLFA) is advised for sites within Flood Zone 1 that contain significant groundwater flood risk.

7.5 Opportunities for flood betterment

Many of these developments must provide flood betterment alongside sustainable development. Such opportunities should be discussed with the LLFA and Environment Agency as appropriate at an early planning stage. These include:

- All developments should take the opportunity to implement exemplar SuDS design, delivering multiple benefits for the development (water quality, biodiversity, amenity, green infrastructure).
- Opportunities for developer contributions to flood mitigation options under consideration by organisations such as Hertfordshire County Council or the Environment Agency.
- All existing watercourses on sites should remain as open channels. Consultation with the Environment Agency confirmed that the Agency will object to the culverting of watercourses, and will expect any existing culverts within a site to be opened up, or 'daylighted'. In addition, any other structures encountered on the site which may restrict flow of water should be removed, (subject to approval of any necessary watercourse, heritage and environmental consents) to allow better management of flood risk, provide amenity space and improve habitats.
- Any proposed river crossings on the sites must ensure they are clear span in design and allow sufficient clearance of flood flows, to prevent future risk of blockage and backing up.
- Opportunities for mitigation of surface water flow routes to improve flood risk on adjoining land – particularly to public buildings such as hospitals and schools.

Opportunities have been highlighted on the relevant site summary sheets in Appendix A.

8 Future use of SFRA data

The Level 2 SFRA has examined each of the sites deemed to be at flood risk in more detail. The aim of the Level 2 assessments is to determine whether or not the Exception Test could be passed, i.e. development could be achieved safely, for sites that have been found to be at flood risk by the Level 1 assessment. The limitations of the available detailed modelling have been highlighted, and detailed flood risk assessments will be required on all of these sites to ensure that they are designed safely.

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change. In particular the Environment Agency's detailed river models may be updated as part of their ongoing flood risk mapping programme.

The SFRA should be periodically updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by the Council, Hertfordshire County Council (in its role as LLFA), the Highways Authority, Thames Water and the Environment Agency. It is recommended that the SFRA is reviewed internally on an annual basis, allowing a cycle of review, followed by checking with the above bodies for any new information to allow a periodic update.

Appendices

A Site screening

B Level 2 site summary sheets and maps

C Residual Risk Maps – Blockage Scenarios

D Residual Risk Maps – Breach Scenarios

Offices at

Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Limerick
Newcastle upon Tyne
Newport
Peterborough
Saltaire
Skipton
Tadcaster
Thirsk
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Site Code	Name	Site (Ha)	FZ3b (Ha)	FZ3b (%)	FZ3a (Ha)	FZ3a (%) only	FZ3a (%) total	FZ2 (Ha)	FZ2 (%) only	FZ2 (%) total	FZ1 (%)	FZ3a+CC 35% (Ha)	FZ3a+CC 35% (%)	FZ3a+CC 70% (Ha)	FZ3a+CC 70% (%)	HFM (Ha)	HFM (%)	RES (Ha)	RES (%)	SW30 (Ha)	SW30 (%)	SW100 (Ha)	SW100 (%)	SW1000 (Ha)	SW1000 (%)	SW100 + 40%CC (Ha)	SW100 + 40%CC (%)	Groundwater Cat 1 (>5m below ground in 1 in 100-year)	GW Cat 1 (%)	Groundwater Cat 2 (0.5 - 5m below ground in 1 in 100-year)	GW Cat 2 (%)	Groundwater Cat 3 (0.025 - 0.5m below ground in 1 in 100-year)	GW Cat 3 (%)	Groundwater Cat 4 (<0.025m below ground in 1 in 100-year)	GW Cat 4 (%)	Total groundwater in Cat 3 or 4 (%)	Canal Risk <=100m Embankment
HS18	Land at 80 Cassio Road	0.08	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.08	100%	0.00	0%	0.00	0%	0.00	0%	0%	No
MX11	Wellstones Car Park	0.23	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.23	100%	0.00	0%	0.00	0%	0.00	0%	0%	No
HS24	Land at Waterfields Shopping Park	1.88	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.38	20%	0.00	0%	0.00	0%	0.07	4%	0.00	0%	0.00	0%	1.88	100%	0.01	0%	0.00	0%	0%	No
HS20	Derby Road Skate Park	0.27	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.01	4%	0.01	2%	0.00	0%	0.27	100%	0.00	0%	0.00	0%	0%	No
HS35	Land and Garages at Riverside Road	0.10	0.00	0%	0.0	4%	4%	0.10	96%	100%	0%	0.10	100%	0.10	100%	0.00	1%	0.10	100%	0.00	0%	0.00	2%	0.01	11%	0.00	4%	0.00	0%	0.00	0%	0.00	0%	0.10	100%	100%	No
HS05	The Badger PH	0.15	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.06	44%	0.00	0%	0.00	0%	0.15	100%	0.00	0%	0.00	0%	0%	No
HS13	16-18 St. Albans Road	0.21	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	1%	0.00	1%	0.00	1%	0.00	0%	0.21	100%	0.00	0%	0.00	0%	0%	No
EM01	11-19 Cassiobury House Station Road	0.24	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.03	13%	0.01	4%	0.00	0%	0.24	100%	0.00	0%	0.00	0%	0%	No
HS19	120-122 Exchange Road	0.05	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.05	100%	0.00	0%	0.00	0%	0.00	0%	0%	No
HS34	Bushey Station	0.31	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	1%	0.00	0%	0.00	0%	0%	No
HS25	Land and buildings at 247 Lower High Street	0.14	0.00	0%	0.1	90%	90%	0.14	10%	100%	0%	0.14	100%	0.14	100%	0.00	0%	0.14	100%	0.00	0%	0.00	1%	0.11	74%	0.08	59%	0.00	0%	0.00	0%	0.00	0%	0.14	100%	100%	No
MX03	Lemarie Centre	0.10	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.01	13%	0.01	11%	0.00	0%	0.10	100%	0.00	0%	0.00	0%	0%	No
MX07	Land at Colonial Way/Clive Way	1.98	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.02	1%	0.27	13%	0.09	5%	0.00	0%	1.98	100%	0.00	0%	0.00	0%	0%	No
MX05	Land and Buildings at 94-114 St Albans Road	2.47	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.04	1%	0.23	9%	0.70	28%	0.44	18%	0.02	1%	2.45	99%	0.00	0%	0.00	0%	0%	No
HS02	Land and buildings at 275 Sheepcot Lane	0.35	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.35	100%	0.00	0%	0.00	0%	0%	No
MX08	Centrepoint Community Centre	0.13	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.13	100%	0.00	0%	0.00	0%	0%	No
HS22	Car Park Vicarage Road_Exchange Road	0.05	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.05	96%	0.00	0%	0.00	0%	0%	No
HS32	Bushey Arches Car Park	0.10	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.04	41%	0.06	61%	0.08	84%	0.07	69%	0.00	0%	0.00	0%	0.10	100%	0.00	0%	100%	No
HS31	Chalk Hill Car Park	0.04	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	2%	0.00	12%	0.00	5%	0.00	0%	0.00	0%	0.03	85%	0.01	15%	100%	No
HS16	Corner of Park Avenue and Rickmansworth Road	0.10	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.10	100%	0.00	0%	0.00	0%	0%	No
HS29	Croxley View, land south of Morrisons	3.20	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.01	0%	0.03	1%	0.29	9%	0.12	4%	0.00	0%	3.08	96%	0.11	4%	0.01	0%	4%	No
MX06	Land at Watford Junction Station	7.46	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.70	9%	1.54	21%	3.73	50%	2.34	31%	0.00	0%	7.45	100%	0.00	0%	0.00	0%	0%	No
HS08	Meriden Former School Site	1.74	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.01	1%	0.00	0%	0.00	0%	0.00	0%	1.74	100%	0.00	0%	0.00	0%	0%	No
MX17	Land at Riverwell	11.98	0.32	3%	2.7	20%	23%	6.44	34%	54%	46%	6.44	54%	6.44	54%	0.87	7%	6.79	57%	0.78	6%	1.41	12%	2.82	24%	2.01	17%	0.00	0%	4.82	40%	4.36	36%	2.80	23%	59%	No
HS23	Crown Passage Car Park	0.09	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.09	100%	0.00	0%	0.00	0%	0%	No
HS15	Land to the Rear of 125-127 The Parade	0.26	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.01	4%	0.25	96%	0.00	0%	0.00	0%	0%	No
MX12	Land at Tesco Lower High Street	7.61	0.57	7%	2.9	30%	38%	6.83	60%	90%	10%	6.83	90%	6.83	90%	1.65	22%	7.55	99%	0.19	2%	0.64	8%	3.11	41%	1.34	18%	0.00	0%	0.20	3%	5.39	71%	2.02	27%	98%	No
HS09	Bill Everett Centre	1.07	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.04	4%	0.02	2%	1.07	100%	0.00	0%	0.00	0%	0.00	0%	0%	No
MX01	Woodside Community Centre	0.20	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.20	100%	0.00	0%	0.00	0%	0%	No
HS17	Land and Buildings at 87 Cassio Road	0.11	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.11	100%	0.00	0%	0.00	0%	0.00	0%	0%	No
HS04	Land and buildings at 5 Sheepcot Lane	0.17	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.17	100%	0.00	0%	0.00	0%	0.00	0%	0%	No
HS33	Wiggenhall Road Depot	1.49	0.00	0%	0.0	1%	1%	0.17	11%	12%	88%	0.17	12%	0.17	12%	0.17	12%	0.22	15%	0.00	0%	0.03	2%	0.12	8%	0.06	4%	0.00	0%	0.00	0%	0.77	52%	0.72	48%	100%	No
HS30	41 Aldenham Road	0.05	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0%	No
HS06	Land and Garages adjacent to 1-7 Heronslea	0.11	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.11	100%	0.00	0%	0.00	0%	0%	No
HS14	Land and Garages between 139 and 149 Queens Road	0.05	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.05	90%	0.05	100%	0.05	100%	0.05	100%	0.00	0%	0.05	100%	0.00	0%	0.00	0%	0%	No
HS28	Land and Garages to the rear of 2-24 Elfirda Road	0.08	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	1%	0.05	63%	0.04	52%	0.00	0%	0.05	66%	0.03	35%	0.00	0%	35%	No
HS26	Land between 41 and 61 Brightwell Road	0.05	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.01	19%	0.00	0%	0.00	0%	0.05	100%	0.00	0%	0.00	0%	0%	No
HS03	Land and Garages adjacent to 1 Lavinia Avenue	0.08	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.08	100%	0.00	0%	0.00	0%	0%	No
HS36	Kingsfield Court Garages	0.06	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.05	96%	0.00	0%	0.00	0%	0%	No
MX13	Land 44-56 Vicarage Road	0.13	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.12	96%	0.00	4%	0.00	0%	0.00	0%	0%	No
HS10	Longspring Car Park	0.27	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	2%	0.07	24%	0.02	7%	0.26	95%	0.01	5%	0.00	0%	0.00	0%	0%	No
HS01	Land Garages at Lych Gate	0.10	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.10	100%	0.00	0%	100%	No
EM03	Gateway Zone	1.71	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.06	4%	0.45	26%	0.19	11%	0.00	0%	0.00	0%	0.00	0%	1.71	100%	100%	No
EM04	Land between 14-18 Greenhill Crescent	0.09	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.09	98%	0.00	2%	0.00	0%	2%	No
HS11	Land at 420-420a St Albans Road	0.11	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.01	9%	0.05	46%	0.08	71%	0.06	56%	0.00	0%	0.11	100%	0.00	0%	0.00	0%	0%	No
HS21	Land and Buildings at 176-186 Rickmansworth Road	0.16	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.01	6%	0.00	1%	0.00	0%	0.15	97%	0.00	3%	0.00	0%	3%	No
HS12	Land at Langley Way	0.09	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.09	100%	0.00	0%	0.00	0%	0%	No
MX09	23-37 The Parade	0.41	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.03	7%	0.02	5%	0.32	78%	0.09	22%	0.00	0%	0.00	0%	0%	No
MX14	Colne Valley Retail Park	2.64	0.03	1%	0.3	12%	13%	2.54	84%	96%	4%	2.54	96%	2.54	96%	0.05	2%	2.64	100%	0.07	3%	0.31	12%	0.87	33%	0.59	22%	0.00	0%	0.00	0%	0.05	2%	2.60	98%	100%	No
MX18	Colne Bridge Retail Park	0.81	0.02	2%	0.3	31%	33%	0.73	59%	90%	10%	0.73	90%	0.73	90%	0.27	33%	0.55	68%	0.13	16%	0.30	37%	0.52	64%	0.39	48%	0.00	0%	0.00	0%	0.00	0%	0.81	100%	100%	No
MX16	Land East of Ascot Road	0.45	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.01	2%	0.00	1%	0.00	0%	0.20	45%	0.12	27%	0.13	28%	55%	No
HS07	Land at Russell Lane	1.61	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.06	4%	0.01	1%	0.00	0%	1.61	100%	0.00	0%	0.00	0%	0%	No
EM02	Land to the south of Wiggenhall IE	0.58	0.00	0%	0.1	25%	25%	0.18	5%	30%	70%	0.18	30%	0.18	30%	0.02	3%	0.58	100%	0.01	2%	0.05	9%	0.16	27%	0.09	15%	0.00	0%	0.06	11%	0.33	57%	0.19	32%	89%	No
MX10	19-21 Clarendon Road	0.08	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.08	97%	0.00	3%	0.00	0%	0.00	0%	0%	No
HS27	Liverpool Road Garages	0.21	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.21	100%	0.00	0%	0.00	0%	0%	No
MX04	Land at 453 St Albans Road	0.30	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.01	4%	0.03	10%	0.05	17%	0.04	12%	0.29	97%	0.01	3%	0.00	0%	0.00	0%	0%	No
MX02	Land at 501 St Albans Road	0.21	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.02	10%	0.05	21%	0.03	15%	0.20	97%	0.01	3%	0.00	0%	0.00	0%	0.00	0%	0%	No
MX15	Land To West Of And Parallel To Ascot Road	0.71	0.00	0%	0.0	0%	0%	0.00	0%	0%	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%	0.02	3%	0.06	8%	0.19	27%	0.08	12%	0.00	0%	0.09	12%	0.11	15%	0.51	72%	87%	No

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Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

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Site code	EM02
Site name	Land to the south of Wiggenhall Industrial Estate

Site details	**OS Grid reference**	TQ 10983 95529
	Area	0.58 ha
	Current land use	Brownfield
	Proposed site use	Employment
	Flood risk vulnerability	Less vulnerable
	Watford Sustainability Area Band	Area of High Sustainability
Sources of flood risk	**Existing watercourses**	There are no watercourses within the site boundary. Approximately 100m south of the site, the River Colne flows in a westerly direction.
	Flood history	The northern border of the site is located within the EA Recorded Flood Outlines. The site has previously been affected by fluvial flooding during two recorded events: • December 2000 • February 2014 Both of these events occurred as a result of channel exceedance on the River Colne.
	Fluvial	**Fluvial**

Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
	0%	25%	5%
Maximum flood level on site (mAOD)	N/A	53.45	53.79

Available modelled data:
The site is covered by the 2010 Upper Colne 1D-2D hydraulic model. Flood depth and hazard results were not provided with this model, and therefore water level results have been used. Flood Zone 2 has been used as a proxy for Flood Zone 3a +35%CC and +70%CC extents, as the Upper Colne model became unstable when higher flows were applied.

Flood characteristics:
The northern and western boundaries of the site are located within Flood Zones 3a and 2.

	Surface Water	**Proportion of site at risk (RoFSW)**		
		3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**
		2%	9%	27%

Description of surface water flow paths:
The northern and western boundaries of the site are at medium to high risk of flooding from surface water. The surface water flooding here is associated with a large area of ponding which forms in a low point where the industrial estate is located.
The surface water risk is located within the same area as fluvial risk, although surface water flooding may occur independently.

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Site name	Land to the south of Wiggenhall Industrial Estate

	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1 in 100-year (1% AEP) risk categories**		
		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**
		32%	57%	89%
		The majority of the site is at high risk of groundwater flooding. The area of highest flood risk is the northern and eastern boundary of the site, which is located within Category 4 (where groundwater is predicted to lie at or within 0.025m of the surface during a 1% AEP event). The rest of the site is largely located within Category 3 (where groundwater is predicted to lie 0.025 to 0.5m below the surface during a 1% AEP event).		
	Reservoir	The entire site is at risk of reservoir flooding in the extremely unlikely event of a breach at either Aldenham or Hilfield Park reservoirs.		
	Canal	There are no canals witin the site.		
Flood risk management infrastructure	**Defences**	**Defence Type**	**Standard of Protection**	**Condition**
		There are no defences within the site or within close proximity.		
	Residual risk	**Culvert / structure blockage?**	There are no culverts present within the vicinity of the site.	
		Impounded water body failure?	The entire site is at risk of reservoir flooding in the event of a breach event on Aldenham or Hilfield Park reservoir.	
		Defence breach / overtopping?	**Breach Zone**	
			N/A	
Emergency planning	**Flood warning**	The site is covered by the following EA Flood Warning and Flood Alert Areas: • **Flood Alert Area**: The Middle River Colne at Watford and Rickmansworth including Carpenders Park • **Flood Warning Area**: The River Colne at Watford including Bushey		
	Access and egress	The site is likely to be accessed from Wiggenhall Road or Thomas Sawyer Way. Both of these routes are at risk of fluvial flooding during a 1% AEP event and surface water flooding during a 3.3% AEP event. This is likely to restrict access and egress during a flood event, with Wiggenhall Road, adjacent to the site, at high risk of surface water flooding.		
Climate Change	**Climate change allowances for '2080s'**	**River Basin District**	**Central**	**Higher Central**	**Upper End**
		Thames	25%	35%	70%
	Implications for the site	Due to model instability when applying 35% and 70% climate change allowances to inflows, Flood Zone 2 has been used as a proxy for climate change. This provides a conservative extent, with 31% of the site identified as at risk from a 1% AEP (1 in 100-year) + 70%CC flood event.. The 1% AEP (1 in 100-year) surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 0.1% (1 in 1,000-year) surface water flood extent.		

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Site name	Land to the south of Wiggenhall Industrial Estate

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.	
	Superficial Geology	There are glacial sand and gravel deposits across the site.	
	Soils	Loamy and clayey floodplain soils with naturally high groundwater.	
	SuDS	Storage of surface water runoff from the development during extreme events should be located out of fluvial flood risk areas. It is advised that source control SuDS techniques (such as green roofs, rainwater harvesting and permeable paving) are utilised across the site. Conveyance features should be designed above ground and follow natural flow paths where possible. Groundwater flood risk is variable across the site and therefore it is recommended that groundwater monitoring is undertaken (preferably during winter months), to better understand the groundwater dynamics. Where below ground storage is proposed, the base of the feature must be located at least 1m above the highest groundwater level, to reduce the risk of groundwater ingress or flotation. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding and the site is located within Groundwater Source Protection Zone 1. Therefore further site investigation should be carried out to assess potential for drainage by infiltration, including at least 12 months of groundwater level monitoring on site. Infiltration techniques should only be used where there are suitable levels of surface water runoff treatment, and following the granting of any required environmental permits from the Environment Agency.	
	Groundwater Source Protection Zone	The site is within Groundwater Source Protection Zone 1 (inner zone). This is defined as the 50 day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There are no historic landfill sites within the site boundary or within close proximity.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of flood peaks downstream on the River Colne and existing surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Colne (from Confluence with Ver to Gade)	High
	Sequential Test and Exception Test requirements		

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Site code	EM02
Site name	Land to the south of Wiggenhall Industrial Estate

Recommend-ations for Local Plan policy

The Sequential Test must be satisfied. Only once the Sequential Test is satisfied should the Exception Test be applied. **It is anticipated that proposed development will be sequentially located within Flood Zone 1**. For this site, the Exception Test must be satisfied:

- If More Vulnerable and Essential Infrastructure is located in FZ3a or FZ3a plus climate change.
- If Highly Vulnerable development is located in FZ2.

If Essential Infrastructure is located in Flood Zone 3b then it must be demonstrated that the exception test is satisfied. Development will not be permitted in the following scenarios:

- Highly Vulnerable development within FZ3a or FZ3a plus climate change and FZ3b.
- More Vulnerable and Less Vulnerable development within FZ3b.

Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers

Flood risk assessment:

- At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.
- A site-specific flood risk assessment will be required because the site is within Flood Zone 2 and 3 and at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).
- Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
- Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future.
- The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration.

Guidance for site design and making development safe:

- Development must seek opportunities to reduce overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100 plus climate change event.
- All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- Storage for runoff from the development in extreme events should be located out of fluvial flood risk areas.
- Floodplain compensation must be demonstrated for any loss in floodplain storage through the raising of levels for development.
- Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.

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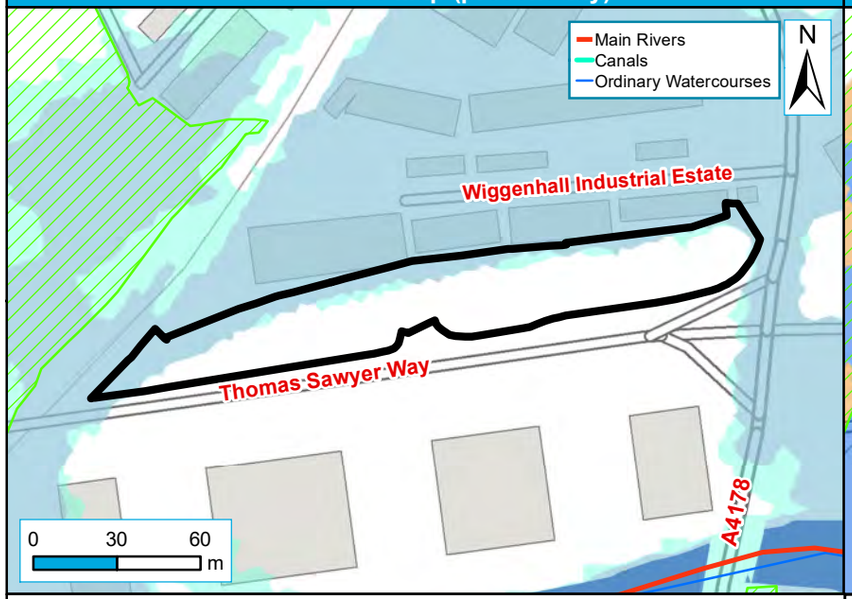
Site name	Land to the south of Wiggenhall Industrial Estate

	• The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property. • SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	EM02
Site Name	Land to the south of Wiggenhall IE

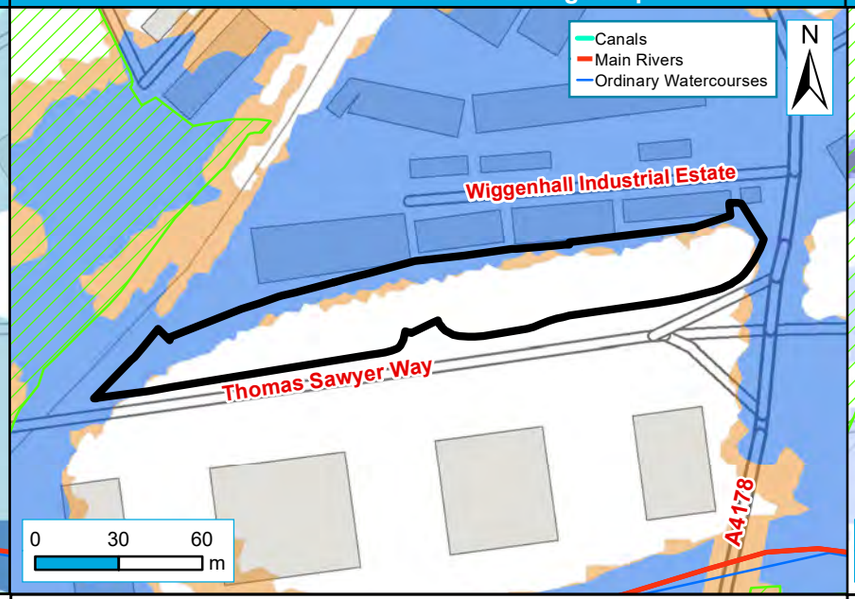
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



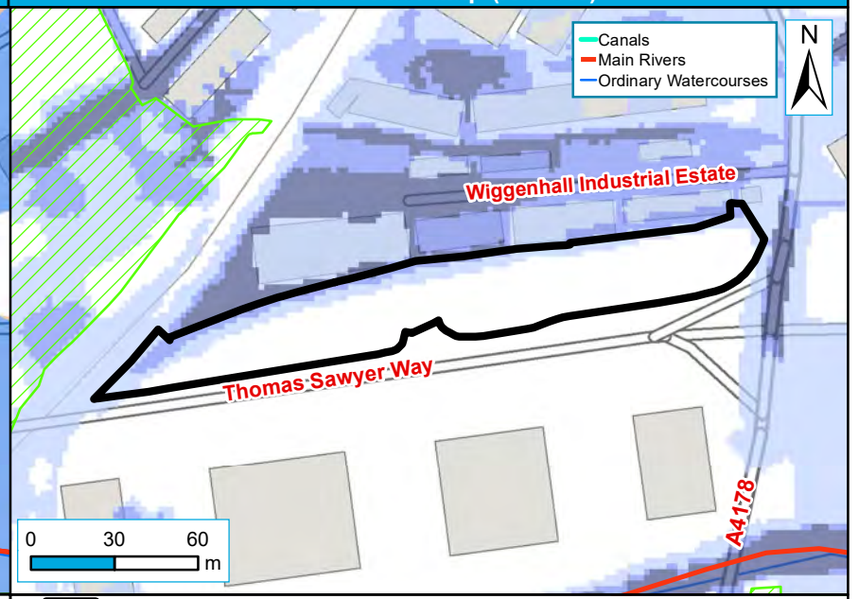
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



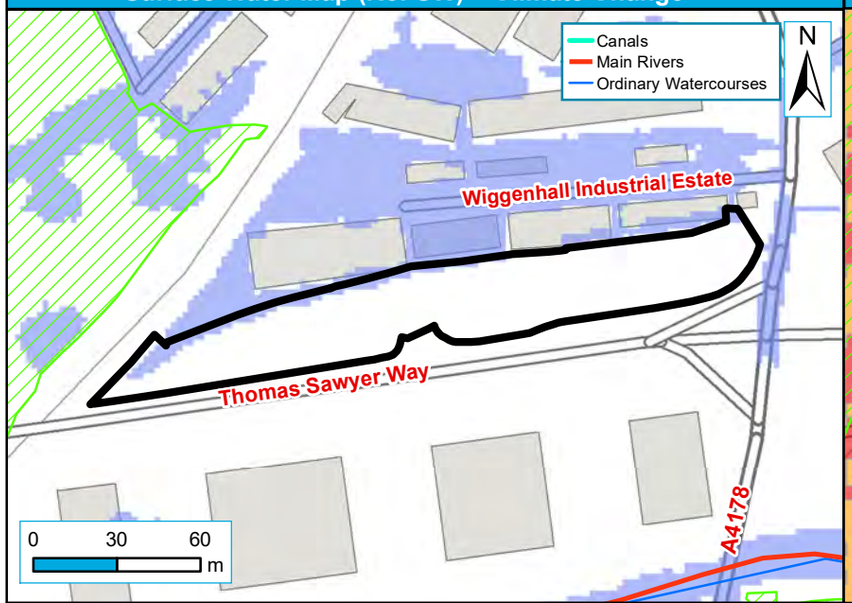
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



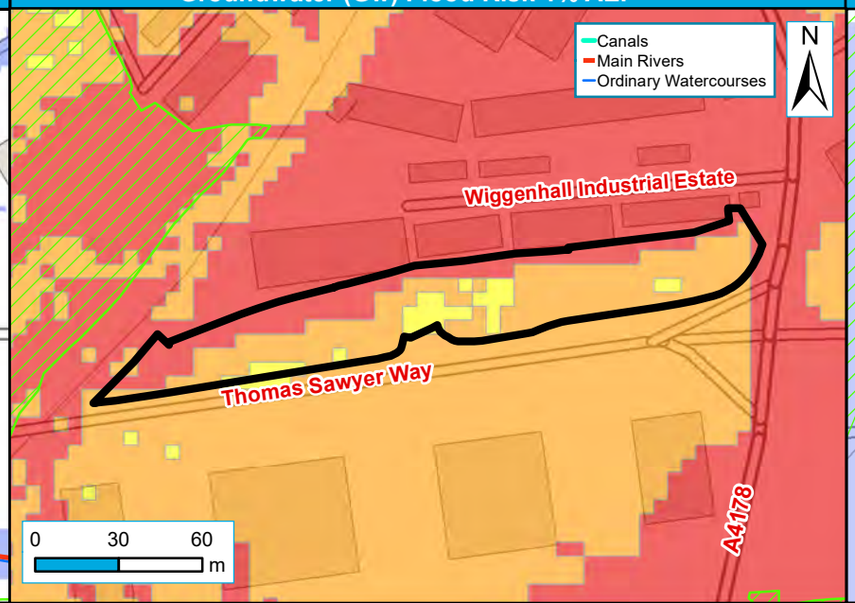
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



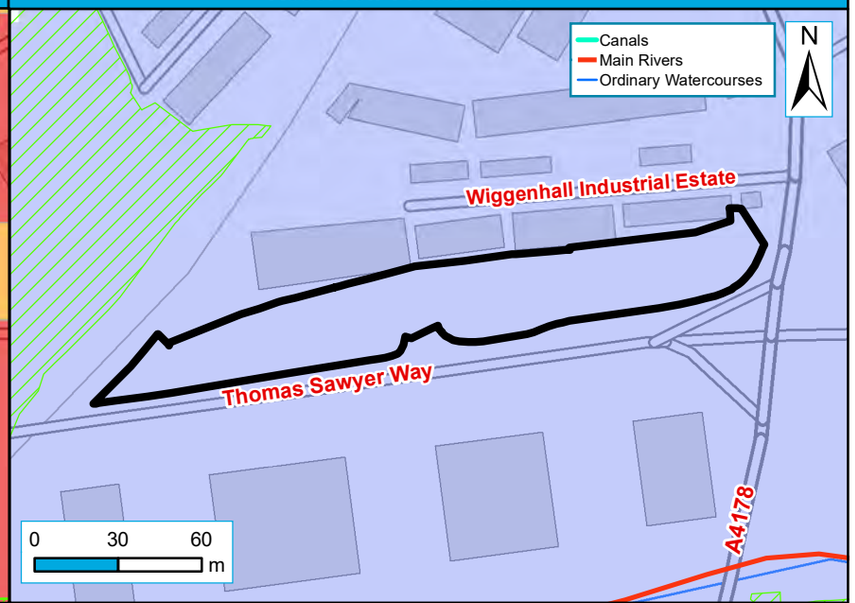
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

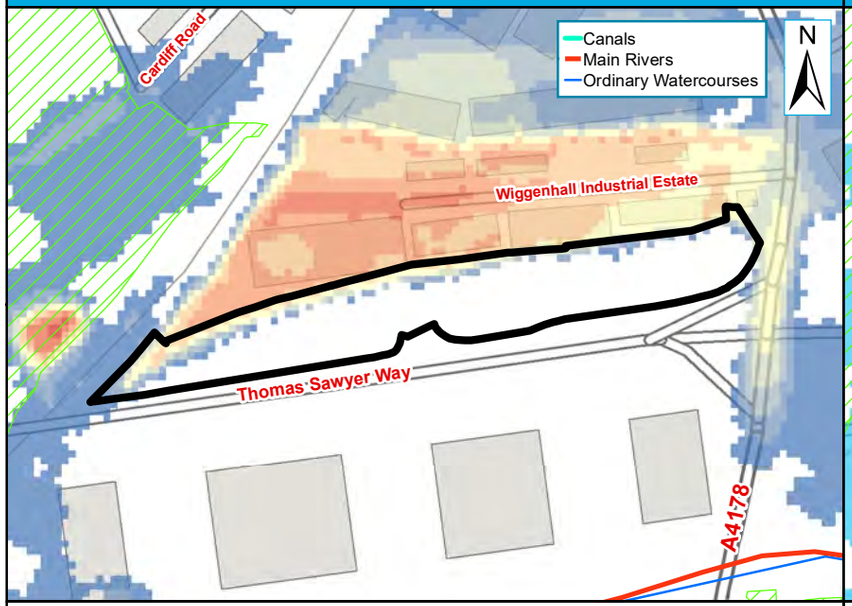


Site Boundary
Other L2 Sites
Reservoir Flood Risk

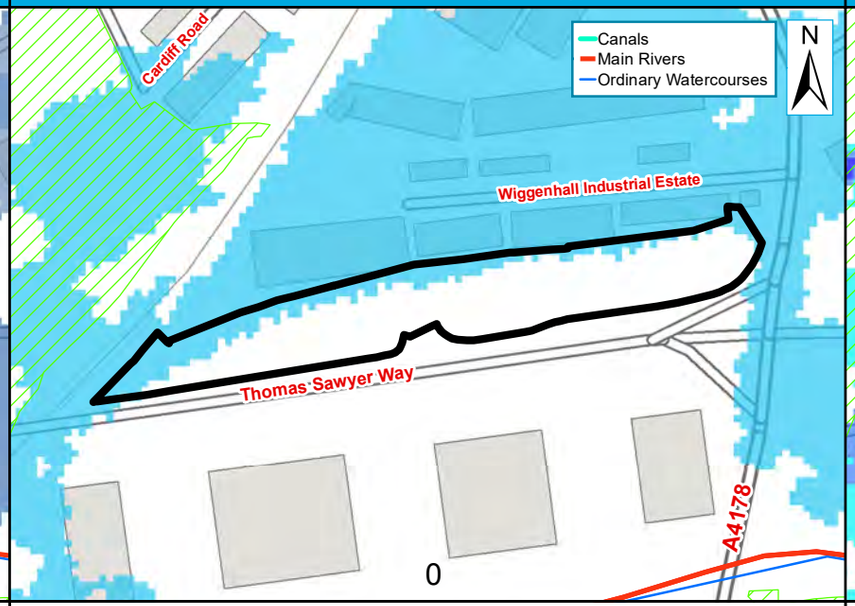
Site reference	EM02
Site Name	Land to the south of Wiggenhall IE

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

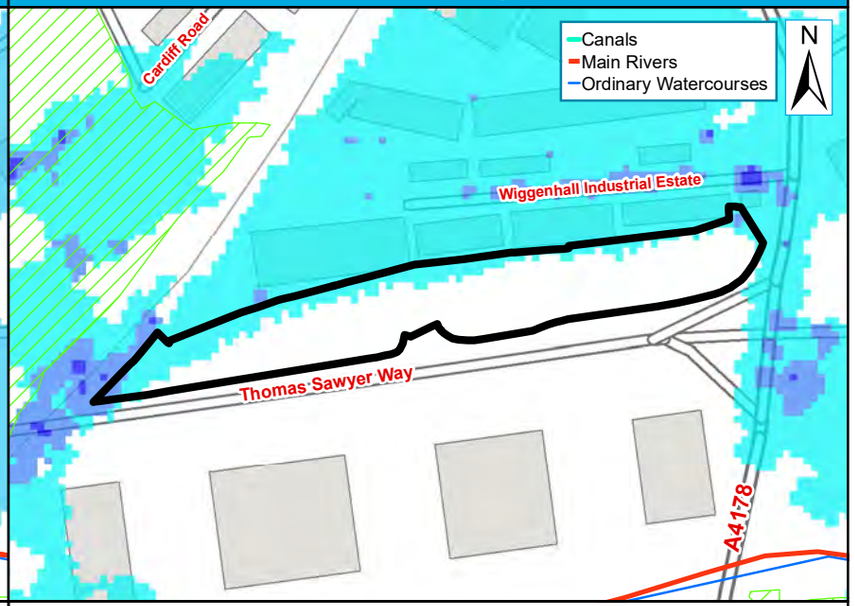
Maximum Fluvial Flood Depth (m) - 1% AEP



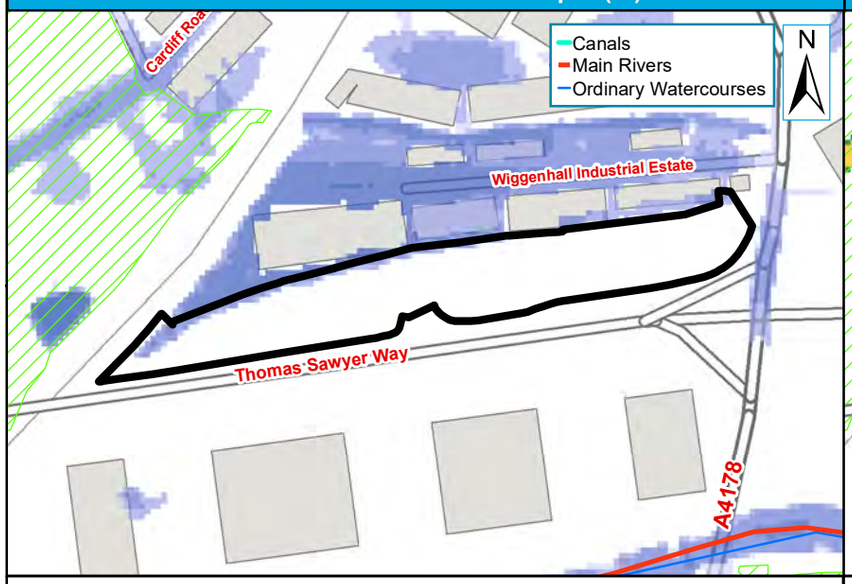
Maximum Fluvial Flood Level (mAOD) - 1% AEP



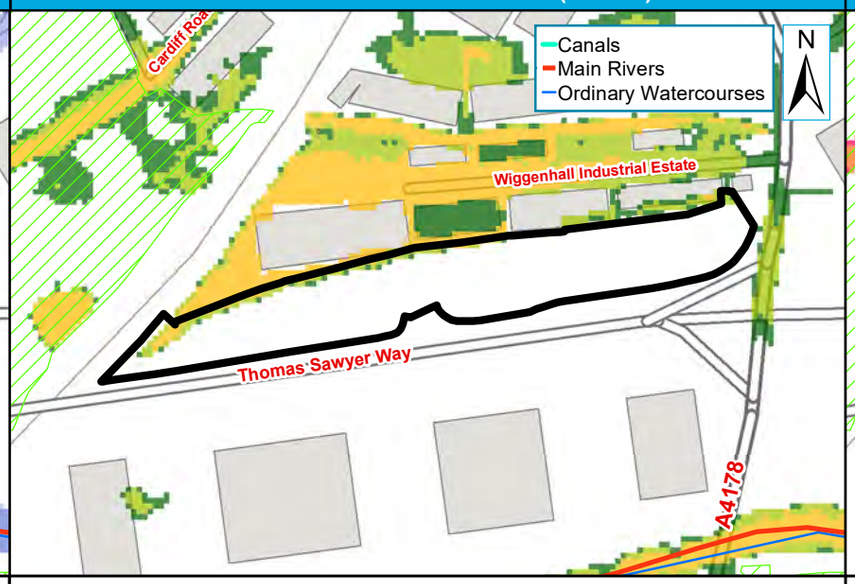
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



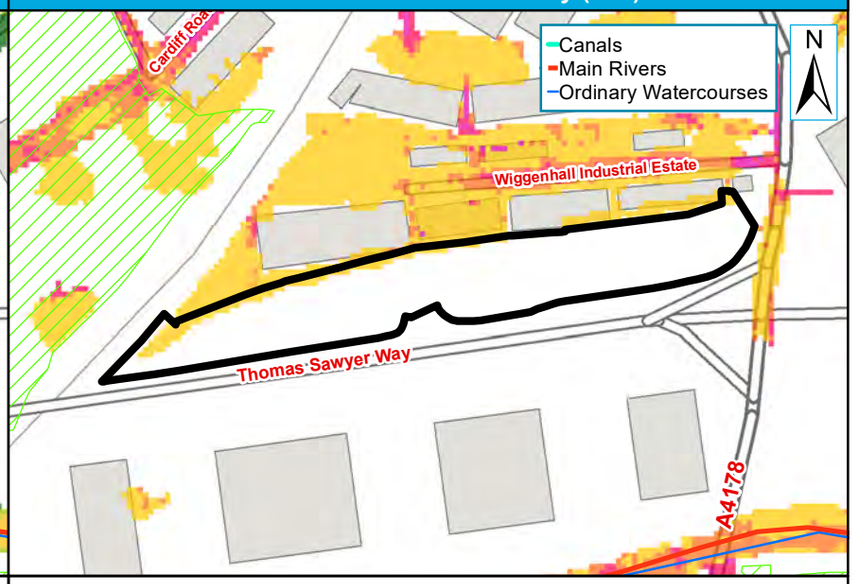
Maximum Surface Water Flood Depth (m) -1% AEP



Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	EM03
Site name	Gateway Zone

Site details	**OS Grid reference**	TQ 08916 95391			
	Area	1.7 Ha			
	Current land use	Commercial			
	Proposed site use	Employment			
	Flood risk vulnerability	Less vulnerable			
	Watford Sustainability Area Band	Area of Medium Sustainability			
Sources of flood risk	**Existing watercourses**	There are no watercourses within the site boundary. The River Gade is located approximately 90m from the western boundary of the site.			
	Flood history	The site is located within an EA Recorded Flood Outline. There are no HCC recorded flood incidents within the site.			
	Fluvial	**Fluvial**			
		Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
			0%	0%	0%
		Available modelled data: There is no fluvial model data available for the site, as it is located within Flood Zone 1. **Flood characteristics:** The site is located within Flood Zone 1, and is therefore at negligible risk of fluvial flooding.			
	Surface Water	**Proportion of site at risk (RoFSW)**			
		3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**	
		0%	4%	26%	
		Description of surface water flow paths: The site is at low to moderate risk of surface water flooding, where water ponds on low points in the topography. The north and east of the site are at risk of flooding during the 0.1% AEP (1 in 1,000-year) event, with the north of the site also at risk during the 1% AEP (1in 100-year) event.			
	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1% AEP (1 in 100-year) risk categories**			
		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**	
		100%	0%	100%	
		The site is at a high risk of groundwater flooding, with the entire site located within Category 4, where groundwater levels are estimated to be within 0.025m of the ground surface during a 1% AEP (1 in 100-year) event.			
	Reservoir	The site is not at risk of reservoir flooding.			
	Canal	There are no canals witin the site.			

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	EM03
Site name	Gateway Zone

<table>
<tr><td rowspan="5">Flood risk management infrastructure</td><td rowspan="2">Defences</td><td>Defence Type</td><td colspan="2">Standard of Protection</td><td>Condition</td></tr>
<tr><td colspan="4">There are no defences within close proximity of the site.</td></tr>
<tr><td rowspan="3">Residual risk</td><td>Culvert / structure blockage?</td><td colspan="3">There are no culverts within, or within close proximity to, the site.</td></tr>
<tr><td>Impounded water body failure?</td><td colspan="3">The site is not at risk of flooding due to reservoir breach.</td></tr>
<tr><td rowspan="2">Defence breach / overtopping?</td><td colspan="3">Breach Zone</td></tr>
<tr><td colspan="3">N/A</td></tr>
<tr><td rowspan="2">Emergency planning</td><td>Flood warning</td><td colspan="4">The site is not covered by an EA Flood Warning or Flood Alert Area.</td></tr>
<tr><td>Access and egress</td><td colspan="4">The site is expected to be accessed via Greenhill Crescent. This route is predicted to affected by surface water flooding during the 1% AEP (1 in 100-year) and 0.1% AEP (1 in 1,000-year) rainfall events, which may affect access.</td></tr>
<tr><td rowspan="3">Climate Change</td><td rowspan="2">Climate change allowances for ‘2080s’</td><td colspan="2">River Basin District</td><td>Central</td><td>Higher Central</td><td>Upper End</td></tr>
<tr><td colspan="2">Thames</td><td>25%</td><td>35%</td><td>70%</td></tr>
<tr><td>Implications for the site</td><td colspan="5">The site is predicted to remain within Flood Zone 1, when climate change allowances are applied.

The 1% AEP (1 in 100-year) surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 0.1% (1 in 1,000-year) surface water flood extent.</td></tr>
</table>

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	EM03
Site name	Gateway Zone

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by the Sussex White Chalk formation.	
	Superficial Geology	There are alluvium deposits across the site.	
	Soils	Freely draining slightly acid loamy soils.	
	SuDS	SuDS are possible on all sites, including previously developed sites such as this one. All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding and its location within Groundwater Source Protection Zone 1. Therefore further site investigation should be carried out to assess potential for drainage by infiltration, including at least 12 months of groundwater level monitoring on site. Infiltration techniques should only be used where there are suitable levels of surface water runoff treatment, and following the granting of any required environmental permits from the Environment Agency.	
	Groundwater Source Protection Zone	The site is within Groundwater Source Protection Zone 1 (inner zone). This is defined as the 50 day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There is no landfill below the proposed site boundary. Adjacent to the western border of the site is an industrial landfill.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of existing surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Gade (from confluence with Bulbourne to Chess)	Medium
Recommend-ations for Local Plan policy	**Sequential Test and Exception Test requirements**		
	The site is within Flood Zone 1 but at risk from other sources of flooding. The Sequential Test must be passed. The Exception Test is not required under the NPPF, but it must be shown that the development will be safe for its lifetime and the risk can be managed through a sequential approach to design.		
	Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers		
	Flood risk assessment: • At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required. • Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage. • A site-specific flood risk assessment will be required because the site is at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).		

Site code	EM03
Site name	Gateway Zone

- Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
- Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future.
- The site is located within a catchment identified as moderately sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- High level assessment suggests the catchment is largely at risk of surface water flooding, and so efforts should be made within all new developments to limit runoff to greenfield rates.

