STM environmental

ENVIRONMENTAL CONSULTING , SOFTWARE & TRAINING

FLOOD RISK ASSESSMENT

Site Address

57 Thornhill Road
Ickenham
UB10 8SQ

Client

Adnan Bashier

Date

22/07/2022

1 Document Control

FLOOD RISK ASSESSMENT

Site Address:	57 Thornhill Road Ickenham UB10 8SQ
National Grid Reference:	507061, 185830
STM Reference:	FRA – 2021 – 000180
Version No:	1.0
Prepared for:	Adnan Bashier
Date:	22/07/2022
Report Author:	Rima Hassan (BSc) Junior Environmental Consultant
Reviewed and authorised by:	**Josh Braithwaite (BSc)** **Flood Risk & Drainage Consultant** **Matthew Ashdown (BSc)** **Senior Environmental Consultant**

Contents

2 Abbreviations

Abbreviation	Description
STM	STM Environmental Consultants Limited
BGS	British Geological Survey
EA	Environment Agency
OS	Ordnance Survey of Great Britain
FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
FWD	Floodline Warning Direct
FRMS	Flood Risk Management Strategy
[LBH]	London Borough of Hillingdon
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
CDA	Critical Drainage Area
SuDS	Sustainable Urban Drainage Systems
GWSPZ	Groundwater Source Protection Zone
LLFA	Lead Local Flood Authority
mbgl	metres below ground level
DCLG	Department for Communities and Local Government
PPGPS	Planning practice guidance and Planning system

3 Disclaimer

This report and any information or advice which it contains, is provided by STM Environmental Consultants Ltd (STM) and can only be used and relied upon by Adnan Bashier (Client).

STM has exercised such professional skill, care and diligence as may reasonably be expected of a properly qualified and competent consultant when undertaking works of this nature. However, STM gives no warranty, representation or assurance as to the accuracy or completeness of any information, assessments or evaluations presented within this report. Furthermore, STM accepts no liability whatsoever for any loss or damage arising from the interpretation or use of the information contained within this report. Any party other than the Client using or placing reliance upon any information contained in this report, do so at their own risk.

4 Executive Summary

SECTION	SUMMARY
Location	57 Thornhill Road, Ickenham, UB10 8SQ Grid Reference: 507061, 185830
Proposed Development	The proposal is for a ground floor rear extension, the first-floor rear and side extension, along with garage and loft conversions.
Flood Zone	Fluvial flood Zones 2 and 3.
Topography	The ground level at the site ranges from 36mAOD (E) to 37.11mAOD (W) with the proposed development sitting at approximately 36.6mAOD.
Sequential and Exception Tests	Development is minor and less vulnerable so Sequential and Exception Tests should not be required. LLFA to decide.
Main Sources of Flooding	Fluvial flooding from the River Pinn, which is adjacent to the site's eastern boundary, and surface water ponding along the same channel.
Flood Defences	No flood defences were identified in the EA data.
Records of Historic Flooding	The EA data identifies two fluvial flooding events from 1977 and 1988.
Fluvial (River) and Tidal (Sea) Flood Risk	Low - The proposed extension sits at approximately 36.6mAOD. During the modelled 1% AEP + 35% CC fluvial event, the flood level reaches a maximum of 36.88mAOD. As such the flood depth on site can be expected to reach 280mm.
Pluvial (Surface Water) Flood Risk	Medium – Flood depths for the 1 in 100-year pluvial event reach a maximum of 600mm along the eastern boundary of the site. During the 1 in 1000-year pluvial event, the entire site will witness flooding of depths up to 1200mm. There have been 11-15 recorded sewer flooding incidents.
Flood Risk from Artificial (Canals and Reservoirs) Sources	Low – No significant artificial sources identified.
Groundwater Flood Risk	Low – Although site is potentially susceptible to groundwater flooding, no recorded incidents have been identified.
Development Impacts on Local Flood Risk	The development is external and will increase the site impermeable area by 21.2m^2 and has potential to impact upon local flood storage and potentially alter flood flow pathways.

SECTION	SUMMARY
Proposed Flood Risk Mitigation Measures	• The finished floor level will be set to approximately 36.85mAOD (no lower than the existing FFL); • The proposal will displace approximately 5.9m^3 of flood plain storage; • The CFS scheme will provide 7.6m^3 of flood plain storage. The proposal will provide a betterment of 2m^3 of flood plain storage; • Occupants will sign up for EA Emergency Flood Warning Direct Service; • Safe egress to flood zone 1 is a 1-minute walk away and safe refuge is available on upper floors.
Surface Water Management (SuDS)	SuDS would reduce current surface water run off rates and given the large size of the site (832m^2), there is good potential for implementation. Consideration should be given to rainwater harvesting and permeable paving where possible.
Conclusions	Based on the information reviewed and taking into account the proposed mitigation measures, it is considered that overall flood risk to the proposed development is acceptable and that it will not increase local flood risk. As such, the development is considered to be in compliance with local planning policy and the NPPF.

5 Introduction

STM Environmental Consultants Limited (STM) has been appointed by Adnan Bashier (Client) to provide a Flood Risk Assessment (FRA) at a site located at 57 Thornhill Road, Ickenham, UB10 8SQ.

6 Development Proposal

The FRA is required to support a planning application for a ground floor rear extension, the first-floor rear and side extension, along with garage and loft conversions. Further details including drawings of the development plans are available in Appendix 2.

7 Report Aims and Objectives

The purpose of this report is to establish the flood risk to the site from all potential sources and, where possible, to propose suitable mitigation methods to reduce any risks to an acceptable level. It aims to make an assessment of whether the development will be safe for its lifetime, taking into account climate change and the vulnerability of its users, without increasing flood risk elsewhere.

The FRA assesses flood risk to the site from tidal, fluvial, surface water, groundwater, sewers and artificial sources. The FRA has been produced in accordance with the National Planning Policy Framework (NPPF) and its supporting guidance.

8 Summary of Data Review Undertaken

The following research has been undertaken as part of the FRA:

- Desktop assessment of topographical, hydrological and hydrogeological settings through review of the information sourced from the British Geological Survey (BGS), the Environment Agency (EA) and the Ordnance Survey (OS);
- Review of publicly available flood risk mapping provided by the EA;
- Review of the Preliminary Flood Risk Assessment (PFRA) and Level 1 Strategic Flood Risk Assessment (SFRA) produced by the LLFA outlining flood risk from various sources within the borough.

9 Legislative and Policy Context

9.1 Legislative Context

The Flood and Water Management Act was introduced in 2010. The Act defines the role of lead local flood authority (LLFA) for an area. All LLFA are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area, called “local flood risk management strategy”.

Alongside the Act, Flood Risk Regulations (2009) outline the roles and responsibilities of the various authorities, which include preparing Flood Risk Management Plans and identifying how significant flood risks are to be mitigated.

9.2 Policy Context

9.2.1 National Planning Policy Framework (NPPF)

The NPPF (updated July 2021) sets out the government’s planning policies for England and how these are expected to be applied. It also provides a set of guidelines and philosophy with which local planning authorities (LPAs) can build their own unique policies to appropriately regulate development within their jurisdictions.

Section 14 entitled “Meeting the challenge of climate change, flooding and coastal change” deals specifically with flood risk.

Paragraph 159 states that “Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk

(whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere".

In addition, Paragraph 161 outlines that "All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

- applying the sequential test and then, if necessary, the exception test as set out below;
- safeguarding land from development that is required, or likely to be required, for current or future flood management;
- using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management);
- where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations".

The NPPF then states in Paragraph 163 that "if it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification".

It further states that when determining any planning application, LPAs should "ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment[55]. Development should

only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
- development is appropriately flood resilient and resistant;
- it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

Applications for minor development and changes of use should not be subject to the Sequential or Exception Tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55.

Footnote 55 states: “A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.”

The NPPF also lays out requirements for how LPAs should deal with planning applications in coastal areas. They should ensure that should they “reduce risk from coastal change by avoiding inappropriate development in vulnerable areas or adding to the impacts of physical changes to the coast.”

Developments in Coastal Change Management Areas should only be considered appropriate where it is demonstrated that:

- it will be safe over its planned lifetime and will not have an unacceptable impact on coastal change;
- the character of the coast including designations is not compromised;
- the development provides wider sustainability benefits;
- the development does not hinder the creation and maintenance of a continuous signed and managed route around the coast.