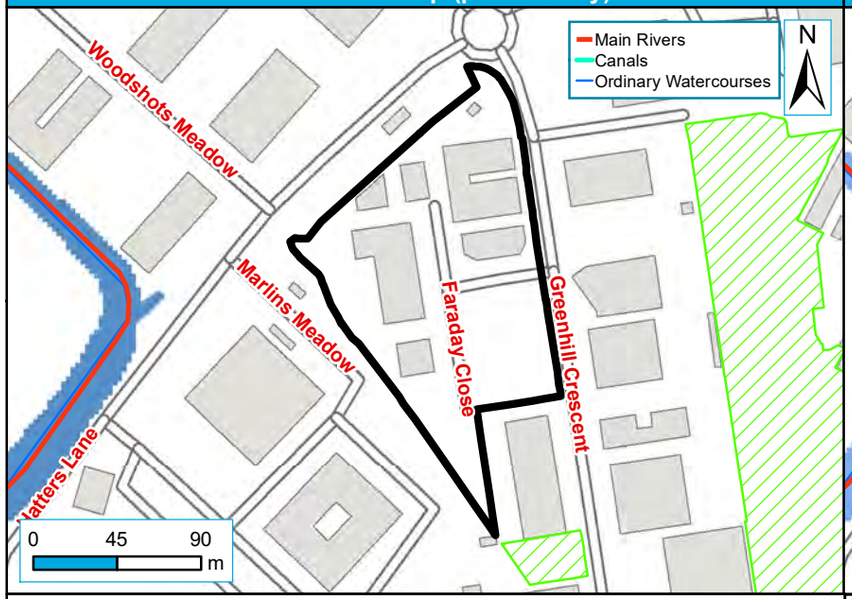
Guidance for site design and making development safe:

- Development must seek opportunities to reduce overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100 plus climate change event.
- All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.
- Mitigation for seasonal high groundwater levels must be considered (for example by raising finished floor levels to an appropriate height above ground level).
- The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property.
- SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	EM03
Site Name	Gateway Zone

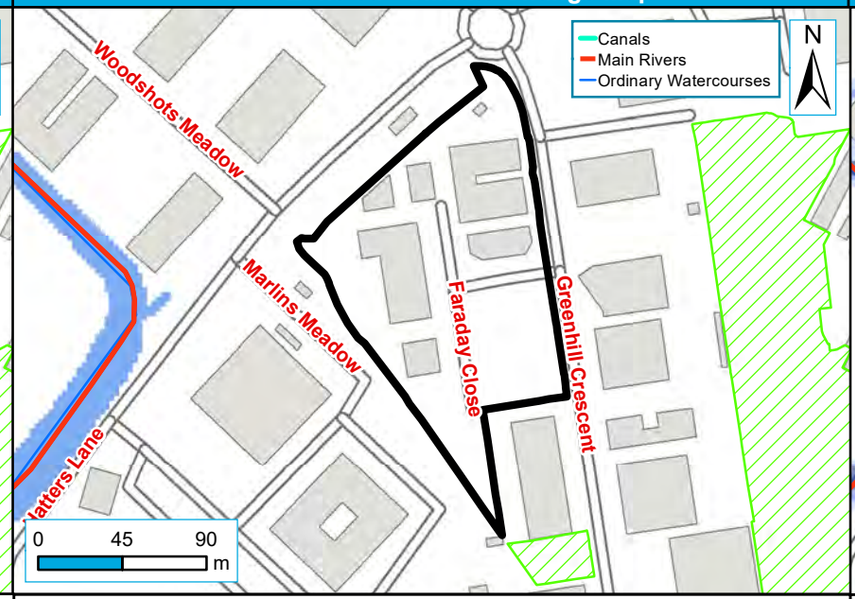
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



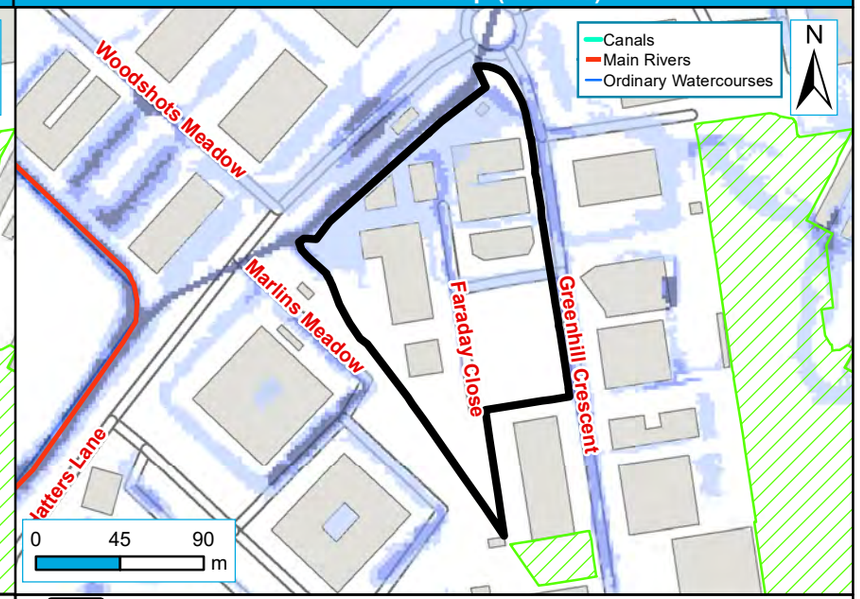
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



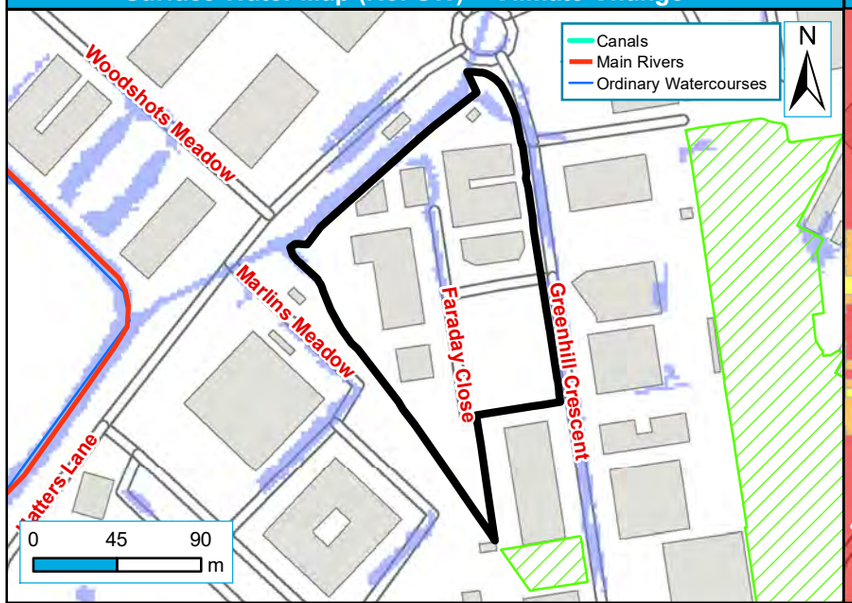
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



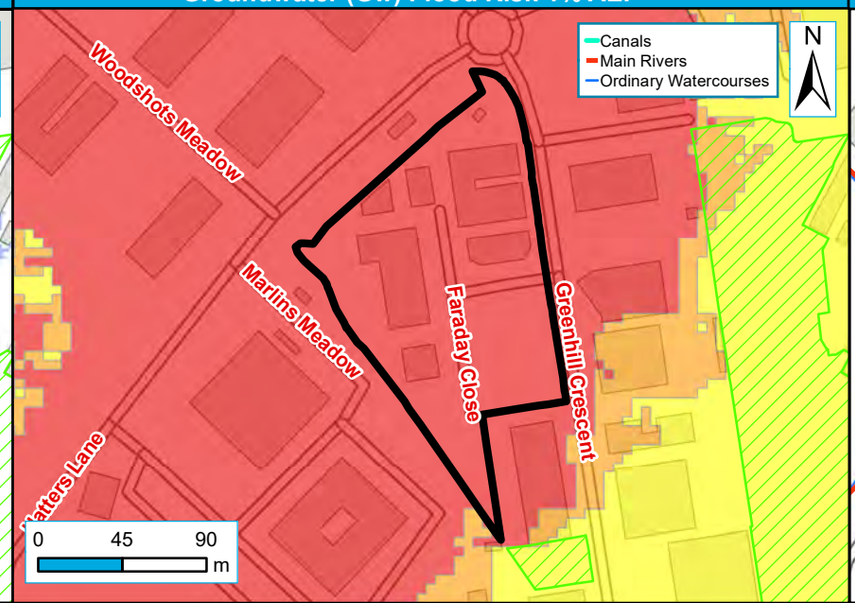
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



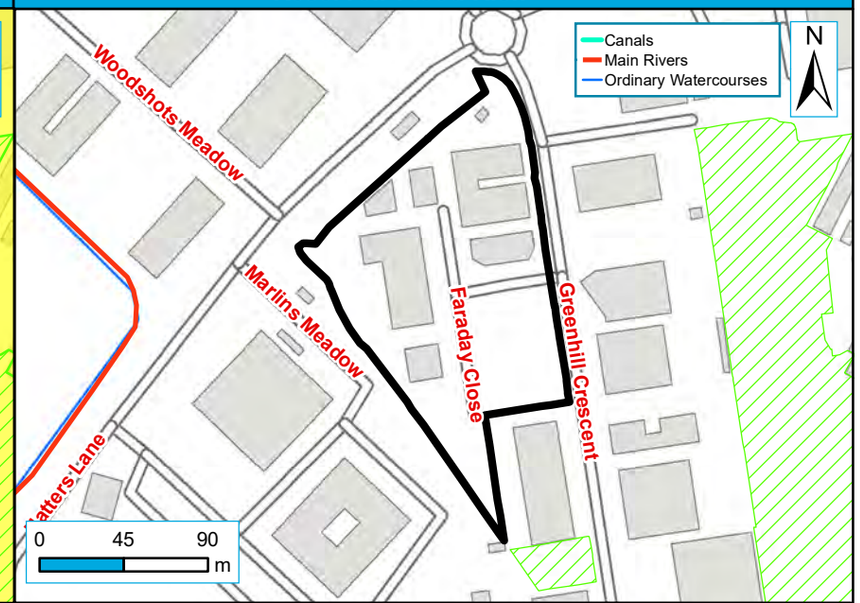
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

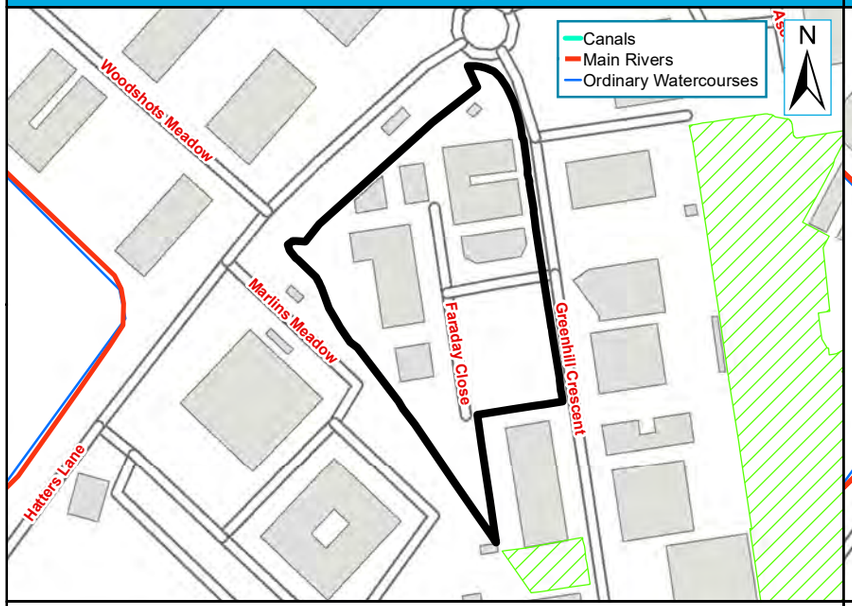


Site Boundary
Other L2 Sites
Reservoir Flood Risk

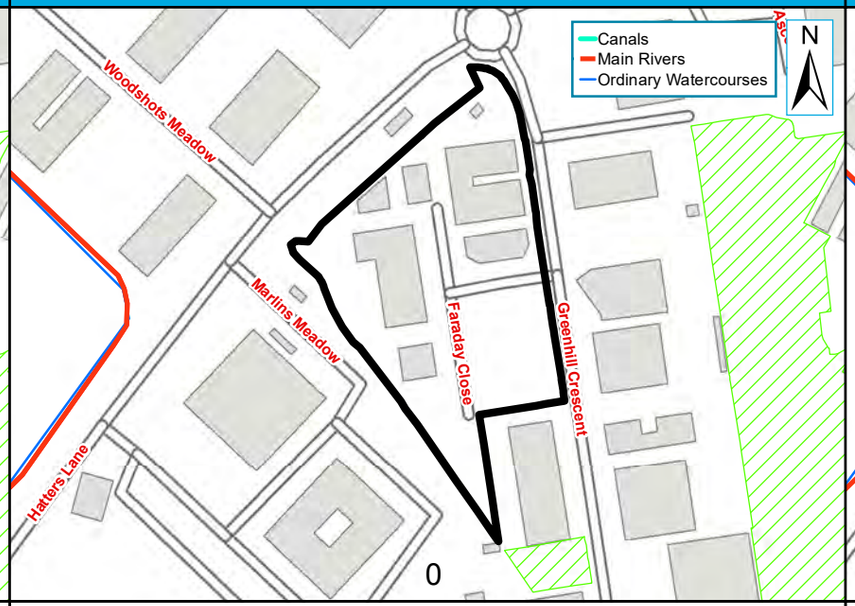
Site reference	EM03
Site Name	Gateway Zone

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

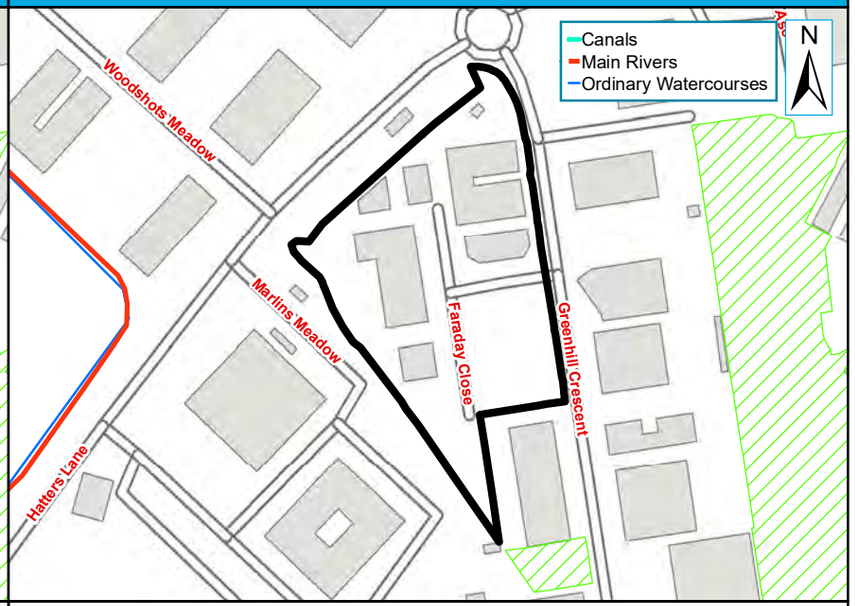
Maximum Fluvial Flood Depth (m) - 1% AEP



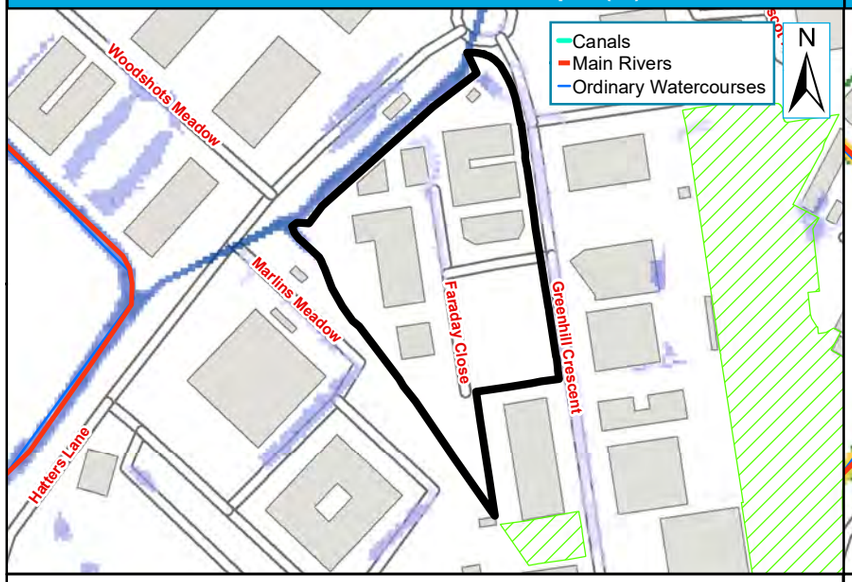
Maximum Fluvial Flood Level (mAOD) - 1% AEP



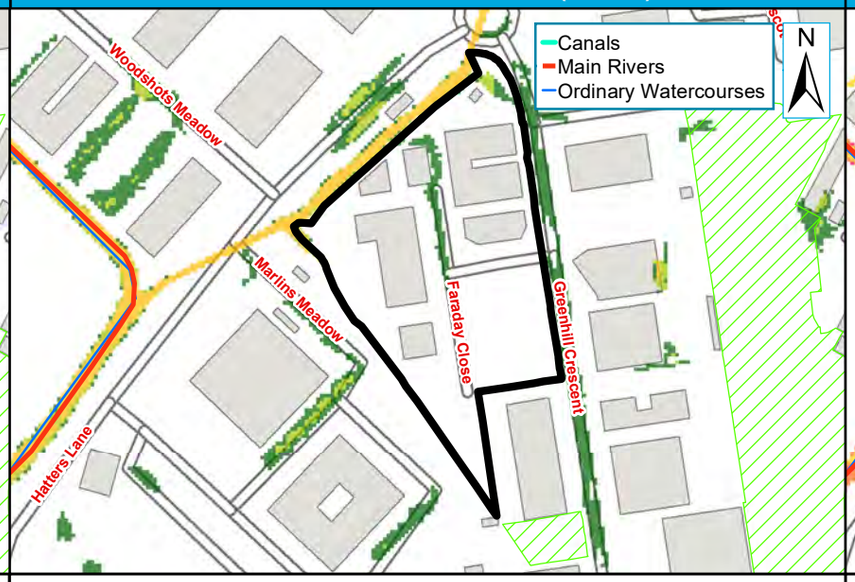
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



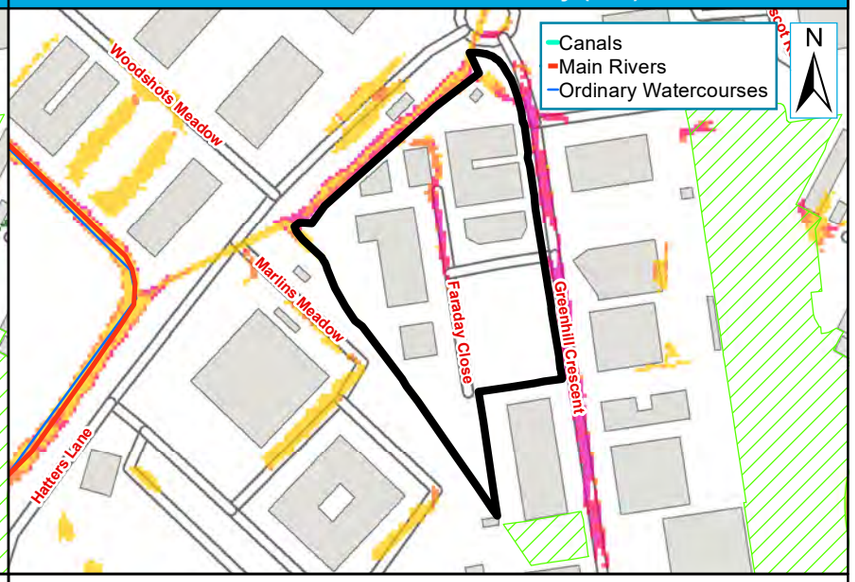
Maximum Surface Water Flood Depth (m) -1% AEP



Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS11
Site name	Lane at 420 – 420a St Albans Road

Site details	**OS Grid reference**	TQ 10992 98839
	Area	0.1 Ha
	Current land use	Brownfield
	Proposed site use	Residential
	Flood risk vulnerability	More vulnerable
	Watford Sustainability Area Band	Area of Medium Sustainability
Sources of flood risk	**Existing watercourses**	There are no watercourses within or near the site.
	Flood history	There are no reported flood incidents within or near the site.
	Fluvial	**Fluvial**
		Proportion of the site at risk (%) / **FZ3b (5% AEP)** / **FZ3a (1% AEP)** / **FZ2 (0.1% AEP)**
		0% / 0% / 0%
		Available modelled data: There is no fluvial model data available for the site, as it is located within Flood Zone 1. **Flood characteristics:** The site is located within Flood Zone 1, and is therefore at negligible risk of fluvial flooding.
	Surface Water	**Proportion of site at risk (RoFSW)**
		3.3% AEP (1 in 30) / **1% AEP (1 in 100)** / **0.1% AEP (1 in 1,000)**
		9% / 46% / 71%
		Description of surface water flow paths: The majority of the site is at moderate risk of surface water flooding, with runoff predicted to enter the site from both Bushey Mill Lane and St Albans Road. The highest risk is concentrated in the north eastern corner of the site, where flooding is predicted to occur during a 3.3% AEP (1 in 30-year) rainfall event. The extent of flooding is predicted to increase to cover the north and south west of the site during the 1% AEP (1 in 100-year) event, and the majority of the site during the 0.1% AEP (1 in 1,000-year) rainfall event.
	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1% AEP (1 in 100-year) risk categories**
		Depth below surface 0-0.025m / **Depth below surface 0.025-0.5m** / **Total in highest risk categories**
		0% / 0% / 0%
		The site is at moderate risk of groundwater flooding, and is located within Category 3, where groundwater levels are predicted to lie 0.5 to 5m below the surface during a 1% AEP (1in 100-year) flood event.
	Reservoir	The site is not at risk of reservoir flooding.

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS11
Site name	Lane at 420 – 420a St Albans Road

	Canal	There are no canals witin the site.		
Flood risk management infrastructure	**Defences**	**Defence Type**	**Standard of Protection**	**Condition**
		There are no defences within the site boundary.		
	Residual risk	**Culvert / structure blockage?**	There are no culverts within the site.	
		Impounded water body failure?	The site is not at risk of flooding due to reservoir breach.	
		Defence breach / overtopping?	**Breach Zone**	
			N/A	
Emergency planning	**Flood warning**	The site is not covered by an EA Flood Warning or Flood Alert Area.		
	Access and egress	The site is liley to be accessed via St Albans Road, to the west of the site. This road, is at high risk of surface water flooding, with flooding predicted to occur during the 3.3% AEP (1 in 30-year) rainfall event. Management of this surface water flood risk would be required to ensure safe access and egress to the site.		
Climate Change	**Climate change allowances for '2080s'**	**River Basin District**	**Central**	**Higher Central**	**Upper End**
		Thames	25%	35%	70%
	Implications for the site	The site is predicted to remain within Flood Zone 1, when climate change allowances are applied. The 1% AEP (1 in 100-year) surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 0.1% (1 in 1,000-year) surface water flood extent.		

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS11
Site name	Lane at 420 – 420a St Albans Road

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.	
	Superficial Geology	There are glacial sand and gravel deposits across the site.	
	Soils	Freely draining slightly acid loamy soils.	
	SuDS	SuDS are possible on all sites, including previously developed sites such as this one. All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding, therefore further site investigation should be carried out to assess potential for drainage by infiltration, Including at least 12 months of groundwater level monitoring on site. If infiltration is suitable it should be avoided in areas where the depth to the water table is <1m.	
	Groundwater Source Protection Zone	The site is within Groundwater Source Protection Zone 2. This is defined as a 400-day travel time from a point below the water table.	
	Historic Landfill Site	There are no historic land fill sites within close proximity of the site.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction in surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Colne (from Confluence with Ver to Gade)	High
Recommend-ations for Local Plan policy	**Sequential Test and Exception Test requirements**		
	The site is within Flood Zone 1 but at risk from other sources of flooding. The Sequential Test must be passed. The Exception Test is not required under the NPPF, but it must be shown that the development will be safe for its lifetime and the risk can be managed through a sequential approach to design.		
	Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers		
	Flood risk assessment: • At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required. • Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage. • A site-specific flood risk assessment will be required because the site is at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications). • Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.		

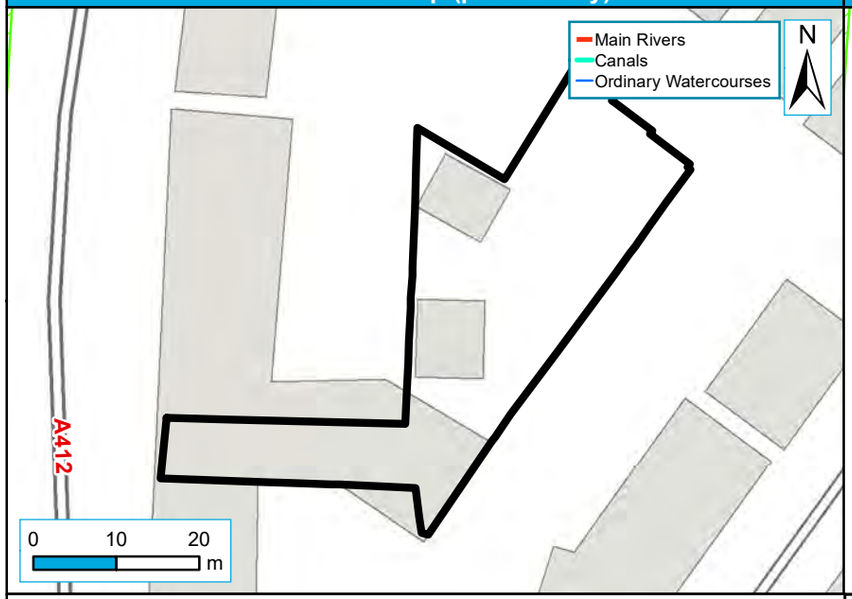
Site code	HS11
Site name	Lane at 420 – 420a St Albans Road

	• Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future. • The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment. • Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration. **Guidance for site design and making development safe:** • Development must seek opportunities to reduce overall level of flood risk at the site. • Safe access and egress should be demonstrated in the 1 in 100 plus climate change event. • Flow routes would need to be preserved if carrying out land-raising within an area of surface water flood risk area, and a safe access route provided. • As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required. • All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. • Example features may include swales, attenuation features, green roofs, rainwater capture and reuse and permeable paving. • The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property. • SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	HS11
Site Name	Land at 420-420a St Albans Road

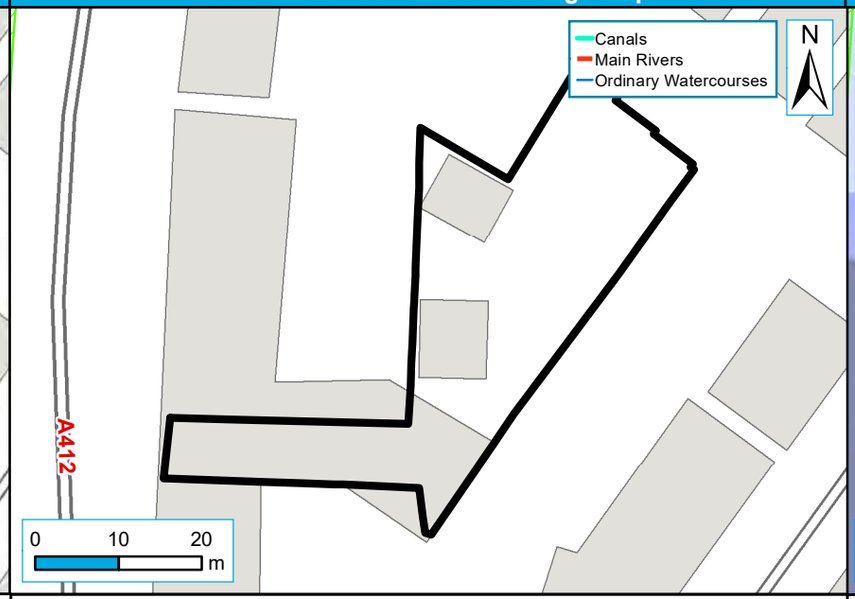
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



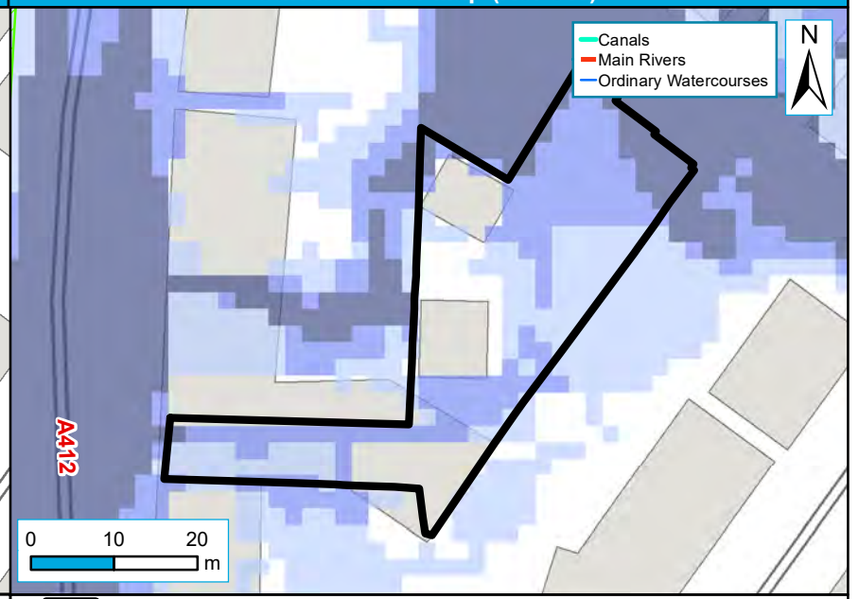
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



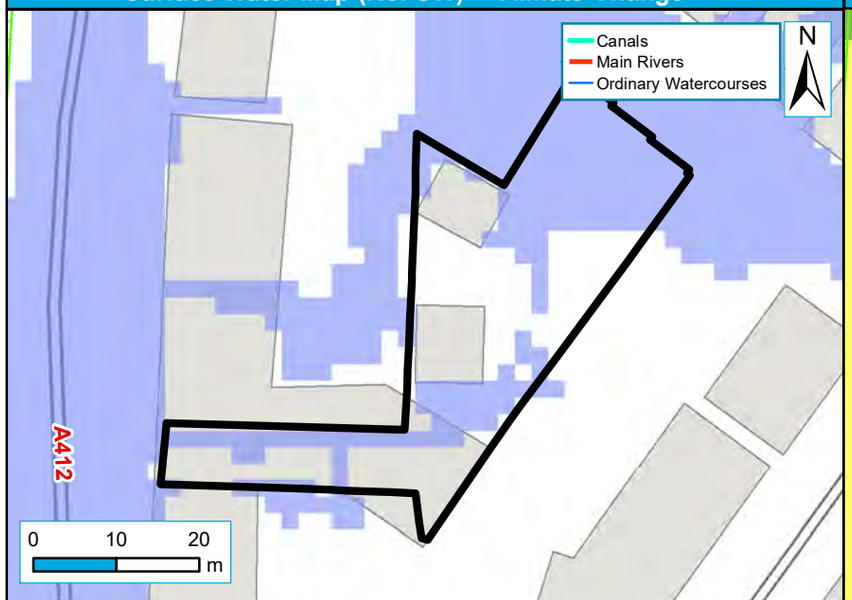
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



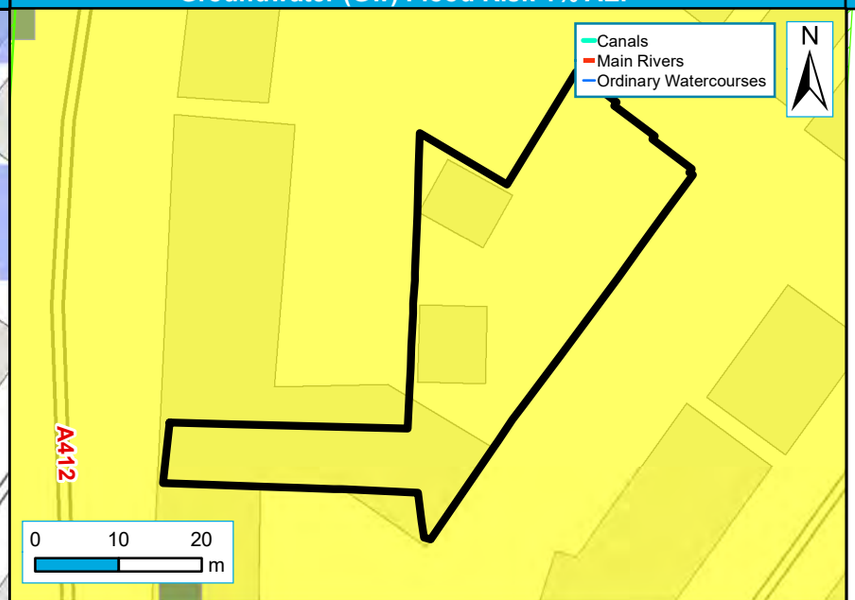
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



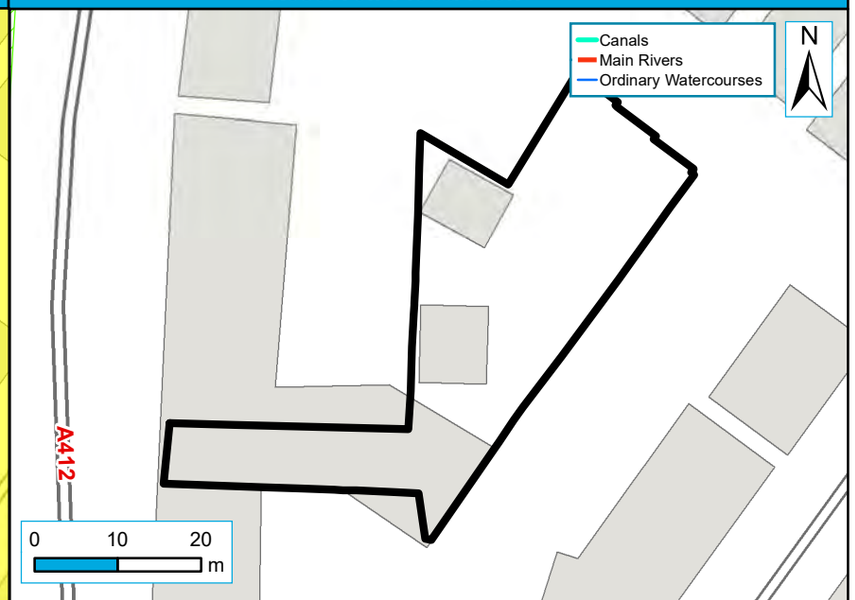
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

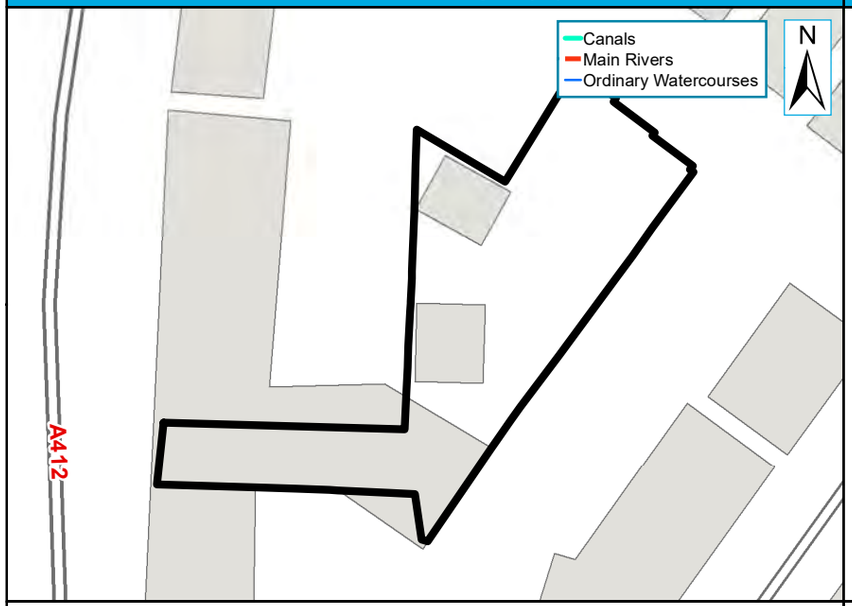


Site Boundary
Other L2 Sites
Reservoir Flood Risk

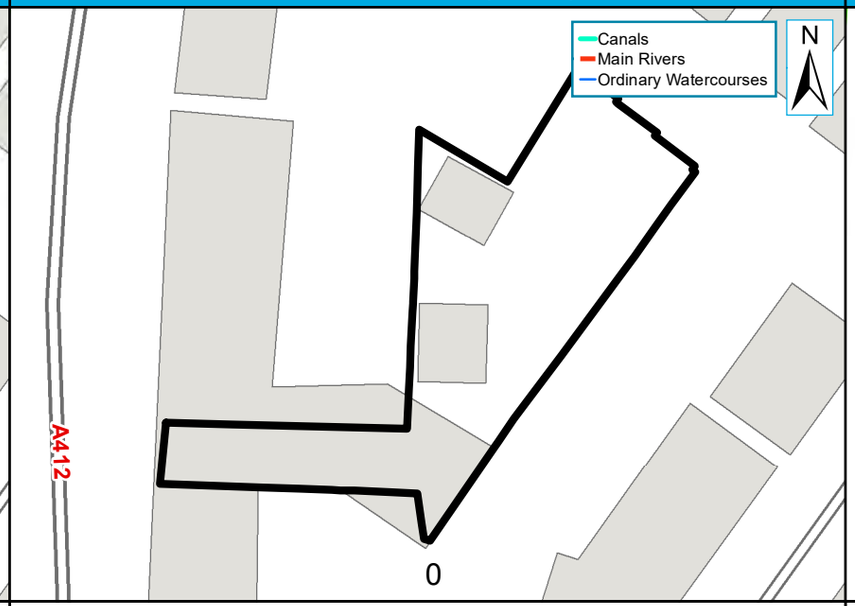
Site reference	HS11
Site Name	Land at 420-420a St Albans Road

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

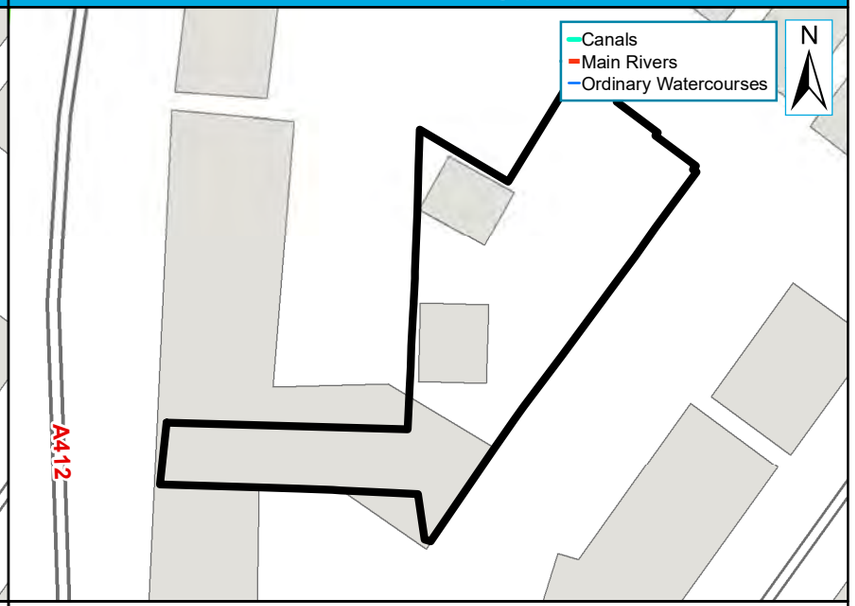
Maximum Fluvial Flood Depth (m) - 1% AEP



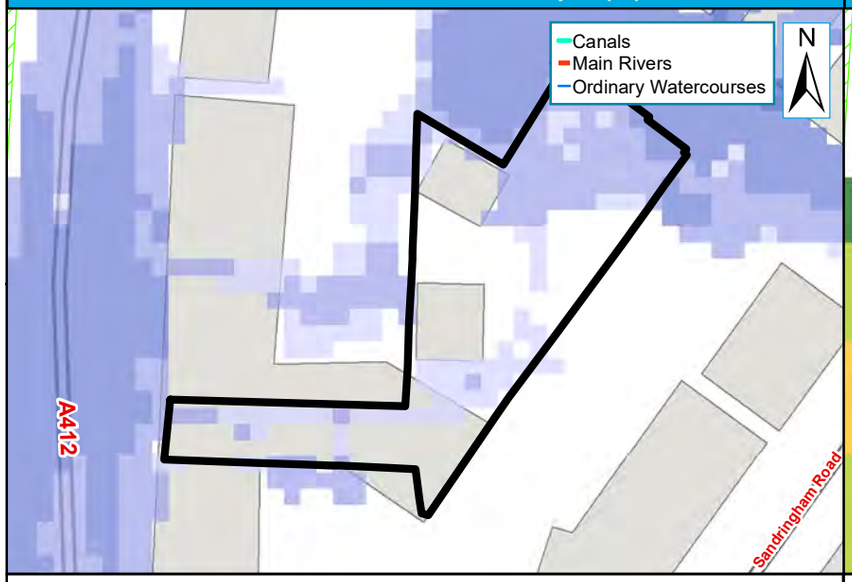
Maximum Fluvial Flood Level (mAOD) - 1% AEP



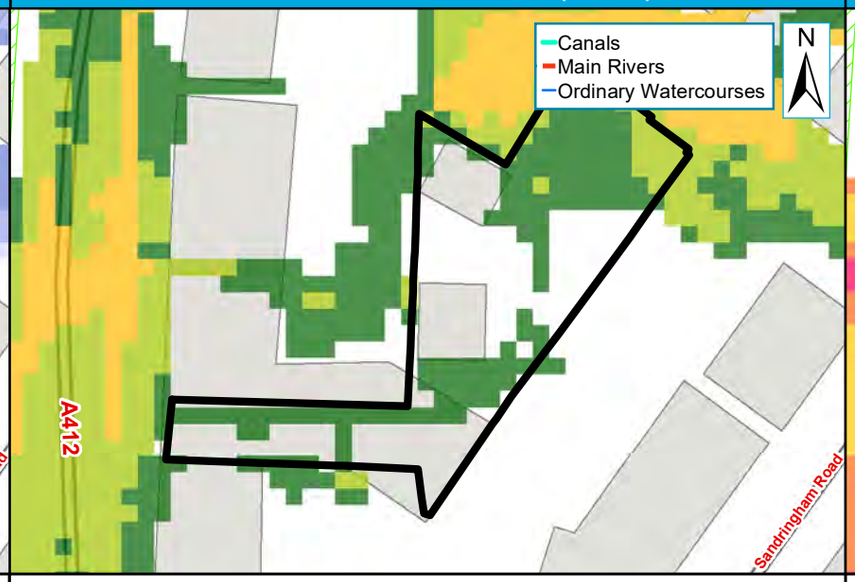
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



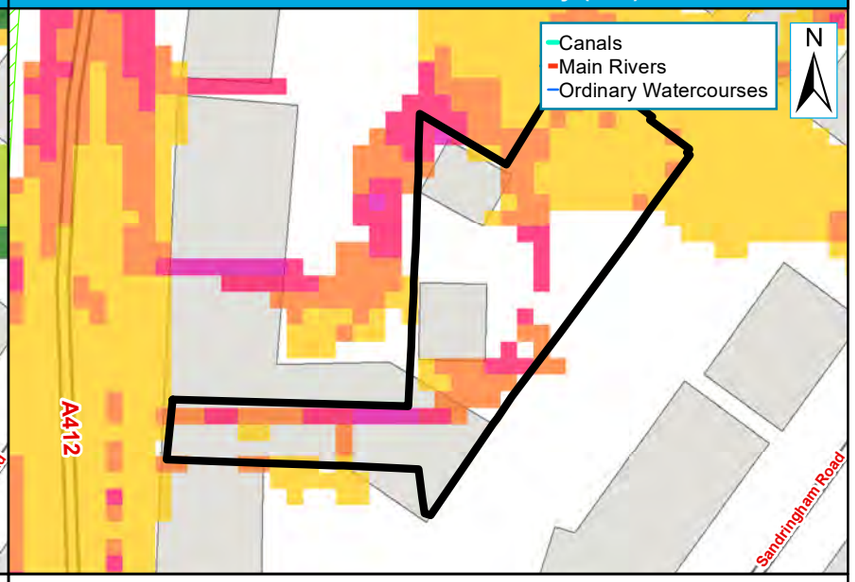
Maximum Surface Water Flood Depth (m) -1% AEP



Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS25
Site name	Land and buildings at Lower High Street

Site details	**OS Grid reference**	TQ 11621 95891			
	Area	0.14 Ha			
	Current land use	Brownfield			
	Proposed site use	Residential			
	Flood risk vulnerability	More vulnerable			
	Watford Sustainability Area Band	Area of High Sustainability			
Sources of flood risk	**Existing watercourses**	There are no watercourses within the site. The River Colne flows in a southerly direction approximately 60m east of the western border.			
	Flood history	There are no records of historical fluvial flooding within the site boundary, within the EA Recorded Flood Outline dataset. An HCC recorded flood incident is located on Lower High Street, adjacent to the site, which occurred due to surface water flooding.			
	Fluvial	**Fluvial**			
		Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
			0%	90%	10%
		Maximum modelled flood level on site (mAOD)	N/A	N/A	54.48
		Available modelled data: The site is covered by the 2010 Upper Colne 1D-2D hydraulic model. Flood depth and hazard results were not provided with this model, and therefore water level results have been used. Flood Zone 2 has been used as a proxy for Flood Zone 3a +35%CC and +70%CC extents, as the Upper Colne model became unstable when higher flows were applied. Flood levels for Flood Zone 3a were not available within the site boundary. **Flood characteristics:** The site is entirely within Flood Zone 2 (0.1% AEP), with the majority of the site also within Flood Zone 3a (1% AEP).			
	Surface Water	**Proportion of site at risk (RoFSW)**			
		3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**	
		0%	1%	74%	
		Description of surface water flow paths: Surface water flooding is predicted to cover the majority of the site during a 0.1% AEP (1 in 1,000-year) rainfall event, with the exception of an area in the north of the site. The surface water risk is located within the same area as fluvial risk, although surface water flooding may occur independently.			
	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1% AEP (1 in 100-year) risk categories**			

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS25
Site name	Land and buildings at Lower High Street

		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**
		100%	0%	0%
		The site is at a high risk of groundwater flooding, with the entire site within Category 4 (where groundwater is likely to be within 0.025m of the ground surface during a 1% AEP event).		
	Reservoir	The entire site is at risk of reservoir flooding in the extremely unlikely event of a breach at Aldenham or Hilfield Park reservoir.		
	Canal	There are no canals within the site.		
Flood risk management infrastructure	**Defences**	**Defence Type**	**Standard of Protection**	**Condition**
		There are no flood defences present at the site.		
	Residual risk	**Culvert / structure blockage?**	There are no culverts within the site.	
		Impounded water body failure?	The entire site is at risk of flooding in the unlikely event of a breach event on either Aldenham or Hilfield Park reservoir.	
		Defence breach / overtopping?	**Breach Zone**	
			N/A	
Emergency planning	**Flood warning**	The site is covered by both EA Flood Alert and Flood Warning Areas: • **Flood Alert Area**: The Middle River Colne at Watford and Rickmansworth including Carpenders Park • **Flood Warning Area**: The River Colne at Watford including Bushey		
	Access and egress	The site is likely to be accessed via Lower High Street which is adjacent to the western borer of the site. Access is likely to be affected by surface water flooding, as the road is at risk of flooding during a 3.3% AEP rainfall event and has several reported incidents of surface water flooding.		
Climate Change	**Climate change allowances for '2080s'**	**River Basin District**	**Central**	**Higher Central**	**Upper End**
		Thames	25%	35%	70%
	Implications for the site	Due to model instability when applying 35% and 70% climate change allowances to inflows, Flood Zone 2 has been used as a proxy for climate change. This provides a conservative extent, with 100% of the site identified as at risk from a 1 in 100-year + 70%CC flood event. The 1 in 100-year surface water flood extent within the site increases significantly, to cover the majority of the site, when a 40% climate change allowance is applied to rainfall. However, it does not reach the 1 in 1,000-year surface water flood extent.		

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS25
Site name	Land and buildings at Lower High Street

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation	
	Superficial Geology	There are alluvium deposits across the site.	
	Soils	Loamy and clayey floodplain soils with naturally high groundwater.	
	SuDS	As the site is located entirely within Flood Zones 2 and 3, it is advised that source control SuDS techniques (such as green roofs, rainwater harvesting and permeable paving) are utilised across the site. Conveyance features should be designed above ground and follow natural flow paths where possible. Groundwater flood risk is high across the site and therefore it is recommended that groundwater monitoring is undertaken (preferably during winter months), to better understand the groundwater dynamics. Where below ground storage is proposed, the base of the feature must be located at least 1m above the highest groundwater level, to reduce the risk of groundwater ingress or flotation. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding, therefore further site investigation should be carried out to assess potential for drainage by infiltration, Including at least 12 months of groundwater level monitoring on site. If infiltration is suitable it should be avoided in areas where the depth to the water table is <1m. The site is also located within Groundwater Source Protection Zone 1, and therefore infiltration techniques should only be used where there are suitable levels of treatment, and the required environmental permits from the Environment Agency have been granted.	
	Groundwater Source Protection Zone	The site is within Groundwater SPZ 1 (inner zone). This is defined as the 50-day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There are no historic landfill sites within close proximity of the proposed development.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of flood peaks downstream and existing surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water had previously been connected to combined sewers, there is an opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
		Water Framework Directive Catchment	**Sensitivity to cumulative impacts**

Site code	HS25
Site name	Land and buildings at Lower High Street

	Cumulative impacts of development	Colne (from Confluence with Ver to Gade)	High

Recommend-ations for Local Plan policy

Sequential Test and Exception Test requirements

The Sequential Test must be passed. For this site, More Vulnerable development is proposed within FZ3a, and therefore, the Exception Test must be applied.
The site is at high risk of flooding from multiple sources, and therefore it may not be safe to develop the site for residential purposes. Strong evidence that both parts of the Exception Test can be fulfilled will be required to justify development of the site.

Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers

Flood risk assessment:

- At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.
- A site-specific flood risk assessment will be required because the site is within Flood Zone 2 and 3 and at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).
- Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
- Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future.
- The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration.

Guidance for site design and making development safe:

- Development must seek opportunities to reduce overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100 plus climate change event.
- All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- Floodplain compensation must be demonstrated for any loss in floodplain storage through the raising of levels for development.
- Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.
- Mitigation for seasonal high groundwater levels must be considered (for example by raising finished floor levels to an appropriate height above ground level).