9.2.2 Local Planning Policy – London Borough of Hillingdon Council

Policy EM6 from the London Borough of Hillingdon Council's Local Plan states the following regarding flood risk:

Policy EM6: Flood Risk Management

The Council will require new development to be directed away from Flood Zones 2 and 3 in accordance with the principles of the National Planning Policy Framework (NPPF).

The subsequent Hillingdon Local Plan: Part 2 -Site Specific Allocations LDD will be subjected to the Sequential Test in accordance with the NPPF. Sites will only be allocated within Flood Zones 2 or 3 where there are overriding issues that outweigh flood risk. In these instances, policy criteria will be set requiring future applicants of these sites to demonstrate that flood risk can be suitably mitigated.

The Council will require all development across the borough to use sustainable urban drainage systems (SUDS) unless demonstrated that it is not viable. The Council will encourage SUDS to be linked to water efficiency methods. The Council may require developer contributions to guarantee the long term maintenance and performance of SUDS is to an appropriate standard.

Implementation of Policy EM6 includes:

- Working with the Environment Agency, British Waterways, Natural England and other partners to develop a management plan for the Grand Union Canal and other Blue Ribbon Networks where they are not currently in place;
- Developing flood risk policies including SUDS in the Hillingdon Local Plan: Part 2- Development Management Policies LDD.

Monitoring of Policy EM6 will include:

- Monitoring of Policy EM6 will be through the Annual Monitoring Report with a specific link to: E1 (Core) Indicator: Number of planning permissions granted contrary to the advice of the Environment Agency on either flood defence grounds or water quality. Target: No planning permission will be granted contrary to the advice of the Environment Agency on either flood defence grounds or water quality.
- NI 189 - Flood risk management indicator.
- Number of planning permissions granted contrary to the advice of the Environment Agency.
- Number of new homes built in medium and high flood risk areas.

9.3 EA Standing Advice on Flood Risk

The Environment Agency's standing advice lays out the process that must be followed when carrying out flood risk assessments for developments.

Flood Risk Assessments are required for developments within one of the Flood Zones. This includes developments:

- in Flood Zone 2 or 3 including minor development and change of use more than 1 hectare (ha) in Flood Zone 1;
- less than 1 ha in Flood Zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they

could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs);
- in an area within Flood Zone 1 which has critical drainage problems as notified by the Environment Agency.

10 Site Description and Environmental Characteristics

10.1 Site Location and Area

The site is located at 57 Thornhill Road, Ickenham, UB10 8SQ and is centred at national grid 507061, 185830. The site has an area of 832m^2.

10.2 Site Access

The site is accessed via Thornhill Road.

10.3 Local Planning Authority

The site falls within the jurisdiction of London Borough of Hillingdon Council in terms of the planning process.

10.4 Lead Local Flood Authority

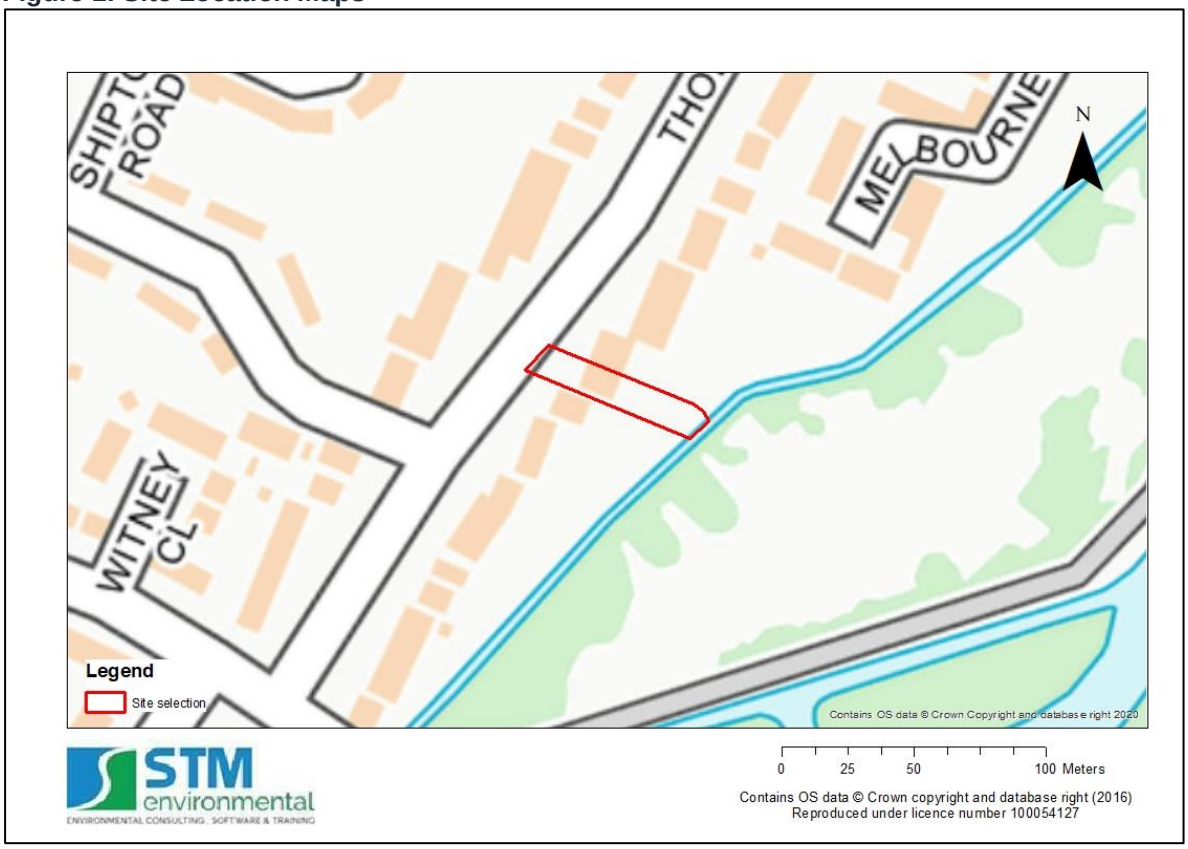
London Borough of Hillingdon is also the Lead Local Flood Authority (LLFA).

10.5 Flood Zone

For planning purposes, the site is located in Flood Zones 2 and 3 as defined by the EA and LLFA.

A site location map and aerial photo are shown below. Photographs of the site are available in Appendix 1.

Figure 1: Site Location Maps



10.6 Site and Surrounding Land Uses

10.6.1 Site Current Land Use

The site currently comprises a two storey residential dwelling and associated gardens.

10.6.2 Surrounding Land Uses

A description of the current and surrounding land uses of the site is given in Table 1.

Table 1: Summary of surrounding land uses

Boundary	Land Use Description	
	Immediately Adjacent (within 0 – 25m)	**General Local Area (i.e. within 25 - 250m)**
Northern	Residential, Thornhill Road	Residential
Eastern	River Pinn	Swakeleys Park Play Area
Southern	Residential, River Pinn	Swakeleys Park Play Area, Residential
Western	Residential Properties	Residential

10.7 Hydrology

The nearest main watercourse is the River Pinn which is located directly along the eastern boundary of the site.

10.8 Geology

Data from the British Geological Survey indicates that the underlying superficial geology is characterised as Alluvium Deposits. The underlying bedrock geology is characterized as the Lambeth Group.

10.9 Hydrogeology

The site lies upon a Secondary A Bedrock Aquifer. No superficial deposits were identified within the search. Appendix 3 provides BGS mapping showing the hydrogeology at the site location.

10.10 Topography

The ground level at the site ranges from 36mAOD (E) to 37.11mAOD (W), with the proposed extension sitting at an average of 36.60mAOD.

11 The Sequential and Exception Tests

11.1 The Sequential Test

The Sequential Test aims to steer developments and redevelopments to areas of lower flood risk. The test compares the proposed development site with other available sites, in terms of flood risk, to aid the steering process. The Sequential Test is not required if the proposed development is a minor development or if it involves a change of use unless the development is a caravan, camping chalet, mobile home or park home site.

Based on Government Guidance, Minor Development means:

- minor non-residential extensions: industrial/commercial/leisure etc extensions with a footprint less than 250 square metre.
- alterations: development that does not increase the size of buildings eg alterations to external appearance.
- householder development: For example; sheds, garages, games rooms etc within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling eg subdivision of houses into flats.