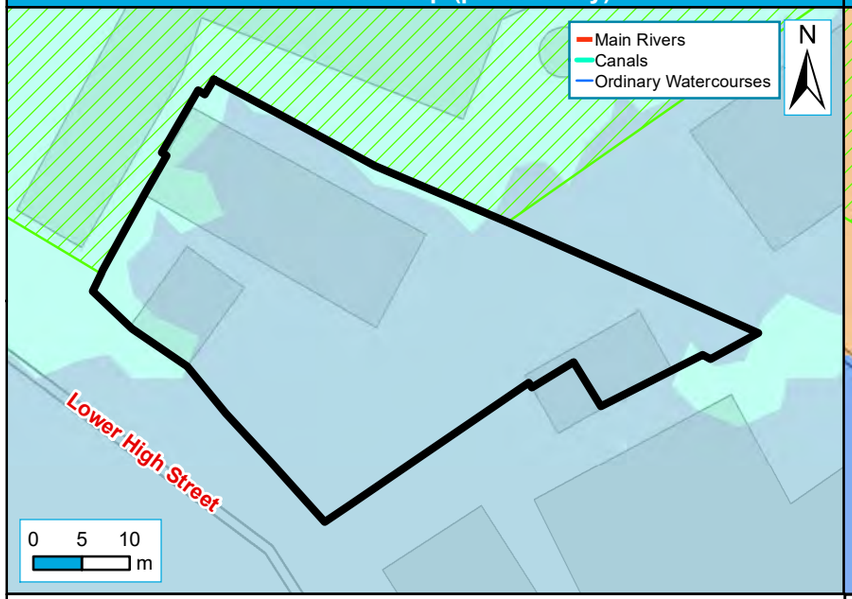
Site code	HS25
Site name	Land and buildings at Lower High Street

	• Storage for runoff from the development in extreme events should be located out of flood risk areas. • Flow routes would need to be preserved if carrying out land-raising within an area of surface water flood risk area, and a safe access route provided. • The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property. • SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	HS25
Site Name	Land and buildings at 247 Lower High Street

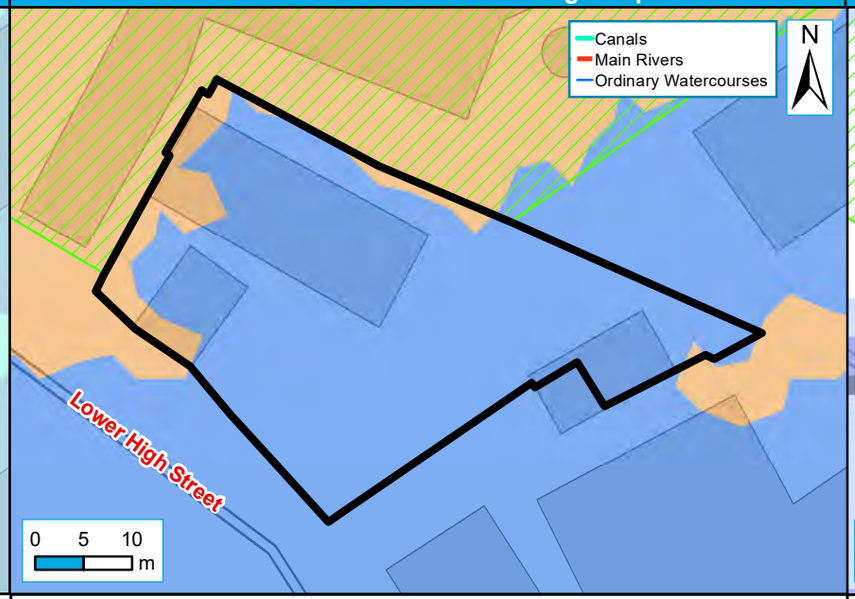
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



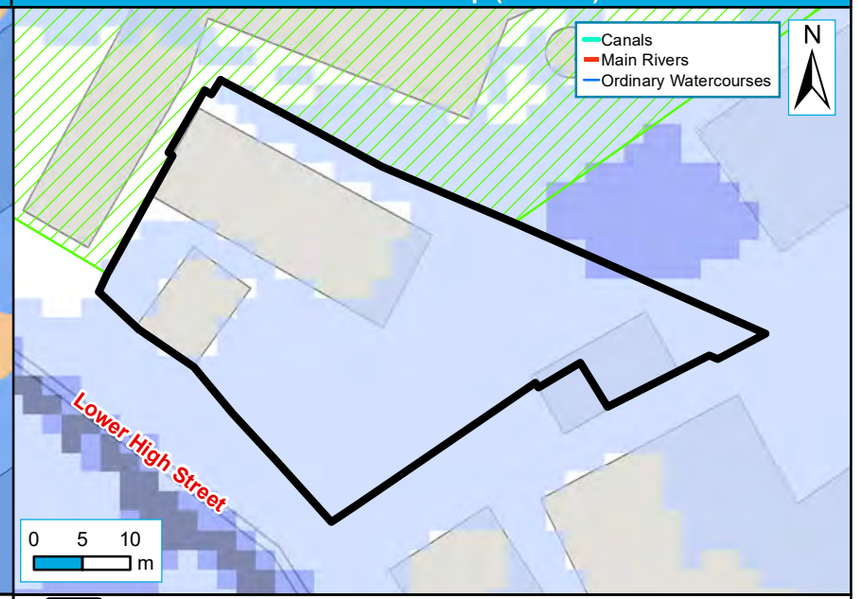
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



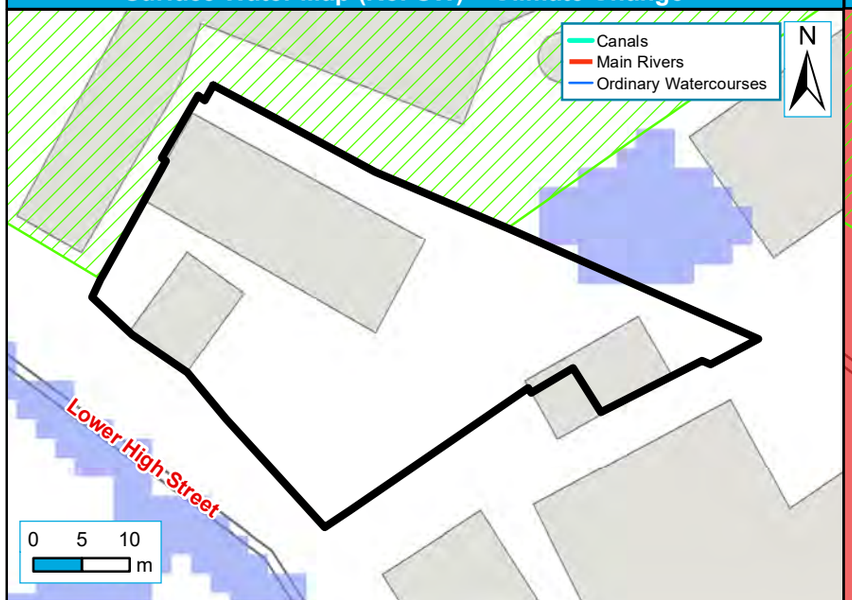
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



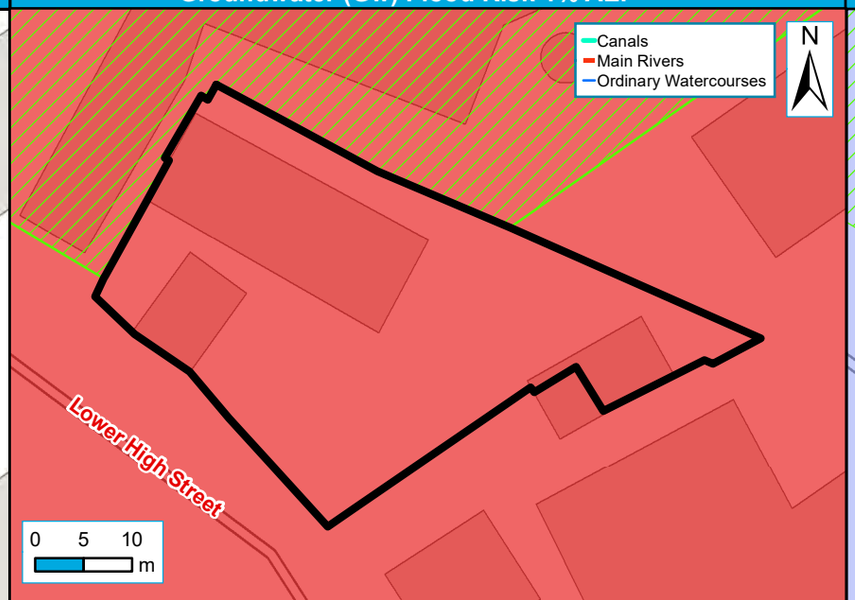
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



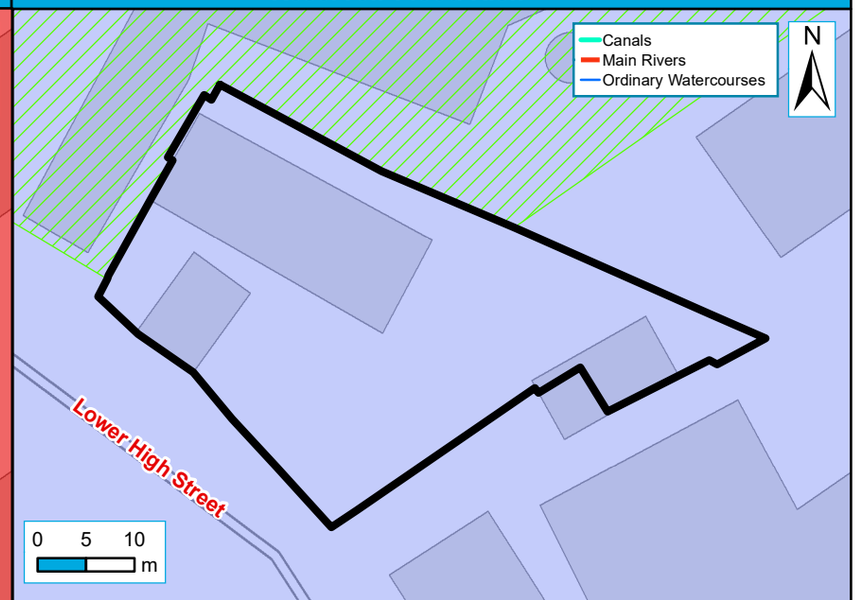
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

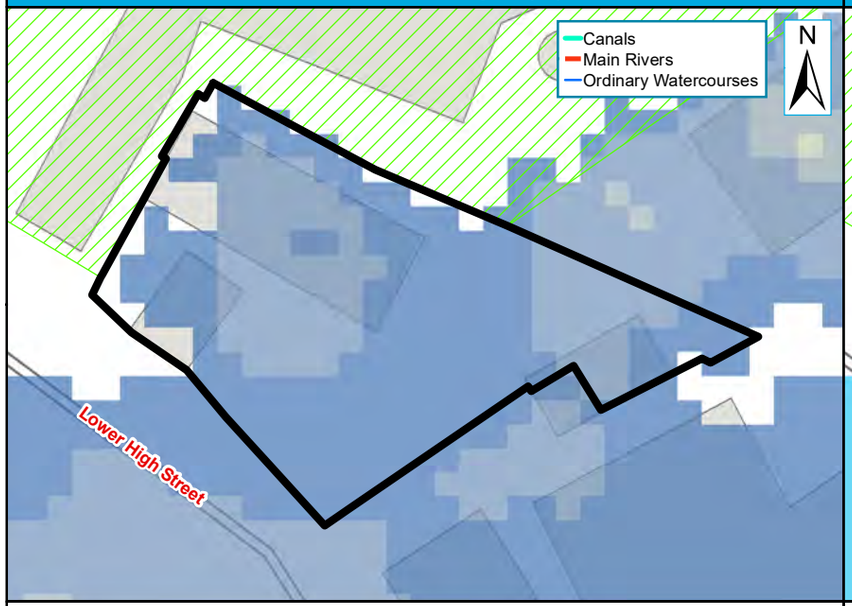


Site Boundary
Other L2 Sites
Reservoir Flood Risk

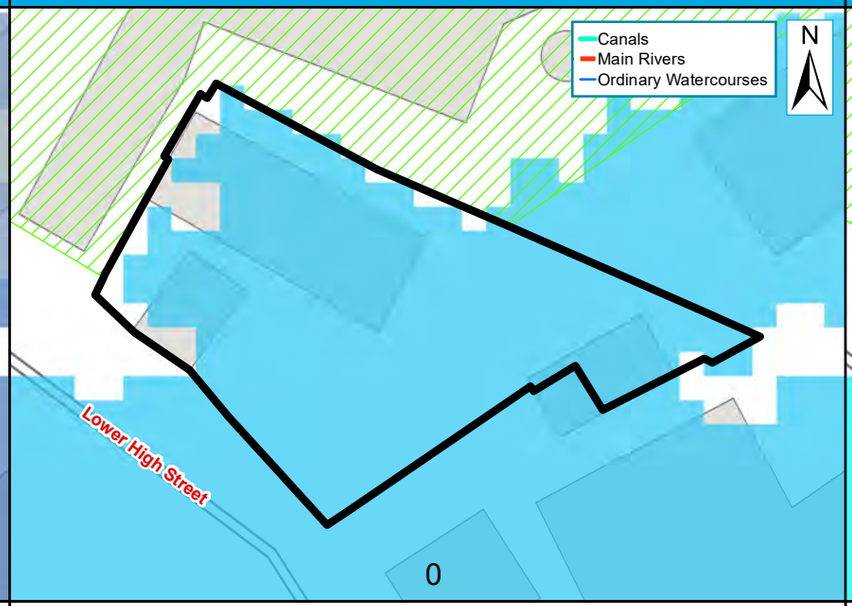
Site reference	HS25
Site Name	Land and buildings at 247 Lower High Street

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

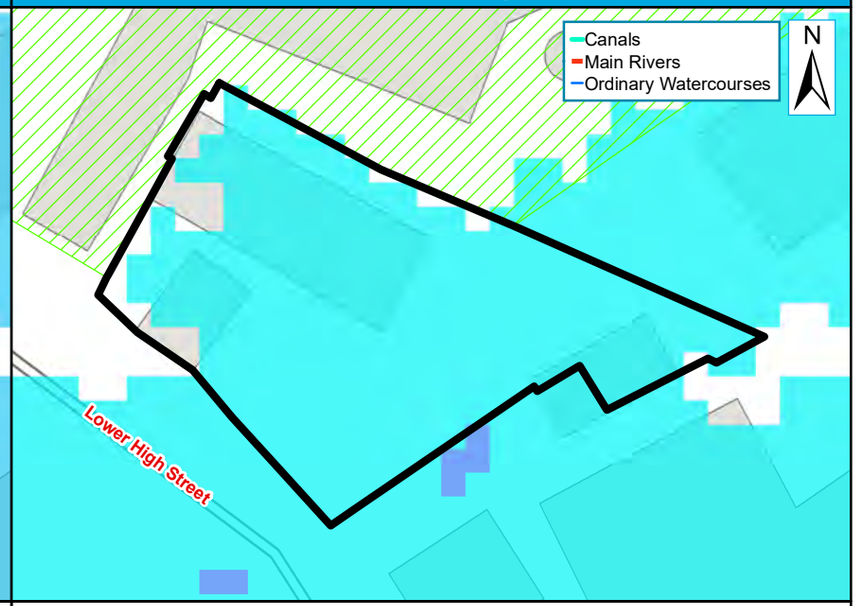
Maximum Fluvial Flood Depth (m) - 1% AEP



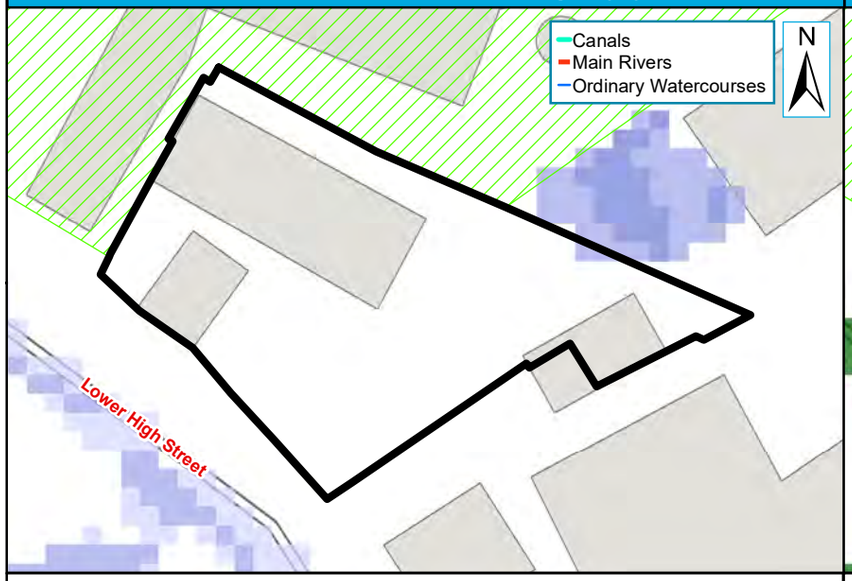
Maximum Fluvial Flood Level (mAOD) - 1% AEP



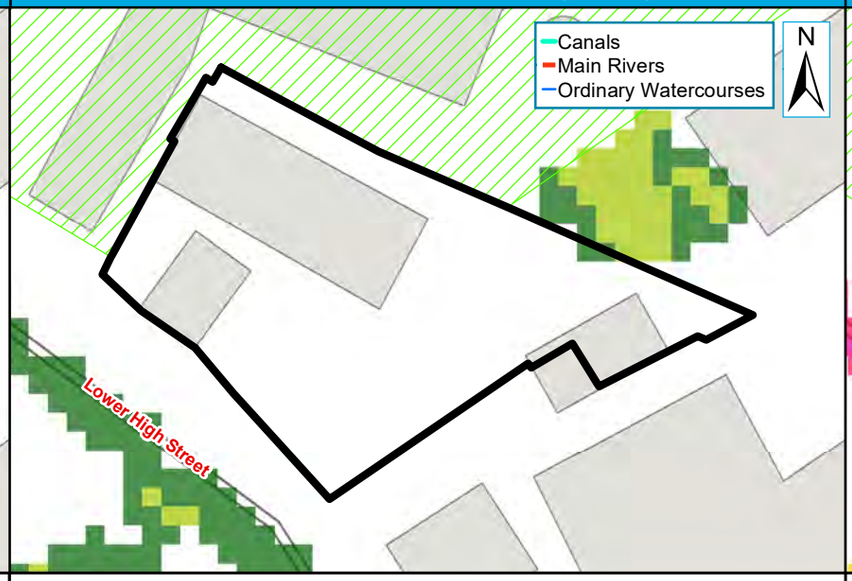
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



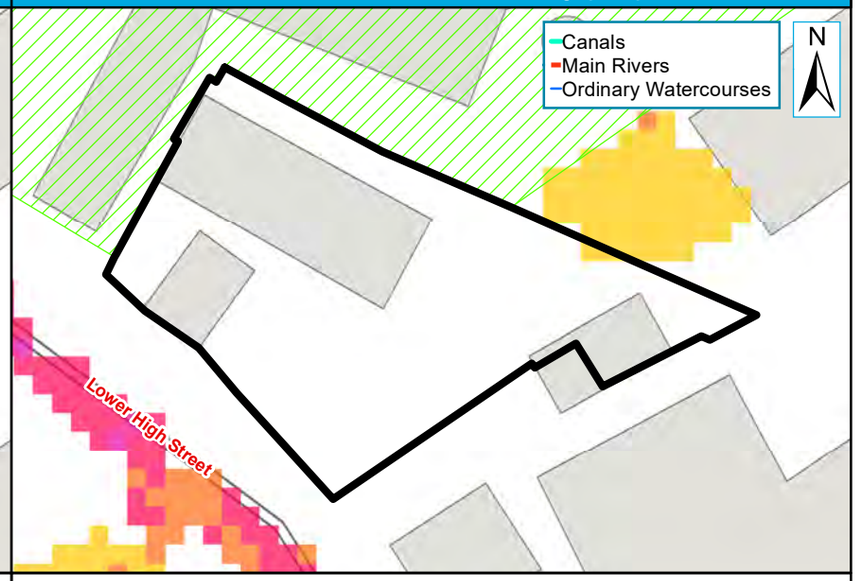
Maximum Surface Water Flood Depth (m) -1% AEP



Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS28
Site name	Land and garages to the rear of 2-24 Elfrida Road

Site details	**OS Grid reference**	TQ 11140 95716			
	Area	0.08 Ha			
	Current land use	Brownfield			
	Proposed site use	Residential			
	Flood risk vulnerability	More vulnerable			
	Watford Sustainability Area Band	Area of High Sustainability			
Sources of flood risk	**Existing watercourses**	There are no watercourses within the site.			
	Flood history	The site is not included within the EA recorded flood outlines. There are also no reported flood incidents near the site.			
	Fluvial	**Fluvial**			
		Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
			0%	0%	0%
		Available modelled data: There is no fluvial model data available for the site, as it is located within Flood Zone 1. **Flood characteristics:** The site is located within Flood Zone 1, and is therefore at negligible risk of fluvial flooding.			
	Surface Water	**Proportion of site at risk (RoFSW)**			
		3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**	
		0%	1%	63%	
		Description of surface water flow paths: The majority of the site is at risk of surface water flooding during the 0.1% AEP (1 in 1,000-year) rainfall event. The flooding is caused by ponding against the railway embankment, to the west of the site. A very small area in the north of the site is at greater risk, with flooding predicted to occur during the 1% AEP (1 in 100-year) event.			
	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1% AEP (1 in 100-year) risk categories**			
		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**	
		0%	35%	35%	
		The south of the site is at a high risk of groundwater flooding. Located within Category 3, groundwater is predicted to lie between 0.025 – 0.5m below the ground surface during a 1% AEP flood event (1 in 100-year). The remaining areas of the site are located within Category 2, with groundwater levels predicted to lie between 0.5 – 5m below the ground surface.			
	Reservoir	The site is not at risk of reservoir flooding.			

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS28
Site name	Land and garages to the rear of 2-24 Elfrida Road

<table>
<tr><td></td><td>Canal</td><td colspan="4">There are no canals witin the site.</td></tr>
<tr><td rowspan="5">Flood risk management infrastructure</td><td rowspan="2">Defences</td><td>Defence Type</td><td colspan="2">Standard of Protection</td><td>Condition</td></tr>
<tr><td colspan="4">There are defences present within the site.</td></tr>
<tr><td rowspan="3">Residual risk</td><td>Culvert / structure blockage?</td><td colspan="3">There are no culverts within the site.</td></tr>
<tr><td>Impounded water body failure?</td><td colspan="3">The site is not at risk of flooding due to reservoir breach.</td></tr>
<tr><td>Defence breach / overtopping?</td><td colspan="3">Breach Zone
N/A</td></tr>
<tr><td rowspan="2">Emergency planning</td><td>Flood warning</td><td colspan="4">The site is not included within EA Flood Alert or Flood Warning Areas.</td></tr>
<tr><td>Access and egress</td><td colspan="4">The site is likely to be accessed from Elfrida Road to the east of the site. Surface water flooding is predicted to affect the road during a 0.1% AEP (1 in 1,000-year) event. Within the adjacent cul-de-sac area, there is a small area of ponding which occurs during the 1% AEP (1 in 100-year) event.</td></tr>
<tr><td rowspan="3">Climate Change</td><td rowspan="2">Climate change allowances for ‘2080s’</td><td colspan="2">River Basin District</td><td>Central</td><td>Higher Central</td><td>Upper End</td></tr>
<tr><td colspan="2">Thames</td><td>25%</td><td>35%</td><td>70%</td></tr>
<tr><td>Implications for the site</td><td colspan="4">The site remains in Flood Zone 1 when accounting for the impact of climate change.

The 1% AEP (1 in 100-year) surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 0.1% (1 in 1,000-year) surface water flood extent.</td></tr>
</table>

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS28
Site name	Land and garages to the rear of 2-24 Elfrida Road

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.	
	Superficial Geology	Across the site there are glacial sand and gravel deposits.	
	Soils	Freely draining slightly acidic loamy soils.	
	SuDS	SuDS are possible on all sites, including previously developed sites such as this one. All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding, therefore further site investigation should be carried out to assess potential for drainage by infiltration, Including at least 12 months of groundwater level monitoring on site. If infiltration is suitable it should be avoided in areas where the depth to the water table is <1m. The site is also located within Groundwater Source Protection Zone 1, and therefore infiltration techniques should only be used where there are suitable levels of treatment, and the required environmental permits from the Environment Agency have been granted.	
	Groundwater Source Protection Zone	The site is within Groundwater SPZ 1 (inner zone). This is defined as the 50-day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There are no historic landfill sites within close proximity of the proposed development.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of flood peaks downstream and existing surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water had previously been connected to combined sewers, there is an opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Colne (from Confluence with Ver to Gade)	High
Recommend-ations for Local Plan policy	**Sequential Test and Exception Test requirements**		
	The site is within Flood Zone 1 but at risk from other sources of flooding. The Sequential Test must be passed. The Exception Test is not required under the NPPF, but it must be shown that the development will be safe for its lifetime and the risk can be managed through a sequential approach to design.		
	Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers		
	Flood risk assessment: • At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required.		

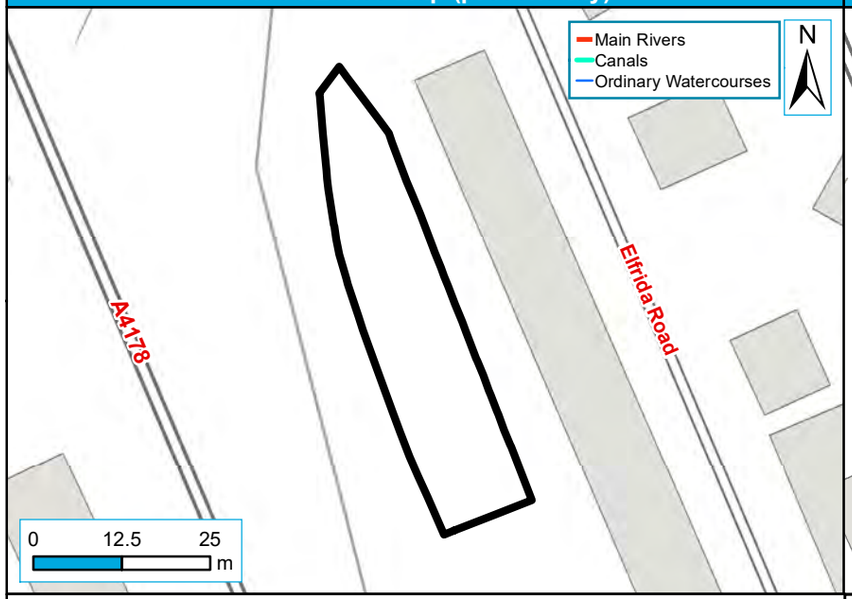
Site code	HS28
Site name	Land and garages to the rear of 2-24 Elfrida Road

	• Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage. • A site-specific flood risk assessment will be required because the site is at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications). • Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater. • Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future. • The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment. • Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration. **Guidance for site design and making development safe:** • Development must seek opportunities to reduce overall level of flood risk at the site. • Safe access and egress should be demonstrated in the 1 in 100 plus climate change event. • As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required. • All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. • Mitigation for seasonal high groundwater levels must be considered (for example by raising finished floor levels to an appropriate height above ground level). • Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design. • The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property. • SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	HS28
Site Name	Land and Garages to the rear of 2-24 Elfirda Road

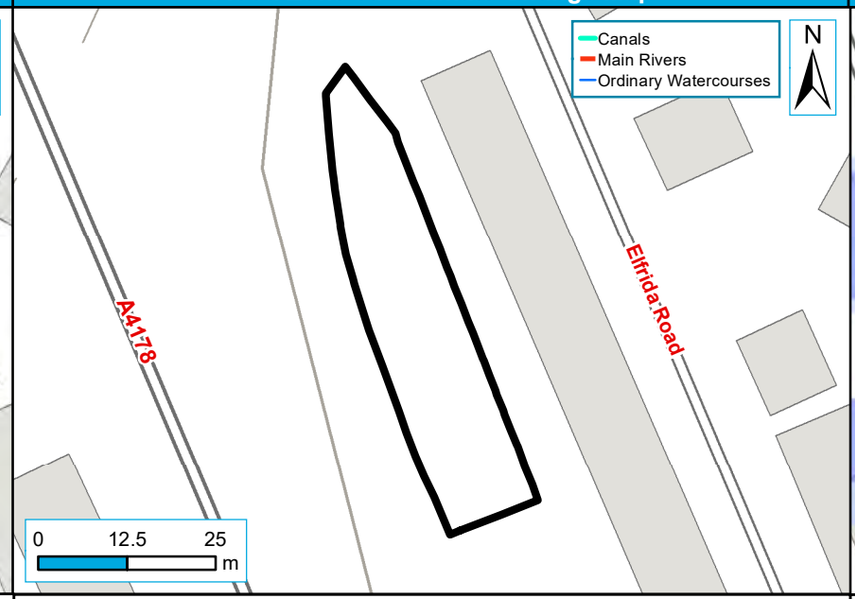
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



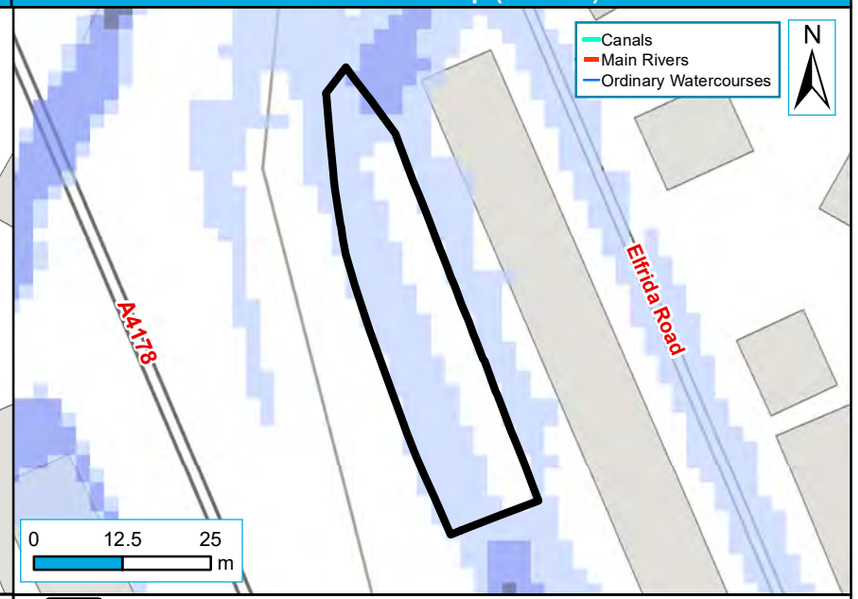
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



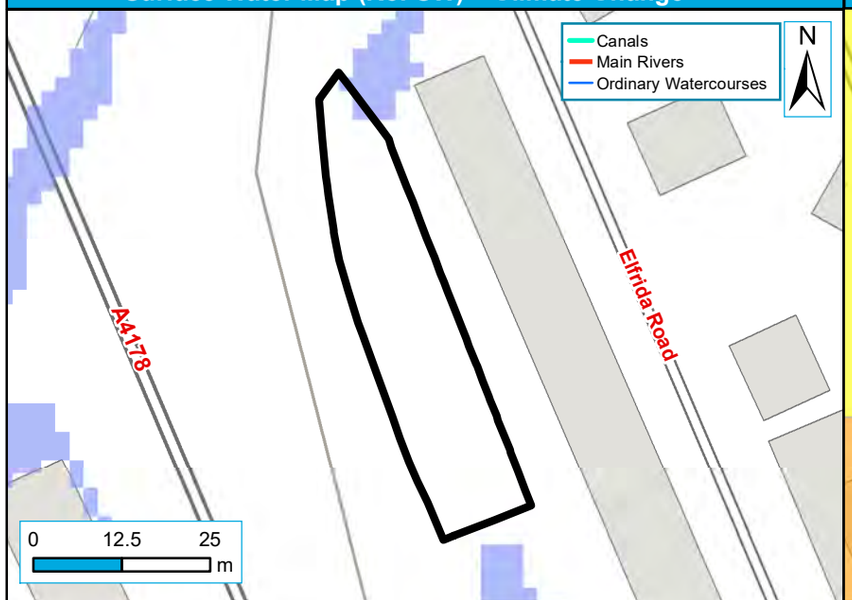
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



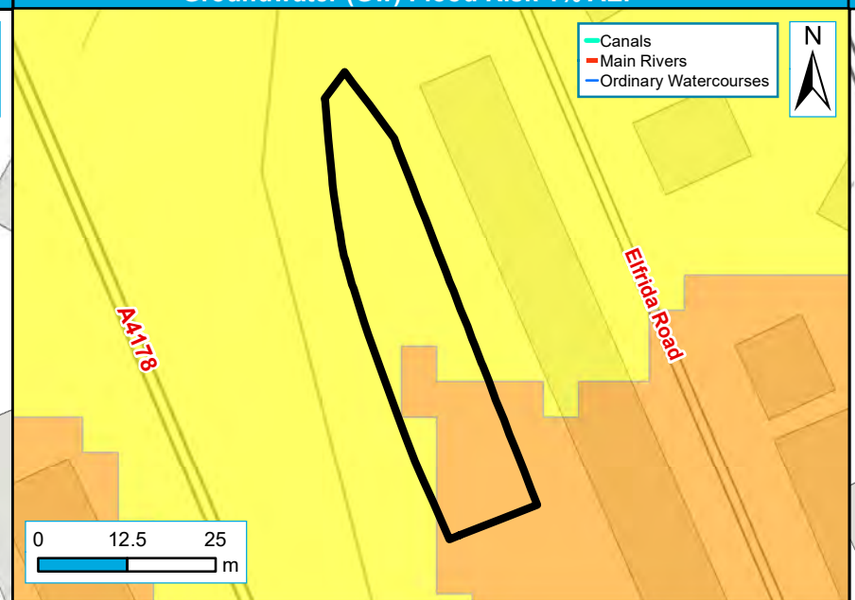
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



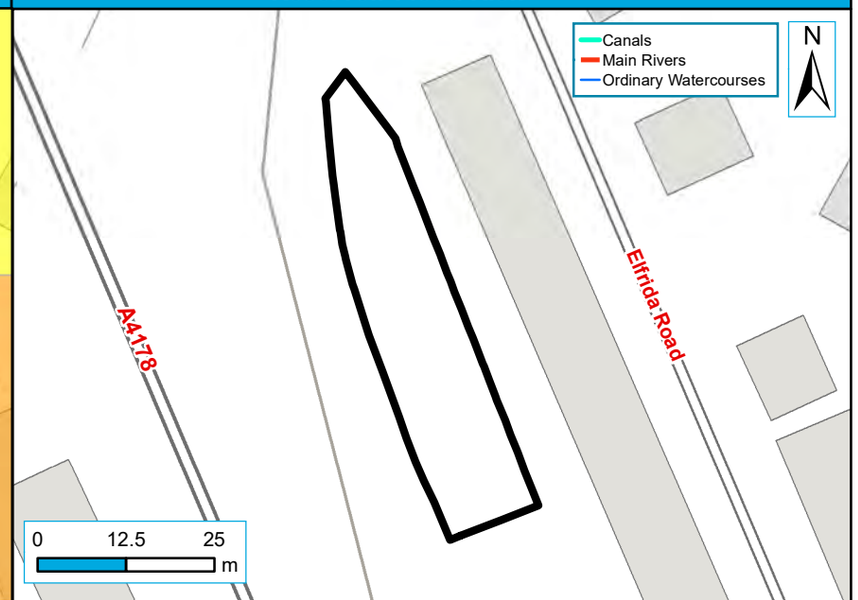
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

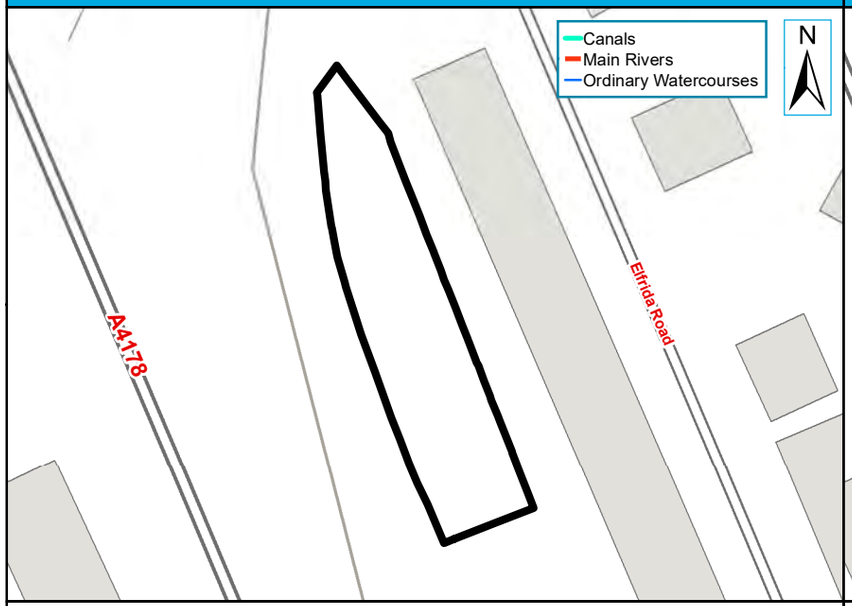


Site Boundary
Other L2 Sites
Reservoir Flood Risk

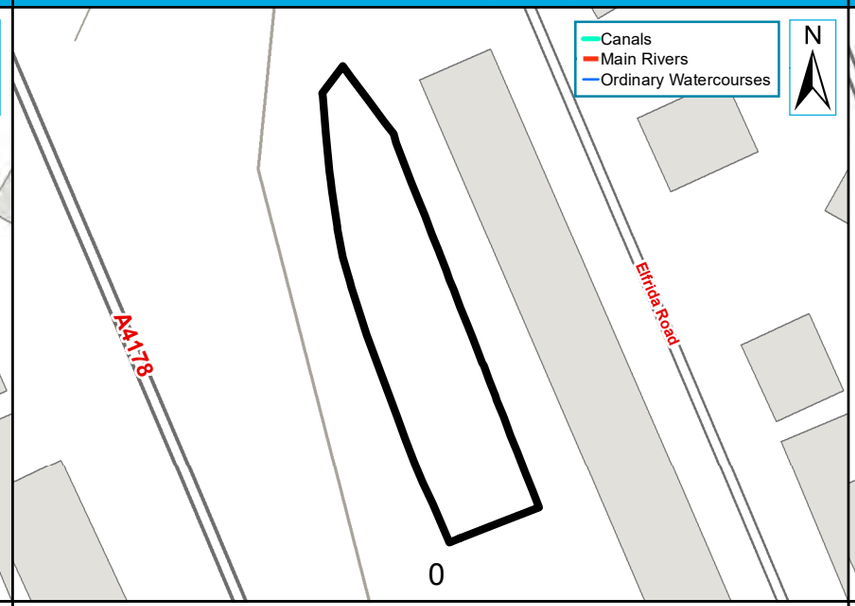
Site reference	HS28
Site Name	Land and Garages to the rear of 2-24 Elfirda Road

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

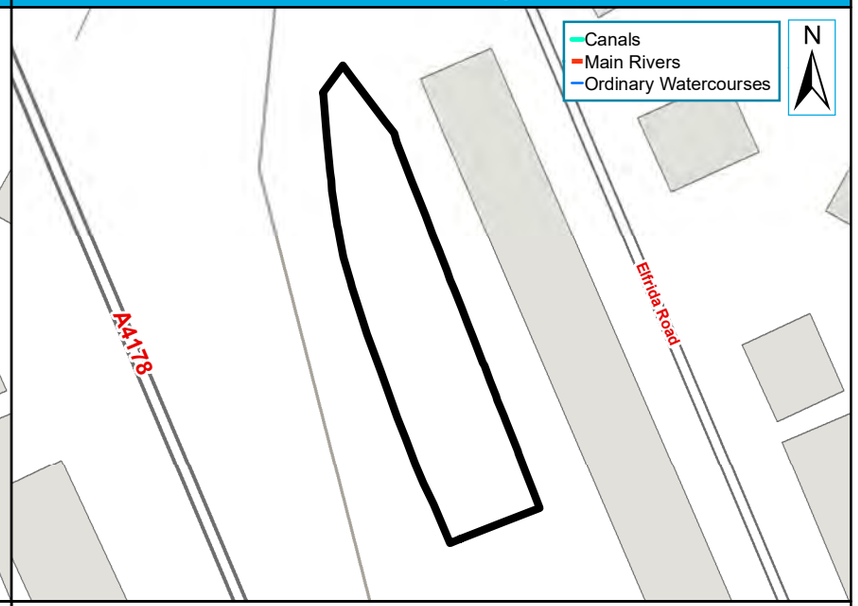
Maximum Fluvial Flood Depth (m) - 1% AEP



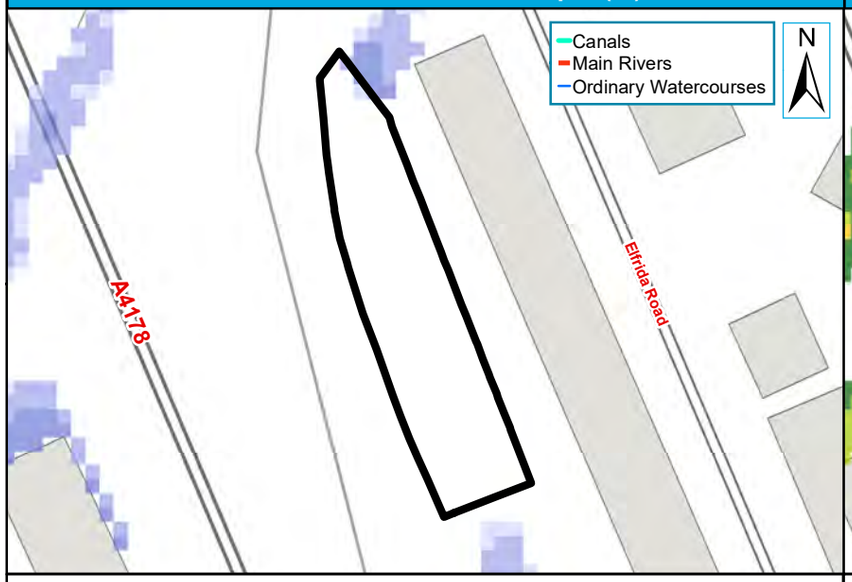
Maximum Fluvial Flood Level (mAOD) - 1% AEP



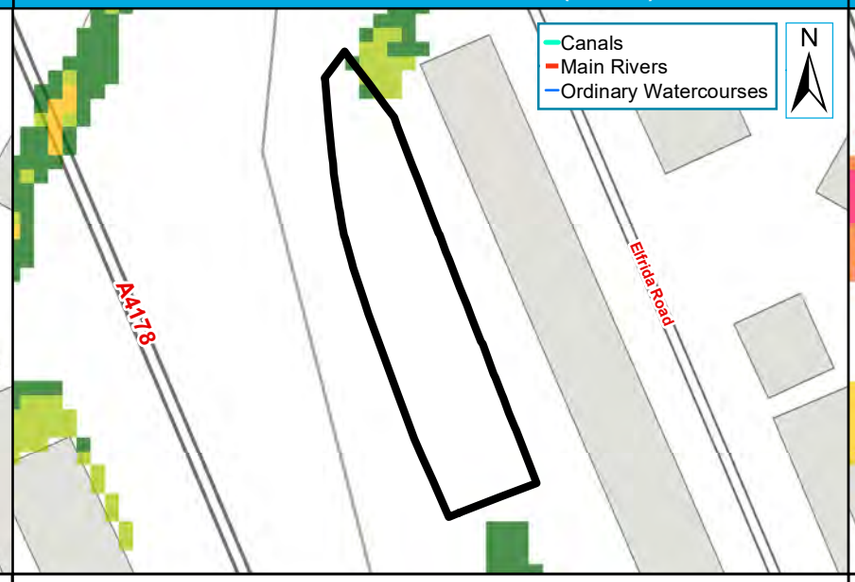
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



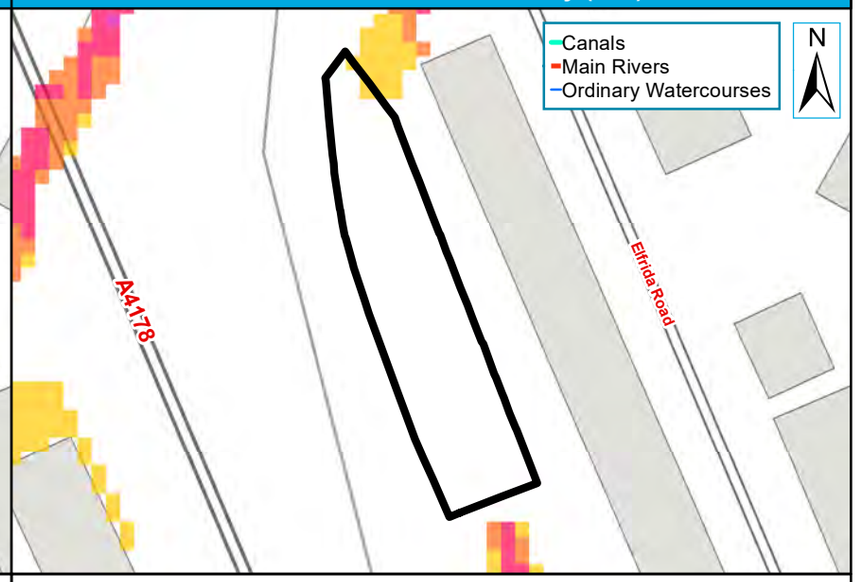
Maximum Surface Water Flood Depth (m) -1% AEP



Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS31
Site name	Chalk Hill Car Park

Site details	**OS Grid reference**	TQ 11905 95478			
	Area	0.04 Ha			
	Current land use	Brownfield			
	Proposed site use	Residential			
	Flood risk vulnerability	More vulnerable			
	Watford Sustainability Area Band	Area of High Sustainability			
Sources of flood risk	**Existing watercourses**	There are no watercourses within close proximity of the proposed site.			
	Flood history	The site is not included within the EA recorded flood outline layer.			
	Fluvial	**Fluvial**			
		Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
			0%	0%	0%
		Available modelled data: There is no fluvial model data available for the site, as it is located within Flood Zone 1. **Flood characteristics:** The site is located within Flood Zone 1, and is therefore at negligible risk of fluvial flooding.			
	Surface Water	**Proportion of site at risk (RoFSW)**			
		3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**	
		0.2%	2%	12%	
		Description of surface water flow paths: A small proportion of the site is at risk of surface water flooding. The south west corner of the site is at risk of flooding during the 1% AEP (1 in 100-year) rainfall event, with the area at risk extending during the 0.1% AEP (1 in 1,000-year) event.			
	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1% AEP (1 in 100-year) risk categories**			
		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**	
		15%	85%	100%	
		The site is at high risk of groundwater flooding during a 1% AEP (1 in 100-year event). The south west corner of the site is within Category 4 (where groundwater is expected to be at or within 0.025m of the ground surface) and the majority of the site is within Category 3 (where groundwater is expected to be 0.025 – 0.5m of the ground surface).			
	Reservoir	The site is not at risk of reservoir flooding.			

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS31
Site name	Chalk Hill Car Park

	Canal	There are no canals witin the site.		
Flood risk management infrastructure	**Defences**	**Defence Type**	**Standard of Protection**	**Condition**
		There are no defences present within the site.		
	Residual risk	**Culvert / structure blockage?**	There are no culverts within the site.	
		Impounded water body failure?	The site is not at risk of flooding due to reservoir breach.	
		Defence breach / overtopping?	**Breach Zone**	
			N/A	
Emergency planning	**Flood warning**	The site is not within EA Flood Warning or Flood Alert Area.		
	Access and egress	The site is likely to be accessed from Chalk Hill, at the south of the site. This route is at a high risk of surface water flooding, particularly to the north-west of the site, where flooding is expected to occur during the 3.33% AEP (1 in 30-year) event. To the north west of the site, Chalk Hill is also located within Flood Zone 2 and Flood Zone 3a.		
Climate Change	**Climate change allowances for '2080s'**	**River Basin District**	**Central**	**Higher Central**	**Upper End**
		Thames	25%	35%	70%
	Implications for the site	The site is predicted to remain within Flood Zone 1, when climate change allowances are applied. The 1 in 100-year surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 1 in 1,000-year surface water flood extent.		

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS31
Site name	Chalk Hill Car Park

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.	
	Superficial Geology	There are glacial sand and gravel deposits across the site.	
	Soils	Freely draining slightly acidic loamy soils.	
	SuDS	SuDS are possible on all sites, including previously developed sites such as this one. All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding and its location within Groundwater Source Protection Zone 1. Therefore further site investigation should be carried out to assess potential for drainage by infiltration, including at least 12 months of groundwater level monitoring on site. Infiltration techniques should only be used where there are suitable levels of surface water runoff treatment, and following the granting of any required environmental permits from the Environment Agency.	
	Groundwater Source Protection Zone	The site is within Groundwater SPZ 1 (inner zone). This is defined as the 50-day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There are no historic landfill sites within the proposed development area.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of existing surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Colne (from Confluence with Ver to Gade)	High
Recommend-ations for Local Plan policy	**Sequential Test and Exception Test requirements**		
	The site is within Flood Zone 1 but at risk from other sources of flooding. The Sequential Test must be passed. The Exception Test is not required under the NPPF, but it must be shown that the development will be safe for its lifetime and the risk can be managed through a sequential approach to design.		
	Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers		
	Flood risk assessment: • At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required. • Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.		

Site code	HS31
Site name	Chalk Hill Car Park

- A site-specific flood risk assessment will be required because the site is at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).
- Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
- Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future.
- The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration.