With regard to residential and commercial developments, major development, as defined by the Town and Country Planning (Development Management Procedure) means one or more of the following:

- c(i) - the number of dwelling houses to be provided is 10 or more; or
- c(ii) - the development is to be carried out on a site having an area of 0.5 hectares or more and it is not known whether the development falls within sub-paragraph (c)(i);
- the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more;
- or development carried out on a site having an area of 1 hectare or more.

The development is considered to be minor and as such the Sequential Test should not be required by the LLFA.

11.2 The Exception Test

Where the Sequential Test is undertaken and alternative sites of lower flood risk are not available, then the proposed development may require an Exception Test in order to be granted planning permission. Where the exception test is required, it should be applied as soon as possible to all local development document allocations for developments and all planning applications other than for minor developments. All three elements of the exception test have to be passed before development is allocated or permitted. For the exception test to be passed:

- It must demonstrate that the development provides wider sustainability benefits to the community that outweigh the flood risk, informed by an SFRA, where one has been prepared;
- The development should be on developed land or on previously developed land;
- A flood risk assessment must demonstrate that the development will be safe without increasing flood risk elsewhere, and where possible will reduce the overall flood risk.

The requirements for an Exception Test are given in Table 2 and are defined in terms of Flood Zone and development vulnerability classification.

Table 2: NPPF Flood Zone vulnerability compatibility (source: NPPF).

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a	Exception Test required	✗	Exception Test required	✓	✓
Zone 3b	Exception Test required	✗	✗	✗	✓

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Based on its scale and nature, the development is considered to be minor. As such the Exception Test is should not be required by the LLFA.

12 Site Specific Flood Risk Analysis

The PFRA and Level 1 SFRA produced by the LLFA and maps from the EA provide information regarding historic flooding events and incidents as well as predictions of flood extents and depths during extreme rainfall events.

12.1 Fluvial (River) and Tidal (Sea) Flood Risk

12.1.1 Mechanisms for Fluvial Flooding

Fluvial, or river flooding, occurs when excessive rainfall over an extended period of time or heavy snow melt causes a river to exceed its capacity. The damage from a fluvial flood can be widespread as the overflow may affect downstream tributaries, overtopping defences and flooding nearby inhabited areas. Fluvial flooding consists of two main types:

- Overbank flooding – this occurs when water rises steadily and overflows over the edges of a river or stream;
- Flash flooding – this is characterized by an intense, high velocity torrent of water that occurs in an existing river channel with little to no notice. Flash floods are very dangerous and destructive not only because of the force of the water, but also the hurtling debris that is often swept up in the flow.

12.1.2 Definition of EA Modelled Fluvial Flood Risk Zones

Fluvial flood risk is assessed using flooding maps produced by the Environment Agency. These maps use available historic data and hydraulic modelling to define zones of flood risk. The maps allow a site to be defined in terms of its flood zone (e.g. 1, 2, 3) and in terms of the overall flood risk (very low, low, medium or high). It is important to note that existing flood defences are not taken into account within the models or the maps. The EA fluvial flood zones are defined as follows:

- Flood zone 1: Less than 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 2: Between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 3: Greater than 1 in 100 (1%) annual probability of fluvial flooding.

Flood zone 3 is split into two sub-categories (3a and 3b) by LLFAs depending on whether the land is considered to be a functional flood plain (i.e. an important storage area for flood waters in extreme events).

- Flood zone 3a: Greater than 1 in 100 (1%) annual probability of fluvial flooding and/or greater than 1 in 200 (0.5%) annual probability of tidal flooding;
- Flood zone 3b: Functional flood plain (definition specific to the LLFA). Less than a 1 in 20 (5%) annual probability of fluvial and/or tidal flooding.

12.1.3 Main Potential Sources of Local Fluvial Flooding

The nearest potential source of fluvial flooding to the site is considered to be the River Pinn located adjacent the eastern boundary.

12.1.4 Records of Historic Fluvial Flooding Incidents

On examination of mapping EA mapping, there has been two fluvial flooding events in 1977 and 1988. The flood extents did impact the area of the existing and proposed development; however, no flood depth was indicated.

12.1.5 Potential Sources of Tidal Flooding

The area in which the site is located is considered unlikely to be affected by tidal flooding according to the LLFA's SFRA.