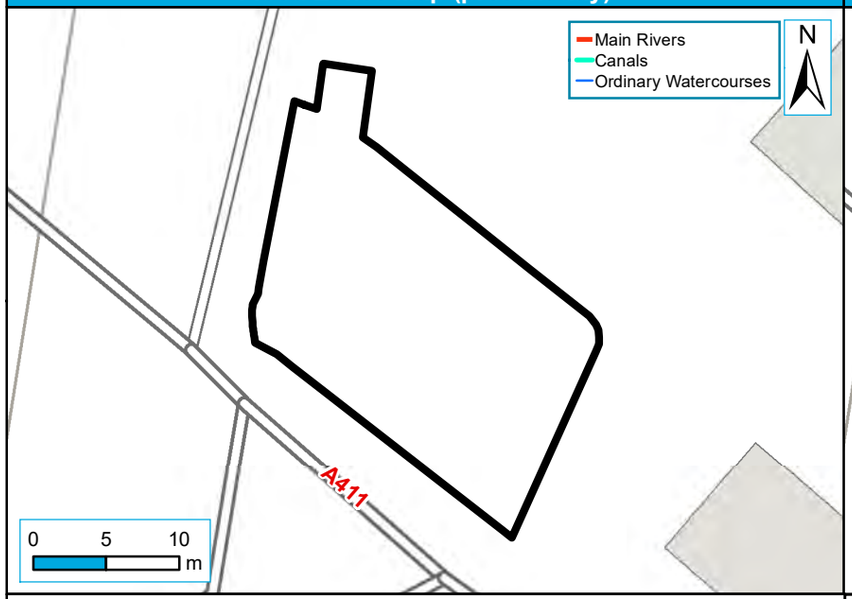
Guidance for site design and making development safe:

- Development must seek opportunities to reduce overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100 plus climate change event.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- Mitigation for seasonal high groundwater levels must be considered (for example by raising finished floor levels to an appropriate height above ground level).
- Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.
- Example features may include swales, attenuation features, green roofs, rainwater capture and reuse and permeable paving.
- Storage for runoff from the development in extreme events should be located out of flood risk areas.
- The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property.
- SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	HS31
Site Name	Chalk Hill Car Park

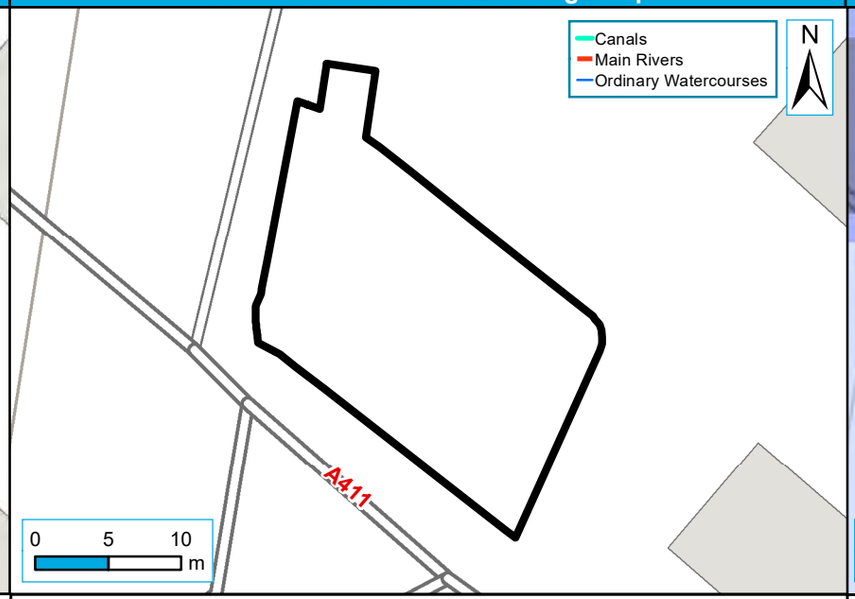
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



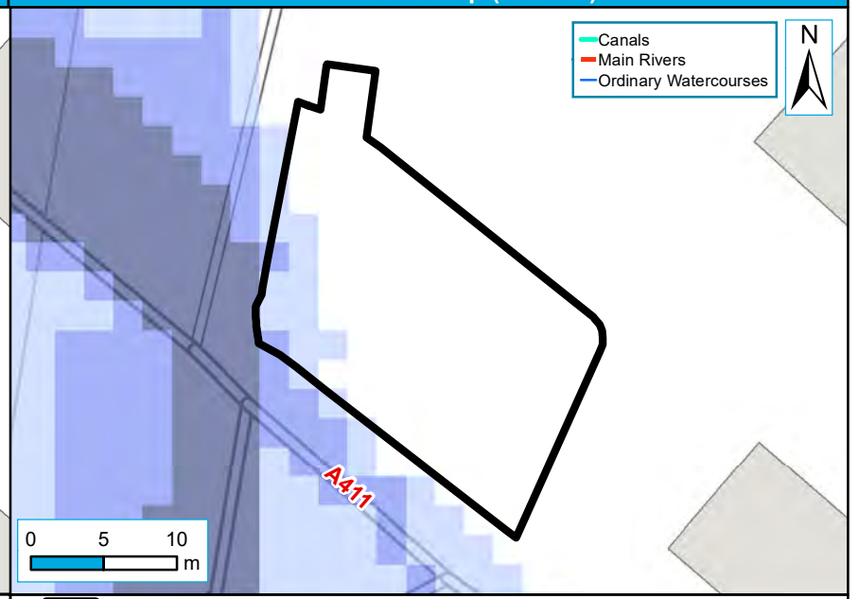
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



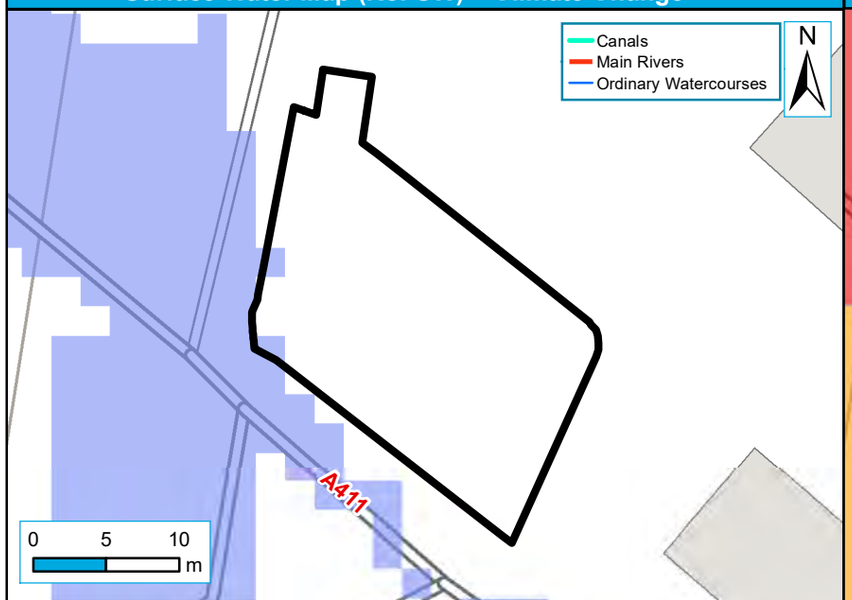
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



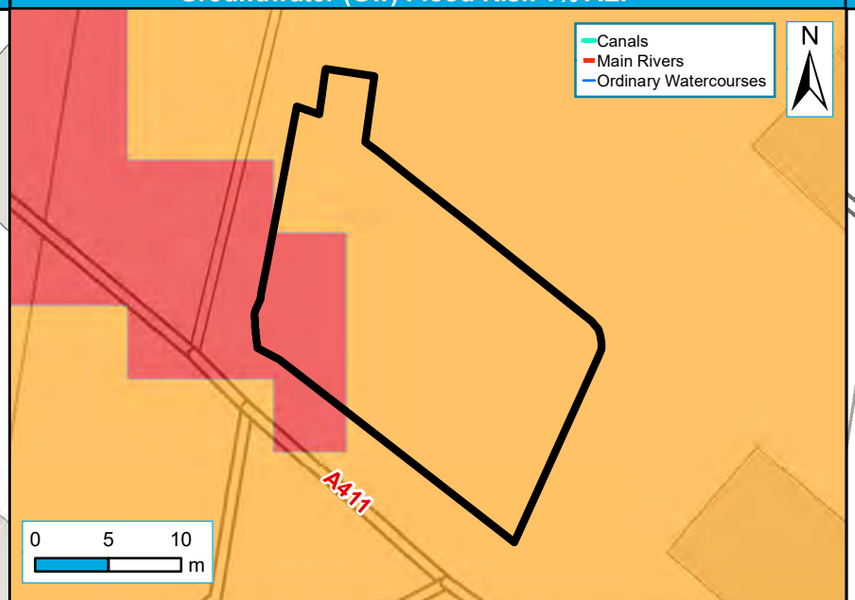
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



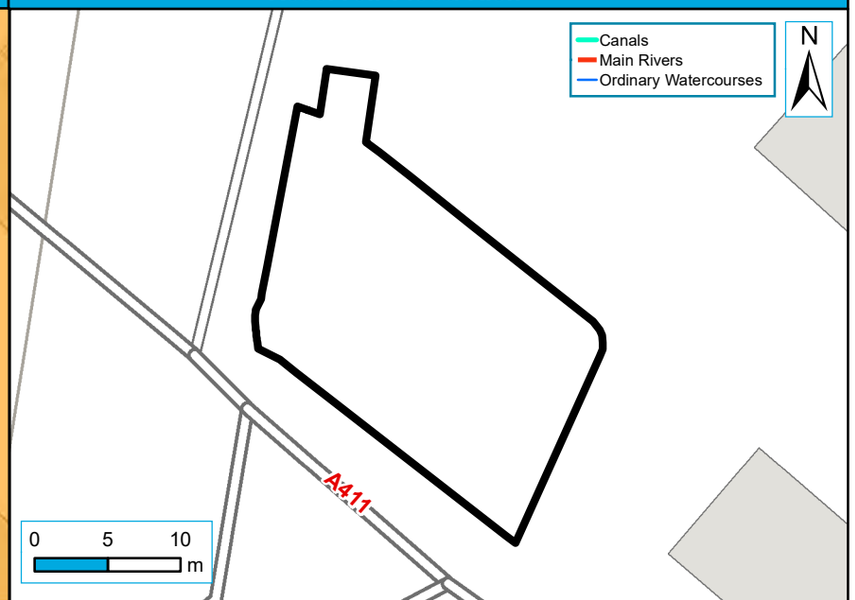
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

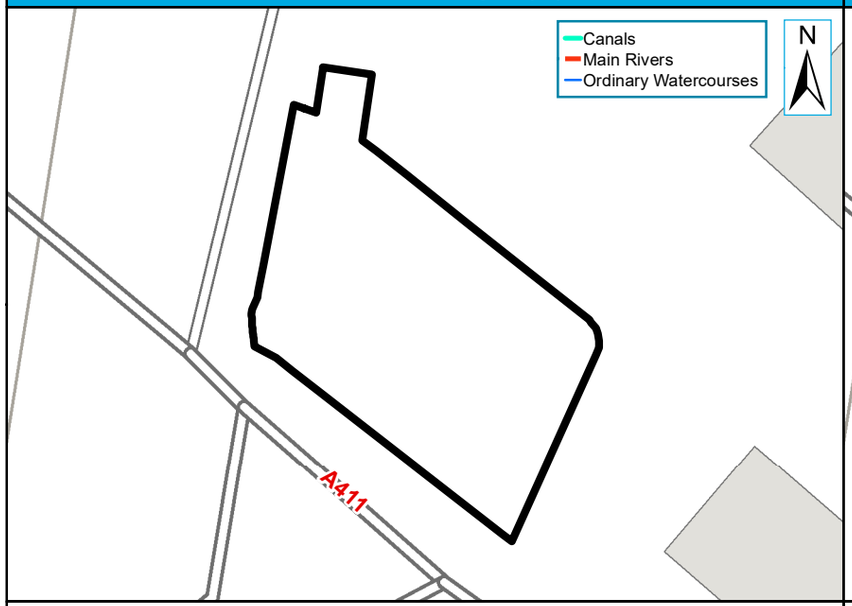


Site Boundary
Other L2 Sites
Reservoir Flood Risk

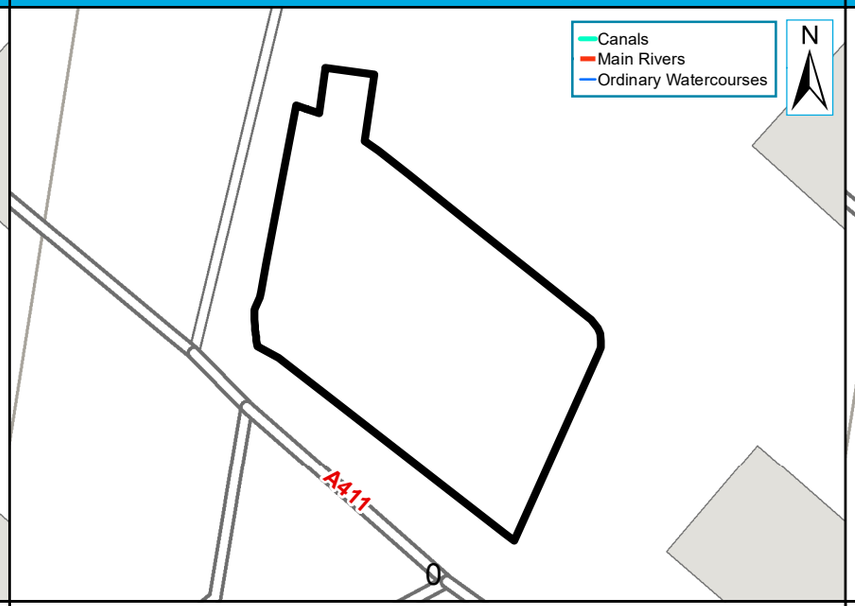
Site reference	HS31
Site Name	Chalk Hill Car Park

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

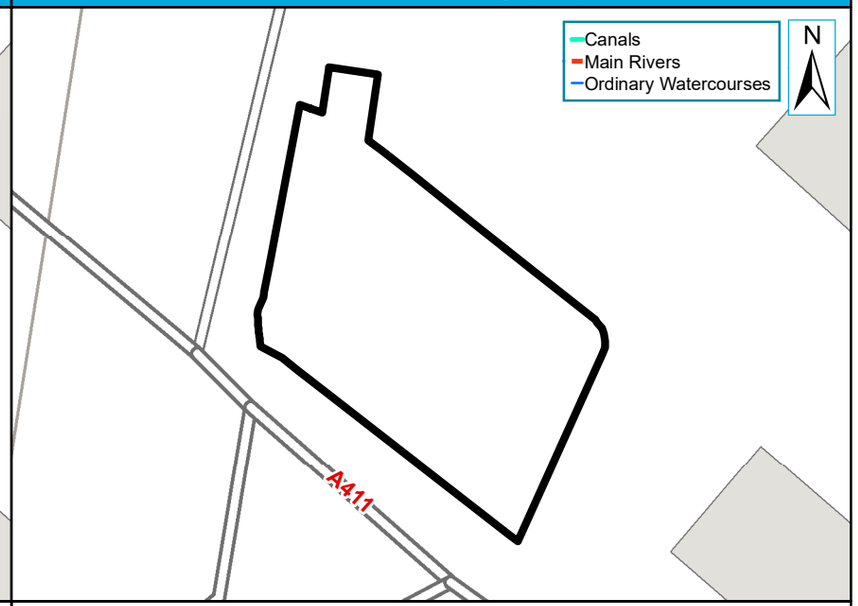
Maximum Fluvial Flood Depth (m) - 1% AEP



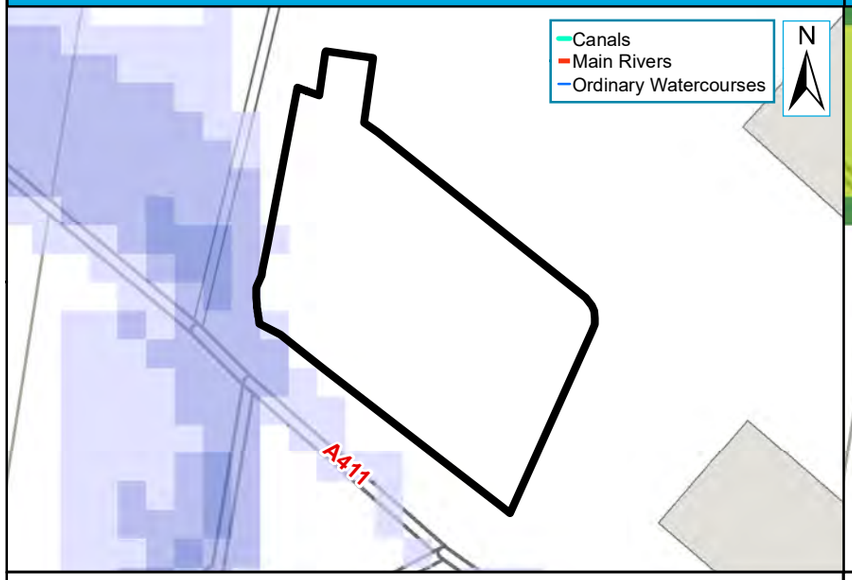
Maximum Fluvial Flood Level (mAOD) - 1% AEP



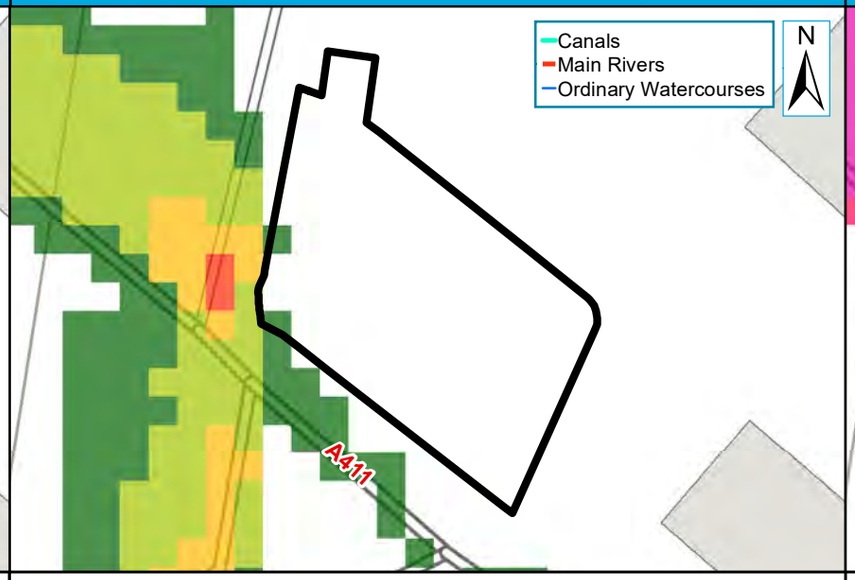
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



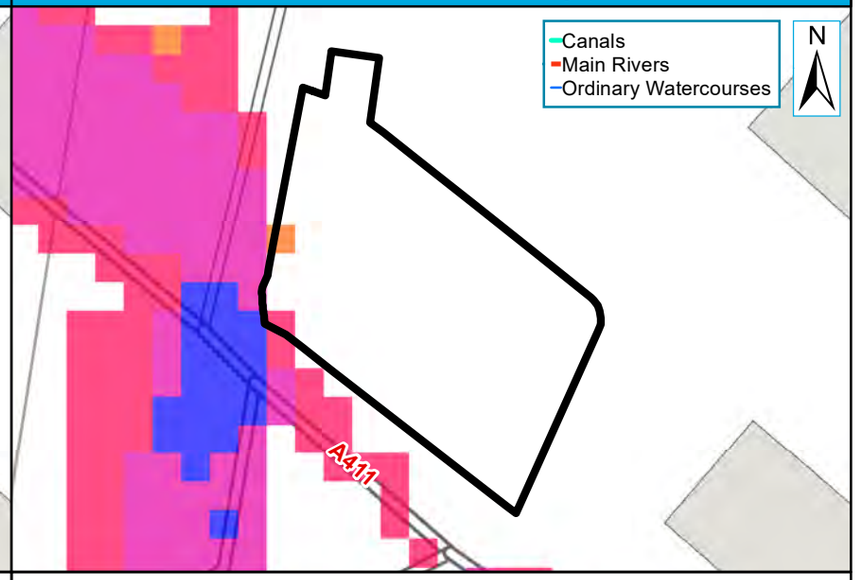
Maximum Surface Water Flood Depth (m) -1% AEP



Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS33
Site name	Wiggenhall Road Depot

Site details	**OS Grid reference**	TQ 11221 95315
	Area	1.5 Ha
	Current land use	Brownfield
	Proposed site use	Residential
	Flood risk vulnerability	More vulnerable
	Watford Sustainability Area Band	Area of High Sustainability
Sources of flood risk	**Existing watercourses**	There are no watercourses within the site boundary. The River Colne flows in a westerly direction within 10m of the northern boundary.
	Flood history	The EA Recorded Flood Outlines identifies that two historic flood events have affected the northern boundary of the site. These occurred due to channel exceedance in: • July 1987 • December 2000
	Fluvial	**Fluvial**

Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
	0%	1%	12%
Maximum modelled flood level on site (mAOD)	N/A	53.46	53.91

Available modelled data:
The site is covered by the 2010 Upper Colne 1D-2D hydraulic model. Flood depth and hazard results were not provided with this model, and therefore water level results have been used. Flood Zone 2 has been used as a proxy for Flood Zone 3a +35%CC and +70%CC extents, as the Upper Colne model became unstable when higher flows were applied.

Flood characteristics:
The north of the site is at risk of fluvial flooding. A small area of the site is within Flood Zone 3a, where flooding is expected to occur during the 1% AEP (1in 100-year) event. This area extends to cover the northern boundary of the site during a 0.1% AEP (1 in 1,000-year) event.

Surface Water

Proportion of site at risk (RoFSW)		
3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**
0%	2%	8%

Description of surface water flow paths:
The site is at low risk of surface water flooding. Isolated areas within the north, centre and south of the site are at risk of surface water flooding, during the 1% AEP (1 in 100-year) event. In the north of the site, surface water risk is located within the same area as fluvial risk, although surface water flooding may occur independently.

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS33
Site name	Wiggenhall Road Depot

	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1% AEP (1 in 100-year) risk categories**			
		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**	
		48%	52%	100%	
		The entirety of the site is at high risk of groundwater flooding. The north and west of the site are at highest risk, located within Category 4, where groundwater levels are expected to be at or within 0.025m of the ground surface during a 1% AEP (1 in 100-year) event. The rest of the site is located within Category 3, where groundwater is expected to be between 0.025 – 0.5m of the ground surface during a flood event.			
	Reservoir	The north of the site is at risk of flooding in the extremely unlikely event of a breach on Aldenham or Hilfield Park reservoir.			
	Canal	There are no canals witin the site.			
Flood risk management infrastructure	**Defences**	**Defence Type**	**Standard of Protection**	**Condition**	
		There are no flood defences present.			
	Residual risk	**Culvert / structure blockage?**	There are no culverts present within the site.		
		Impounded water body failure?	The north of the site is at risk of flooding from reservoirs in the unlikely event of a breach on either Aldenham or Hilfield Park reservoir.		
		Defence breach / overtopping?	**Breach Zone**		
			N/A		
Emergency planning	**Flood warning**	The northern area of the site is included within both EA Flood Warning and Flood Alert areas: • **Flood Alert Area:** The Middle River Colne at Watford and Rickmansworth including Carpenders Park • **Flood Warning Area:** The River Colne at Watford including Bushey			
	Access and egress	The site is likely to be accessed via Deacons Hill at the western border of the site. This route is at risk of fluvial flooding during a 0.1% AEP event. The road is also at high risk of flooding during a 3.3% AEP (1 in 30-year) rainfall event. Therefore access to the site may be restrcted during times of flood.			
Climate Change	**Climate change allowances for '2080s'**	**River Basin District**	**Central**	**Higher Central**	**Upper End**
		Thames	25%	35%	70%
	Implications for the site	Due to model instability when applying 35% and 70% climate change allowances to inflows, Flood Zone 2 has been used as a proxy for climate change. This provides a conservative extent, with 12% of the site identified as at risk from a 1 in 100-year + 70%CC flood event. The 1% AEP (1 in 100-year) surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 0.1% (1 in 1,000-year) surface water flood extent.			

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS33
Site name	Wiggenhall Road Depot

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.	
	Superficial Geology	There are glacial sand and gravel deposits across the site.	
	Soils	Freely draining slightly acidic loamy soil.	
	SuDS	SuDS are possible on all sites, including previously developed sites such as this one. All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. Where below ground storage is proposed, the base of the feature must be located at least 1m above the highest groundwater level, to reduce the risk of groundwater ingress or flotation. Storage of surface water runoff from the development during extreme events should be located out of fluvial flood risk areas. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding and its location within Groundwater Source Protection Zone 1. Therefore further site investigation should be carried out to assess potential for drainage by infiltration, including at least 12 months of groundwater level monitoring on site. Infiltration techniques should only be used where there are suitable levels of surface water runoff treatment, and following the granting of any required environmental permits from the Environment Agency.	
	Groundwater Source Protection Zone	The site is within Groundwater SPZ 1 (inner zone). This is defined as the 50-day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There are no historic landfill sites within the site boundary.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of existing surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Colne (from Confluence with Ver to Gade)	High
	Sequential Test and Exception Test requirements		

Site code	HS33
Site name	Wiggenhall Road Depot

Recommend-ations for Local Plan policy

The Sequential Test must be satisfied. Only once the Sequential Test is satisfied should the Exception Test be applied. **It is anticipated that proposed development will be sequentially located within Flood Zone 1**. For this site, the Exception Test must be satisfied:

- If More Vulnerable and Essential Infrastructure is located in FZ3a or FZ3a plus climate change.
- If Highly Vulnerable development is located in FZ2.

If Essential Infrastructure is located in Flood Zone 3b then it must be demonstrated that the exception test is satisfied. Development will not be permitted in the following scenarios:

- Highly Vulnerable development within FZ3a or FZ3a plus climate change and FZ3b.
- More Vulnerable and Less Vulnerable development within FZ3b.

Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers

Flood risk assessment:

- At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.
- A site-specific flood risk assessment will be required because the site is within Flood Zone 2 and 3 and at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).
- Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
- Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future.
- The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration.

Guidance for site design and making development safe:

- Development must seek opportunities to reduce overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100 plus climate change event.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible.
- Floodplain compensation must be demonstrated for any loss in floodplain storage through the raising of levels for development.
- Mitigation for seasonal high groundwater levels must be considered (for example by raising finished floor levels to an appropriate height above ground level).
- Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.

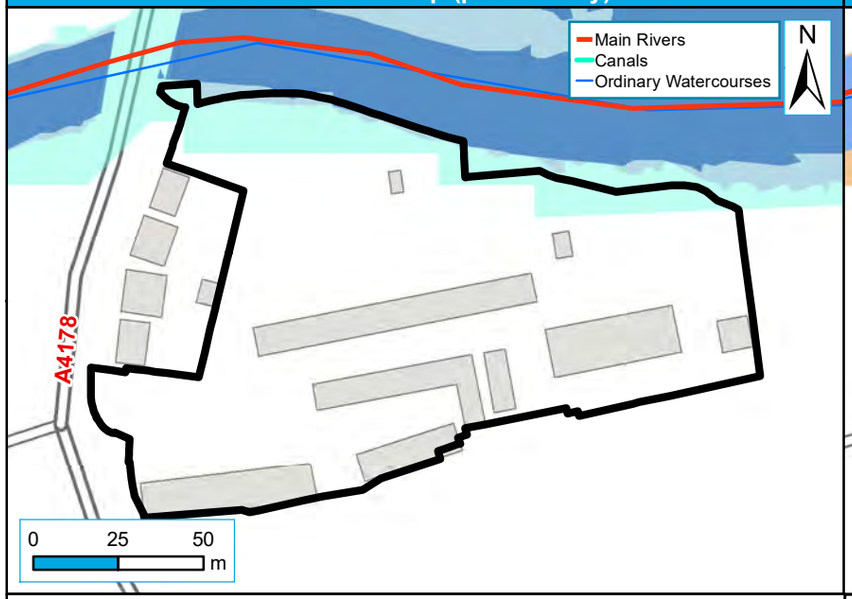
Site code	HS33
Site name	Wiggenhall Road Depot

	• Storage for runoff from the development in extreme events should be located out of flood risk areas. • The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property. • SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	HS33
Site Name	Wiggenhall Road Depot

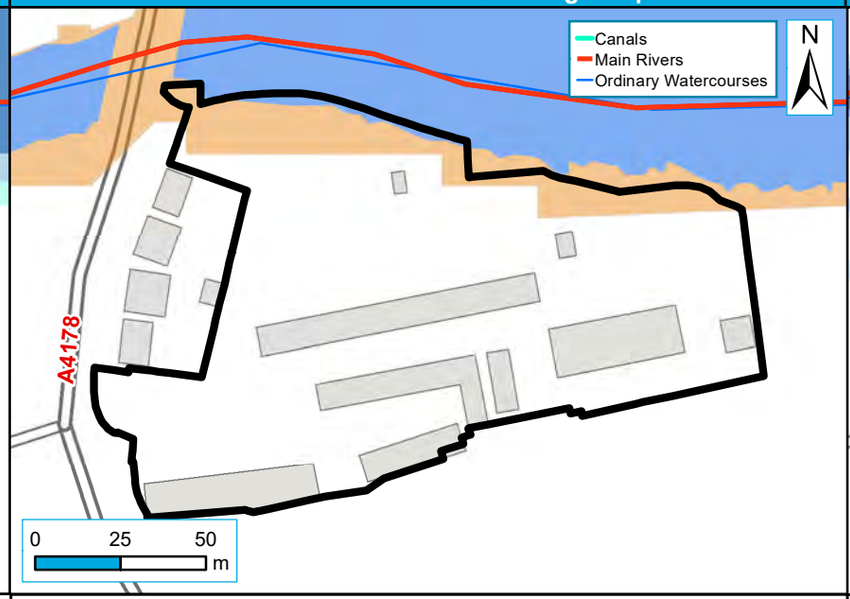
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



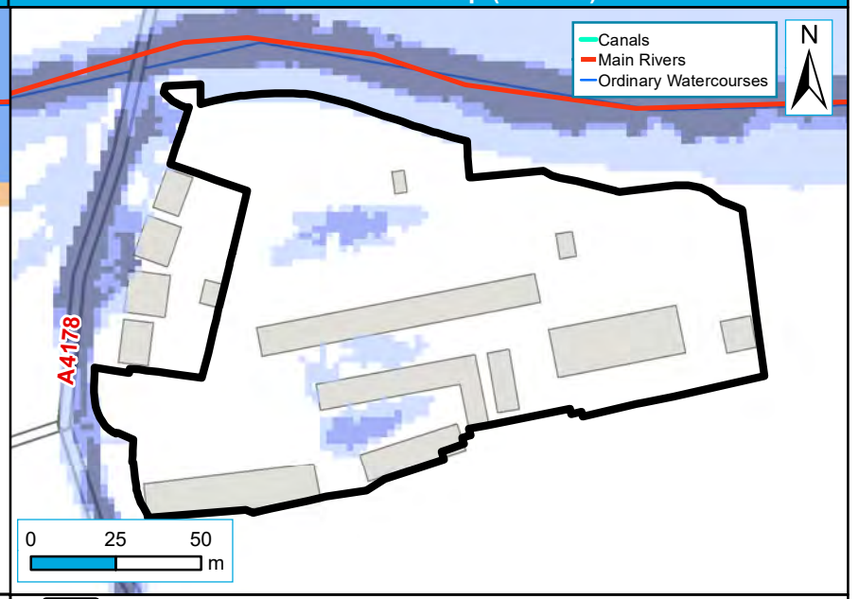
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



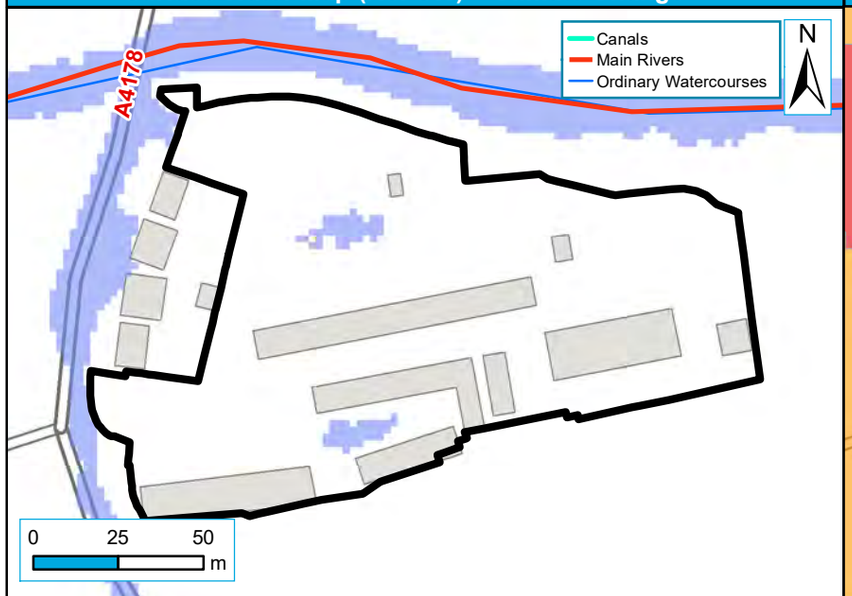
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



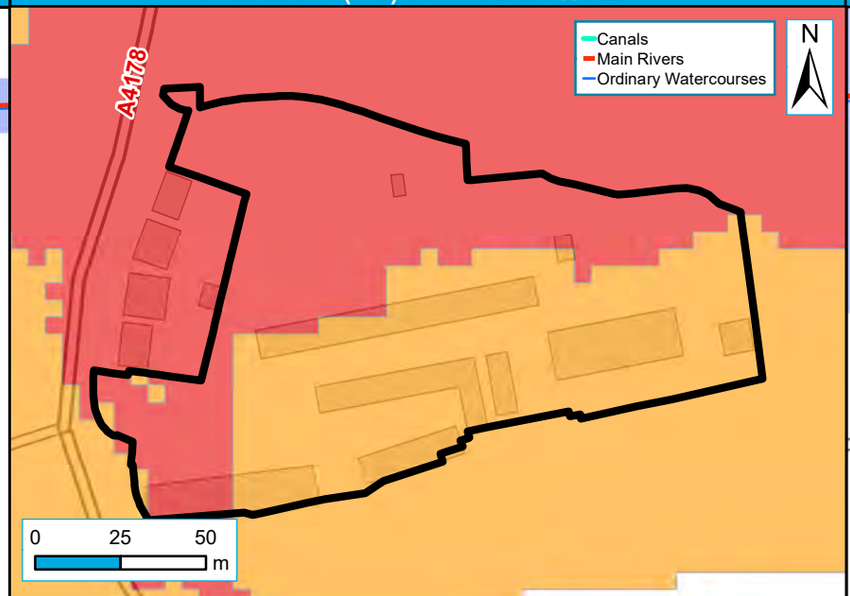
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



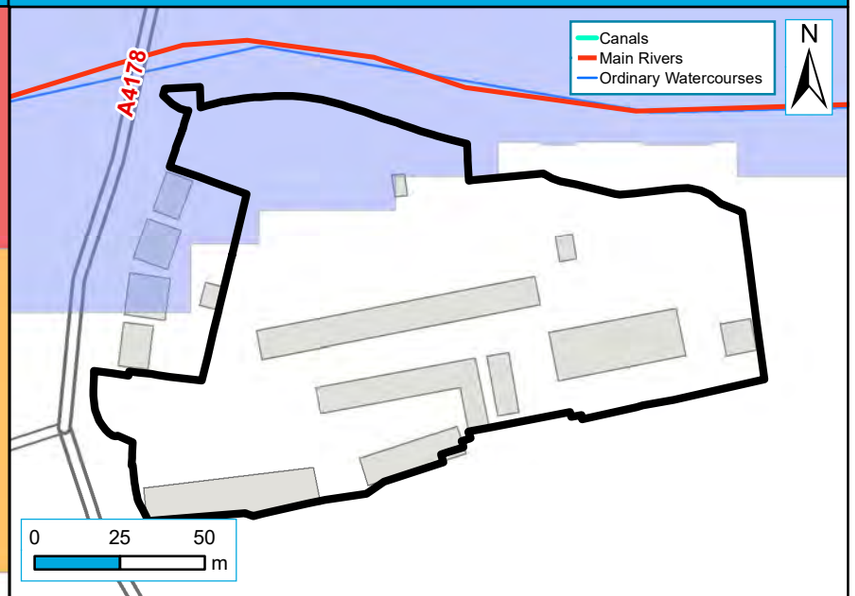
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

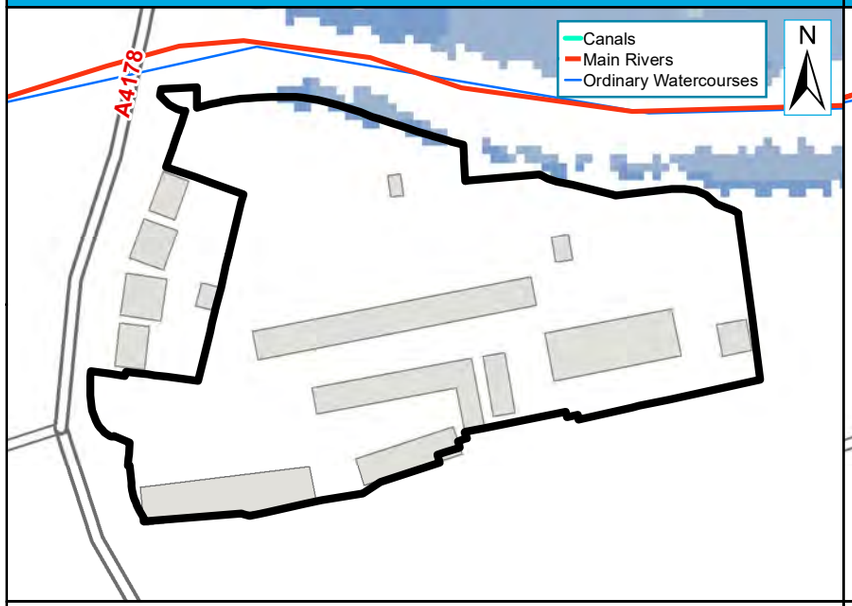


Site Boundary
Other L2 Sites
Reservoir Flood Risk

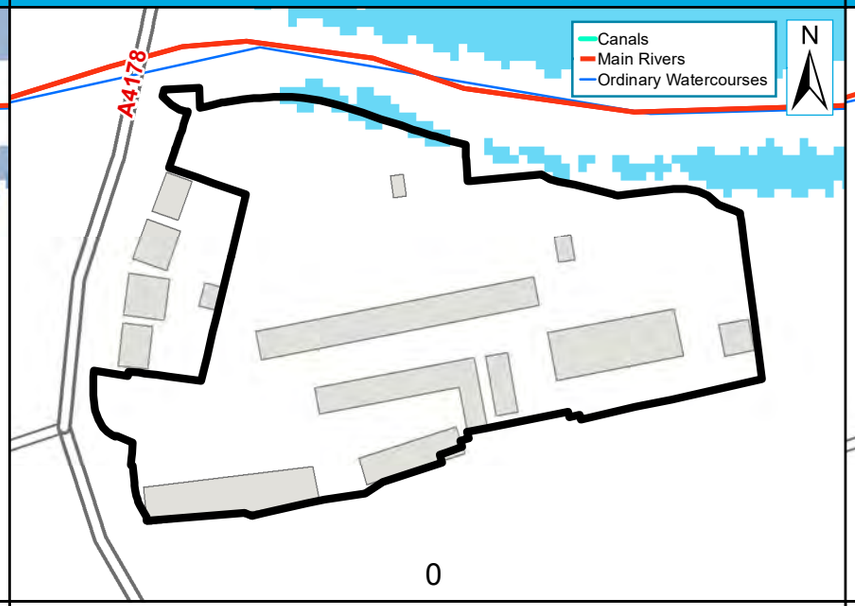
Site reference	HS33
Site Name	Wiggenhall Road Depot

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

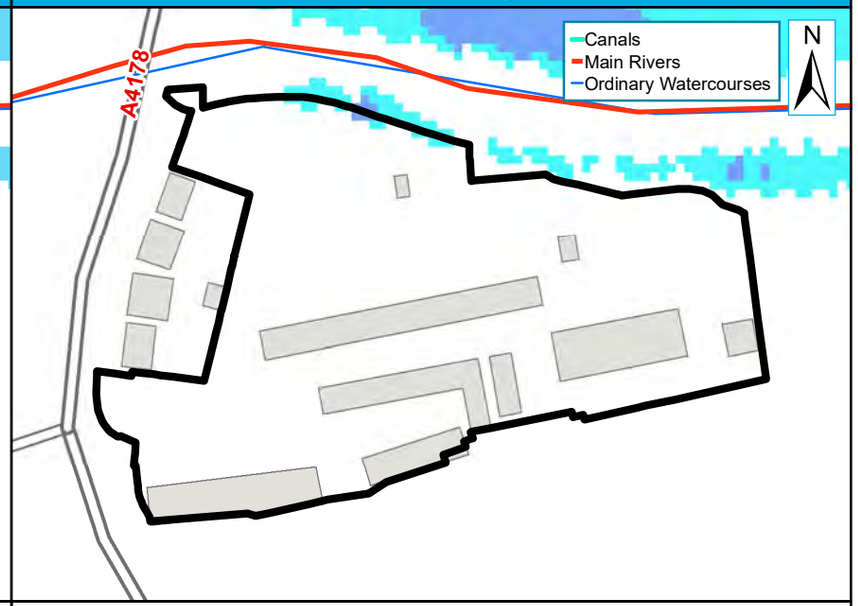
Maximum Fluvial Flood Depth (m) - 1% AEP



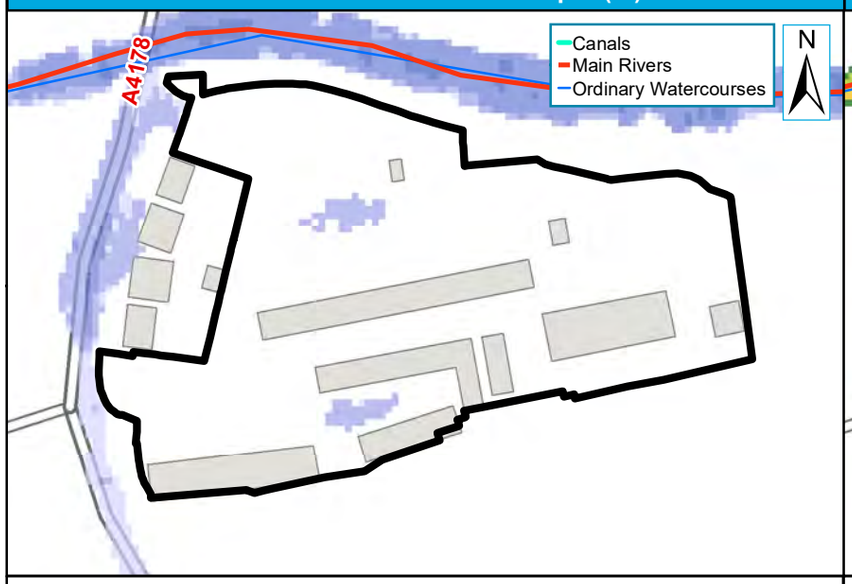
Maximum Fluvial Flood Level (mAOD) - 1% AEP



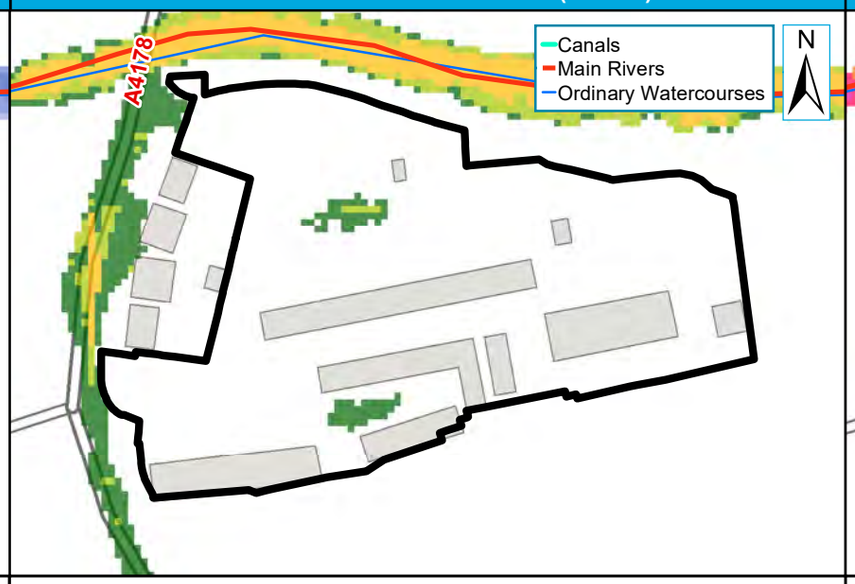
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



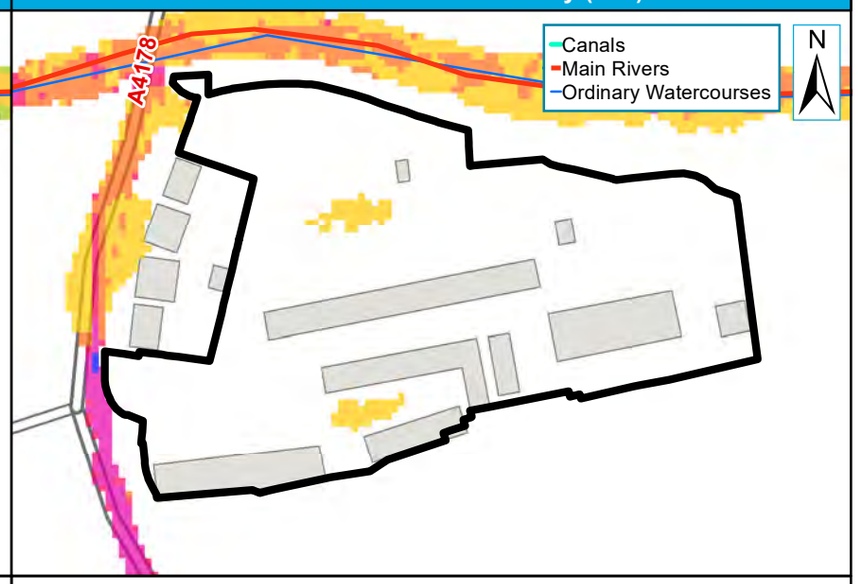
Maximum Surface Water Flood Depth (m) -1% AEP



Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS35
Site name	Land and Garages at Riverside Road

Site details	**OS Grid reference**	TQ 10678 95070
	Area	0.1 Ha
	Current land use	Brownfield
	Proposed site use	Residential
	Flood risk vulnerability	More vulnerable
	Watford Sustainability Area Band	Area of Medium Sustainability
Sources of flood risk	**Existing watercourses**	An ordinary watercourse forms the north eastern border of the site, and flows in a north westerly direction to join the River Colne (Main River) 30m north of the site
	Flood history	The EA Recorded Flood Outlines identifies that one historic flood event, occurring in December 2000, reached the north east boundary of the site. This is reported to have occurred due to exceedance in channel capacity on the River Colne. An incident of external surface water flooding to residential property was also recorded on Riverside Road, although the date of flooding was not specified.
	Fluvial	**Fluvial**

Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
	0%	4%	96%
Maximum modelled flood level on site (mAOD)	N/A	52.12	52.38

Available modelled data:
The site is covered by the 2010 Upper Colne 1D-2D hydraulic model. Flood depth and hazard results were not provided with this model, and therefore water level results have been used. Flood Zone 2 has been used as a proxy for Flood Zone 3a +35%CC and +70%CC extents, as the Upper Colne model became unstable when higher flows were applied.

Flood characteristics:
The entire site is located within Flood Zone 2, and is therefore at risk of fluvial flooding during a 0.1% AEP (1 in 1,000-year) event. A small area at the north east corner of the site is located within Flood Zone 3a, and is therefore at higher risk, with flooding expected to occur during the 1% AEP (1 in 100-year) event.

	Surface Water	**Proportion of site at risk (RoFSW)**		
		3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**
		0%	2%	11%

Description of surface water flow paths:
The majority of the site is at very low risk of surface water flooding. However, the eastern and southern borders are at moderate risk, with surface water flooding predicted to enter the site from Riverside Road during the 1% AEP (1 in 100) rainfall event. In the north eastern boundary of the site, surface water risk is located within the same area as fluvial risk, although surface water flooding may occur independently.

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS35
Site name	Land and Garages at Riverside Road

	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1% AEP (1 in 100-year) risk categories**		
		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**
		100%	0%	100%
		The entirety of the site is at high risk of groundwater flooding, with groundwater levels expected to lie at or within 0.025m of the ground surface during a 1% AEP (1 in 100-year) event.		
	Reservoir	The entire site is at risk of flooding in the extremely unlikely event of a breach on Hilfield Park reservoir.		
	Canal	There are no canals witin the site.		
Flood risk management infrastructure	**Defences**	**Defence Type**	**Standard of Protection**	**Condition**
		There are no flood defences present.		
	Residual risk	**Culvert / structure blockage?**	There are no culverts present within the site.	
		Impounded water body failure?	The entire site is at risk of flooding in the extremely unlikely event of a breach on Hilfield Park reservoir.	
		Defence breach / overtopping?	**Breach Zone**	
			N/A	
Emergency planning	**Flood warning**	The site is included within the following EA Flood Warning and Flood Alert Areas: • **Flood Alert Area:** The Middle River Colne at Watford and Rickmansworth including Carpenders Park • **Flood Warning Area:** The River Colne at Watford including Bushey		
	Access and egress	The site is likely to be accessed via Riverside Road at the southern border of the site. This route is at risk of fluvial flooding during a 0.1% AEP event within the vicinity of the site, and is also at high risk of surface water flooding during a 3.3% AEP (1 in 30-year) rainfall event. Therefore access to the site may be restrcted during times of flood.		
Climate Change	**Climate change allowances for '2080s'**	**River Basin District**	**Central**	**Higher Central**	**Upper End**
		Thames	25%	35%	70%
	Implications for the site	Due to model instability when applying 35% and 70% climate change allowances to inflows, Flood Zone 2 has been used as a proxy for climate change. This provides a conservative extent, with the entire site identified as at risk from a 1 in 100-year + 70%CC flood event. The 1% AEP (1 in 100-year) surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 0.1% (1 in 1,000-year) surface water flood extent.		

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	HS35
Site name	Land and Garages at Riverside Road

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.	
	Superficial Geology	There are glacial sand and gravel deposits across the site.	
	Soils	Loamy and clayey floodplain soils with naturally high groundwater.	
	SuDS	SuDS are possible on all sites, including previously developed sites such as this one. All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. Where below ground storage is proposed, the base of the feature must be located at least 1m above the highest groundwater level, to reduce the risk of groundwater ingress or flotation. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding and its location within Groundwater Source Protection Zone 1. Therefore further site investigation should be carried out to assess potential for drainage by infiltration, including at least 12 months of groundwater level monitoring on site. Infiltration techniques should only be used where there are suitable levels of surface water runoff treatment, and following the granting of any required environmental permits from the Environment Agency.	
	Groundwater Source Protection Zone	The site is within Groundwater SPZ 1 (inner zone). This is defined as the 50-day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There are no historic landfill sites within the site boundary.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of existing surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Colne (from Confluence with Ver to Gade)	High
	Sequential Test and Exception Test requirements		

Site code	HS35
Site name	Land and Garages at Riverside Road

Recommend-ations for Local Plan policy

The Sequential Test must be satisfied. Only once the Sequential Test is satisfied should the Exception Test be applied. **It is anticipated that proposed development will be sequentially located within Flood Zone 1**. For this site, the Exception Test must be satisfied:

- If More Vulnerable and Essential Infrastructure is located in FZ3a or FZ3a plus climate change.
- If Highly Vulnerable development is located in FZ2.

If Essential Infrastructure is located in Flood Zone 3b then it must be demonstrated that the exception test is satisfied. Development will not be permitted in the following scenarios:

- Highly Vulnerable development within FZ3a or FZ3a plus climate change and FZ3b.
- More Vulnerable and Less Vulnerable development within FZ3b.

Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers

Flood risk assessment:

- At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.
- A site-specific flood risk assessment will be required because the site is within Flood Zone 2 and 3 and at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).
- Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
- Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future.
- The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration.

Guidance for site design and making development safe:

- Development must seek opportunities to reduce overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100 plus climate change event.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible.
- Floodplain compensation must be demonstrated for any loss in floodplain storage through the raising of levels for development.
- Mitigation for seasonal high groundwater levels must be considered (for example by raising finished floor levels to an appropriate height above ground level).
- Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.