12.1.6 Flood Defences

The EA's flood defences map, which is available in Appendix 7, shows that the site is not within an area benefitting from flood defences. The map shows no indication of any flood defences in the vicinity of the site.

12.1.7 Climate Change - EA Modelled Predictions of Fluvial and Tidal Flood Levels and Extents

The EA Product 4 dataset which is presented in Appendix 11 provides modelled flood levels and flows for model node points close to the site. These are summarised in Table 3 below.

Table 3: EA modelled flood levels and expected flood depths for different return periods and scenarios.

	Defended Modelled Flood Level (mAOD)		
Node ID	1% AEP	1% AEP + 35% CC	0.1% AEP
P76	36.63	36.88	37.22
P77	36.66	36.88	37.23

The proposed extension has an approximate elevation of 36.60mAOD. During the modelled 1% AEP + 35% CC fluvial event, the flood level reaches a maximum of

36.88mAOD. As such the flood depth on site can be expected to reach 280mm on site in the area of the proposed development.

12.1.8 Long Term Fluvial Flood Risk Considering Flood Defences

The EA's long term flood risk maps give an indication of the actual risk associated with flooding after taking into account the effect of any flood defences in the area. Copies of maps for the site which are available in Appendix 9 indicate that the long-term risk from fluvial flooding to the site is medium.

12.2 Pluvial (Surface Water) Flood Risk

A pluvial, or surface water flood, is caused when heavy rainfall creates a flood event independent of an overflowing water body. Surface water flooding occurs when high intensity rainfall leads to run-off which flows over the ground surface, causing ponding in low-lying areas when the precipitation rate or overland flow rate is greater than the rate of infiltration, or return into watercourses. Surface water flooding can be exacerbated when the underlying soil and geology is saturated (as a result of prolonged precipitation or a high-water table) or when the drainage network has insufficient capacity.

12.2.1 Mechanisms of Pluvial Flooding

The chief mechanisms for surface water flooding can be divided into the following categories:

- Runoff from higher topography;
- Localised surface water runoff – as a result of localised ponding of surface water;
- Sewer Flooding – areas where extensive and deep surface water flooding is likely to be influenced by sewer flooding. Where the sewer network has reached capacity, and surcharged, this will exacerbate the flood risk in these areas;

- Low Lying Areas – areas such as underpasses, subways and lowered roads beneath railway lines are more susceptible to surface water flooding;
- Railway Cuttings –railway infrastructure cut into the natural geological formations can cause extra surface run off and pooling disrupting service and potentially affecting adjacent structures;
- Railway Embankments – discrete surface water flooding locations along the up-stream side of the raised network rail embankments where water flows are interrupted and ponding can occur;
- Failure of artificial sources (i.e. man-made structures) such as such as canals and reservoirs.

12.2.2 Main Potential Sources of Local Pluvial Flooding

The main potential source of pluvial flooding to the site is considered to be surface water ponding and flooding associated with heavy rainfall.

12.2.3 Records of Historic Pluvial Flooding Incidents

Examination of the LLFA's Level 1 SFRA revealed no evidence of records of pluvial flooding on or in the vicinity of the site.

12.2.4 Surface Water Flood Risk from Artificial Sources (Reservoirs and Canals)

An examination of OS mapping and the EA's mapping revealed indications of significant artificial sources within the area of the site.

According to the EA's reservoir flood risk map, the site is located within an area at risk from reservoir flooding.

12.2.5 Sewer Flooding

A map showing recorded incidents of sewer flooding is available in Appendix 4. It indicates that the site is in an area that has had 11-15 sewer flooding events within the period from 2011 – 2017.

12.2.6 Climate Change - Modelled Predictions of Surface Water Run-off Flooding

Mapping of the predicted extent and depth of surface water flooding for the 1 in 100-year and 1 in 1000-year rainfall return periods provided by the EA are available in Appendix 6.

Throughout all modelled scenarios the site will witness flooding. During the 1 in 100-year pluvial flood depths of up to 900mm will be witnessed to the eastern side of the site. As for the 1 in 1000-year pluvial event flood is witnessed to the entire extent of the site to depths of over 1200mm.