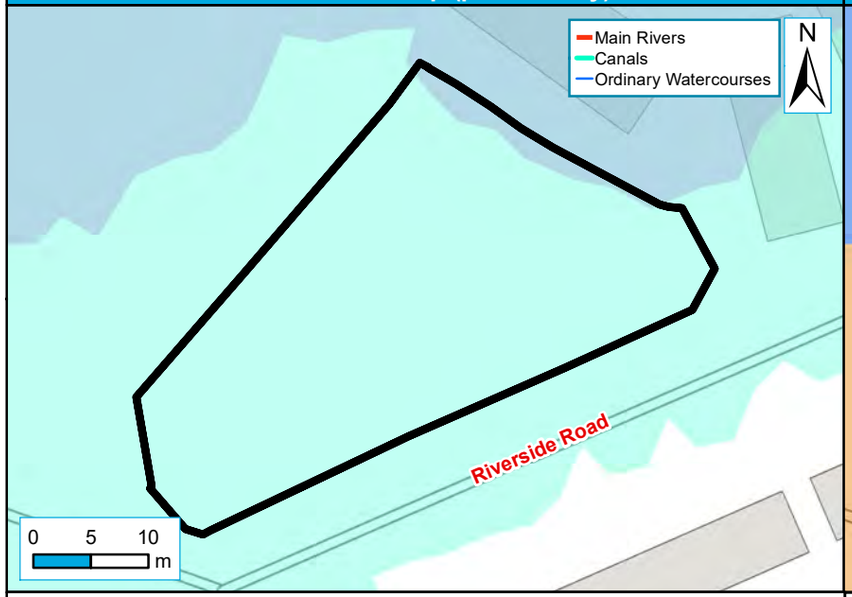
Site code	HS35
Site name	Land and Garages at Riverside Road

	• Storage for runoff from the development in extreme events should be located out of flood risk areas. • The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property. • SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	HS35
Site Name	Land and Garages at Riverside Road

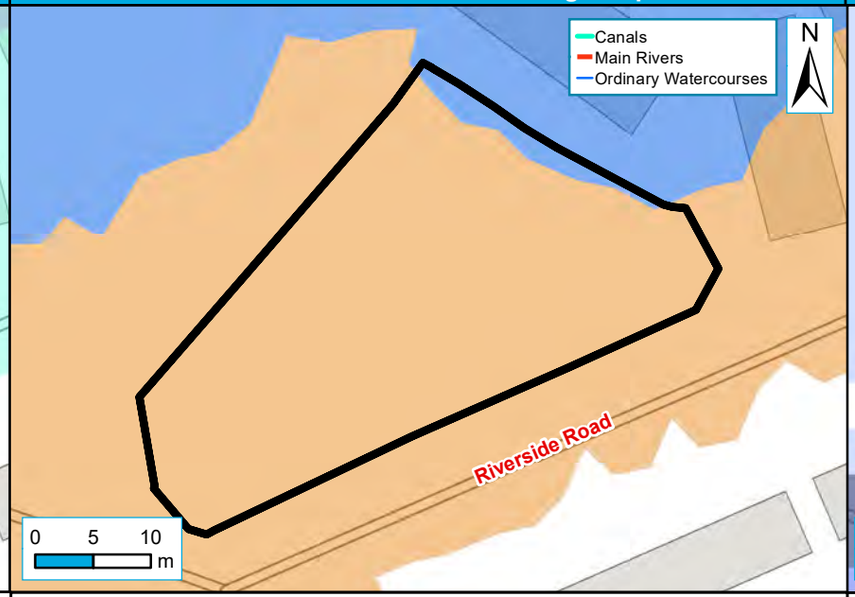
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



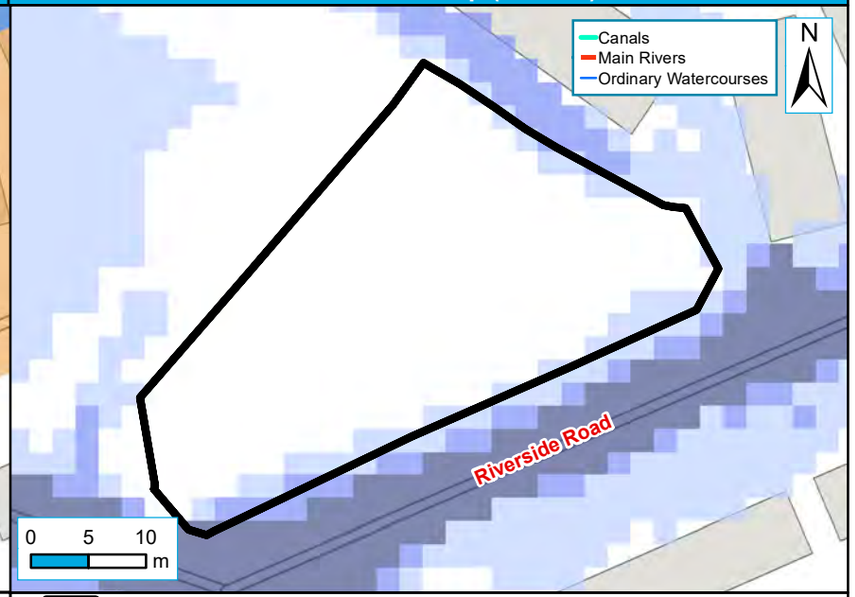
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



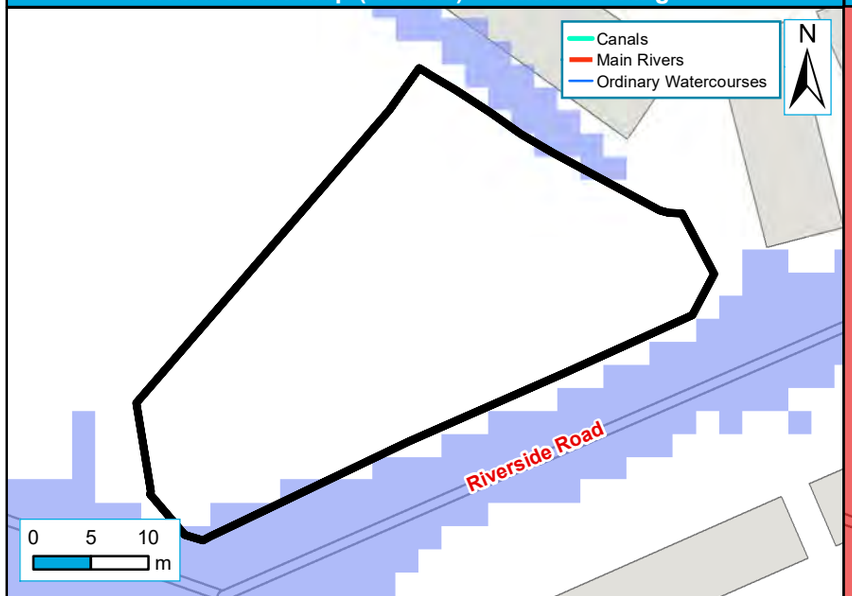
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



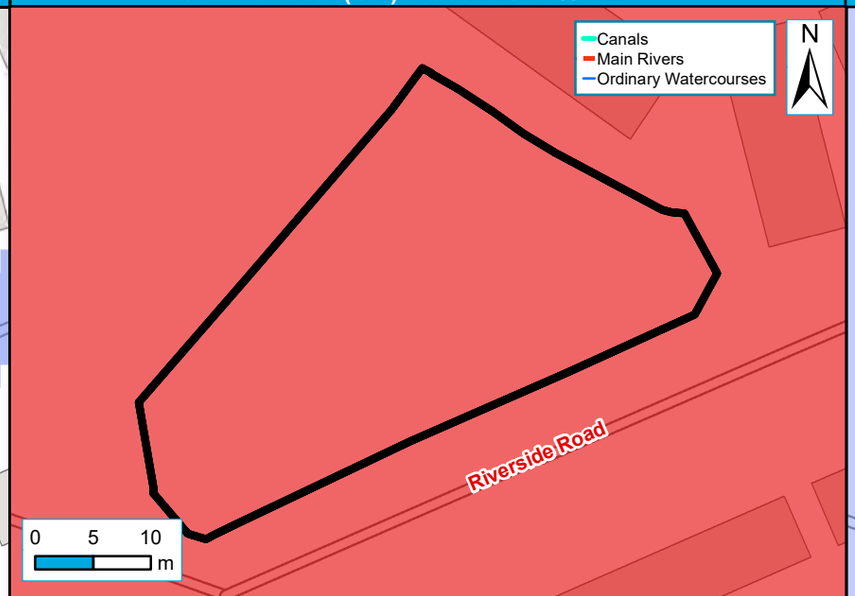
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



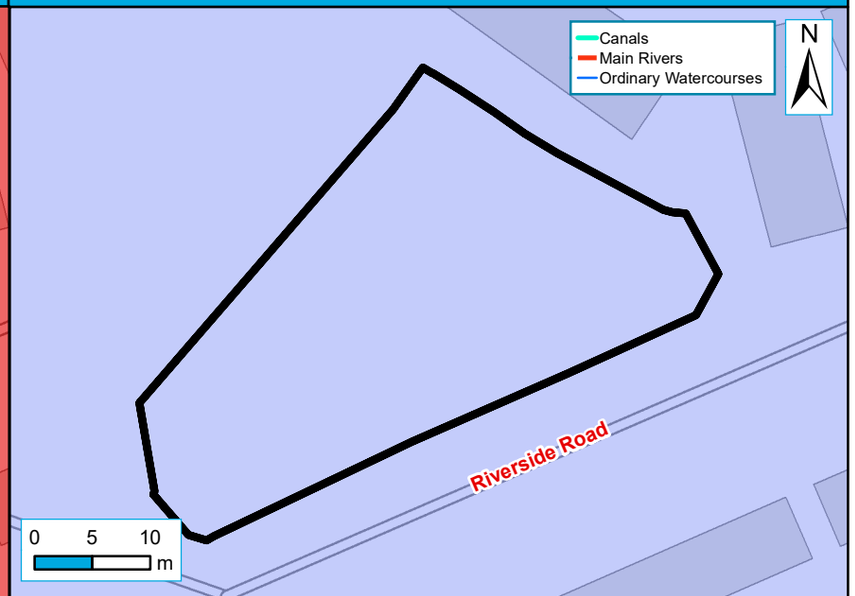
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk



Site Boundary
Other L2 Sites
Reservoir Flood Risk

Site reference	HS35
Site Name	Land and Garages at Riverside Road

Watford Borough Council
Strategic Flood Risk Assessment
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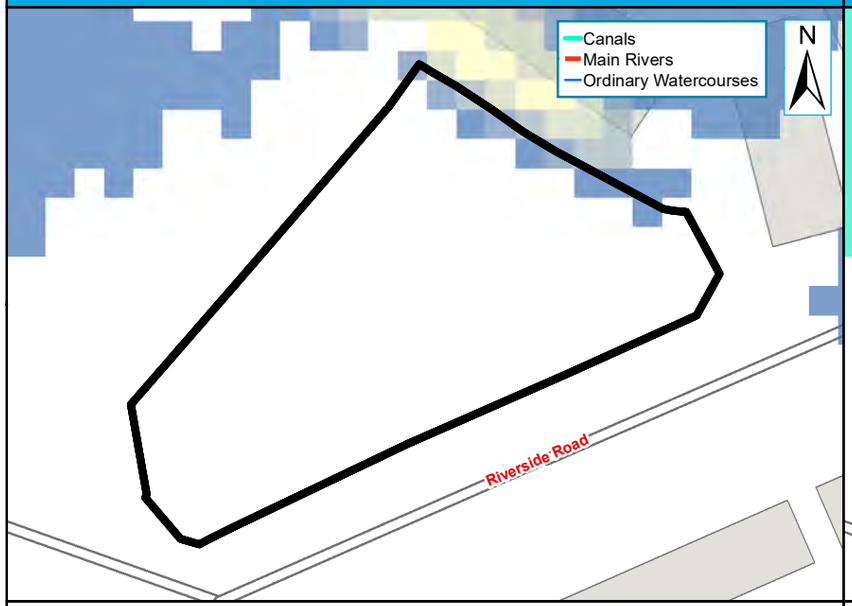
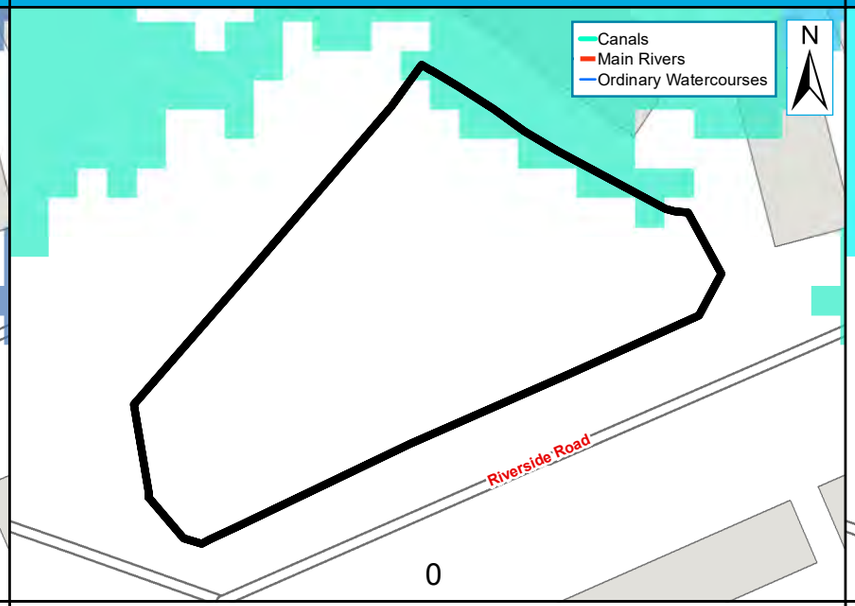
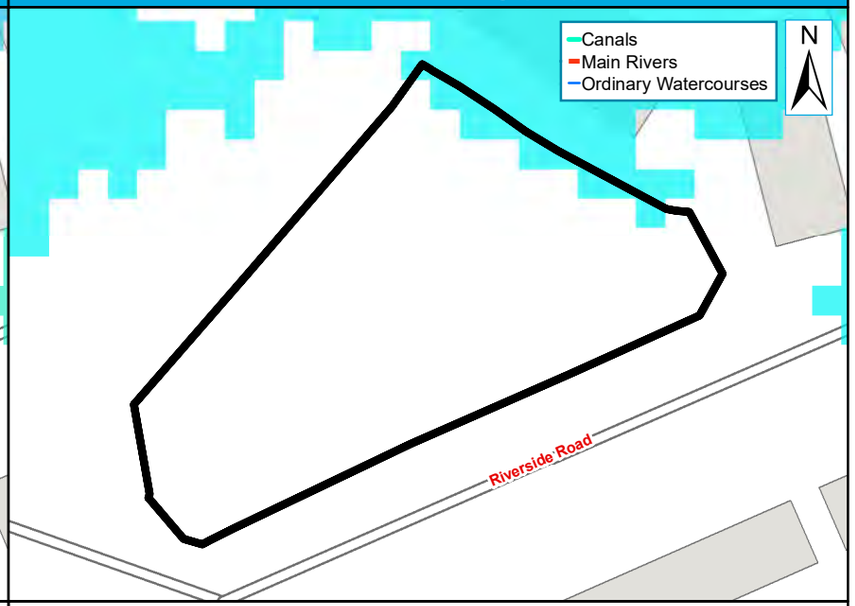
Maximum Fluvial Flood Depth (m) - 1% AEP



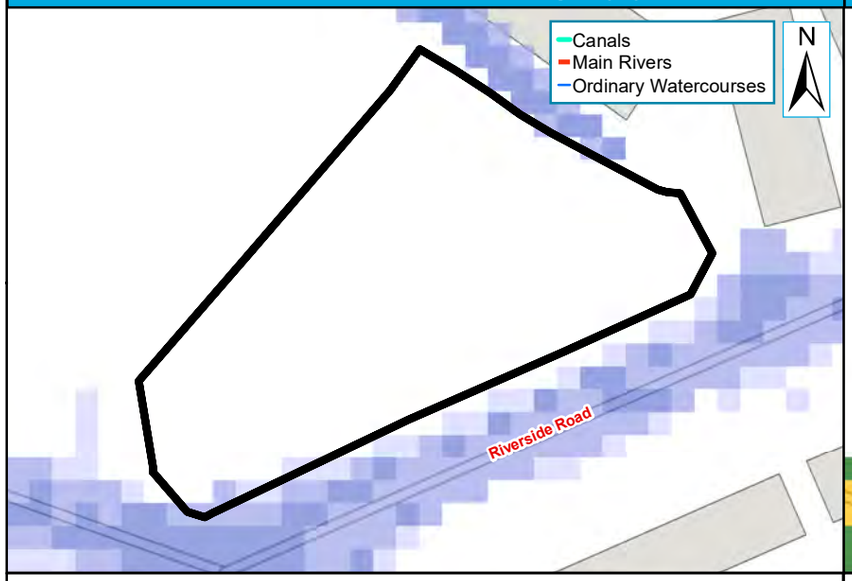
Maximum Fluvial Flood Level (mAOD) - 1% AEP



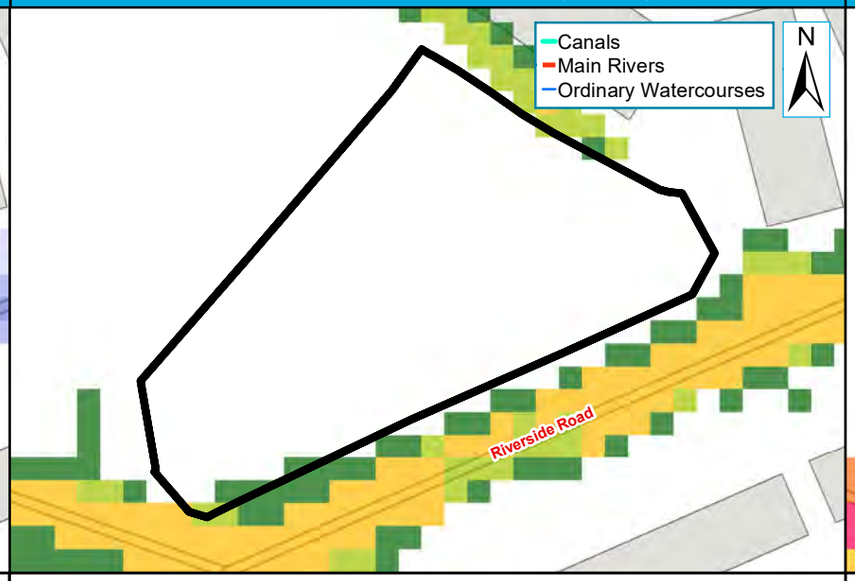
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



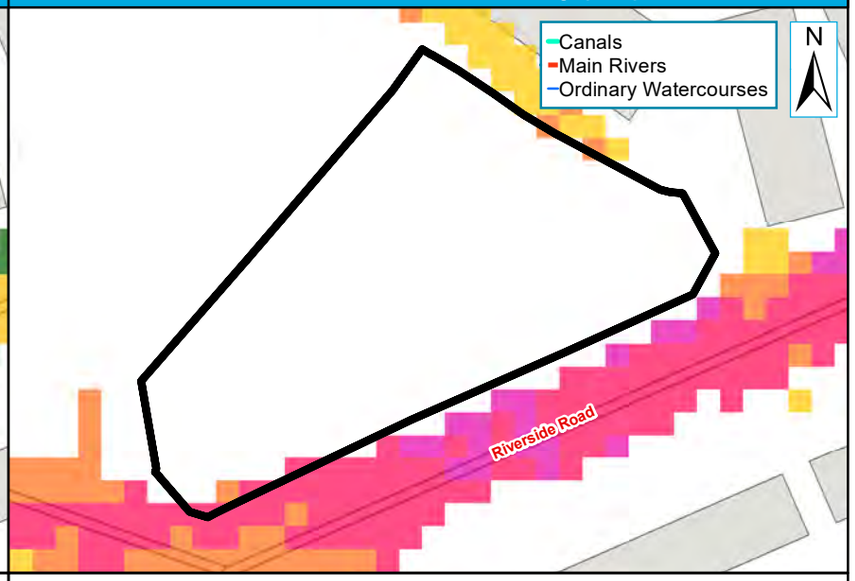
Maximum Surface Water Flood Depth (m) -1% AEP



Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Site code	MX06
Site name	Land at Watford Junction Station

Site details	**OS Grid reference**	TQ 11052 97405			
	Area	7.5 Ha			
	Current land use	Brownfield			
	Proposed site use	Mixed use – residential and commercial			
	Flood risk vulnerability	More vulnerable			
	Watford Sustainability Area Band	Area of High Sustainability			
Sources of flood risk	**Existing watercourses**	There are no watercourses within the site boundary.			
	Flood history	There are no recorded flood incidents within the site.			
	Fluvial	**Fluvial**			
		Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
			0%	0%	0%
		Available modelled data: There is no fluvial model data available for the site, as it is located within Flood Zone 1. **Flood characteristics:** The site is located within Flood Zone 1, and is therefore at negligible risk of fluvial flooding.			
	Surface Water	**Proportion of site at risk (RoFSW)**			
		3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**	
		9%	21%	50%	
		Description of surface water flow paths: The site is at high risk of surface water flooding. The highest areas of risk within the site are in the south (near the existing bus station) and in the north, which are at risk of flooding during a 3.3% AEP (1 in 30-year) rainfall event. A much larger area, through the centre of the site, is at risk of flooding during the 0.1% AEP (1 in 1,000-year) event.			
	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1% AEP (1 in 100-year) risk categories**			
		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**	
		0%	0%	0%	
		The entire site is at moderate risk of groundwater flooding, and is located within Category 3, where groundwater levels are predicted to lie 0.5 to 5m below the surface during a 1% AEP (1in 100-year) flood event.			

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Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX06
Site name	Land at Watford Junction Station

	Reservoir	The site is not at risk of reservoir flooding.		
	Canal	There are no canals witin the site.		
Flood risk management infrastructure	**Defences**	**Defence Type**	**Standard of Protection**	**Condition**
		There are no flood defences within the site.		
	Residual risk	**Culvert / structure blockage?**	There are no culverts or structures to pose a potential risk to the site.	
		Impounded water body failure?	The site is not at risk of flooding due to reservoir breach.	
		Defence breach / overtopping?	**Breach Zone**	
			N/A	
Emergency planning	**Flood warning**	The site is not covered by an EA Flood Warning or Flood Alert Area.		
	Access and egress	The south west of the site is likley to be accessed via Woodford Road. The entirety of this road is at risk of surface water flooding during the 0.1% AEP (1 in 1,000-year) event. The reamaining area of the site is likley to be accessed via St Albans Road, which is also at risk of surface water flooding during the 1 in 100-year event (1% AEP).		
Climate Change	**Climate change allowances for '2080s'**	**River Basin District**	**Central**	**Higher Central** / **Upper End**
		Thames	25%	35% / 70%
	Implications for the site	The site is predicted to remain within Flood Zone 1, when climate change allowances are applied. The 1% AEP (1 in 100-year) surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 0.1% (1 in 1,000-year) surface water flood extent.		

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX06
Site name	Land at Watford Junction Station

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.	
	Superficial Geology	There are glacial sand and gravel deposits across the site.	
	Soils	Freely draining slightly acidic loamy soil.	
	SuDS	SuDS are possible on all sites, including previously developed sites such as this one. All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a moderate risk of groundwater flooding, therefore further site investigation should be carried out to assess potential for drainage by infiltration, Including at least 12 months of groundwater level monitoring on site. If infiltration is suitable it should be avoided in areas where the depth to the water table is <1m.	
	Groundwater Source Protection Zone	The site is within Groundwater Source Protection Zone 2. This is defined as a 400-day travel time from a point below the water table.	
	Historic Landfill Site	There are no historic land fill sites within close proximity of the site.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction in surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Colne (from Confluence with Ver to Gade)	High
Recommend-ations for Local Plan policy	**Sequential Test and Exception Test requirements**		
	The site is within Flood Zone 1 but at risk from other sources of flooding. The Sequential Test must be passed. The Exception Test is not required under the NPPF, but it must be shown that the development will be safe for its lifetime and the risk can be managed through a sequential approach to design.		
	Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers		
	Flood risk assessment: • At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required. • Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage. • A site-specific flood risk assessment will be required because the site is at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).		

Site code	MX06
Site name	Land at Watford Junction Station

- Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
- Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future.
- The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration.

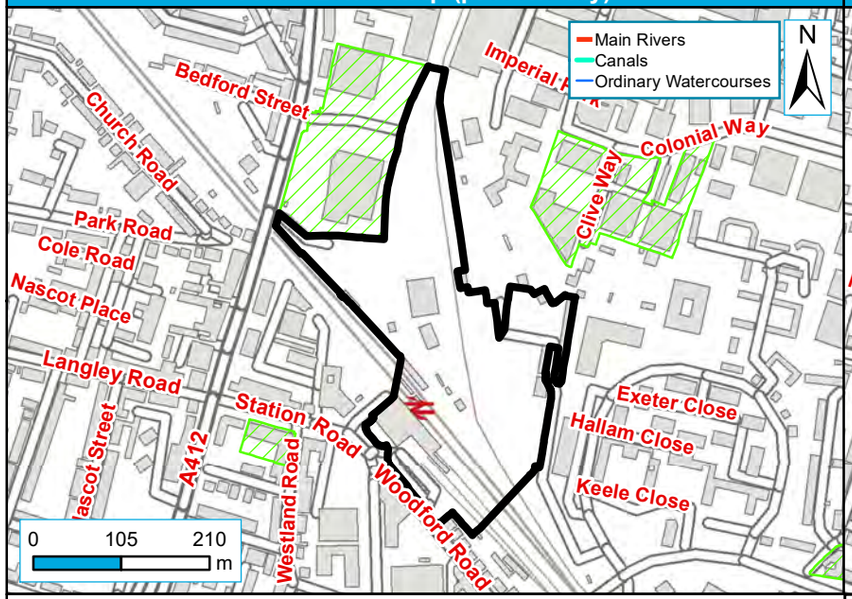
Guidance for site design and making development safe:

- Development must seek opportunities to reduce overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100 plus climate change event.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible.
- Example features may include swales, attenuation features, green roofs, rainwater capture and reuse and permeable paving.
- Storage for runoff from the development in extreme events should be located out of flood risk areas.
- Flow routes would need to be preserved if carrying out land-raising within an area of surface water flood risk area, and a safe access route provided.
- The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property.
- SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	MX06
Site Name	Land at Watford Junction Station

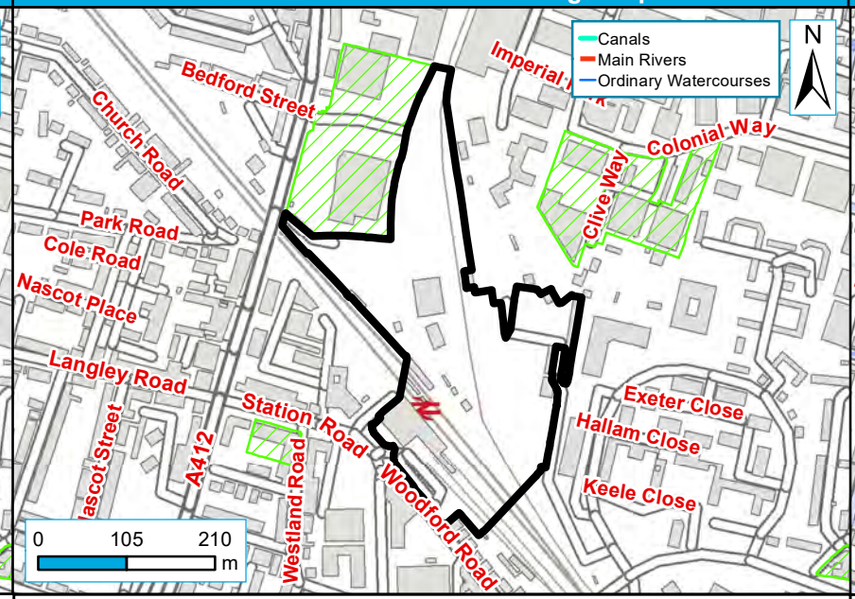
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



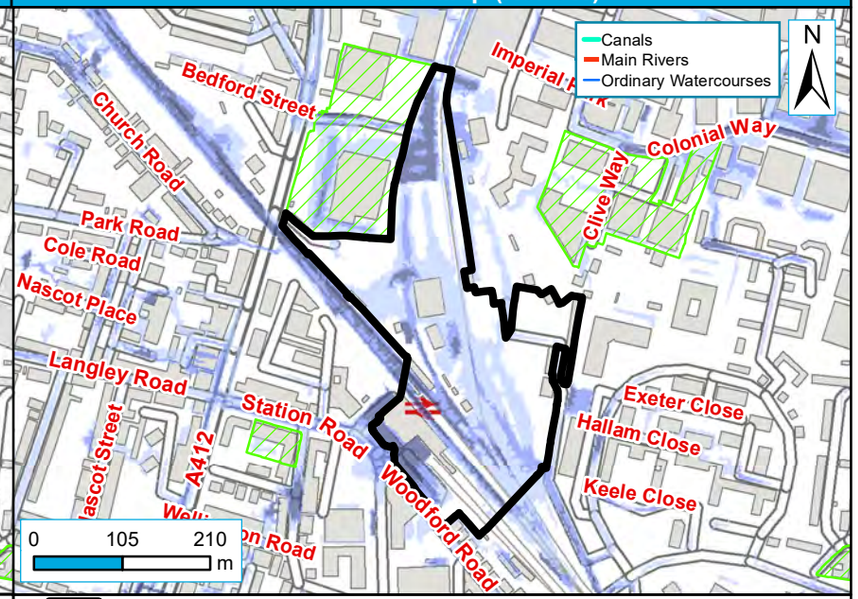
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



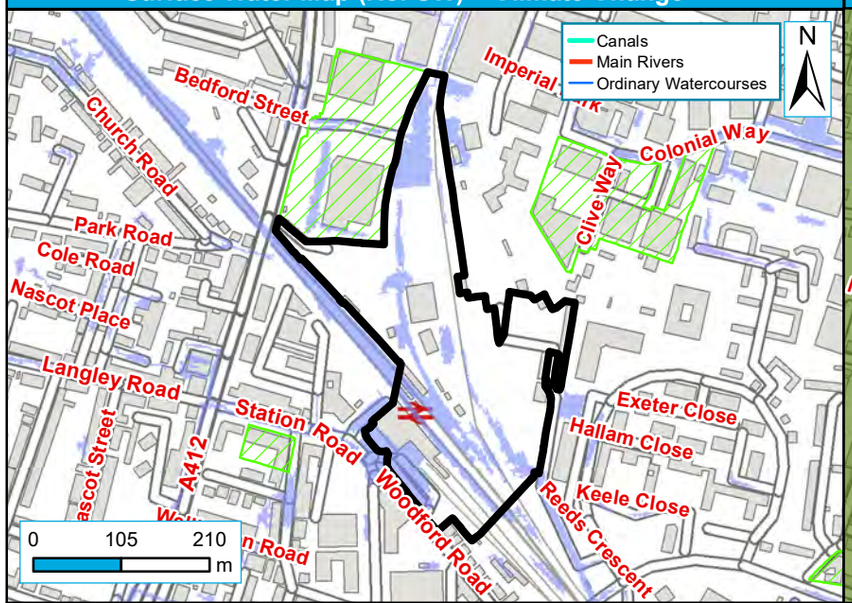
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



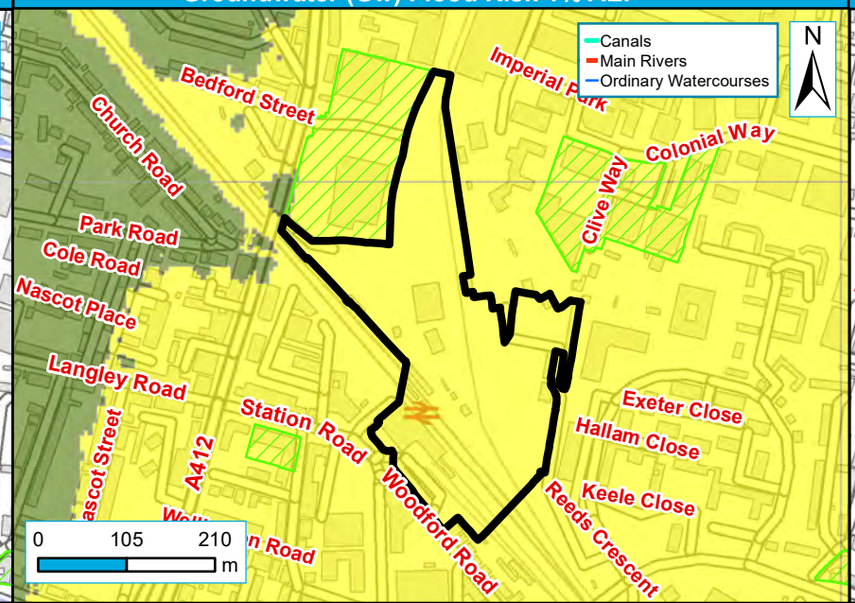
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



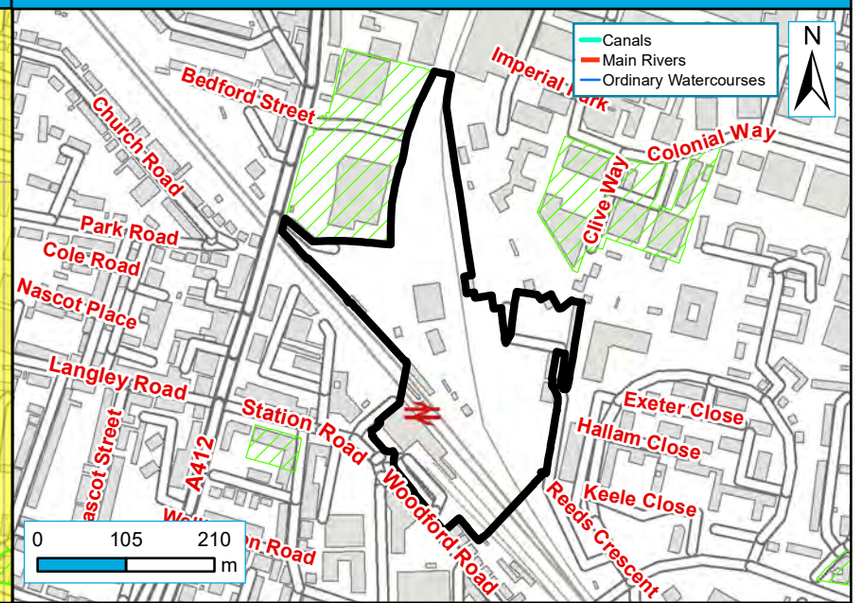
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

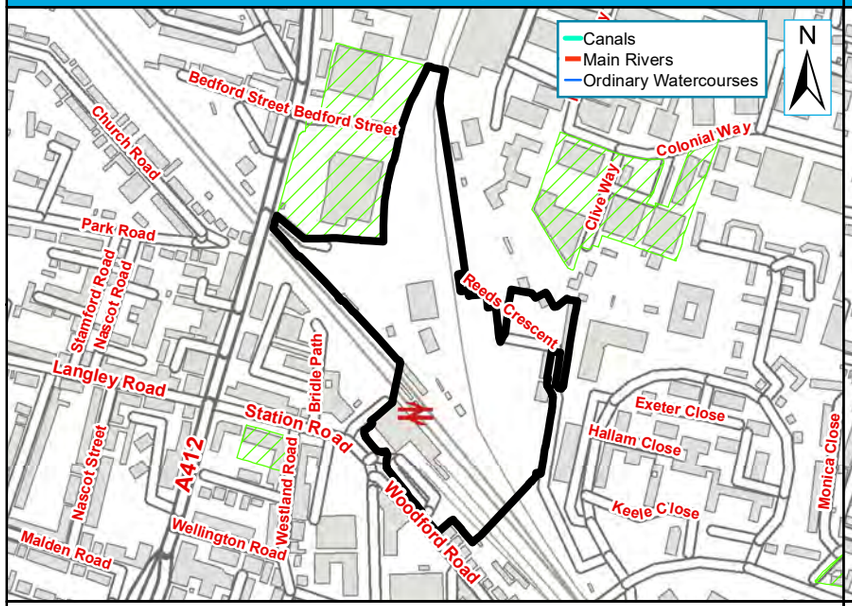


Site Boundary
Other L2 Sites
Reservoir Flood Risk

Site reference	MX06
Site Name	Land at Watford Junction Station

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

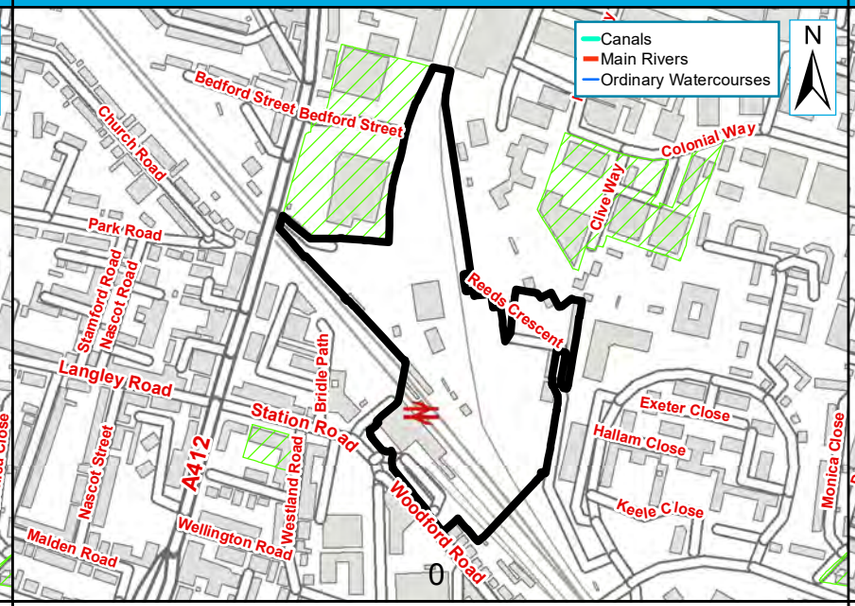
Maximum Fluvial Flood Depth (m) - 1% AEP



Site Boundary
Other L2 Sites
1% AEP Depth (m)
0 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.0
1.0 - 1.25
1.25 - 1.50
1.50 - 1.75
1.75 - 2.0
>2.0

0 100 200 m

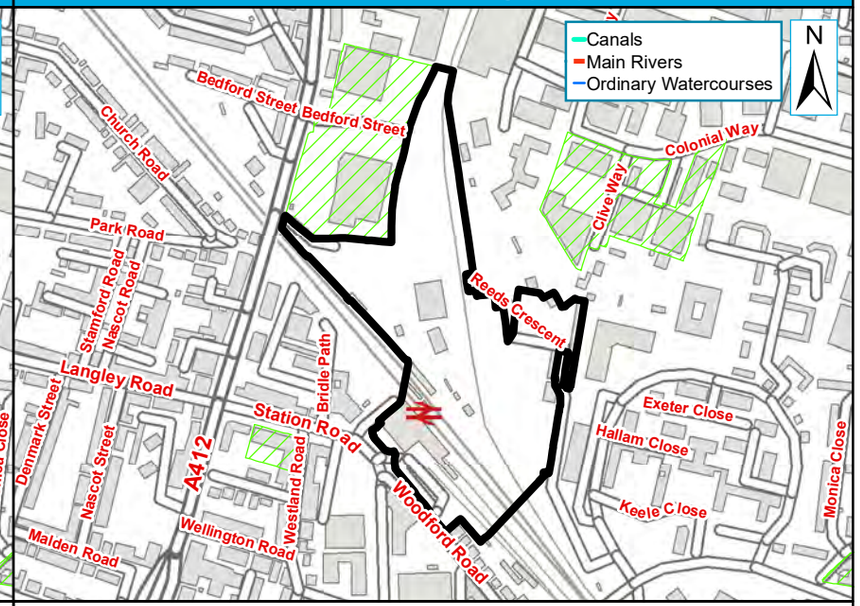
Maximum Fluvial Flood Level (mAOD) - 1% AEP



Site Boundary
Other L2 Sites
1% AEP Flood Level (mAOD)
41.7 - 45.6
45.6 - 48.8
48.8 - 52.6
52.6 - 56.8
56.8 - 67.2
67.2 - 73.0

0 100 200 m

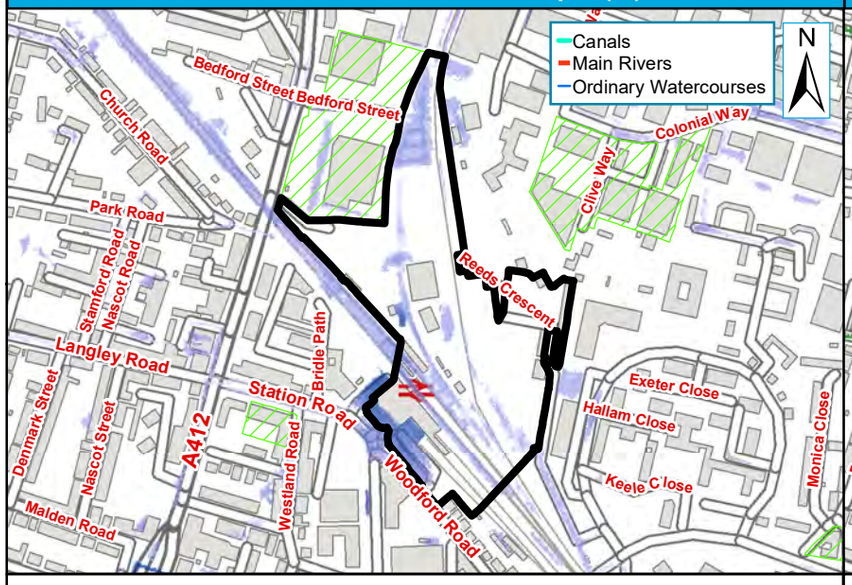
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



Site Boundary
Other L2 Sites
1% AEP Velocity (m/s)
0 - 0.25
0.25 - 0.5
0.5 - 1.0
1.0 - 2.0
>2.0

0 100 200 m

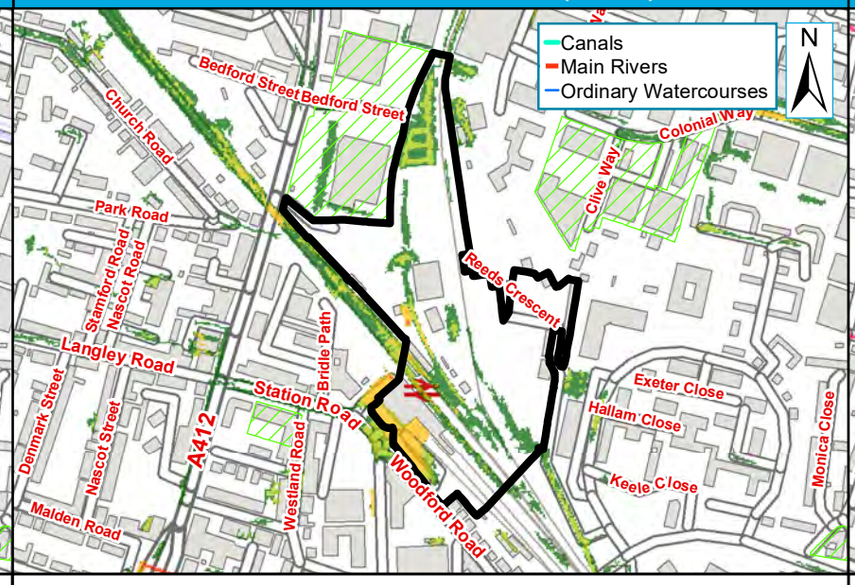
Maximum Surface Water Flood Depth (m) -1% AEP



Site Boundary
Other L2 Sites
RoFSW 1% AEP Depth (m)
0.00 - 0.15
0.15 - 0.30
0.30 - 0.60
0.60 - 0.90
0.90 - 1.20
> 1.20

0 100 200 m

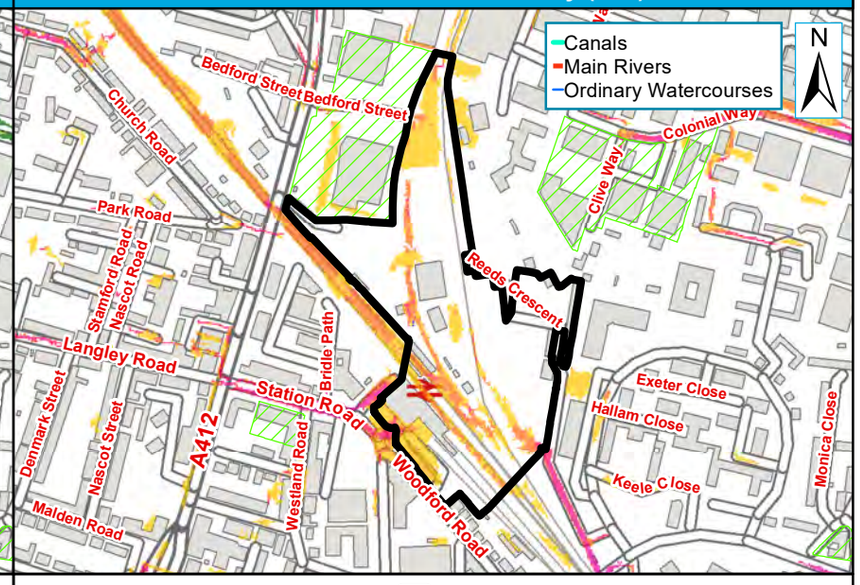
Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Site Boundary
Other L2 Sites
RoFSW 1% AEP Hazard
< 0.75 : Low
0.75 - 1.25 : Moderate
1.25 - 2.00 : Significant
> 2.00 : Extreme

0 100 200 m

Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Site Boundary
Other L2 Sites
RoFSW 1% AEP Velocity (m/s)
0 - 0.25
0.25 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 100 200 m

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX12
Site name	Land at Tesco, Lower High Street, Watford

Site details	**OS Grid reference**	TQ 11700 96099
	Area	7.6 Ha
	Current land use	Commercial site with parking area
	Proposed site use	Mixed use – residential and commercial
	Flood risk vulnerability	More vulnerable
	Watford Sustainability Area Band	Area of high sustainability
Sources of flood risk	**Existing watercourses**	The River Colne flows through the centre of the site in a southernly direction. There is also a culverted watercourse in the south east which connects to the River Colne.
	Flood history	The Environment Agency Recorded Flood Outlines dataset includes the following flood incidents within the site, all of which have occurred as a result of channel exceedance from the River Colne: • July 1987 • October 1993 • December 2000 • February 2009 • February 2014
	Fluvial	**Fluvial**

Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
	7%	30%	60%
Maximum modelled flood level on site (mAOD)	54.24	55.15	55.83

Available modelled data:

The site is covered by the Environment Agency 2010 Upper Colne model. Although a linked 1D-2D model, flood depth grids were not provided with this model. However, modelled water levels were provided and have been used. Due to instability of the model when run with higher flows, Flood Zone 2 has been used as a proxy for Flood Zone 3a + 70%CC.

Flood characteristics:

The majority of the site is located within Flood Zone 2, with a 0.1% chance of fluvial flooding in any given year. A significant area in the north and east of the site is also located within Flood Zone 3a, where there is a 1% chance of flooding in any given year. Flood Zone 3b, the functional floodplain, closely follows the channel of the River Colne.

Surface Water	**Proportion of site at risk (RoFSW)**		
	3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**
	3%	9%	41%

Site code	MX12
Site name	Land at Tesco, Lower High Street, Watford

		Description of surface water flow paths: The site is at risk of surface water flooding, predominantly during a 1 in 1,000-year (0.1% AEP) event. The north of the site is at greatest risk. It should be noted that this area is also within the fluvial flood zones. There are areas within the site that are at a higher risk (1 in 30-year event), but this is associated with the watercourse.		
	Groundwater	**Proportion of site at risk in JBA Groundwater Map 1% AEP (1 in 100-year) risk categories**		
		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**
		27%	71%	98%
		The site is at a high risk of groundwater flooding. Across the majority of the site, groundwater levels predicted to reach 0.025 – 0.5m below the ground surface during a 1% AEP event (Category 3). There are areas of higher risk (Category 4) in the north, centre and south west of the site, where the groundwater is estimated to lie within 0.025m of the ground surface for the same flood event.		
	Reservoir	The entire site is at risk of reservoir flooding in the extremely unlikely event of a breach at Aldenham or Hilfield Park reservoirs.		
	Canal	There are no canals witin the site.		

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX12
Site name	Land at Tesco, Lower High Street, Watford

Flood risk management infrastructure	**Flood defences**	**Defence Type**	**Standard of Protection**	**Condition**
		There are no defences within the site or within close proximity. However, flood defence walls on the River Colne are located 25m downstream of the site. Therefore, the south west boundary of the site is classified as benefiting from defence.		
	Residual risk	**Culvert / structure blockage?**	The A411 bridge over the River Colne, at the south of the site, poses a risk of blockage, although as an open span structure it is not considered to have a high probability of blocking. Results of detailed modelling indicate that blockage of this culvert by 75% significantly increase the risk of flooding during the 1% AEP event, with the majority of the site at risk. Peak flood depths range from 0.02m in the south west of the site, to 3.0m on the northern access roads. The extent of flooding increases with 90% blockage of the bridge, although flood depths remain within a similar range.	
		Impounded water body failure?	In the unlikely event of a reservoir breach at Aldenham Reservoir or Hilfield Park Reservoir, the entire site would be at risk of flooding.	
		Defence breach / overtopping?	**Breach Zone**	
			N/A	
Emergency planning	**Flood warning**	The site is within the following Environment Agency Flood Alert and Flood Warning Areas: • Flood Alert Area: The Middle River Colne at Watford and Rickmansworth including Carpenders Park • Flood Warning Area: The River Colne at Watford including Bushey.		
	Access and egress	There are multiple routes providing access to the site, includimg Water Lane to the north, A411 Waterfields Way to the east/south east and Lower High Street to the south west. Water Lane is located wihin Flood Zone 3b and is therefore at high risk of fluvial flooding, wih access predicted to be restricted during a 5% AEP (1 in 20-year) fluvial flood event. However, the road is at very low risk of surface water flooding. Lower High Street is also at high fluvial risk, particularly near the junction with A411 Waterfields Way, with flooding predicted to restrict access during a 1% AEP (1 in 100-year) and 0.1% AEP (1 in 1,000-year) fluvial flood event. The route is also predicted to flood from surface water during the 3.3% AEP (1 in 30-year) and greater rainfall events. A411 Waterfields Way is located within Flood Zone 3a and therefore, access is likely to be affected by flooding during a 1% AEP (1 in 100-year) fluvial event. However, the surface water flood risk is lower, with only the roundabout to the south east of the site affected during the 1% AEP (1 in 100-year) rainfall event.		

Climate Change	**Climate change allowances for '2080s'**	**River Basin District**	**Central**	**Higher Central**	**Upper End**
		Thames	25%	35%	70%

Site code	MX12
Site name	Land at Tesco, Lower High Street, Watford

	Implications for the site	Due to model instability witihn the Upper Colne when applying plus 35% and 70% climate change allowances to inflows, Flood Zone 2 has been used as a proxy for the extent of Flood Zone 3a plus climate change. This provides a conservative extent, with 90% of the site identified as at risk from a 1% AEP (1 in 100-year) plus 35%/70% climate change flood event. The 1% AEP (1 in 100-year) surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 0.1% AEP (1 in 1,000-year) surface water flood extent.

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX12
Site name	Land at Tesco, Lower High Street, Watford

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.
	Superficial (surface) Geology	The majority of the site is overlain with alluvial deposits. Along the eastern border there is an area of glacial sands and gravels.
	Soils	The site contains loamy and clayey floodplain soils, with naturally high groundwater.
	SuDS	Storage of surface water runoff from the development during extreme events should be located out of fluvial flood risk areas. Due to the constrained space outside Flood Zones 2 and 3, it is advised that source control SuDS techniques (such as green roofs, rainwater harvesting and permeable paving) are utilised across the site. Conveyance features should be designed above ground and follow natural flow paths where possible. Groundwater flood risk is variable across the site and therefore it is recommended that groundwater monitoring is undertaken (preferably during winter months), to better understand the groundwater dynamics. Where below ground storage is proposed, the base of the feature must be located at least 1m above the highest groundwater level, to reduce the risk of groundwater ingress or flotation. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding and its location within Groundwater Source Protection Zone 1. Therefore further site investigation should be carried out to assess potential for drainage by infiltration, including at least 12 months of groundwater level monitoring on site. Infiltration techniques should only be used where there are suitable levels of surface water runoff treatment, and following the granting of any required environmental permits from the Environment Agency.
	Groundwater Source Protection Zone (SPZ)	The site is within Groundwater Source Protection Zone 1 (inner zone). This is defined as the 50-day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.
	Historic Landfill Site	There are no historic landfill sites within the site boundary or within close proximity.

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX12
Site name	Land at Tesco, Lower High Street, Watford

<table>
<tr><td rowspan="3"></td><td>Opportunities for flood risk betterment</td><td colspan="2">Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of flood peaks downstream on the River Colne and existing surface water flow paths leaving the site.
Redevelopment of the site should look to reduce coverage of impermeable areas, where possible.
The River Colne is heavily engineered at this location, and opportunities should be taken to re-naturalise the watercourse, to help mitigate flood risk downstream. Removal, or ‘daylighting’ of the culvert in the east of the site should be undertaken where possible, to increase biodiversity and reduce the risk of flooding due to blockage.
Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.</td></tr>
<tr><td rowspan="2">Cumulative impacts of development (see SW Herts L1 SFRA, 2019)</td><td>Water Framework Directive Catchment</td><td>Sensitivity to cumulative impacts</td></tr>
<tr><td>Colne (from Confluence with Ver to Gade)</td><td>High</td></tr>
<tr><td rowspan="3">Recommend-ations for Local Plan policy</td><td colspan="2">Sequential Test an Exception Test requirements</td></tr>
<tr><td colspan="2">The Sequential Test must be passed. Only once the Sequential Test is passed should the Exception Test be applied. For this site, the Exception Test would be required:
• If More Vulnerable and Essential Infrastructure is located in FZ3a or FZ3a plus climate change.
• If Highly Vulnerable development is located in FZ2.
• If Essential Infrastructure is located in Flood Zone 3b
Development will not be permitted in the following scenarios:
• Highly Vulnerable development within FZ3a or FZ3a plus climate change and FZ3b.
• More Vulnerable and Less Vulnerable development within FZ3b.
• More Vulnerable and Less Vulnerable development within FZ3b.