12.2.7 Long Term Surface Water Flood Risk

The EA's long term flood risk maps which are available in Appendix 9 indicate that the long term risk of flooding from surface water is considered to be high risk.

12.3 Risk of Flooding from Multiple Sources (ROFMS)

The Environment Agency provides a map which gives an indication the overall flood risk from fluvial, tidal and surface water sources considering the presence of river defences. This map indicates there is a greater than 3.3% chance of flooding at the site in any year. A copy of the map is presented in Appendix 8.

12.4 Groundwater Flood Risk

Groundwater flooding occurs when water rises from an underlying aquifer (i.e. at the location of a spring) to such a level where it intersects the ground surface and inundates the surrounding land. Groundwater flooding tends to occur after long periods of intense precipitation, in often low-lying areas where the water table is likely to be at a shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels. A high groundwater table also has the potential to exacerbate the risk of surface water and fluvial flooding by reducing rainfall infiltration capacity, and to increase the risk of sewer flooding through sewer/groundwater interactions.

12.4.1 Historic Records of Groundwater Flooding

The map indicates that there have been no recorded incidents of groundwater flooding at or within 500m of the site. A map showing the locations of historic groundwater flooding incidents is available in Appendix 4.

12.4.2 Susceptibility to Groundwater Flooding

The Groundwater Flood Susceptibility Map provided by BGS and presented in Appendix 10 indicates that the potential for groundwater flooding to occur at the surface exists. The Groundwater Depth map also provided by BGS indicates that the groundwater level may be at approximately less than 3 mbgl.

12.5 Critical Drainage Area

A Critical Drainage Area (CDA) may be defined as “a discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure”. A CDA is defined in the Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006 as “an area within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency”.

According to the LLFAs Surface Water Management Plan, the site is not located within a Critical Drainage Area.

13 Potential Impacts of the Development on Local Flood Risk

13.1 Impacts on Flood Storage

13.1.1 Changes to Impermeable Area and Building Footprint

Changes in ground cover arising from the development are presented in Table 4 below.

Table 4: Existing and proposed site ground cover.

	Impermeable Area (m^2)	Permeable Area (m^2)	Total Area (m^2)
Existing	310.8	414.6	725.4
Proposed	328.5	396.9	725.4

The proposed building would increase the impermeable area by 21.2m^2. As the development will significantly alter the site impermeable area, it is considered possible that it will impact upon flood flow rates.

The development will change the site's built-up area and so is likely to have a significant impact on local flood storage. This is discussed in more detail in Section 14.2.2.

13.2 Impacts on Flood Flow Routes

As the development is increasing the buildings footprint by 21.2m^2, it has the potential to impact flood flow pathways.

14 Flood Risk Mitigation Measures

14.1 SuDS

Planning practice guidance (PPG) which is prepared by the Ministry of Housing, Communities and Local Government (DCLG) states that developers and Local Authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

As such, the developer has the option to implement a SuDS strategy in line with the drainage hierarchy as outlined in Table 5 below to reduce surface water discharges from the site.

Table 5: SuDS Options

- Store rainwater for later use;
- Use infiltration techniques, such as porous surfaces in non-clay areas;
- Attenuate rainwater in ponds or open water features for gradual release;
- Attenuate rainwater by storing in tanks or sealed water features for gradual release;
- Discharge directly to a water course;
- Discharge rainwater directly to a surface water sewer/drain;
- Discharge to a combined sewer.