For this site, More Vulnerable development is proposed within FZ3a, and therefore, the Exception Test must be applied.
The site is at high risk of flooding from multiple sources, and therefore it may not be safe to develop the site for residential purposes. Evidence that both parts of the Exception Test can be fulfilled will be required to justify development of the site.</td></tr>
<tr><td colspan="2">Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers</td></tr>
<tr><td colspan="2">Flood risk assessment:
• At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required.
• Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.
• A site-specific flood risk assessment will be required because the site is within Flood Zone 2 and 3 and at risk from sources of flooding other than rivers. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).
• Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
• Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-</td></tr>
</table>

Site code	MX12
Site name	Land at Tesco, Lower High Street, Watford

allowances) for the type of development and level of risk. The current allowances were published in February 2016 but will be subject to change in the future.

- The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration.

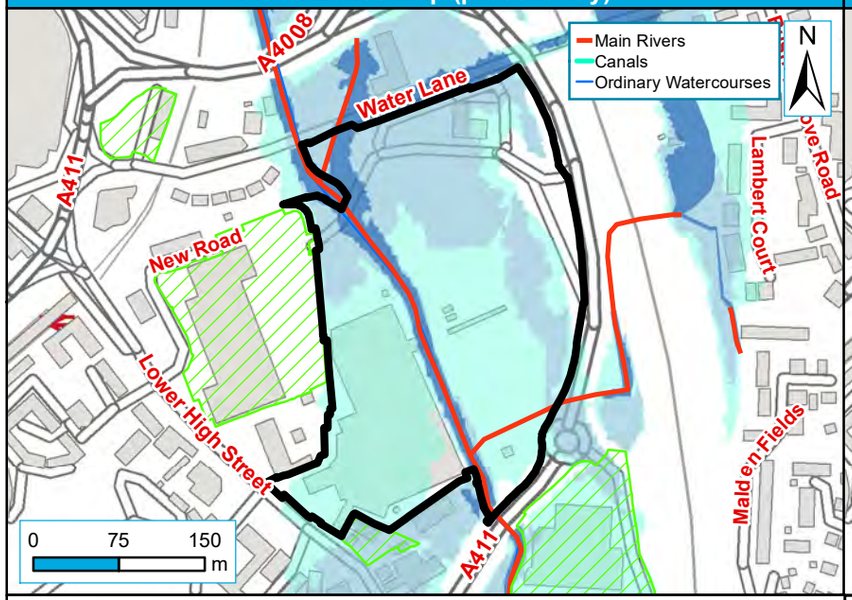
Guidance for site design and making development safe:

- Development must seek opportunities to reduce the overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100-year plus climate change event.
- All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- Storage for runoff from the development in extreme events should be located out of fluvial flood risk areas.
- Floodplain compensation must be demonstrated for any loss in floodplain storage through the raising of levels for development.
- Mitigation for seasonal high groundwater levels must be considered (for example by raising finished floor levels to an appropriate height above ground level).
- Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above-ground conveyance and attenuation can be used, but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.
- The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property.
- SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	MX12
Site Name	Land at Tesco Lower High Street

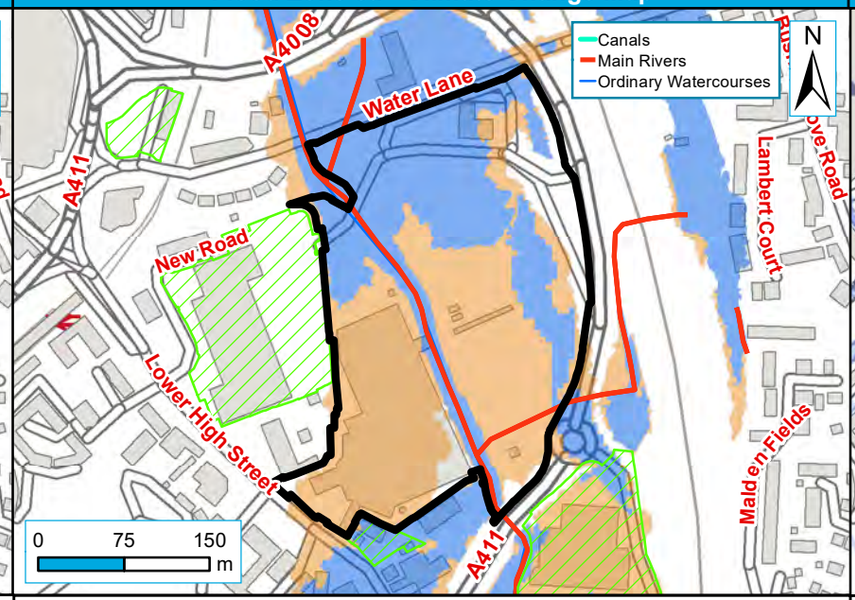
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



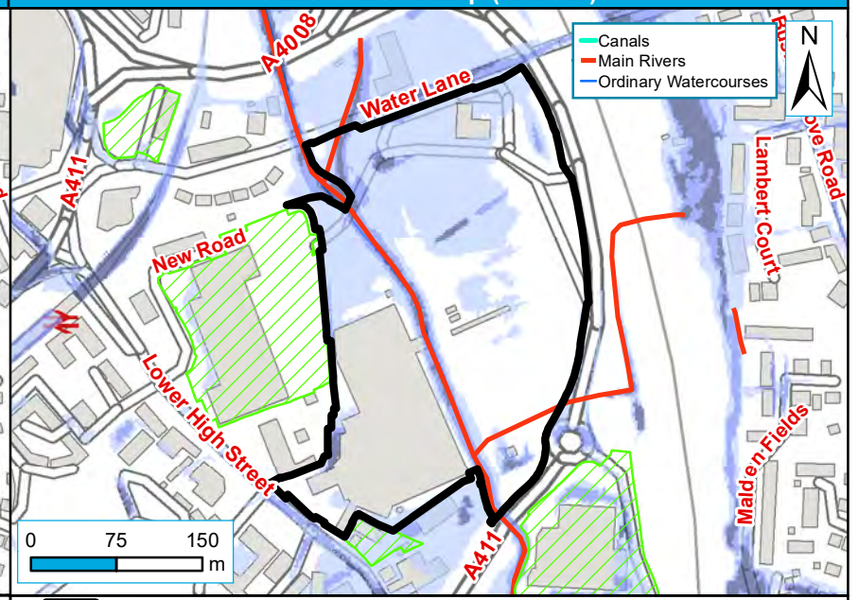
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



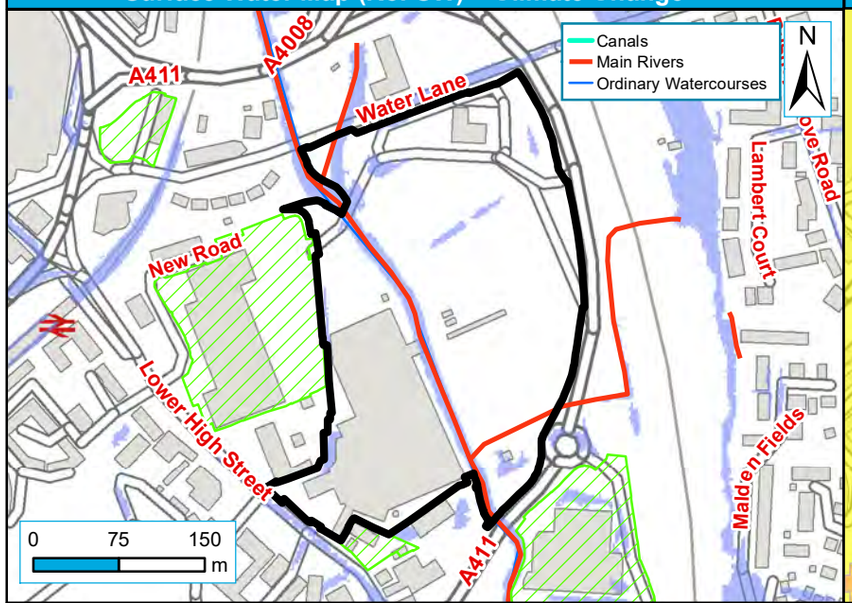
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



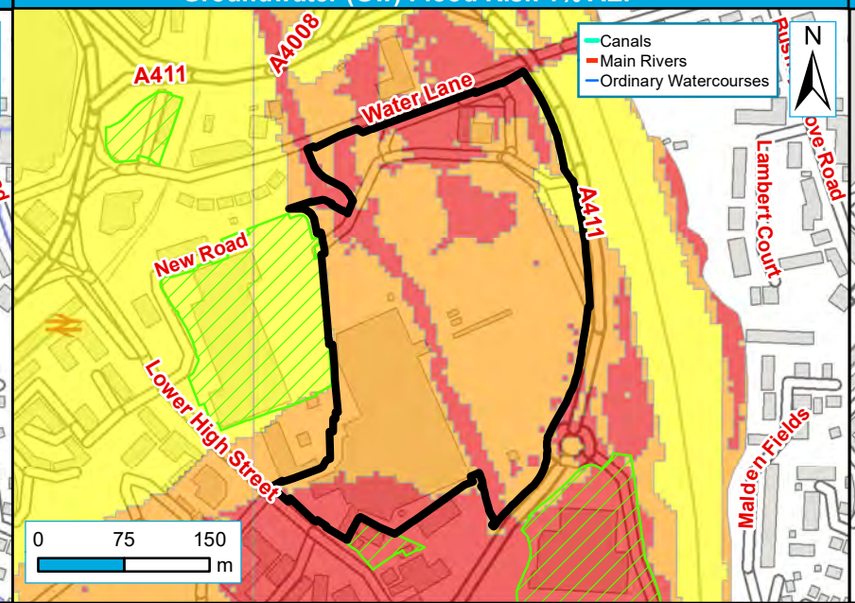
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



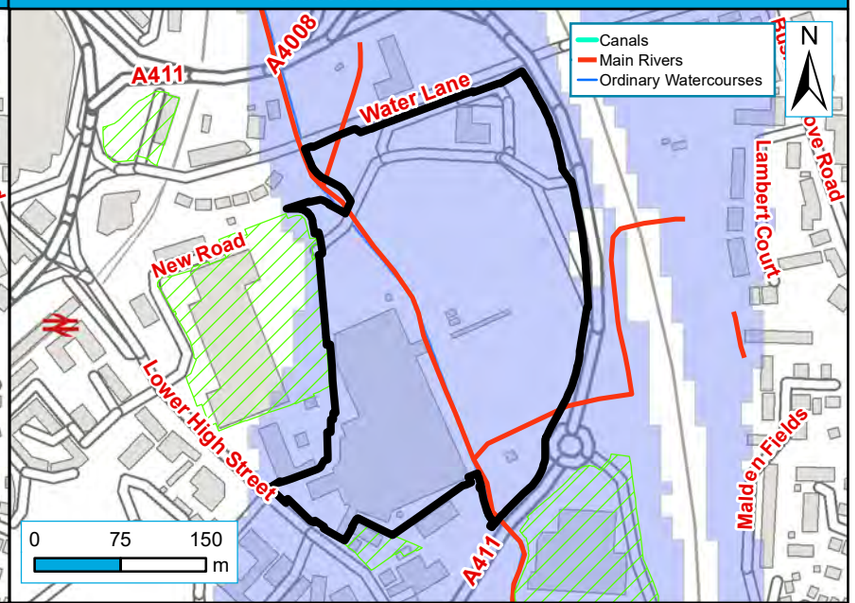
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

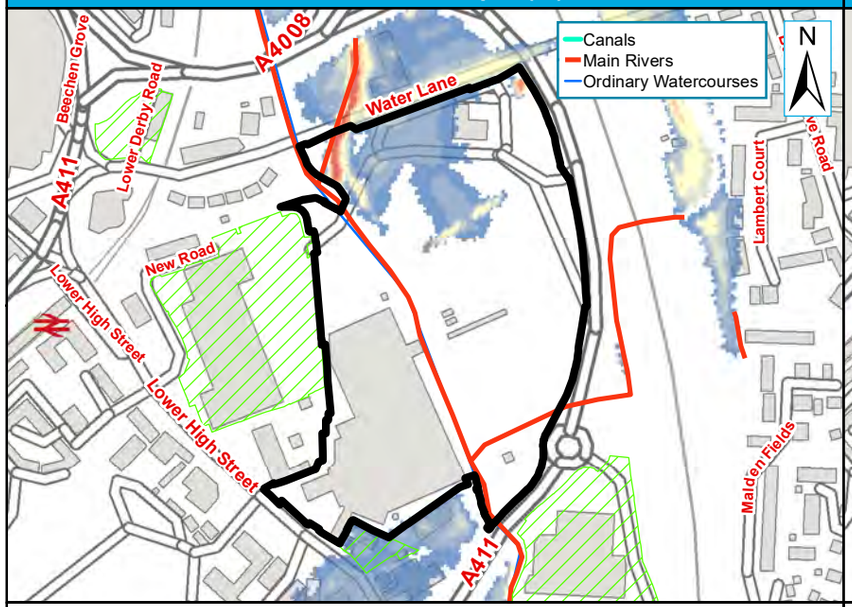


Site Boundary
Other L2 Sites
Reservoir Flood Risk

Site reference	MX12
Site Name	Land at Tesco Lower High Street

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

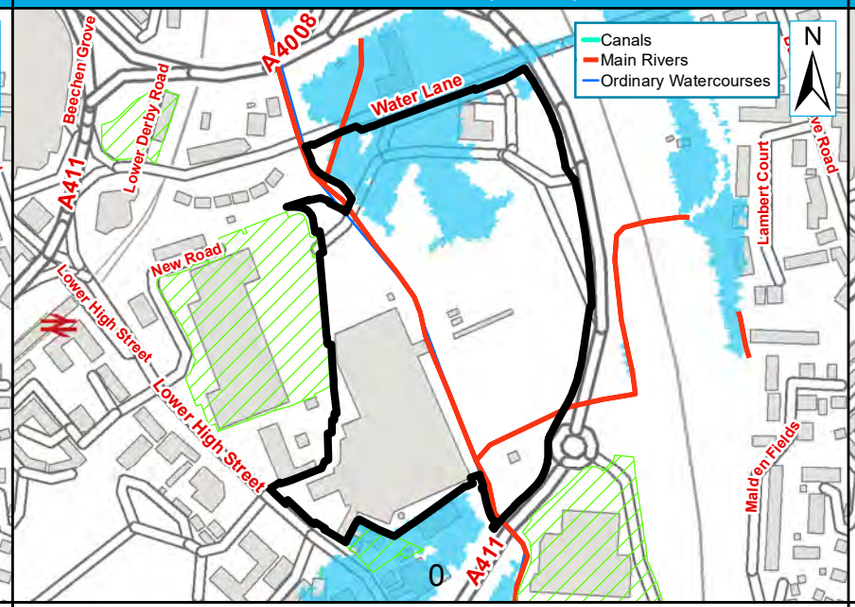
Maximum Fluvial Flood Depth (m) - 1% AEP



Site Boundary **1% AEP**
Other L2 Sites **Depth (m)**
0 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.0
1.0 - 1.25
1.25 - 1.50
1.50 - 1.75
1.75 - 2.0
>2.0

0 75 150 m

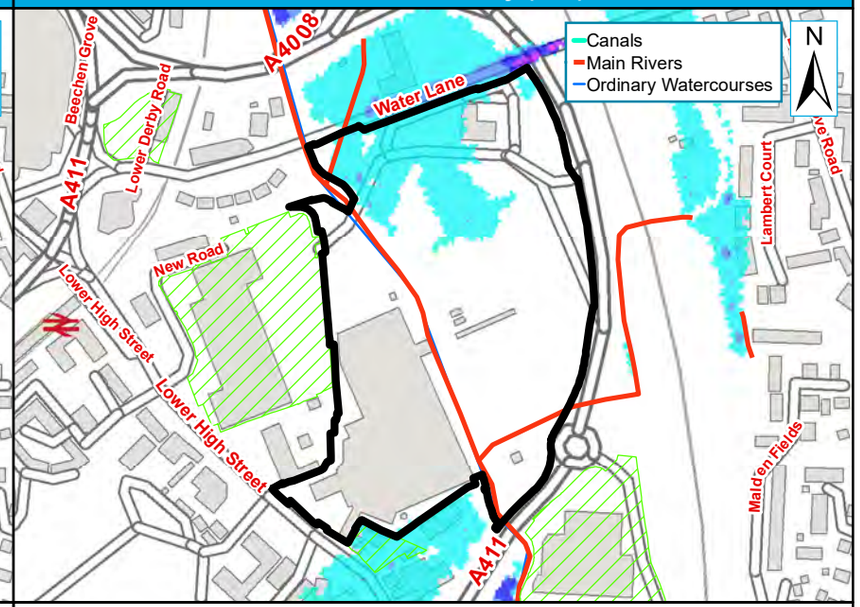
Maximum Fluvial Flood Level (mAOD) - 1% AEP



Site Boundary **1% AEP**
Other L2 Sites **Flood Level (mAOD)**
41.7 - 45.6
45.6 - 48.8
48.8 - 52.6
52.6 - 56.8
56.8 - 67.2
67.2 - 73.0

0 75 150 m

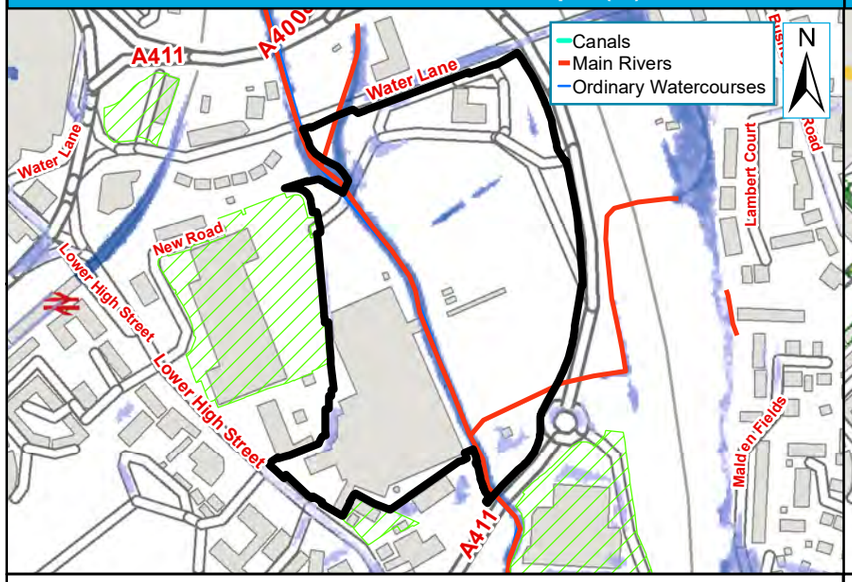
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



Site Boundary **1% AEP**
Other L2 Sites **Velocity (m/s)**
0 - 0.25
0.25 - 0.5
0.5 - 1.0
1.0 - 2.0
>2.0

0 75 150 m

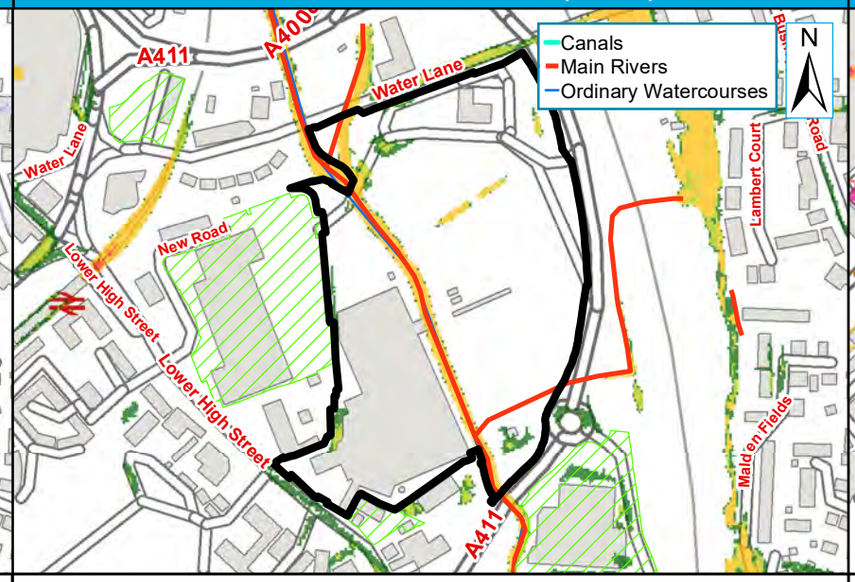
Maximum Surface Water Flood Depth (m) -1% AEP



Site Boundary **RoFSW 1% AEP**
Other L2 Sites **Depth (m)**
0.00 - 0.15
0.15 - 0.30
0.30 - 0.60
0.60 - 0.90
0.90 - 1.20
> 1.20

0 70 140 m

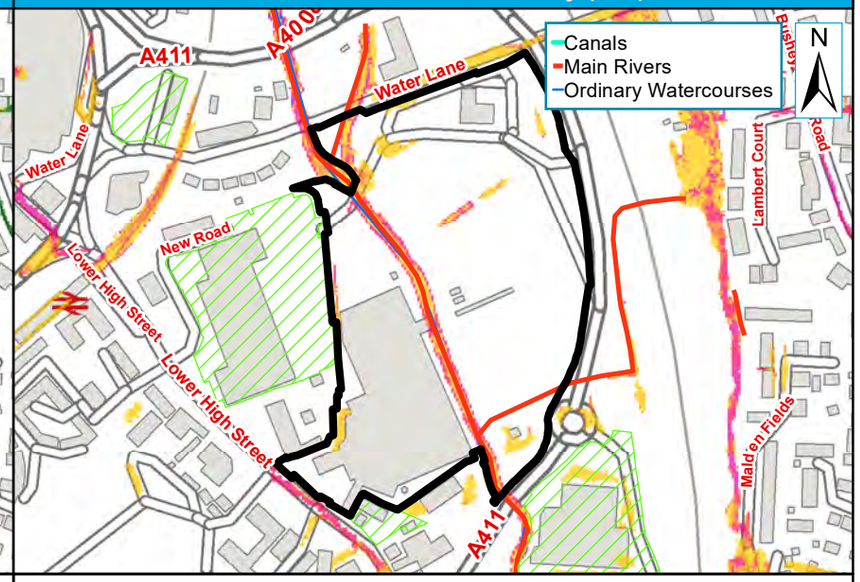
Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Site Boundary **RoFSW 1% AEP**
Other L2 Sites **Hazard**
< 0.75 : Low
0.75 - 1.25 : Moderate
1.25 - 2.00 : Significant
> 2.00 : Extreme

0 75 150 m

Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Site Boundary **RoFSW 1% AEP**
Other L2 Sites **Velocity (m/s)**
0 - 0.25
0.25 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 75 150 m

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX14
Site name	Colne Valley Retail Park

Site details	**OS Grid reference**	TQ 11809 95814
	Area	2.6 Ha
	Current land use	Brownfield
	Proposed site use	Mixed use – residential and employment
	Flood risk vulnerability	More vulnerable
	Watford Sustainability Area Band	Area of High Sustainability
Sources of flood risk)	**Existing watercourses**	The River Colne flows in a southerly direction along the western boundary of the site.
	Flood history	The EA Recorded Flood Outlines identifies that the site has previously been affected by multiple fluvial flood events due to channel exceedance of the River Colne. The incidents occurred in: • July 1987 • December 2000 • January 2003
	Fluvial	**Fluvial**

Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
	1%	12%	84%
Maximum modelled flood level on site (mAOD)	N/A	N/A	55.15

Available modelled data:
The site is covered by the 2010 Upper Colne 1D-2D hydraulic model. Flood depth and hazard results were not provided with this model, and therefore water level results have been used. Flood Zone 2 has been used as a proxy for Flood Zone 3a +35%CC and +70%CC extents, as the Upper Colne model became unstable when higher flows were applied.
Flood levels for Flood Zone 3a were not available within the site boundary.

Flood characteristics:
The majority of the site is within Flood Zone 2, with fluvial flooding expected to occur during a 0.1% AEP (1 in 1,000-year) event. The centre and north of the site are also located within Flood Zone 3a, with flooding expected during the 1% AEP (1 in 100-year) event.

Surface Water	**Proportion of site at risk (RoFSW)**	
3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**
3%	12%	33%

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX14
Site name	Colne Valley Retail Park

		Description of surface water flow paths: The centre and north of the site are at high risk of surface water flooding. Small areas of ponding are predicted to form in low points in the centre and north of the site during the 3.3% AEP (1 in 30-year) rainfall event, which extends during the 1% AEP and 0.1% AEP events, to cover a significantly larger area of the site.		
	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1% AEP (1 in 100-year risk categories**		
		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**
		98%	2%	100%
		The site is at high risk of groundwater flooding, with the site located within Category 4 (where groundwater is predicted to lie at or within 0.025m of the surface during a 1% AEP event).		
	Reservoir	The entire site is at risk of reservoir flooding, in the extremely unlikely event of a breach at Aldenham or Hilfield Park reservoir.		
	Canal	There are no canals witin the site.		

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX14
Site name	Colne Valley Retail Park

<table>
<tr><td rowspan="6">Flood risk management infrastructure</td><td rowspan="2">Defences</td><td>Defence Type</td><td>Standard of Protection</td><td>Condition</td></tr>
<tr><td>Concrete bank protection (filled in with brickwork where gaps)</td><td>1 in 2-year</td><td>2</td></tr>
<tr><td colspan="3">Raised concrete bank protection is located along the western border of the site, on the left bank of the River Colne. The centre of the site is defined as benefitting from this defence.</td></tr>
<tr><td rowspan="3">Residual risk</td><td>Culvert / structure blockage?</td><td colspan="2">There are no culverts located within the site boundary.</td></tr>
<tr><td>Impounded water body failure?</td><td colspan="2">The site is at risk of reservoir flooding in the rare event of reservoir flooding. The risk is associated with a breach at Aldenham or Hilfield Park reservoir.</td></tr>
<tr><td>Defence breach / overtopping?</td><td colspan="2">Breach Zone
A breach of the flood defence along the western boundary has been assessed in detail, as it is identified as providing benefit to areas of the site. Model results for the 1% AEP event indicate that a breach would result in a significant increase in flood extent, extending to affect the majority of the site. Maximum flood depths are predicted to range between 0.1 – 0.57m, with the deepest flood waters in the central and northern areas of the site. Results are provided in Appendix D.</td></tr>
<tr><td rowspan="2">Emergency planning</td><td>Flood warning</td><td colspan="3">The site is included within both EA Flood Warning and Flood Alert Areas:
• Flood Alert Area: The Middle River Colne at Watford and Rickmansworth including Carpenders Park
• Flood Warning Area: The River Colne at Watford including Bushey</td></tr>
<tr><td>Access and egress</td><td colspan="3">The site is likley to be accessed via Waterfields Way, at the northern border of the site. The route is affected by fluvial flooding during the 0.1%AEP (Flood Zone 2) and 1%AEP (Flood Zone 3a). The road is also affected by surface water flooding during the 1% and 0.1% AEP rainfall events.</td></tr>
<tr><td rowspan="3">Climate Change</td><td rowspan="2">Climate change allowances for ‘2080s’</td><td>River Basin District</td><td>Central</td><td>Higher Central</td><td>Upper End</td></tr>
<tr><td>Thames</td><td>25%</td><td>35%</td><td>70%</td></tr>
<tr><td>Implications for the site</td><td colspan="4">Due to model instability when applying 35% and 70% climate change allowances to inflows, Flood Zone 2 has been used as a proxy for climate change. This provides a conservative extent, with 96% of the site identified as at risk from a 1% AEP (1 in 100-year) + 70%CC flood event.

The 1% AEP (1 in 100-year) surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 0.1% AEP (1 in 1,000-year) surface water flood extent.</td></tr>
</table>

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX14
Site name	Colne Valley Retail Park

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.	
	Superficial Geology	There are glacial sand and gravel deposits across the site.	
	Soils	Loamy and clayey floodplain soils with naturally high groundwater.	
	SuDS	Due to the constrained space outside Flood Zones 2 and 3, it is advised that source control SuDS techniques (such as green roofs, rainwater harvesting and permeable paving) are utilised across the site. Conveyance features should be designed above ground and follow natural flow paths where possible. Where below ground storage is proposed, the base of the feature must be located at least 1m above the highest groundwater level, to reduce the risk of groundwater ingress or flotation. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding and its location within Groundwater Source Protection Zone 1. Therefore further site investigation should be carried out to assess potential for drainage by infiltration, including at least 12 months of groundwater level monitoring on site. Infiltration techniques should only be used where there are suitable levels of surface water runoff treatment, and following the granting of any required environmental permits from the Environment Agency.	
	Groundwater Source Protection Zone	The site is within Groundwater Source Protection Zone 1 (inner zone). This is defined as the 50-day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There are no historic landfill sites within the site or within close proximity.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of flood peaks downstream on the River Colne and existing surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Colne (from Confluence with Ver to Gade)	High
Recommend-ations for Local Plan policy	**Sequential Test and Exception Test requirements**		
	The Sequential Test must be passed. For this site, More Vulnerable development is proposed within FZ3a, and therefore, the Exception Test must be applied. The site is at high risk of flooding from multiple sources, and therefore it may not be safe to develop the site for residential purposes. Strong evidence that both parts of the Exception Test can be fulfilled will be required to justify development of the site.		

Site code	MX14
Site name	Colne Valley Retail Park

Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers

Flood risk assessment:

- At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.
- A site-specific flood risk assessment will be required because the site is within Flood Zone 2 and 3 and at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).
- Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
- Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future.
- The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration.

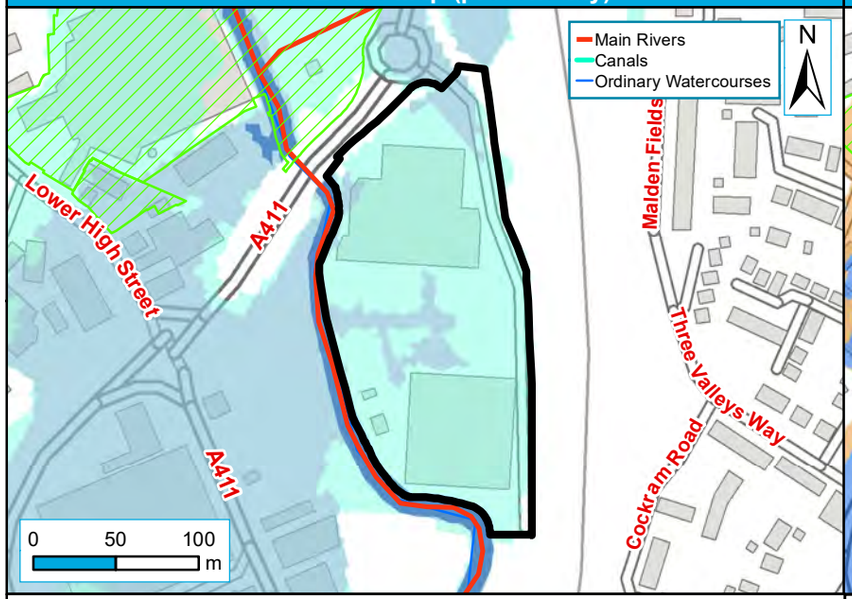
Guidance for site design and making development safe:

- Development must seek opportunities to reduce overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100 plus climate change event.
- SuDS are possible on all sites and a greenfield site such as this should be able to implement an exemplar scheme to deliver multiple benefits including water quality, biodiversity, amenity, green infrastructure etc.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible.
- Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.
- Example features may include swales, attenuation features, green roofs, rainwater capture and reuse and permeable paving.
- Storage for runoff from the development in extreme events should be located out of flood risk areas.
- The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property.
- SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	MX14
Site Name	Colne Valley Retail Park

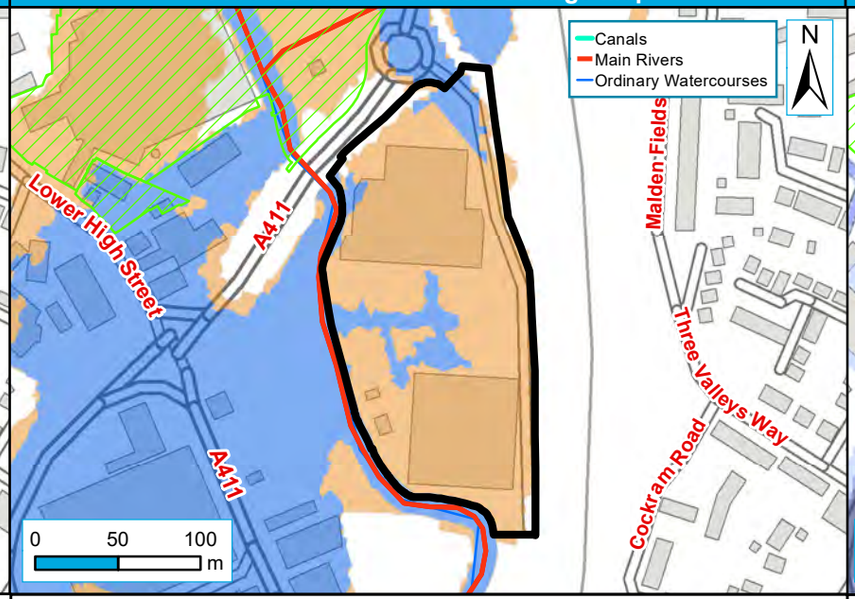
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



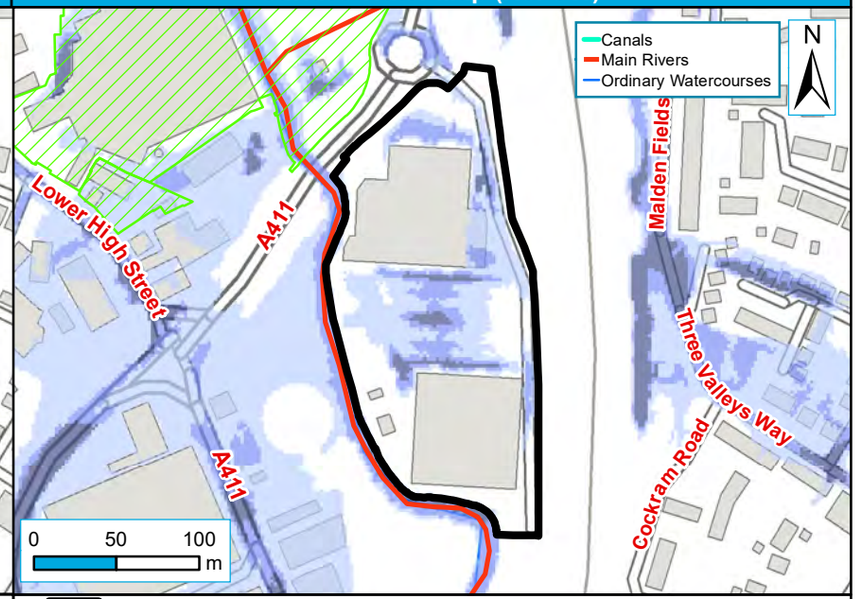
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



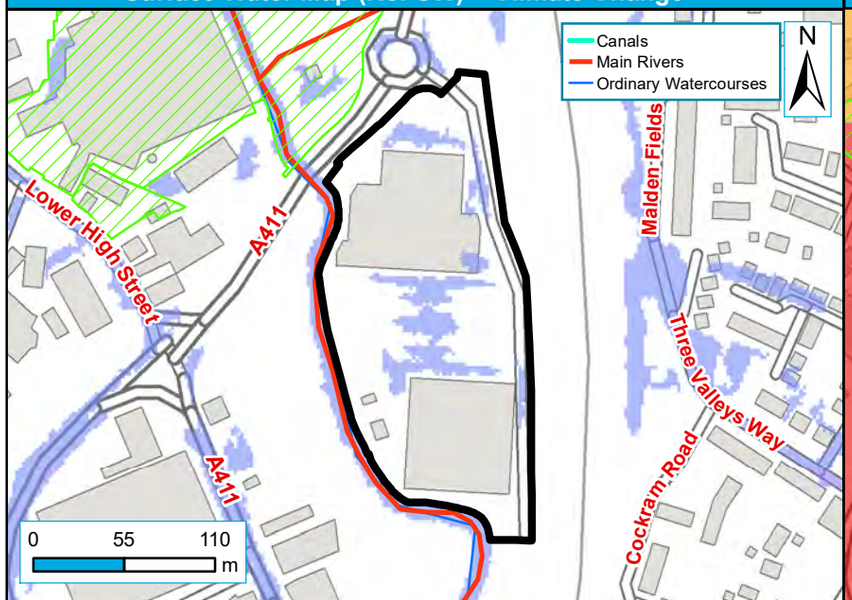
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



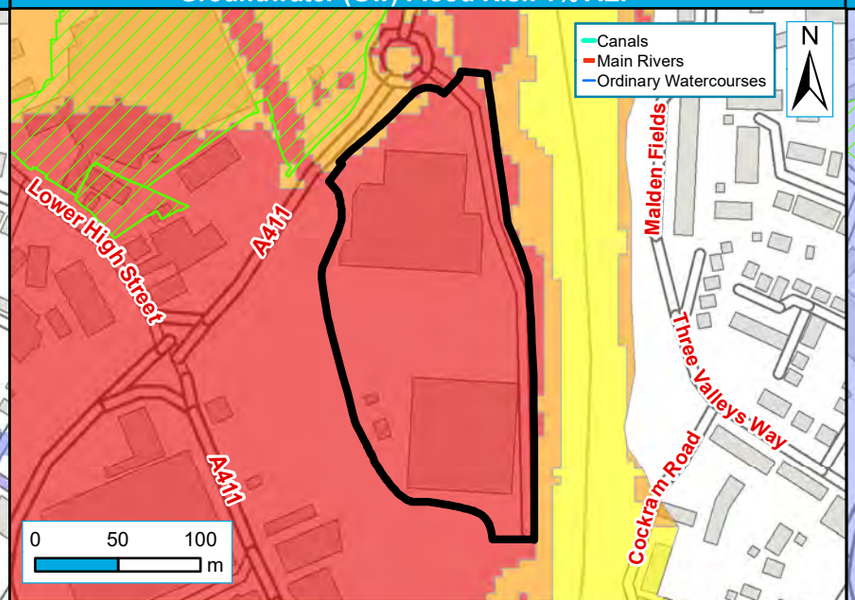
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



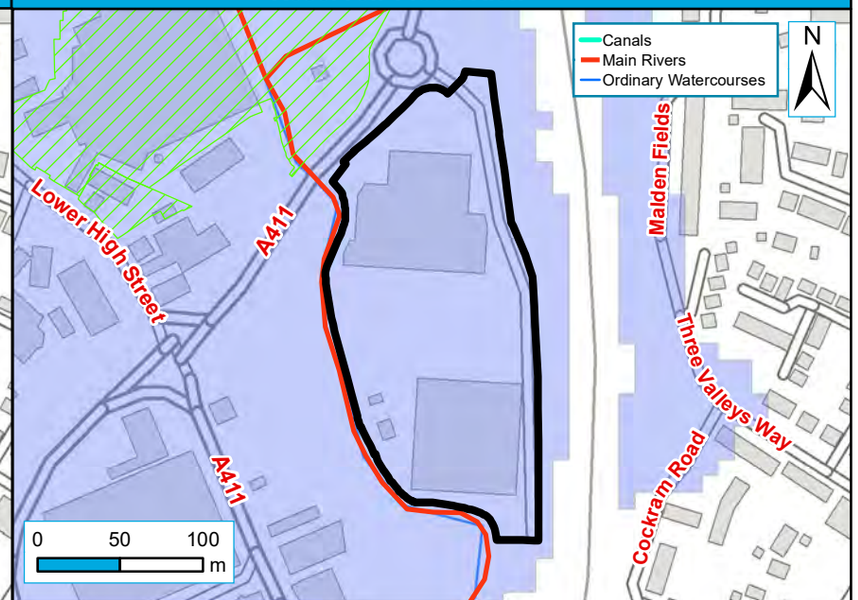
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

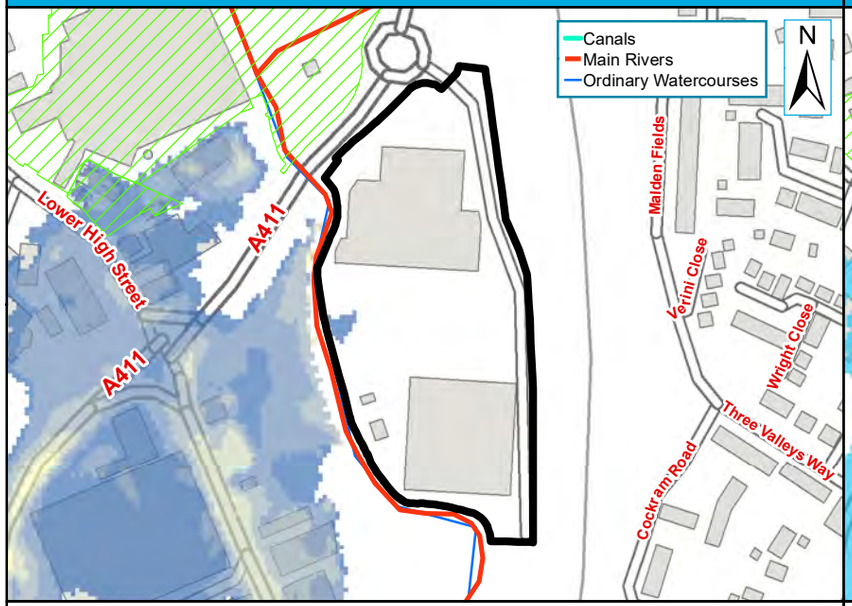


Site Boundary
Other L2 Sites
Reservoir Flood Risk

Site reference	MX14
Site Name	Colne Valley Retail Park

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

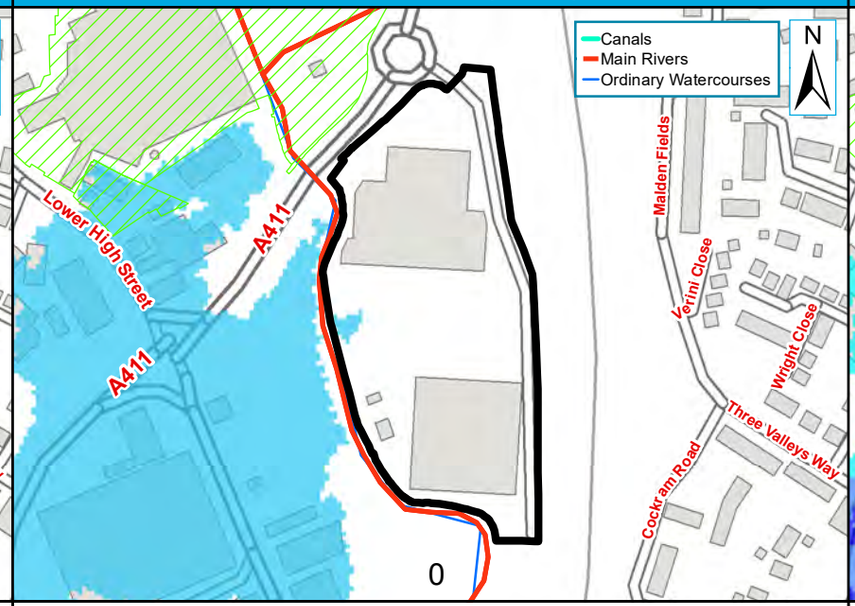
Maximum Fluvial Flood Depth (m) - 1% AEP



Site Boundary **1% AEP**
Other L2 Sites **Depth (m)**
0 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.0
1.0 - 1.25
1.25 - 1.50
1.50 - 1.75
1.75 - 2.0
>2.0

0 50 100 m

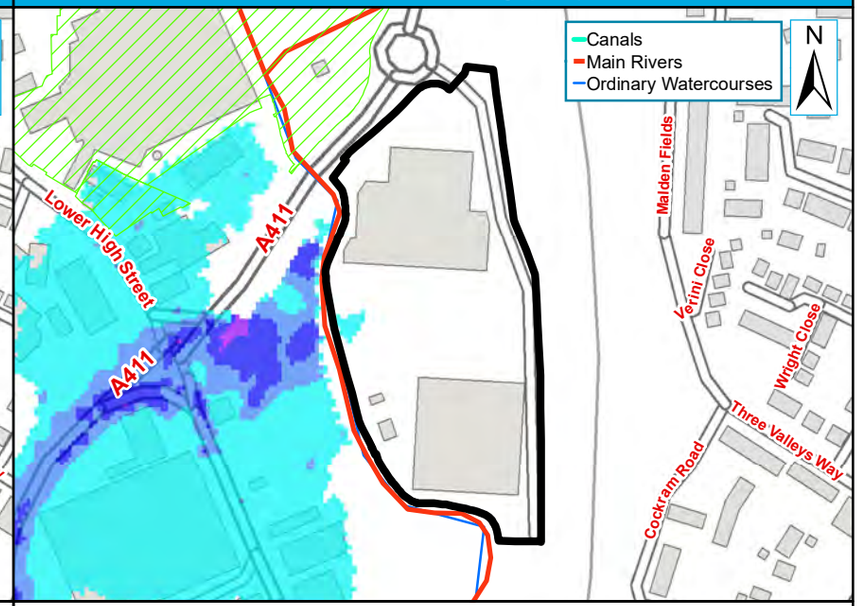
Maximum Fluvial Flood Level (mAOD) - 1% AEP



Site Boundary **1% AEP**
Other L2 Sites **Flood Level (mAOD)**
41.7 - 45.6
45.6 - 48.8
48.8 - 52.6
52.6 - 56.8
56.8 - 67.2
67.2 - 73.0

0 50 100 m

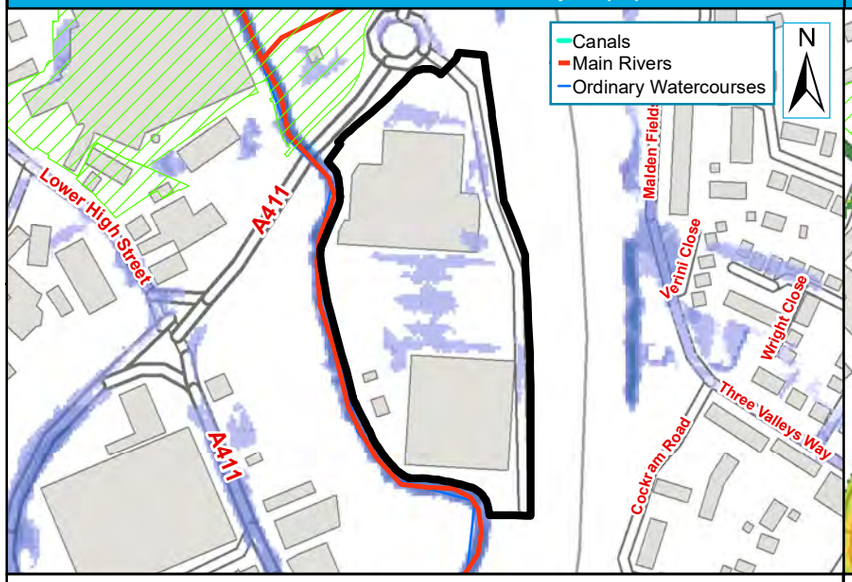
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



Site Boundary **1% AEP**
Other L2 Sites **Velocity (m/s)**
0 - 0.25
0.25 - 0.5
0.5 - 1.0
1.0 - 2.0
>2.0

0 50 100 m

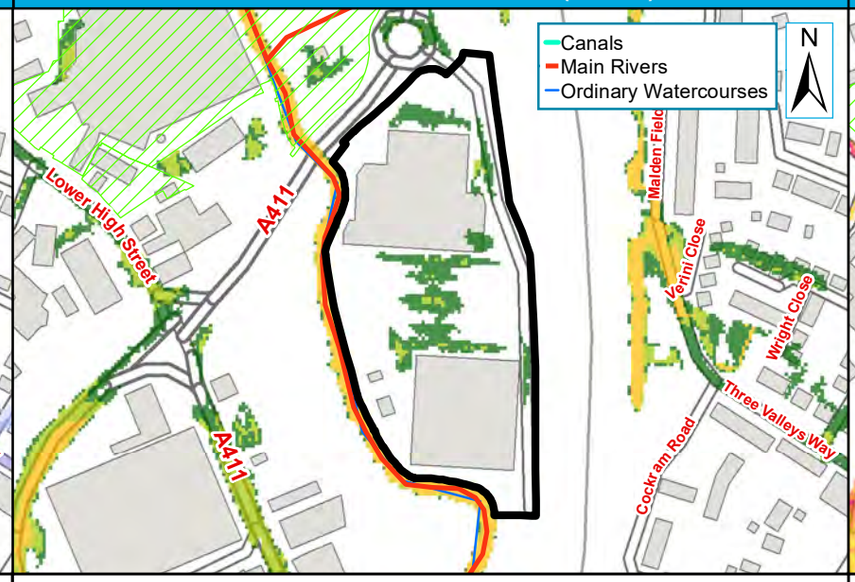
Maximum Surface Water Flood Depth (m) -1% AEP



Site Boundary **RoFSW 1% AEP**
Other L2 Sites **Depth (m)**
0.00 - 0.15
0.15 - 0.30
0.30 - 0.60
0.60 - 0.90
0.90 - 1.20
> 1.20

0 50 100 m

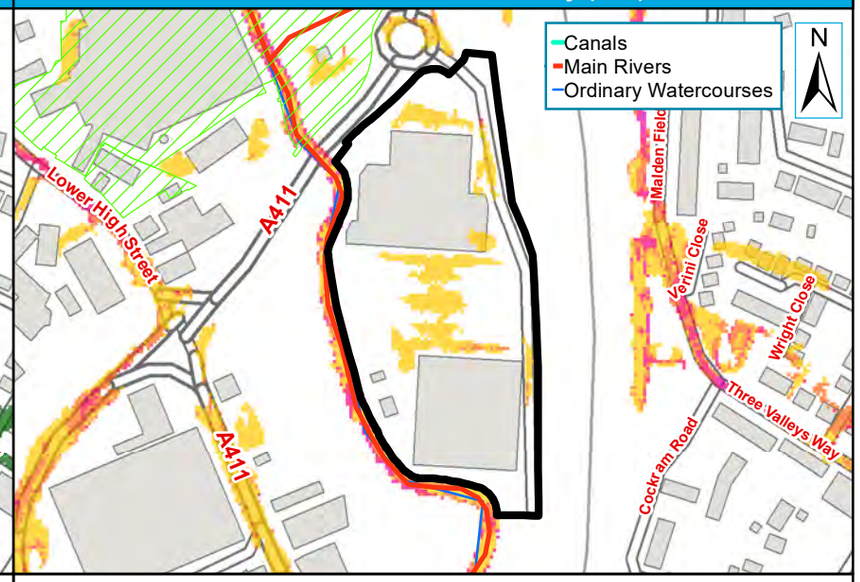
Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Site Boundary **RoFSW 1% AEP**
Other L2 Sites **Hazard**
< 0.75 : Low
0.75 - 1.25 : Moderate
1.25 - 2.00 : Significant
> 2.00 : Extreme

0 50 100 m

Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Site Boundary **RoFSW 1% AEP**
Other L2 Sites **Velocity (m/s)**
0 - 0.25
0.25 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 50 100 m

Site code	MX16
Site name	Land east of Ascot Road

Site details	**OS Grid reference**	TQ 09155 95664
	Area	0.45 Ha
	Current land use	Brownfield
	Proposed site use	Mixed – residential and commercial
	Flood risk vulnerability	More vulnerable
	Watford Sustainability Area Band	Area of Medium Sustainability
Sources of flood risk	**Existing watercourses**	There are no watercourses within the site or within close proximity.
	Flood history	The site is not within the EA historic flood map.
		Fluvial

Proportion of the site at risk (%)	**5% AEP**	**1% AEP**	**0.1% AEP**
	0%	0%	0%

Available modelled data: There is no fluvial model data available for the site, as it is located within Flood Zone 1.

Flood characteristics: The site is located within Flood Zone 1, and is therefore at negligible risk of fluvial flooding.

Surface Water

Proportion of site at risk (RoFSW)		
3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**
0%	0%	2%

Description of surface water flow paths:
The site is at a low risk of flooding from surface water. A very small area in the west of the site is shown to be at risk of flooding during a 0.1% AEP (1 in 1,000-year event). This flooding is associated with a surface water flow path from the highway.

Groundwater

Proportion of the site at risk in JBA Groundwater Map 1% AEP (1 in 100-year) risk categories		
Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**
28%	27%	55%

The western half of the site is shown to be at a high risk of groundwater flooding. Here, the site is within Category 4, where groundwater is predicted to lie at or within 0.025m of the ground surface during a 1 in 100-year event (1% AEP). The east of the site is at moderate flood risk, with groundwater estimated to lie between 0.5 – 5m of the ground surface during a flood event.

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX16
Site name	Land east of Ascot Road

	Reservoir	The site is not at risk of reservoir flooding.		
	Canal	There are no canals witin the site.		
Flood risk management infrastructure	**Defences**	**Defence Type**	**Standard of Protection**	**Condition**
		There are no defences within the site.		
	Residual risk	**Culvert / structure blockage?**	There are no culverts within the site or within close proximity.	
		Impounded water body failure?	The site is not at risk of flooding due to reservoir breach.	
		Defence breach / overtopping?	**Breach Zone**	
			N/A	
Emergency planning	**Flood warning**	The site is not within EA Flood Alert or Flood Warning Areas.		
	Access and egress	The site is likely to be accessed via Ascot Road, from the west or south of the site. Along the western border, this road is shown to be at risk of surface water flooding during the1% AEP (1 in 100-year) rainfall event. However, north of the site boundary, surface water flooding is predicted to affect the road during a 3.3% AEP (1 in 30-year) rainfall event.		
Climate Change	**Climate change allowances for '2080s'**	**River Basin District**	**Central**	**Higher Central**	**Upper End**
		Thames	25%	35%	70%
	Implications for the site	The site is predicted to remain within Flood Zone 1, when climate change allowances are applied. The 1% AEP (1 in 100-year) surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 0.1% (1 in 1,000-year) surface water flood extent.		

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX16
Site name	Land east of Ascot Road

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.	
	Superficial Geology	There are alluvium deposits across the site.	
	Soils	Freely draining slightly acidic loamy soils.	
	SuDS	SuDS are possible on all sites, including previously developed sites such as this one. All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding and its location within Groundwater Source Protection Zone 1. Therefore further site investigation should be carried out to assess potential for drainage by infiltration, including at least 12 months of groundwater level monitoring on site. Infiltration techniques should only be used where there are suitable levels of surface water runoff treatment, and following the granting of any required environmental permits from the Environment Agency.	
	Groundwater Source Protection Zone	The site is within Groundwater SPZ 1 (inner zone). This is defined as the 50-day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There are no historic landfill sites within the site boundary or within close proximity.	
	Opportunities for flood risk betterment	The current site is brownfield and so actions should be taken to increase permeability across the development. Runoff rates within the site should be returned to (or as close to) the greenfield rate.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Gade (from confluence with Bulbourne to Chess)	Medium
Recommend-ations for Local Plan policy	**Sequential Test and Exception Test requirements**		
	The site is within Flood Zone 1 but at risk from other sources of flooding. The Sequential Test must be passed. The Exception Test is not required under the NPPF, but it must be shown that the development will be safe for its lifetime and the risk can be managed through a sequential approach to design.		
	Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers		
	Flood risk assessment: • At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required. • Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage. • A site-specific flood risk assessment will be required because the site is at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications). • Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.		

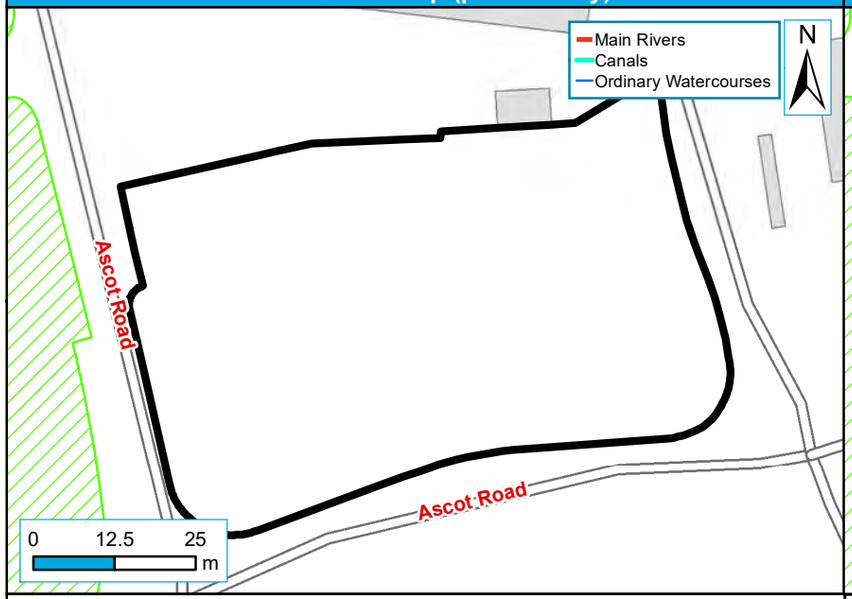
Site code	MX16
Site name	Land east of Ascot Road

	• The site is located within a catchment identified as moderately sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment. • High level assessment suggests the catchment is largely at risk of surface water flooding, and so efforts should be made within all new developments to limit runoff to greenfield rates. • Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future. **Guidance for site design and making development safe:** • Development must seek opportunities to reduce overall level of flood risk at the site. • Safe access and egress should be demonstrated in the 1 in 100 plus climate change event. • As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required. • All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible. • Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design. • Mitigation for seasonal high groundwater levels must be considered (for example by raising finished floor levels to an appropriate height above ground level). • The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property. • SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	MX16
Site Name	Land East of Ascot Road

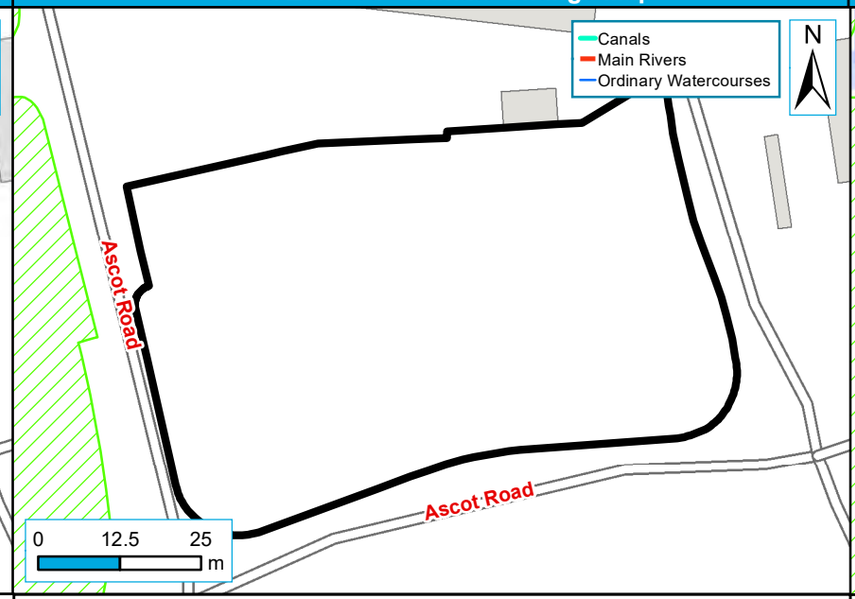
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



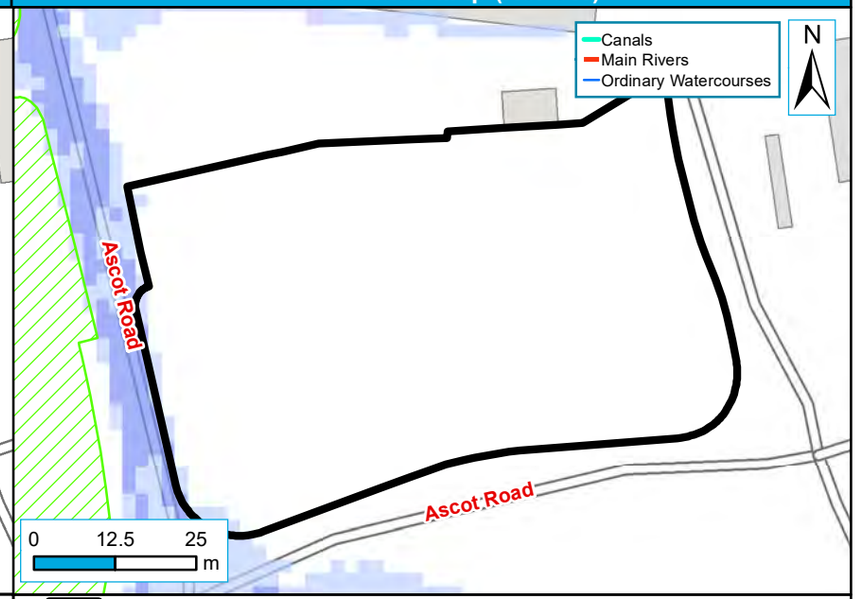
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



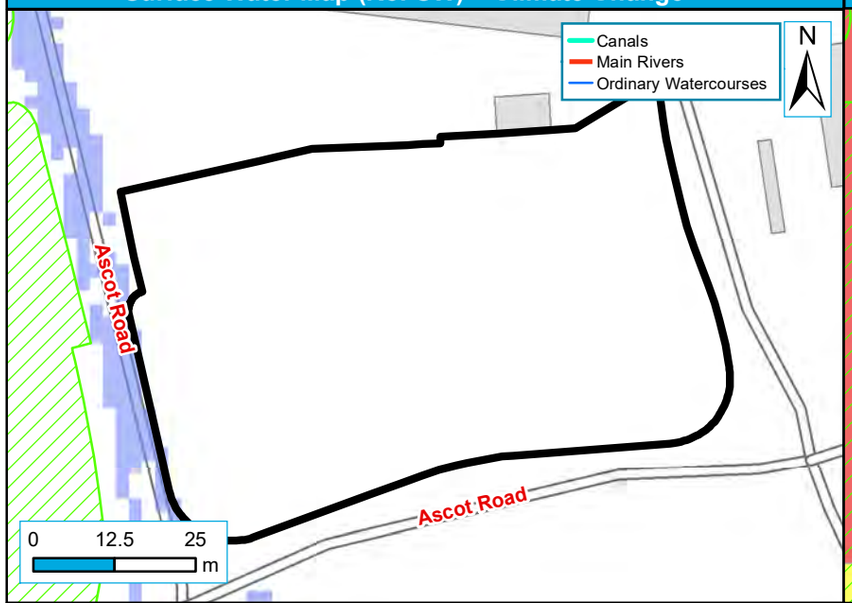
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



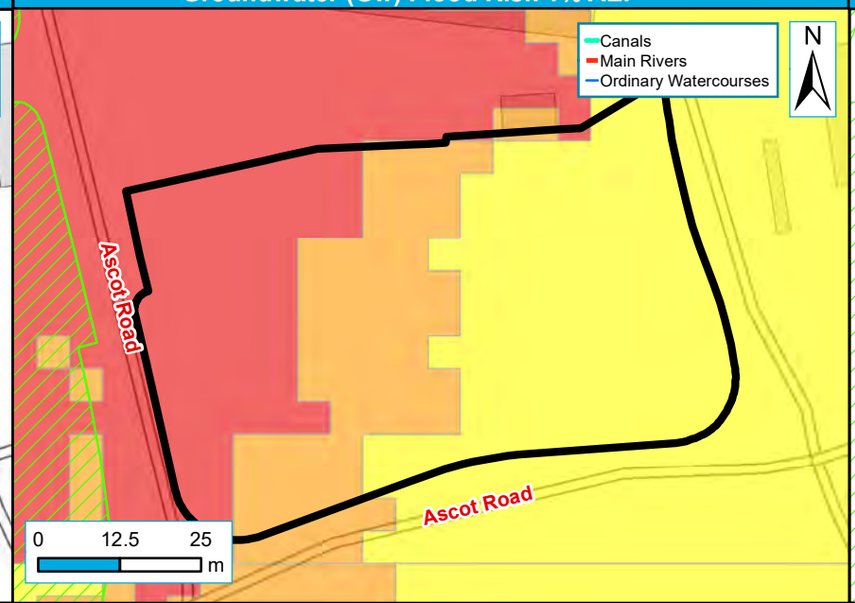
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



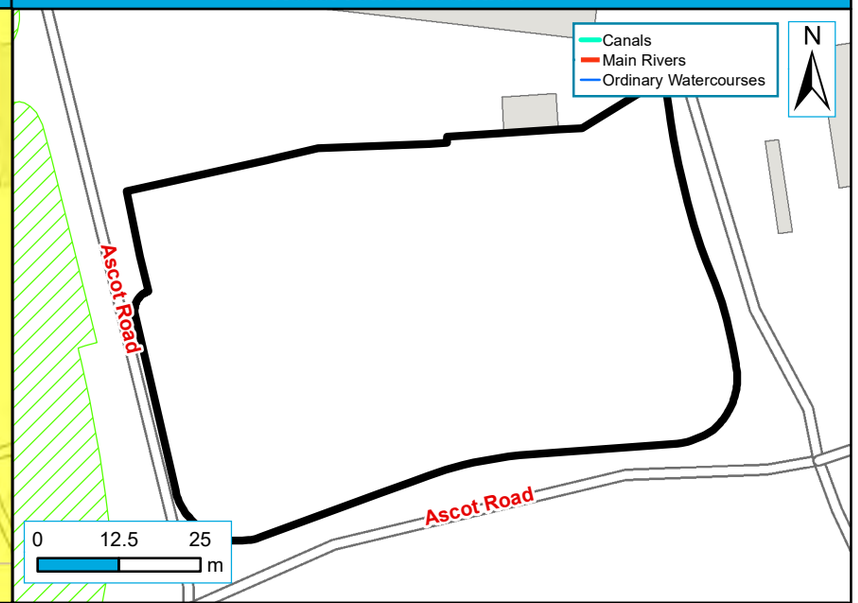
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

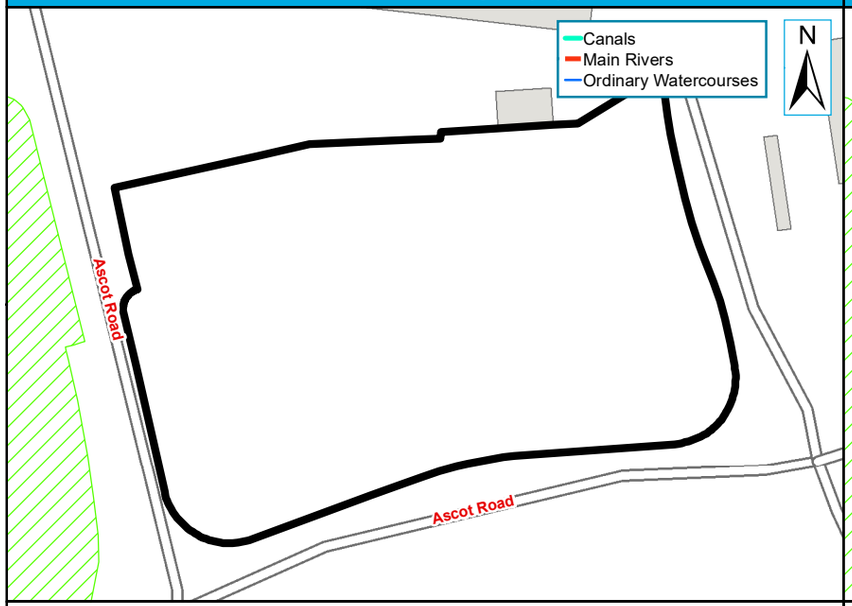


Site Boundary
Other L2 Sites
Reservoir Flood Risk

Site reference	MX16
Site Name	Land East of Ascot Road

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

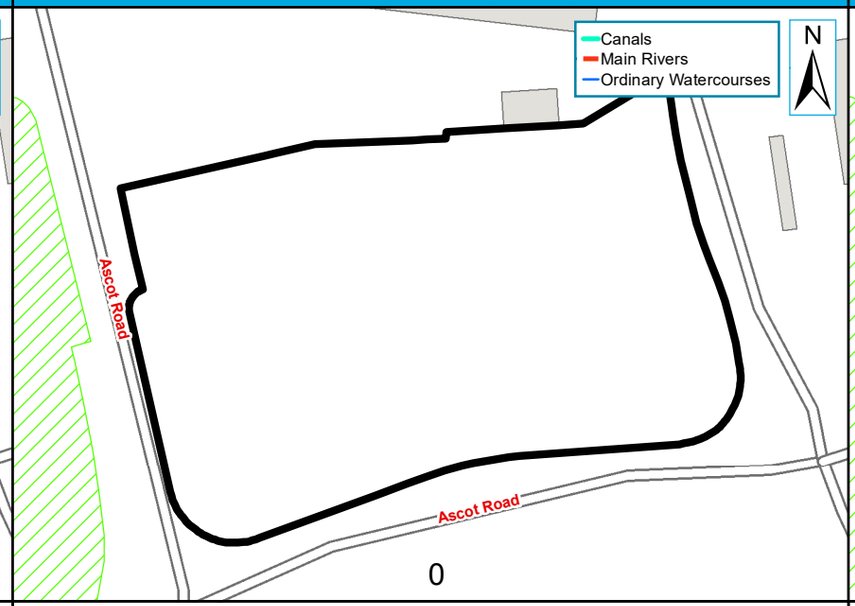
Maximum Fluvial Flood Depth (m) - 1% AEP



Site Boundary
Other L2 Sites
1% AEP
Depth (m)
0 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.0
1.0 - 1.25
1.25 - 1.50
1.50 - 1.75
1.75 - 2.0
>2.0

0 12.5 25 m

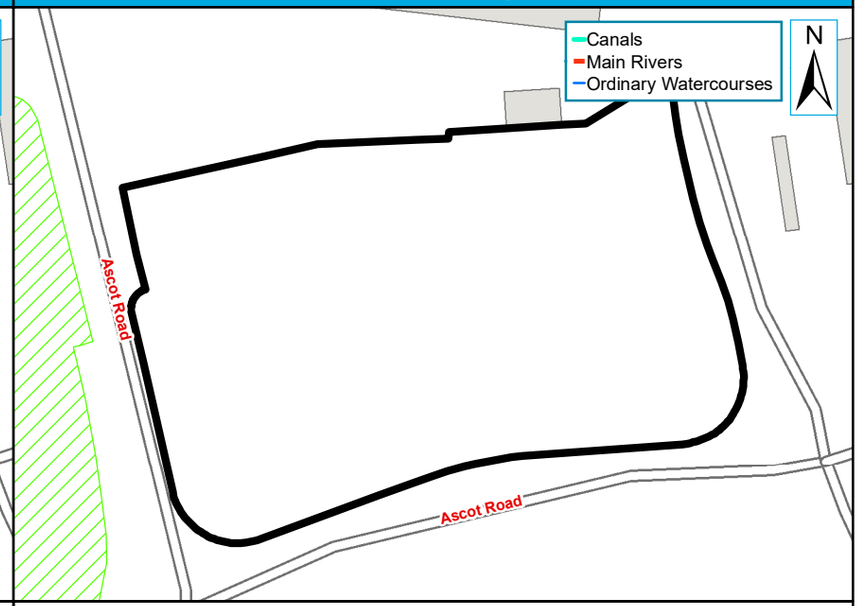
Maximum Fluvial Flood Level (mAOD) - 1% AEP



Site Boundary
Other L2 Sites
1% AEP
Flood Level (mAOD)
41.7 - 45.6
45.6 - 48.8
48.8 - 52.6
52.6 - 56.8
56.8 - 67.2
67.2 - 73.0

0 12.5 25 m

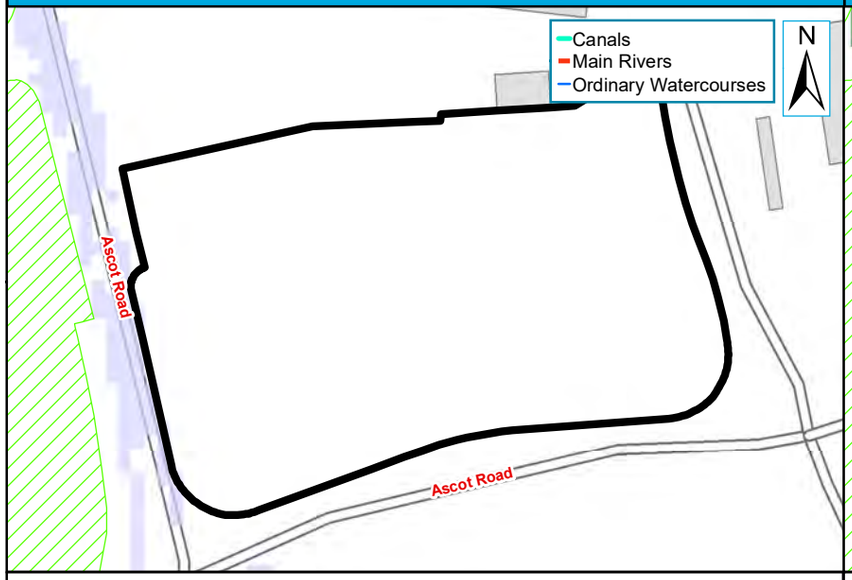
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



Site Boundary
Other L2 Sites
1% AEP
Velocity (m/s)
0 - 0.25
0.25 - 0.5
0.5 - 1.0
1.0 - 2.0
>2.0

0 12.5 25 m

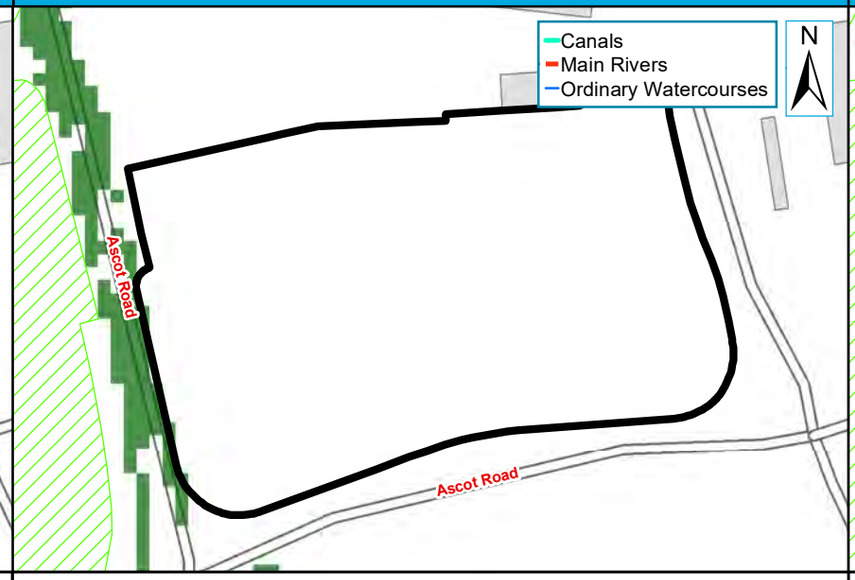
Maximum Surface Water Flood Depth (m) -1% AEP



Site Boundary
Other L2 Sites
RoFSW 1% AEP
Depth (m)
0.00 - 0.15
0.15 - 0.30
0.30 - 0.60
0.60 - 0.90
0.90 - 1.20
> 1.20

0 12.5 25 m

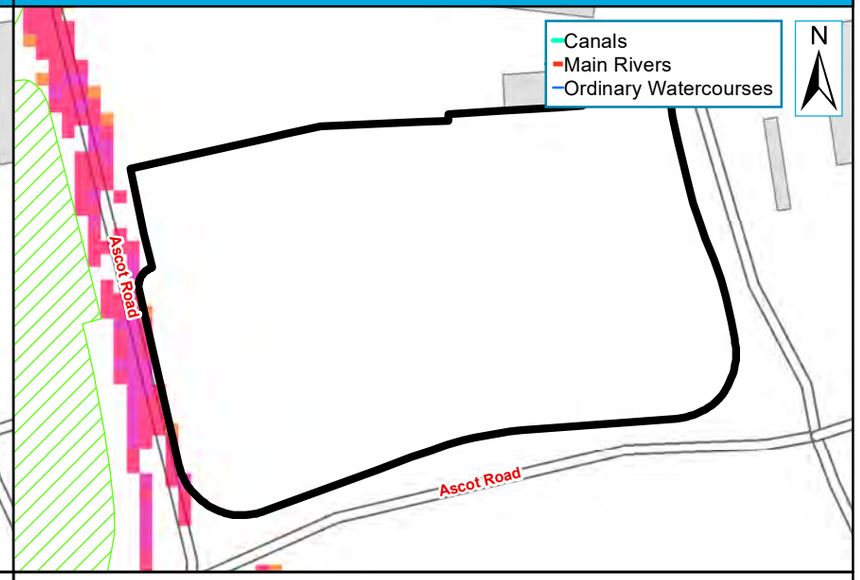
Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Site Boundary
Other L2 Sites
RoFSW 1% AEP
Hazard
< 0.75 : Low
0.75 - 1.25 : Moderate
1.25 - 2.00 : Significant
> 2.00 : Extreme

0 12.5 25 m

Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Site Boundary
Other L2 Sites
RoFSW 1% AEP
Velocity (m/s)
0 - 0.25
0.25 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 12.5 25 m

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX17
Site name	Land at Riverwell

Site details	**OS Grid reference**	TQ 10698 95480
	Area	12 Ha
	Current land use	Brownfield
	Proposed site use	Mixed – residential and commercial
	Flood risk vulnerability	More vulnerable
	Watford Sustainability Area Band	Area of High Sustainability
Sources of flood risk	**Existing watercourses**	The River Colne flows in a westerly direction in the south of the site.
	Flood history	The site is shown to have been previously affected by flooding within the EA recorded flood outlines. The River Colne flooded the south of the site in December 2000 as a result of channel exceedance.
	Fluvial	**Fluvial**

Proportion of the site at risk (%)	**FZ3b (5% AEP)**	**FZ3a (1% AEP)**	**FZ2 (0.1% AEP)**
	3%	20%	34%
Maximum modelled flood level on site (mAOD)	N/A	53.45	53.67

Available modelled data:
The site is covered by the 2010 Upper Colne 1D-2D hydraulic model. Flood depth and hazard results were not provided with this model, and therefore water level results have been used. Flood Zone 2 has been used as a proxy for Flood Zone 3a +35%CC and +70%CC extents, as the Upper Colne model became unstable when higher flows were applied.

Flood characteristics:
Over half of the site is within Flood Zone 2, with the south and east of the site predicted to be affected by fluvial flooding during a 0.1% AEP (1 in 1,000-year) event. A lateral band through the south west and north east of the site is also located within Flood Zone 3a (1% AEP, or in 100-year event).

	Surface Water	**Proportion of site at risk (RoFSW)**		
		3.3% AEP (1 in 30)	**1% AEP (1 in 100)**	**0.1% AEP (1 in 1,000)**
		7%	12%	24%

Description of surface water flow paths:
Surface water flooding in the site is largely associated within a flow path which originates on Cardiff Road in the north east of the site, and extends to the south west of the site. The flow path picks up the extent of a new access road in the site, which is not included in the background mapping. Flooding is predicted to occur during the 3.3% AEP (1 in 30-year) event and extend to cover larger areas of the site during the 1% AEP (1 in 100-year) and 0.1% AEP (1 in 1,000-year) events.

	Groundwater	**Proportion of the site at risk in JBA Groundwater Map 1 in 100-year (1% AEP) risk categories**

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX17
Site name	Land at Riverwell

		Depth below surface 0-0.025m	**Depth below surface 0.025-0.5m**	**Total in highest risk categories**
		23%	36%	59%
		The southern half of the site is at a high risk of groundwater flooding, with coverage of Category 4 (where groundwater is predicted to be at or within 0.025m of the ground surface during a 1% EP event) and Category 3 (where groundwater is predicted to be 0.025 – 0.5m below the ground surface).		
	Reservoir	The southern area of the site is at risk of reservoir flooding, in the extremely unlikely event of a breach at Aldenham or Hilfield Park reservoirs.		
	Canal	There are no canals witin the site.		
Flood risk management infrastructure	**Defences**	**Defence Type**	**Standard of Protection**	**Condition**
		There are no defences present at the site.		
	Residual risk	**Culvert / structure blockage?**	There are multiple culverts or structures within/near the site which may pose a risk to the site in the case of a blockage.	
		Impounded water body failure?	The site is at risk of flooding in the unlikely event of a reservoir breach at Aldenham or Hilfield Park reservoirs.	
		Defence breach / overtopping?	**Breach Zone**	
Emergency planning	**Flood warning**	The site within both EA Flood Alert and Flood Warning Areas: • **Flood Alert Area**: The Middle River Colne at Watford and Rickmansworth including Carpenders Park • **Flood Warning Area**: The River Colne at Watford including Bushey		
	Access and egress	The site is likely to be accessed via Cardiff Road from the east or Willow Lane in the west. It should be noted that the existing road through the centre of the site (Thomas Sawyer Way) no longer exists according to aerial photography from May 2017. The aerial imagery shows a new road that has been constrcuted through the centre of the site which is detected in the RoFSW mapping. A flow path begins on Cardiff Road and continues onto this new access road. This flow path exists during the 3.3% AEP (1 in 30-year) event and greater rainfall events. Willow Lane is identified as at negligible risk of surface water flooding.		
Climate Change	**Climate change allowances for '2080s'**	**River Basin District**	**Central**	**Higher Central**	**Upper End**
		Thames	25%	35%	70%
	Implications for the site	Due to model instability when applying 35% and 70% climate change allowances to inflows, Flood Zone 2 has been used as a proxy for climate change. This provides a conservative extent, with 54% of the site identified as at risk from a 1 in 100-year + 70%CC flood event. The 1 in 100-year surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 1 in 1,000-year surface water flood extent.		

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX17
Site name	Land at Riverwell

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk formation.	
	Superficial Geology	There are glacial sand and gravel deposits across the site.	
	Soils	Loamy and clayey floodplain soils with naturally high groundwater.	
	SuDS	Storage of surface water runoff from the development during extreme events should be located out of fluvial flood risk areas. It is advised that source control SuDS techniques (such as green roofs, rainwater harvesting and permeable paving) are utilised across the site. Conveyance features should be designed above ground and follow natural flow paths where possible. Where below ground storage is proposed within groundwater-risk areas, the base of the feature must be located at least 1m above the highest groundwater level, to reduce the risk of groundwater ingress or flotation. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding and its location within Groundwater Source Protection Zone 1. Therefore further site investigation should be carried out to assess potential for drainage by infiltration, including at least 12 months of groundwater level monitoring on site. Infiltration techniques should only be used where there are suitable levels of surface water runoff treatment, and following the granting of any required environmental permits from the Environment Agency.	
	Groundwater Source Protection Zone	The site is within Groundwater SPZ 1 (inner zone). This is defined as the 50-day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There are no historic landfill sites within the site boundary.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of flood peaks downstream on the River Colne and existing surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Colne (from Confluence with Ver to Gade)	High
	Sequential Test and Exception Test requirements		

Site code	MX17
Site name	Land at Riverwell

Recommend-ations for Local Plan policy

The Sequential Test must be satisfied. Only once the Sequential Test is satisfied should the Exception Test be applied. **It is anticipated that proposed development will be sequentially located within Flood Zone 1**. For this site, the Exception Test must be satisfied:

- If More Vulnerable and Essential Infrastructure is located in FZ3a or FZ3a plus climate change.
- If Highly Vulnerable development is located in FZ2.

If Essential Infrastructure is located in Flood Zone 3b then it must be demonstrated that the exception test is satisfied. Development will not be permitted in the following scenarios:

- Highly Vulnerable development within FZ3a or FZ3a plus climate change and FZ3b.
- More Vulnerable and Less Vulnerable development within FZ3b.

Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers

Flood risk assessment:

- At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.
- A site-specific flood risk assessment will be required because the site is within Flood Zone 2 and 3 and at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).
- Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
- An unmodelled ordinary watercourse has been identified within mapping of the site. This is located along the western boundary and connects to the River Colne. It is advised that this watercourse is modelled to understand any additional risk posed to the site.
- Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future.
- The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration.

Guidance for site design and making development safe:

- Development must seek opportunities to reduce overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100 plus climate change event.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- Floodplain compensation must be demonstrated for any loss in floodplain storage through the raising of levels for development.
- All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible.
- Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.

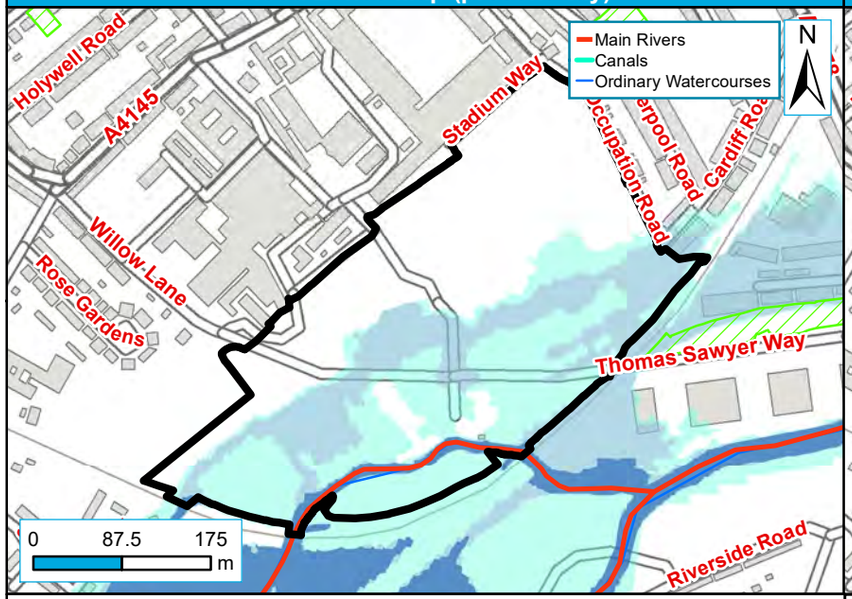
Site code	MX17
Site name	Land at Riverwell

	• The design of SuDS schemes must take into account the seasonally high groundwater table. Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design. • Example features may include swales, attenuation features, green roofs, rainwater capture and reuse and permeable paving. • Storage for runoff from the development in extreme events should be located out of flood risk areas. • The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property. • SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	MX17
Site Name	Land at Riverwell

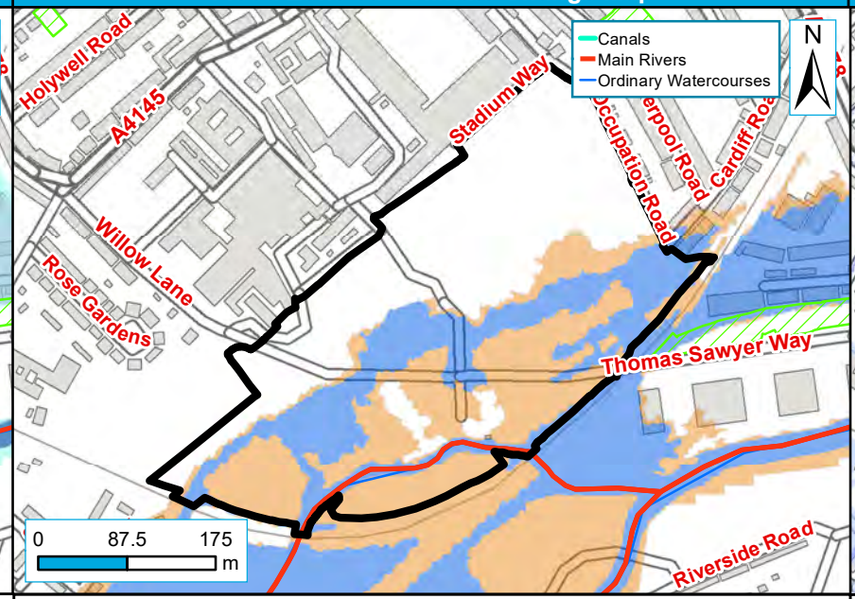
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



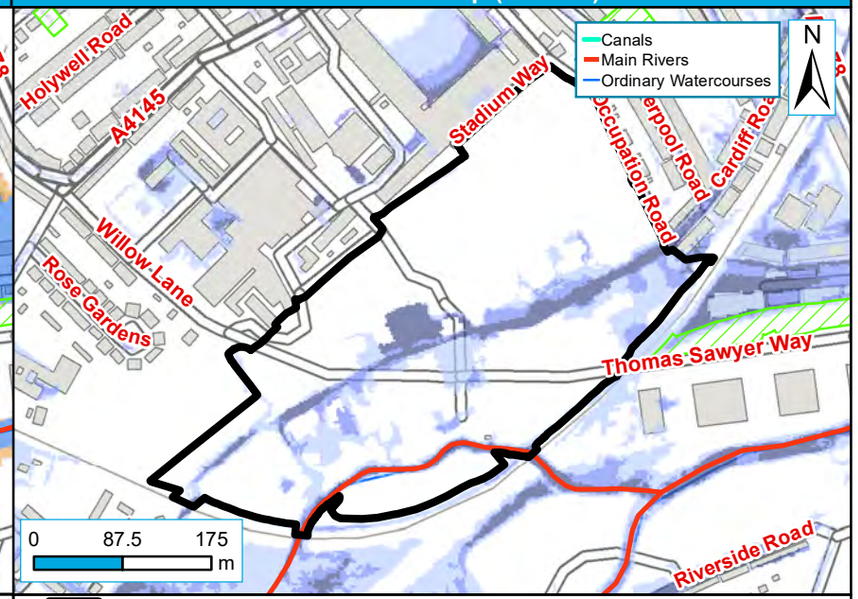
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



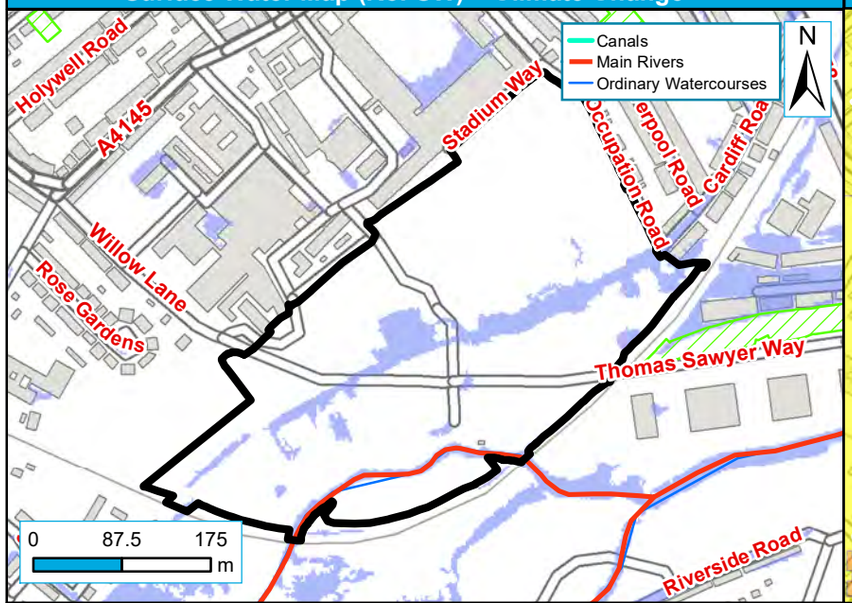
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



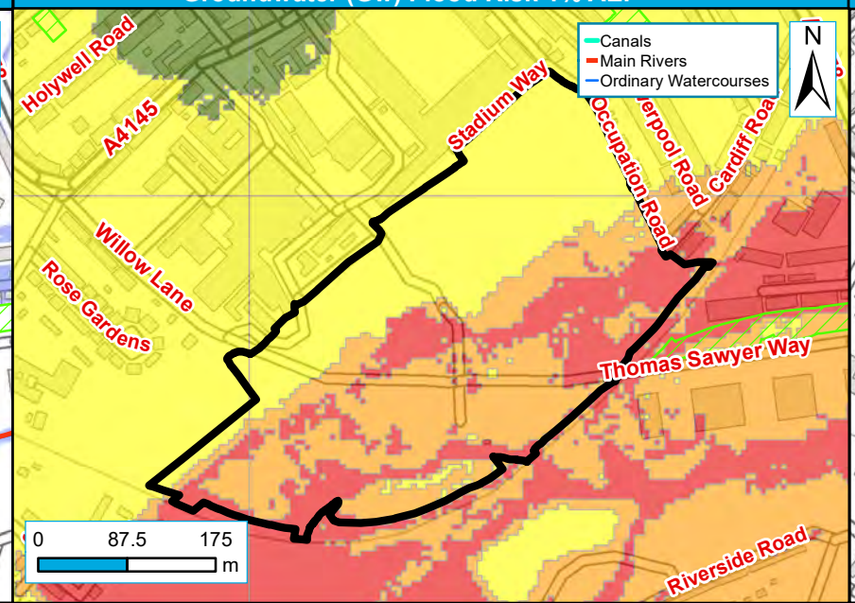
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



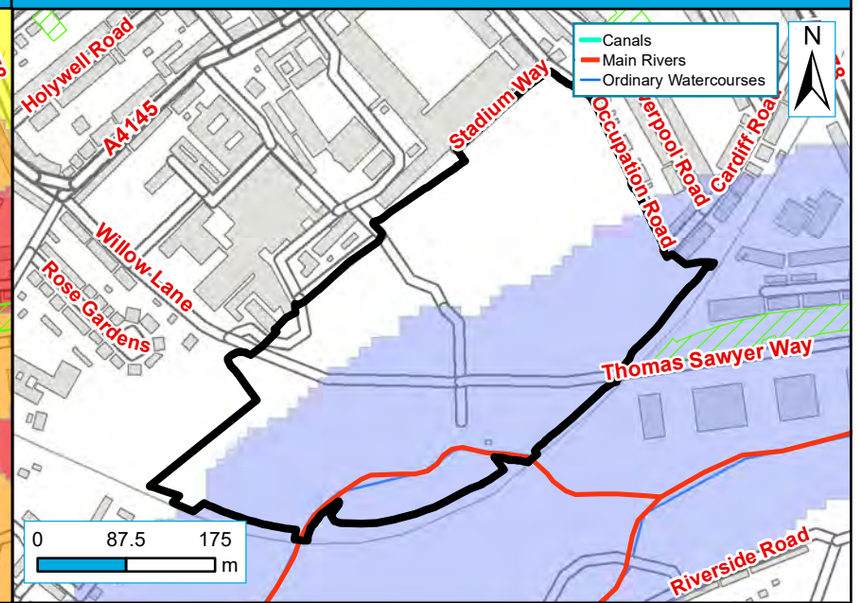
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

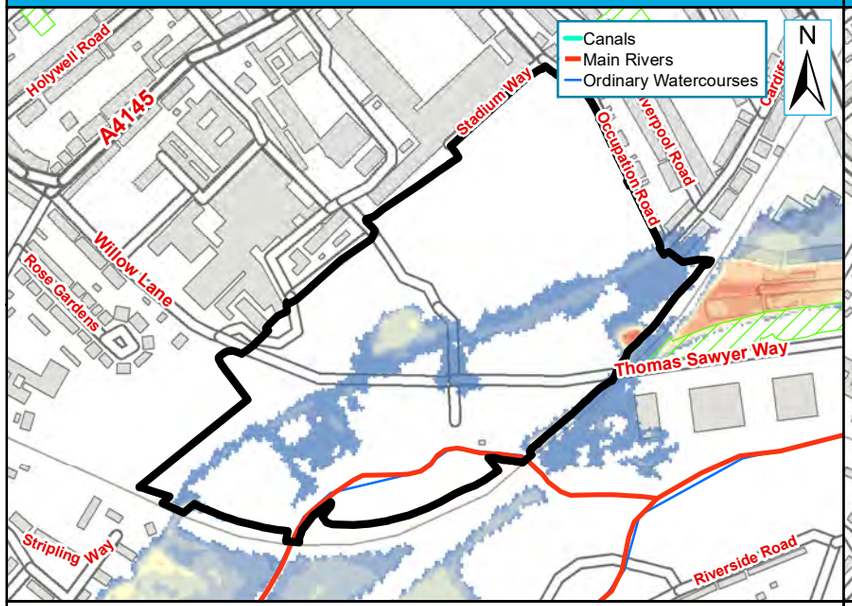


Site Boundary
Other L2 Sites
Reservoir Flood Risk

Site reference	MX17
Site Name	Land at Riverwell

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

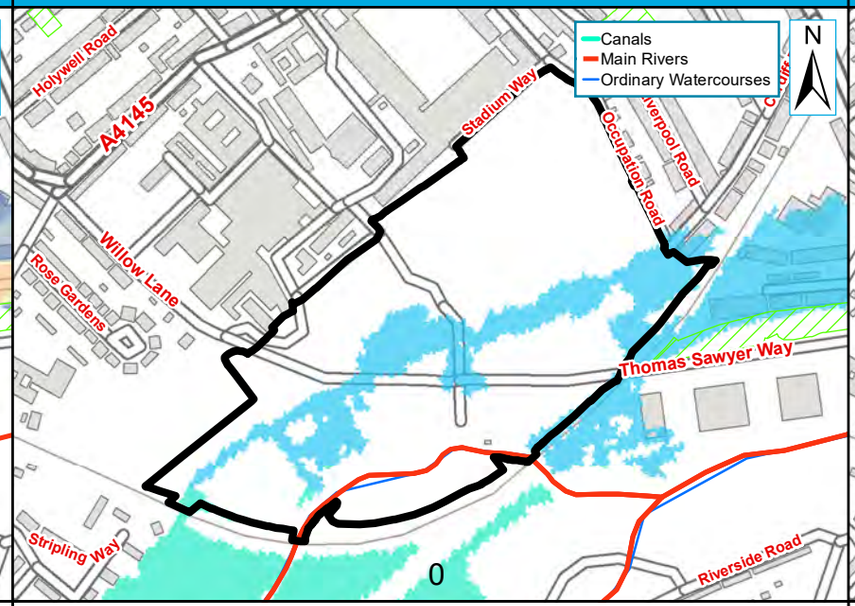
Maximum Fluvial Flood Depth (m) - 1% AEP



Site Boundary **1% AEP**
Other L2 Sites **Depth (m)**
0 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.0
1.0 - 1.25
1.25 - 1.50
1.50 - 1.75
1.75 - 2.0
>2.0

0 80 160 m

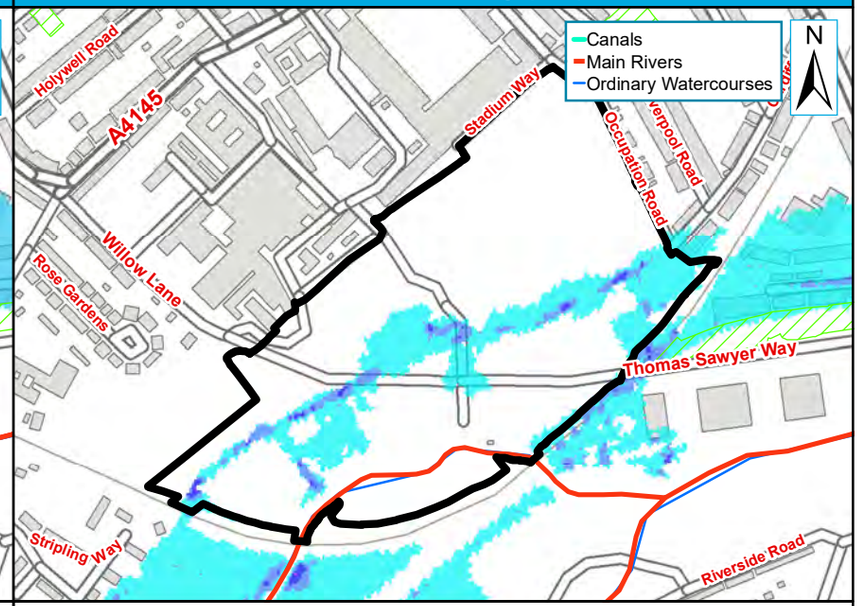
Maximum Fluvial Flood Level (mAOD) - 1% AEP



Site Boundary **1% AEP**
Other L2 Sites **Flood Level (mAOD)**
41.7 - 45.6
45.6 - 48.8
48.8 - 52.6
52.6 - 56.8
56.8 - 67.2
67.2 - 73.0

0 80 160 m

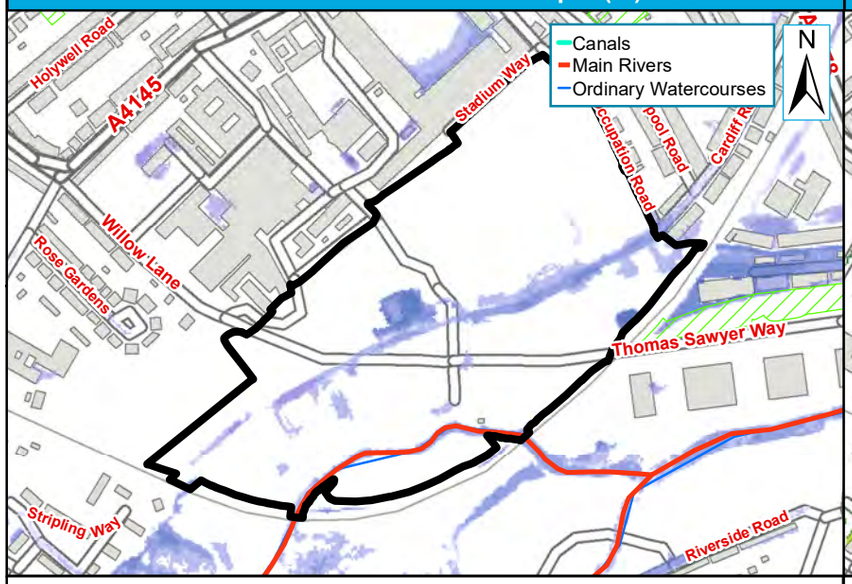
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



Site Boundary **1% AEP**
Other L2 Sites **Velocity (m/s)**
0 - 0.25
0.25 - 0.5
0.5 - 1.0
1.0 - 2.0
>2.0

0 80 160 m

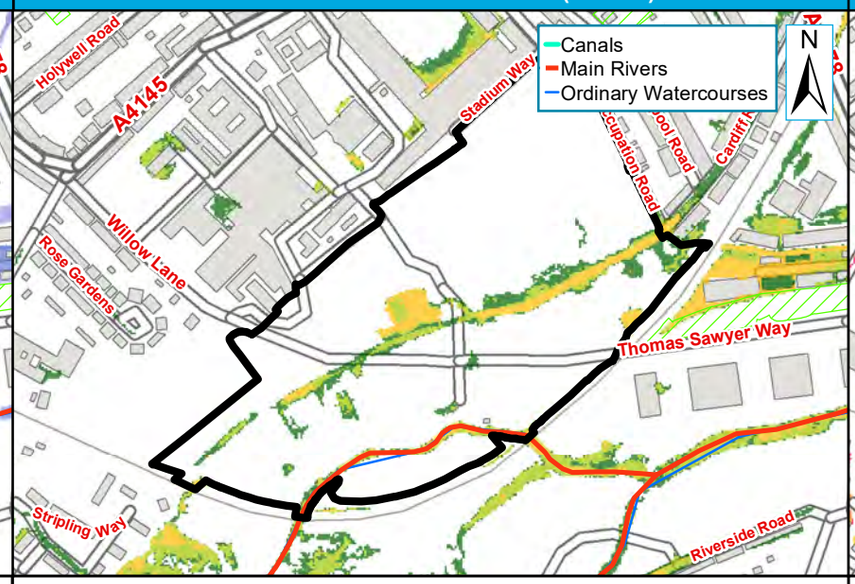
Maximum Surface Water Flood Depth (m) -1% AEP



Site Boundary **RoFSW 1% AEP**
Other L2 Sites **Depth (m)**
0 - 0.15
0.15 - 0.30
0.30 - 0.60
0.60 - 0.90
0.90 - 1.20
> 1.20

0 80 160 m

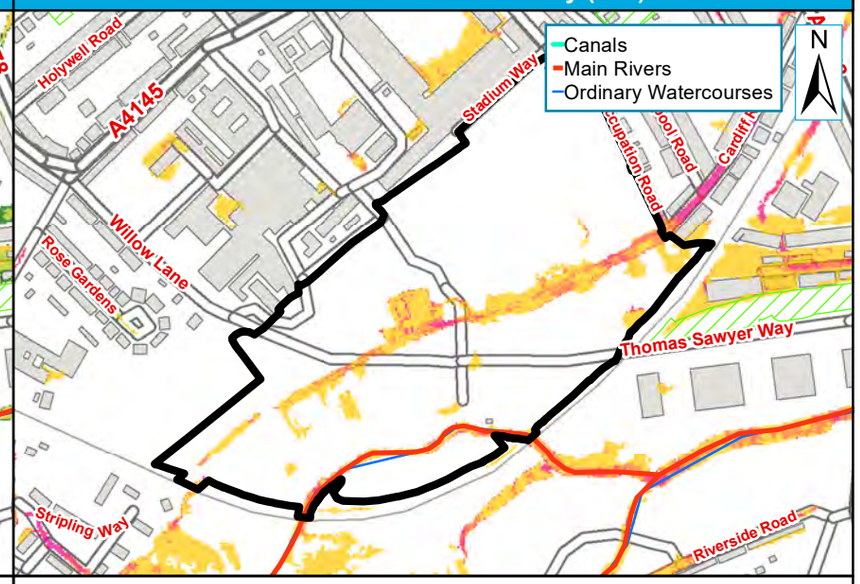
Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Site Boundary **RoFSW 1% AEP**
Other L2 Sites **Hazard**
< 0.75 : Low
0.75 - 1.25 : Moderate
1.25 - 2.00 : Significant
> 2.00 : Extreme

0 85 170 m

Maximum Surface Water Flood Velocity (m/s) - 1% AEP



Site Boundary **RoFSW 1% AEP**
Other L2 Sites **Velocity (m/s)**
0 - 0.25
0.25 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 85 170 m

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX18
Site name	Colne Bridge Retail Park

Site details	**OS Grid reference**	TQ 11773 95520
	Area	0.8 Ha
	Current land use	Brownfield
	Proposed site use	Mixed – Residential and commercial
	Flood risk vulnerability	More vulnerable
	Watford Sustainability Area Band	Area of High Sustainability
Sources of flood risk	**Existing watercourses**	The River Colne flows in a south-westerly direction along the western boundary of the site.
	Flood history	The EA Recorded Flood Outline shows that the site has previously been affected by fluvial flooding, due to channel exceedance on the River Colne. The flooding occurred in: • July 1987 • December 2000
	Fluvial	**Fluvial** **Proportion of the site at risk (%)**: FZ3b (5% AEP) 2%; FZ3a (1% AEP) 31%; FZ2 (0.1% AEP) 59% **Maximum modelled flood level on site (mAOD)**: FZ3b (5% AEP) N/A; FZ3a (1% AEP) 53.88; FZ2 (0.1% AEP) 54.36 **Available modelled data:** The site is covered by the 2010 Upper Colne 1D-2D hydraulic model. Flood depth and hazard results were not provided with this model, and therefore water level results have been used. Flood Zone 2 has been used as a proxy for Flood Zone 3a +35%CC and +70%CC extents, as the Upper Colne model became unstable when higher flows were applied. Flood levels for Flood Zone 3b were not available within the site boundary. **Flood characteristics:** The majority of the site is within Flood Zone 2, and therefore at risk of flooding during a 0.1% AEP event, with a small area in the east of the site at negligible risk, located within Flood Zone 1. Flood risk increases in the west of the site, which is located in Flood Zone 3a and therefore at risk during a 1% AEP event. A small area along the western border of the site is at risk during a 5A% AEP event, and is therefore located within Flood 3b.
	Surface Water	**Proportion of site at risk (RoFSW)** **3.3% AEP (1 in 30)**: 16% **1% AEP (1 in 100)**: 37% **0.1% AEP (1 in 1,000)**: 64%

Site code	MX18
Site name	Colne Bridge Retail Park

<table>
<tr><td rowspan="5"></td><td></td><td>Description of surface water flow paths:
The site is at high risk of surface water flooding, with runoff generated on Chalk Hill to the north as well as within the site itself. The north and south of the site are at highest risk, with flooding expected during a 3.3% AEP (1 in 30-year) rainfall event. The extent of flooding is predicted to increase during the 1% AEP (1 in 100-year) event, to reach the eastern and western borders of the site, and extend again during the 0.1% AEP (1 in 1,000-year) event, to cover the west of the site.

The surface water risk is located within the same area as fluvial risk, although surface water flooding may occur independently. Additionally, the current RoFSW mapping shows ponding against an existing building, which remains dry. This may therefore change when the site is redeveloped.</td></tr>
<tr><td rowspan="4">Groundwater</td><td colspan="3">Proportion of the site at risk in JBA Groundwater Map 1 in 100-year (1% AEP) risk categories</td></tr>
<tr><td>Depth below surface 0-0.025m</td><td>Depth below surface 0.025-0.5m</td><td>Total in highest risk categories</td></tr>
<tr><td>100%</td><td>0%</td><td>100%</td></tr>
<tr><td colspan="3">The site is at a high risk of groundwater flooding. Located within Category 4, it is estimated that groundwater levels will lie at or within 0.025m of the ground surface during a 1% AEP 1 in 100-year event.</td></tr>
<tr><td>Reservoir</td><td colspan="3">The majority of site is at risk of reservoir flooding, in the extremely unlikely event of a breach at Aldenham reservoir or Hillfield Park reservoir.</td></tr>
<tr><td>Canal</td><td colspan="3">There are no canals witin the site.</td></tr>
</table>

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX18
Site name	Colne Bridge Retail Park

<table>
<tr><td rowspan="6">Flood risk management infrastructure</td><td rowspan="2">Defences</td><td>Defence Type</td><td>Standard of Protection</td><td>Condition</td></tr>
<tr><td>Defence wall</td><td>50</td><td>3</td></tr>
<tr><td colspan="3">The defence wall is located along the left bank of the River Colne, upstream of the proposed site. The northern corner of the site boundary is shown to benefit from the defence, although this is not a notable extent. Dalton Way, at the northern boundary of the site, also benefits from defence and therefore the defence does influence the safety of access/egress to the site.</td></tr>
<tr><td rowspan="4">Residual risk</td><td>Culvert / structure blockage?</td><td colspan="2">The River Colne passes below a bridge upstream of the site and through a railway culvert downstream of the site. The impact of blockage to the railway culvert should be considered within a site-specific Flood Risk Assessment.</td></tr>
<tr><td>Impounded water body failure?</td><td colspan="2">The majority of the site is at risk of flooding in the unlikely event of a reservoir breach at Aldenham and Hillfield Park reservoirs.</td></tr>
<tr><td rowspan="2">Defence breach / overtopping?</td><td colspan="2">Breach Zone</td></tr>
<tr><td colspan="2">Overtopping of the flood wall upstream of the site should be considered. This defence has an SOP of 50 years, but safe access and egress is required during 1 in 100-year plus climate change event. Overtopping of the breach is likely to impact Dalton Road (based upon the areas benefitting from defences).</td></tr>
<tr><td rowspan="2">Emergency planning</td><td>Flood warning</td><td colspan="3">The site is within both EA Flood Warning and Flood Alert Areas:
Flood Alert Area: The Middle River Colne at Watford and Rickmansworth including Carpenders Park
Flood Warning Area: The River Colne at Watford including Bushey</td></tr>
<tr><td>Access and egress</td><td colspan="3">Access to the site is likely to be from Dalton Way, along the northern or western boundary of the site. The route is shown to be at risk of fluvial floodig during the 1% AEP (1 in 100-year) event. The road is also expected to experience surface water flooding during the 0.1% AEP (1 in 1,000-year) rainfall event, with multiple surface water flood incidents also reported to HCC for flooding along Dalton Way. Therefore, acces to the site is likely to be restricted by fluvial and surface water flooding.</td></tr>
<tr><td rowspan="2">Climate Change</td><td rowspan="2">Climate change allowances for ‘2080s’</td><td>River Basin District</td><td>Central</td><td>Higher Central</td><td>Upper End</td></tr>
<tr><td>Thames</td><td>25%</td><td>35%</td><td>70%</td></tr>
<tr><td>Implications for the site</td><td colspan="4">Due to model instability when applying 35% and 70% climate change allowances to inflows, Flood Zone 2 has been used as a proxy for climate change. This provides a conservative extent, with 64% of the site identified as at risk from a 1 in 100-year + 70%CC flood event.

The 1 in 100-year surface water flood extent within the site increases when a 40% climate change allowance is applied to rainfall. However, it does not reach the 1 in 1,000-year surface water flood extent.</td></tr>
</table>

Watford Borough Council

Level 2 SFRA Detailed Site Summary Tables – DRAFT DOCUMENT

Site code	MX18
Site name	Colne Bridge Retail Park

Requirement for drainage control and impact mitigation	**Bedrock Geology**	The site is underlain by Sussex White Chalk Formation.	
	Superficial Geology	The majority of the site is underlain by glacial sand and gravel deposits. A small area in the west is underlain by alluvium.	
	Soils	Freely draining slightly acidic loamy soils.	
	SuDS	Storage of surface water runoff from the development during extreme events should be located out of fluvial flood risk areas. It is advised that source control SuDS techniques (such as green roofs, rainwater harvesting and permeable paving) are utilised across the site. Conveyance features should be designed above ground and following natural flow paths where possible. The bedrock geology suggests that infiltration may be suitable. However, mapping indicates a high risk of groundwater flooding and its location within Groundwater Source Protection Zone 1. Therefore further site investigation should be carried out to assess potential for drainage by infiltration, including at least 12 months of groundwater level monitoring on site. Infiltration techniques should only be used where there are suitable levels of surface water runoff treatment, and following the granting of any required environmental permits from the Environment Agency.	
	Groundwater Source Protection Zone	The site is within Groundwater Source Protection Zone 1 (inner zone). This is defined as the 50-day travel time from any point below the water table to the groundwater catchment source. The Environment Agency may object to certain forms of development which present a high risk of groundwater contamination.	
	Historic Landfill Site	There are no historic landfill sites within the site boundary or within close proximity.	
	Opportunities for flood risk betterment	Opportunities for using source control SuDS to manage runoff rates and volumes, contributing to the reduction of flood peaks downstream on the River Colne and existing surface water flow paths leaving the site. Redevelopment of the site should look to reduce coverage of impermeable areas, where possible. Where surface water has previously been connected to combined sewers, there is opportunity to reduce the risk of sewer flooding and Combined Sewer Overflow (CSO) discharges.	
	Cumulative impacts of development	**Water Framework Directive Catchment**	**Sensitivity to cumulative impacts**
		Colne (from Confluence with Ver to Gade)	High
Recommend-ations for Local Plan policy	**Sequential Test and Exception Test requirements**		
	The Sequential Test must be passed. For this site, More Vulnerable development is proposed within FZ3a, and therefore, the Exception Test must be applied. The site is at high risk of flooding from multiple sources, and therefore it may not be safe to develop the site for residential purposes. Strong evidence that both parts of the Exception Test can be fulfilled will be required to justify development of the site.		

Site code	MX18
Site name	Colne Bridge Retail Park

Recommendations for requirements of site-specific Flood Risk Assessment, including guidance for developers

Flood risk assessment:

- At the planning application stage, a site-specific flood risk assessment and surface water drainage strategy will be required.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.
- A site-specific flood risk assessment will be required because the site is within Flood Zone 2 and 3 and at risk from sources of flooding other than rivers and the sea. Government guidance on flood risk assessments must be followed (https://www.gov.uk/guidance/floodrisk-assessment-for-planning-applications).
- Other sources of flooding should also be considered as part of a site-specific flood risk assessment, including surface water and groundwater.
- Climate change should be assessed using recommended climate change allowances at the time of the assessment (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) for the type of development and level of risk. The current allowances were published in February 2016 but may be subject to change in the future.
- Consideration should be made for overtopping of the defences upstream of the site. This should include effect upon the site and access/egress.
- A blockage assessment should be carried out on the railway culvert at the south west corner of the site, to determine the potential flood risk to the site in the event of a structure blockage.
- The site is located within a catchment identified as highly sensitive to the cumulative impact of development. The effects which development of the site may have on flood risk within the catchment will need to be considered within a site-specific flood risk assessment.
- Appropriate storage of surface water runoff will need to be provided, and assessments should identify opportunities to provide off-site betterment, to help offset the cumulative impact of development. For example, this may include contribution to the delivery of schemes within the catchment, such as flood alleviation schemes, Natural Flood Management, SuDS retrofit or river restoration.

Guidance for site design and making development safe:

- Development must seek opportunities to reduce overall level of flood risk at the site.
- Safe access and egress should be demonstrated in the 1 in 100 plus climate change event.
- SuDS are possible on all sites and a greenfield site such as this should be able to implement an exemplar scheme to deliver multiple benefits including water quality, biodiversity, amenity, green infrastructure etc.
- As a brownfield site, post-development surface water runoff rates and volumes should aim to meet the equivalent greenfield values, in line with Defra national guidance. If greenfield rates and volumes are not attainable, consultation with Hertfordshire County Council (the LLFA) will be required.
- Floodplain compensation must be demonstrated for any loss in floodplain storage through the raising of levels for development.
- All development should adopt source control SuDS techniques. Conveyance features should be designed above ground and following natural flow paths where possible.
- Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.
- The design of SuDS schemes must take into account the seasonally high groundwater table. Infiltration techniques may be ineffective and may pose a pollution risk. SuDS may need to be shallow and take up larger areas. Above ground conveyance and attenuation can be used but care must be taken that groundwater does not enter the SuDS feature and reduce the storage capacity and structural integrity of the design.

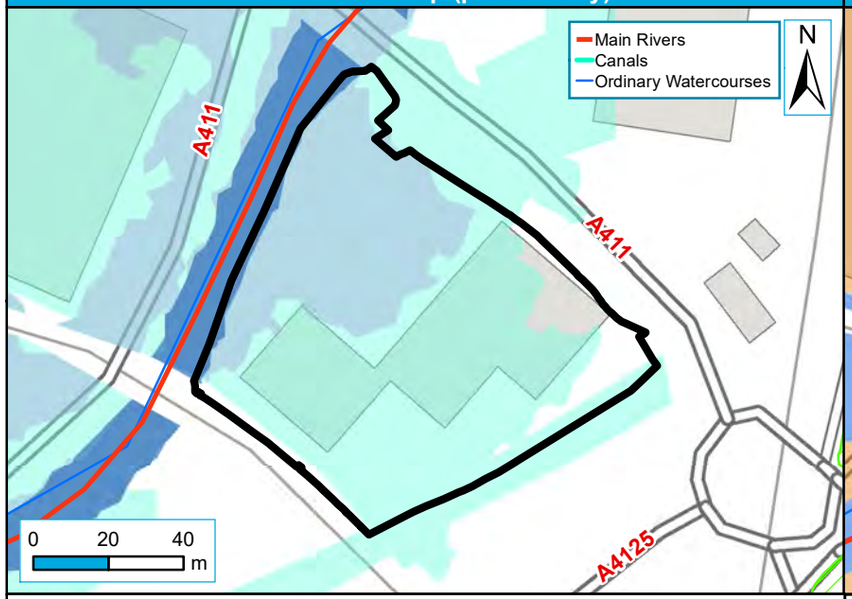
Site code	MX18
Site name	Colne Bridge Retail Park

	• Storage for runoff from the development in extreme events should be located out of flood risk areas. • The design must ensure that flows resulting from rainfall in excess of a 1 in 100-year event are managed via exceedance routes that minimise the risks to people and property. • SuDS design must follow Hertfordshire County Council guidance, meet the Defra National Non-Statutory Technical Standards, and follow current best design practice (CIRIA Manual 2015).

Site reference	MX18
Site Name	Colne Bridge Retail Park

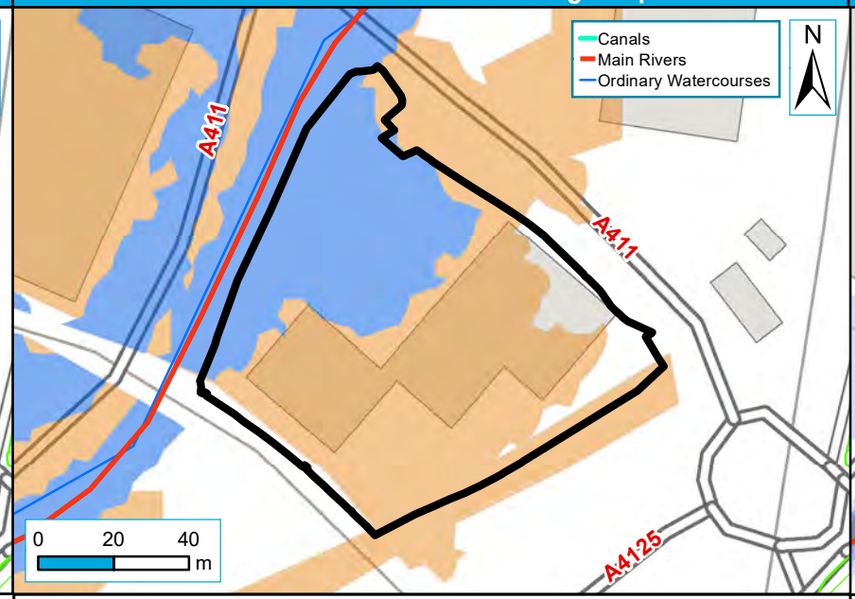
Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

Flood Zones Map (present day)



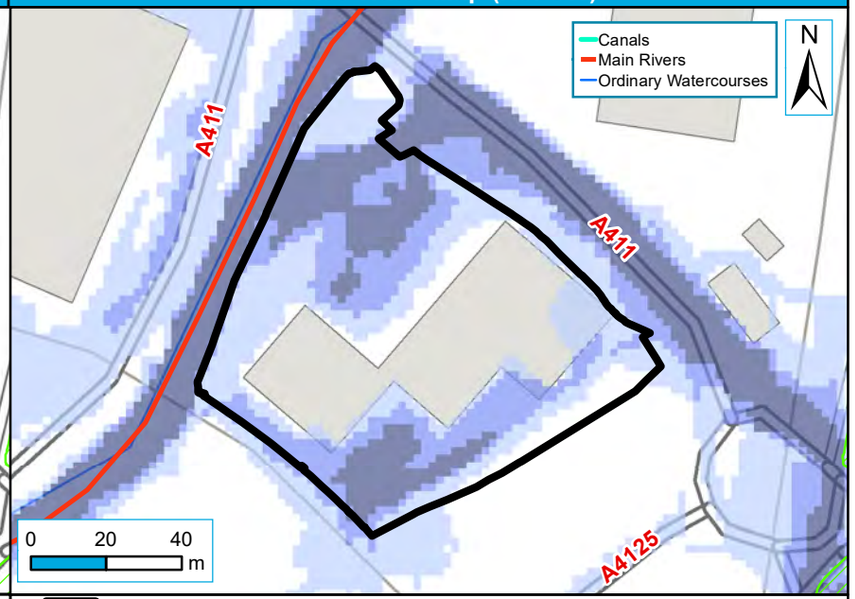
Site Boundary
Other L2 Sites
Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Flood Zone 3a - Climate Change Map



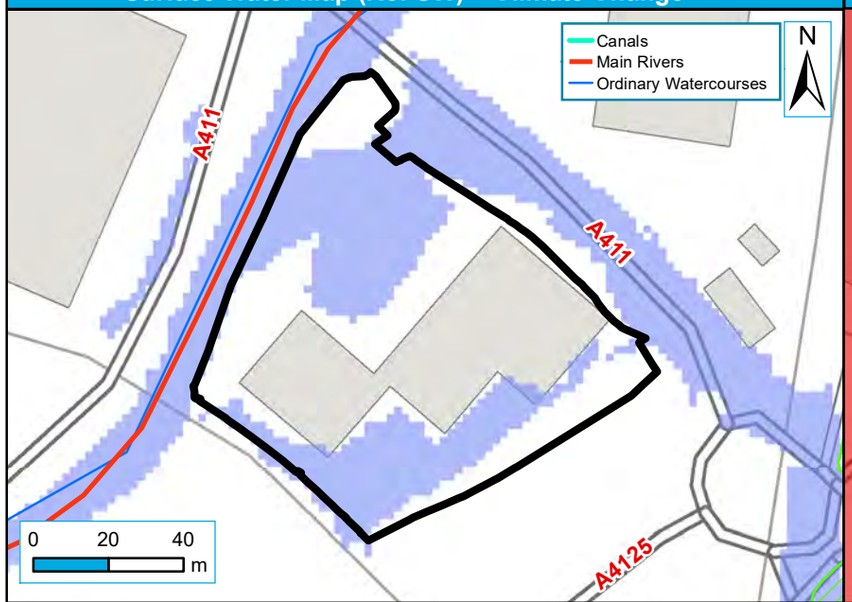
Site Boundary
Other L2 Sites
Flood Zone 3a
Flood Zone 3a Plus 35% Scenario
Flood Zone 3a Plus 70% Scenario

Surface Water Map (RoFSW)



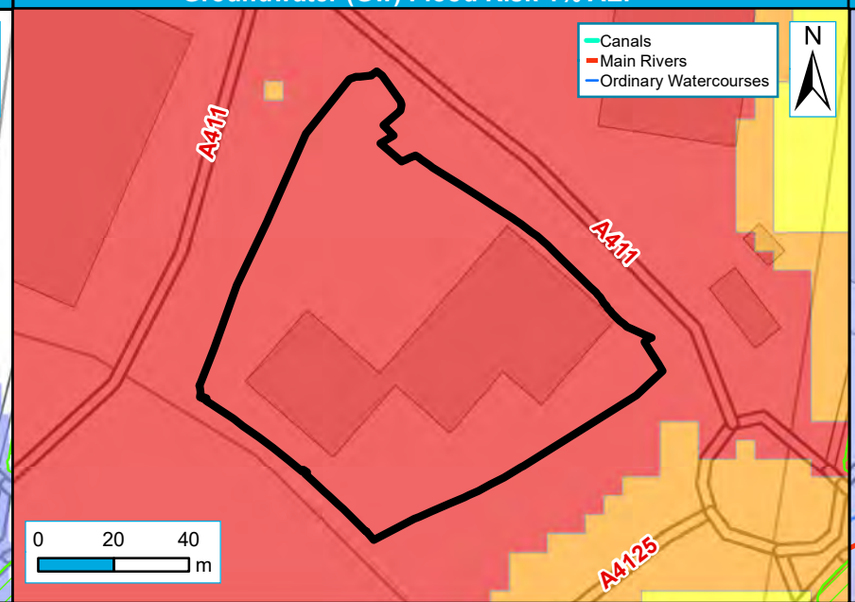
Site Boundary
Other L2 Sites
RoFSW 1 in 30-year extent (3.3% AEP)
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 1000-year extent (0.1% AEP)

Surface Water Map (RoFSW) + Climate Change



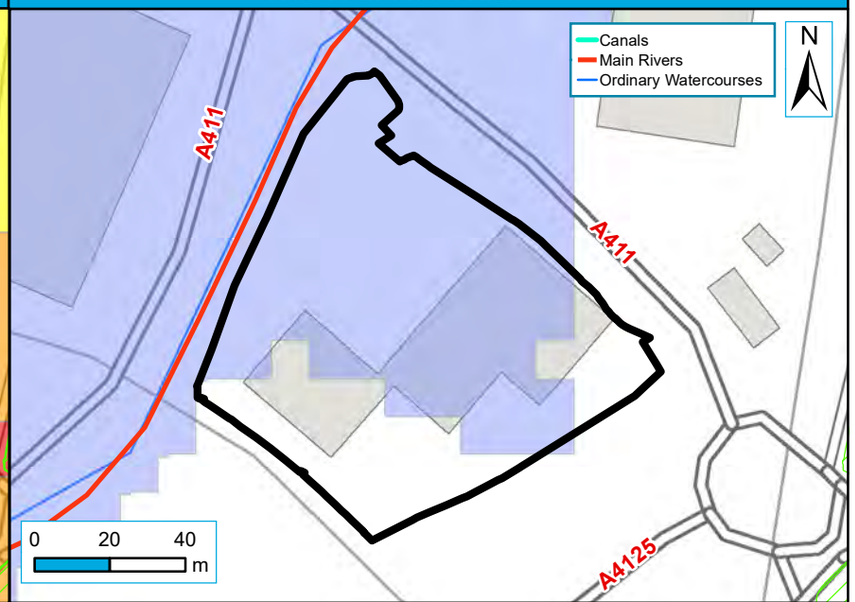
Site Boundary
Other L2 Sites
RoFSW 1 in 100-year extent (1% AEP)
RoFSW 1 in 100-year extent (1% AEP) + 40% CC

Groundwater (Gw) Flood Risk 1% AEP



Site Boundary
Other L2 Sites
Gw levels <0.025m below ground surface
Gw levels 0.025m to 0.5m below ground surface
Gw levels 0.5m to 5m below ground surface
Gw levels at least 5m below ground surface

Reservoir Flood Risk

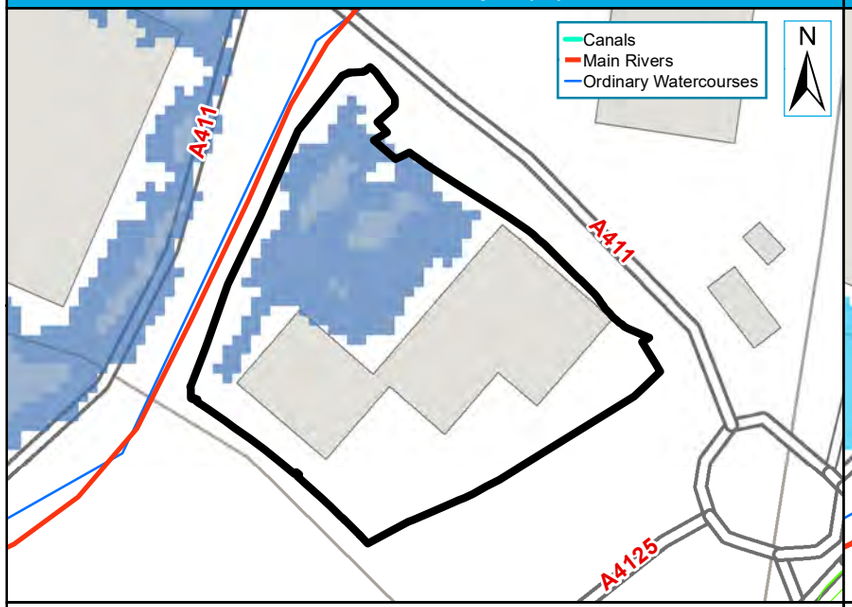


Site Boundary
Other L2 Sites
Reservoir Flood Risk

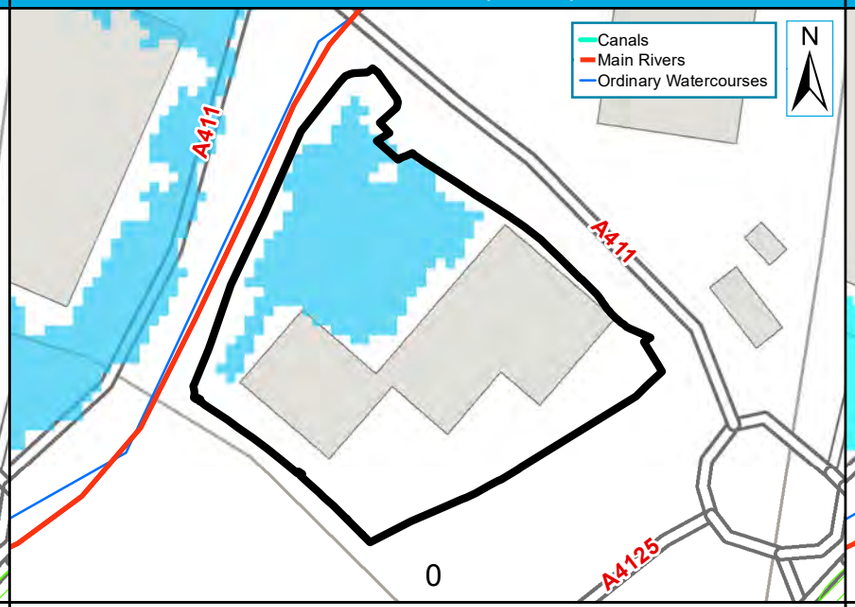
Site reference	MX18
Site Name	Colne Bridge Retail Park

Watford Borough Council
Strategic Flood Risk Assessment
Level 2 Detailed Site Summary Tables

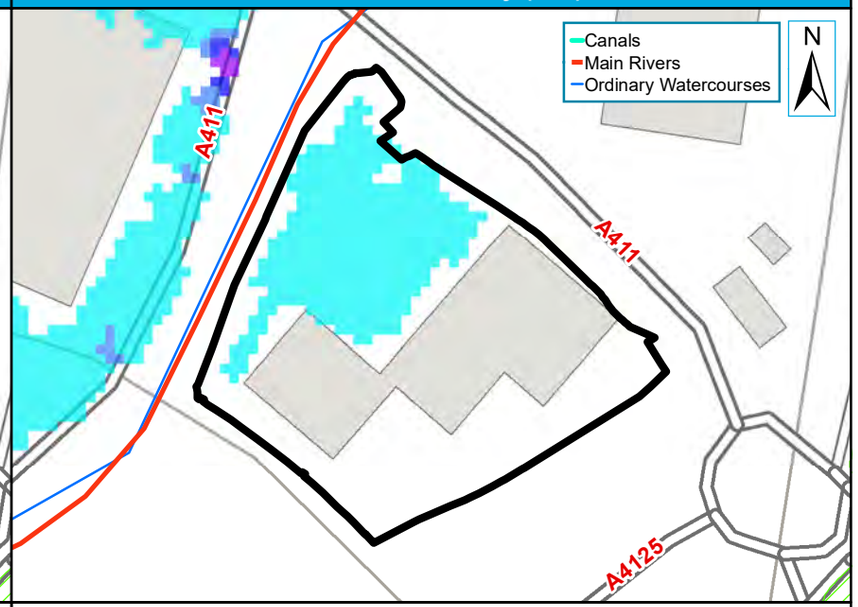
Maximum Fluvial Flood Depth (m) - 1% AEP



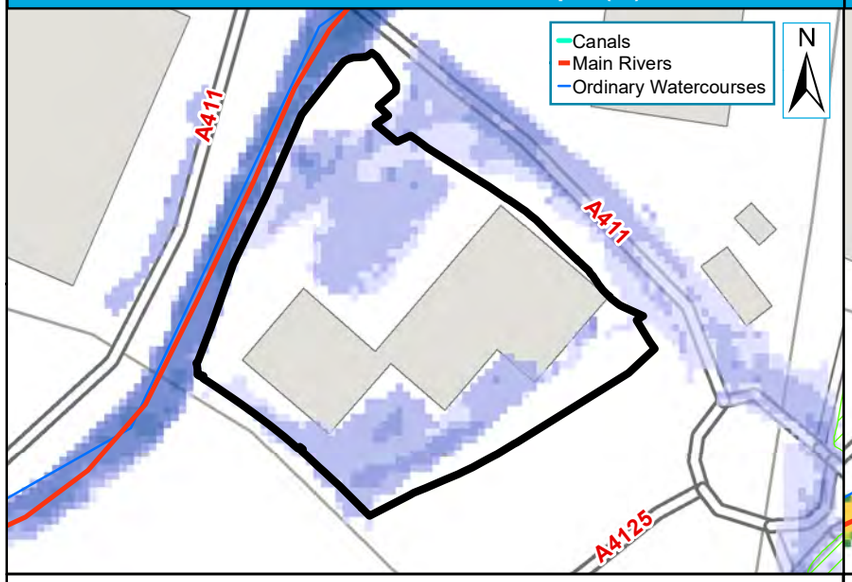
Maximum Fluvial Flood Level (mAOD) - 1% AEP



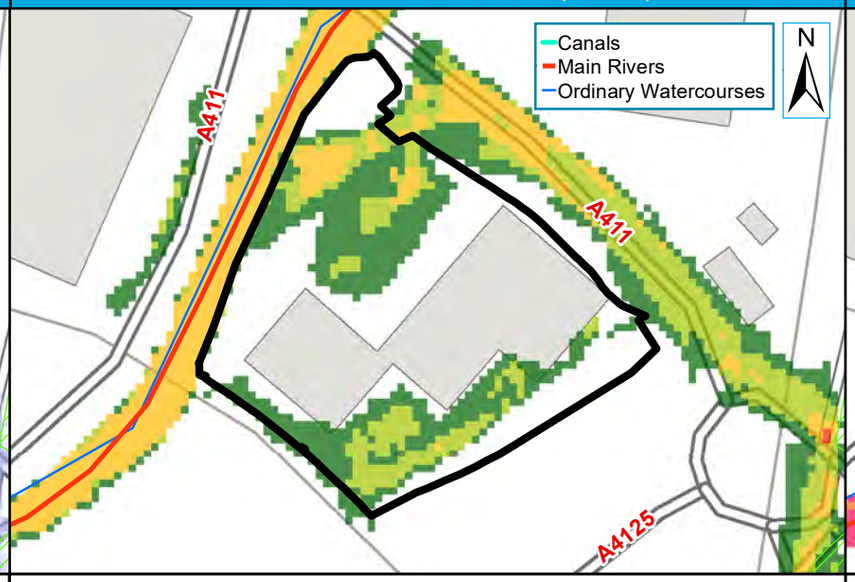
Maximum Fluvial Flood Velocity (m/s) - 1% AEP



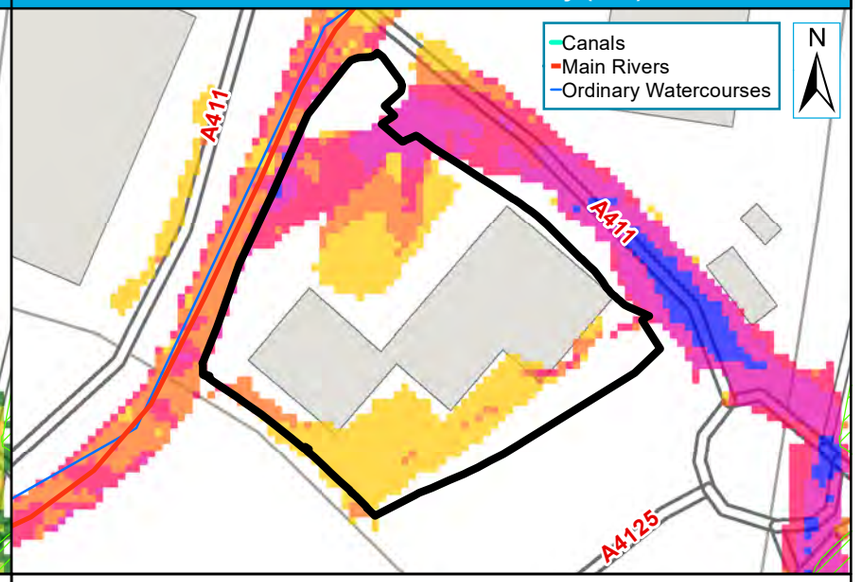
Maximum Surface Water Flood Depth (m) -1% AEP

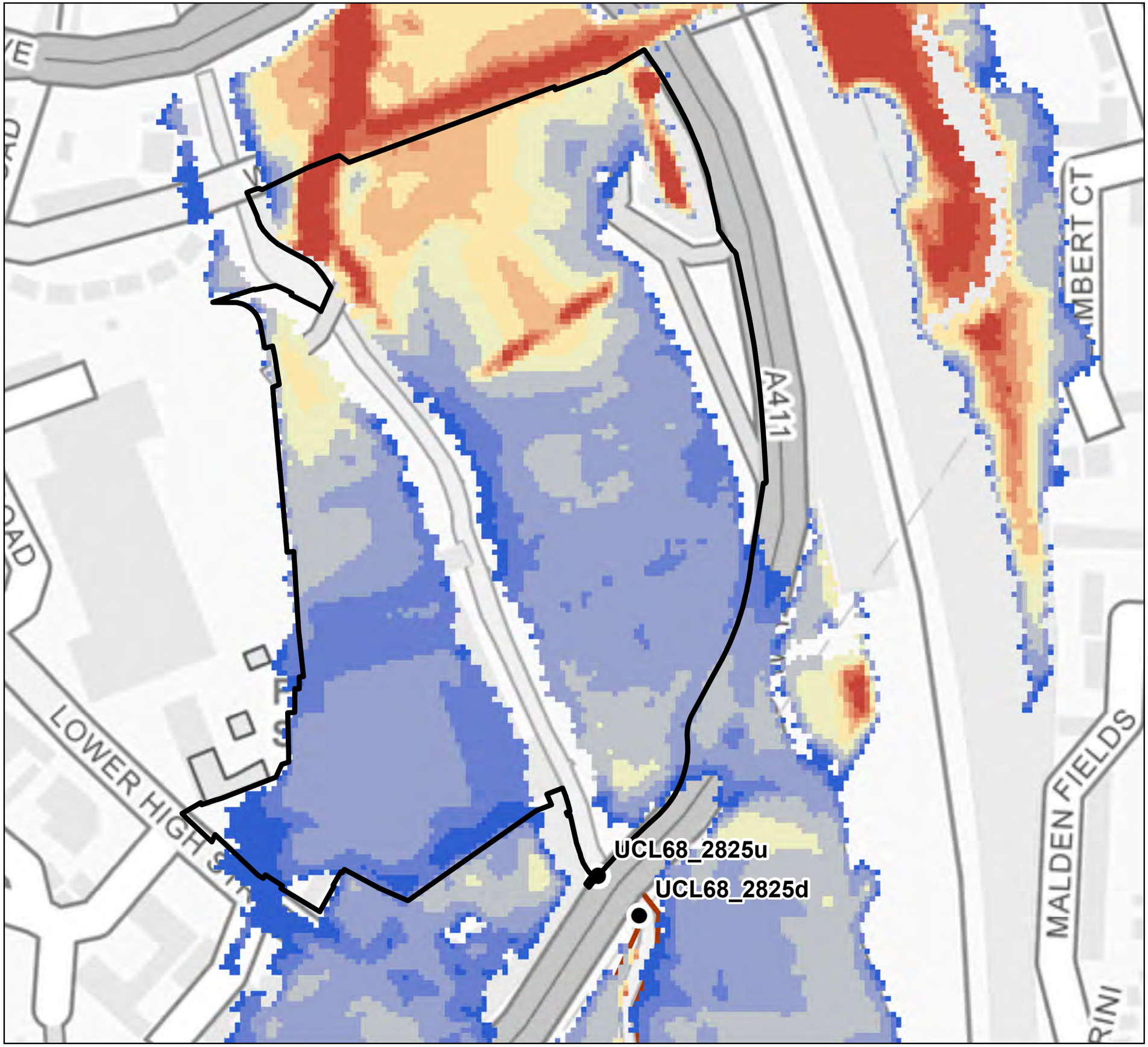


Maxmimum Surface Water Flood Level (mAOD) - 1% AEP



Maximum Surface Water Flood Velocity (m/s) - 1% AEP





North

Watford Borough Council Strategic Flood Risk Assessment Level 2 Detailed Site Summary Blockage Scenario Testing

Site Reference	MX12
Site Name	Land at Tesco Lower High Street

Legend

MX12

90% Blockage (1% AEP)

Depth of Flooding (m)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1.0 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- > 2.0

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0 0.0275 0.055 0.11 Km

North

Watford Borough Council Strategic Flood Risk Assessment Level 2 Detailed Site Summary Blockage Scenario Testing

Site Reference	**MX12**
Site Name	**Land at Tesco Lower High Street**

Legend

- Blockage Location
- MX12
- Baseline (1% AEP)
- 50% Blockage (1% AEP)
- 75% Blockage (1% AEP)
- 90% Blockage (1% AEP)

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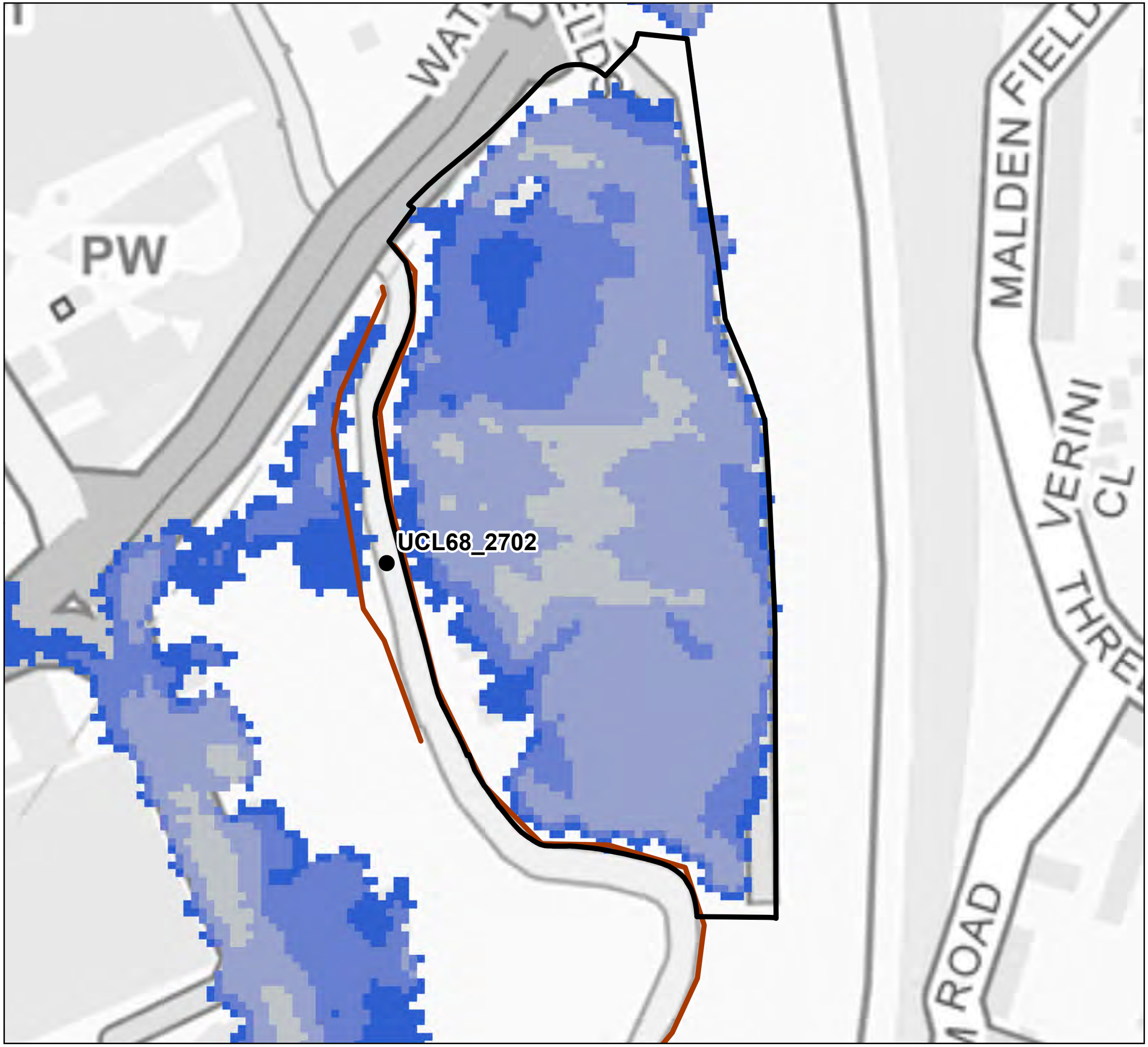
0 0.025 0.05 0.1 Km



North

Watford Borough Council Strategic Flood Risk Assessment Level 2 Detailed Site Summary Blockage Scenario Testing

Site Reference	**MX14**
Site Name	**Colne Valley Retail Park**

Legend

- Breach Location
- MX14

Breach (1% AEP)

Depth of Flooding (m)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1.0 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- > 2.0

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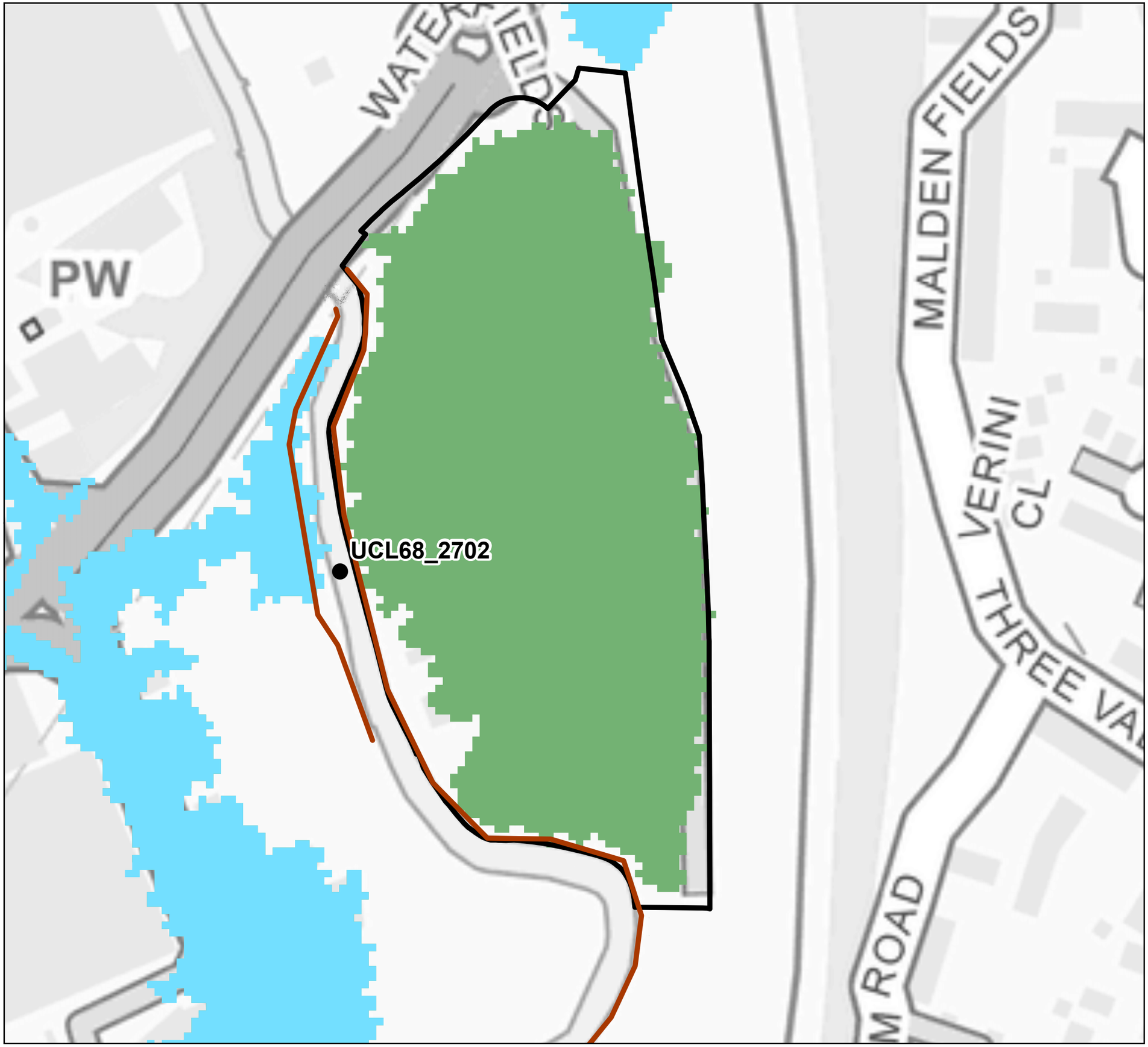
0 0.0175 0.035 0.07 Km



North

Watford Borough Council Strategic Flood Risk Assessment Level 2 Detailed Site Summary Blockage Scenario Testing

Site Reference	MX14
Site Name	Colne Valley Retail Park

Legend

- Breach Location
- MX14
- Wall
- Baseline (1% AEP)
- Breach (1% AEP)

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0 0.02 0.04 0.08 Km