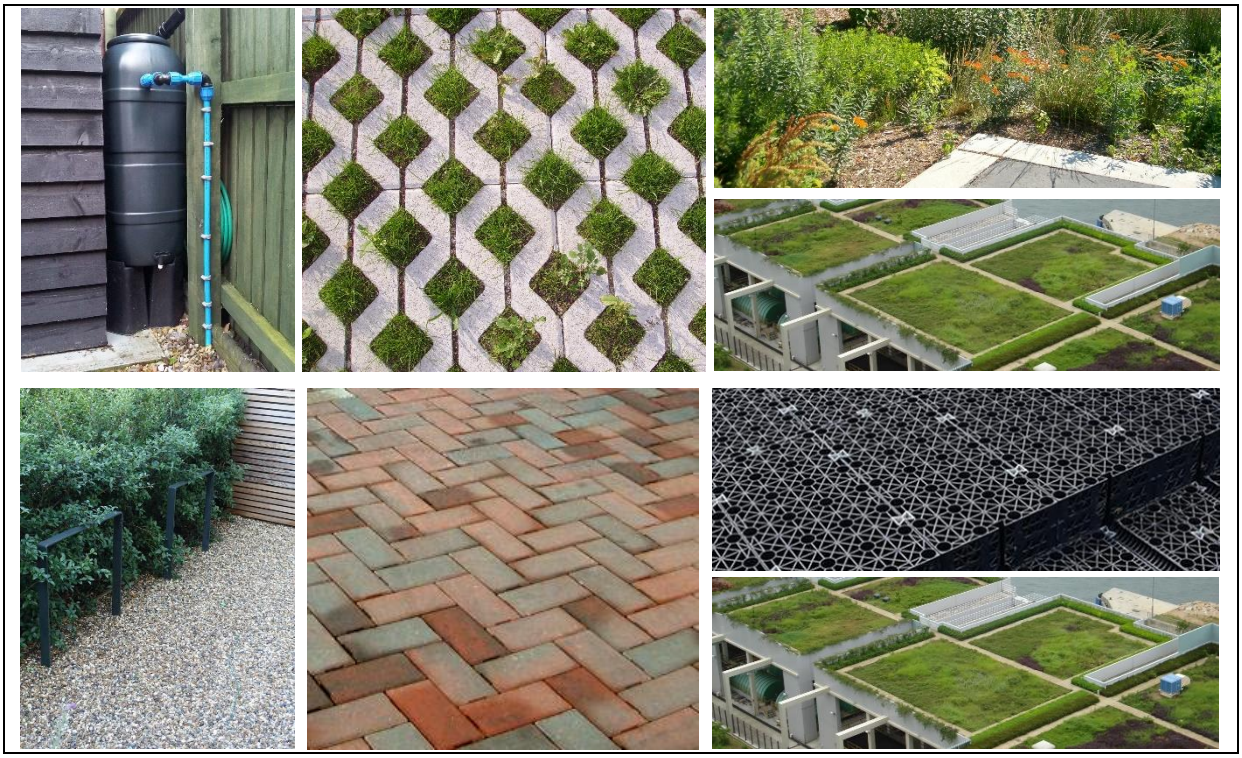


Figure 2: Surface water storage facilities and potential SuDS features - rainwater harvesting, on-site tank storage, rain garden soak-away and green roofs. (Source: UK SuDS Manual)

Given the nature of the development and the size of the site, it is considered that there are good opportunities for implementing SuDS. Measures such as rainwater harvesting, infiltration (soakaways, permeable paving, rain gardens) or attenuation storage tanks should be considered. A full SuDS strategy is outside the scope of works of this FRA.

14.2 Flood Resilience

Flood resilient construction uses methods and materials that reduce the impact from a flood, ensuring that structural integrity is maintained, and the drying out and cleaning required, following inundation and before reoccupation, is minimised.

14.2.1 Finished Floor Levels

The average ground level of proposed development is 36.60mAOD. There is a minimum of 150mm step at all the thresholds into the dwelling. The existing finished floor level is therefore approximately 36.75mAOD.

For **minor extensions,** the EA's Standing Advice states that finished floor levels are either no lower than existing floor levels or 300 millimetres (mm) above the estimated flood level. Where floor levels cannot be set to 300mm above existing flood levels, applicants should check with the LPA if they need to take flood resistance and resilience measures.

During the modelled 1% AEP + 35% CC fluvial event, the flood level reaches a maximum of 36.88mAOD. Following EA Guidance the FFL should be set to 300mm above the 1% AEP + 35% CC fluvial event and so at 37.18mAOD.

As the extension is only 21.2m^2, it is considered impractical to raise the FFL above the existing, as it would have a detrimental impact on its proposed use.

Therefore, FFL will be no lower than the existing.

14.2.2 Compensatory Flood Storage (CFS)

All new development within Flood Zone 3 must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where proposed development results in a change in building footprint, the developer must ensure that it does not impact upon the ability of the floodplain to store water,

and should seek opportunities to provide a betterment with respect to floodplain storage.

During the 1% AEP + 35% Climate Change modelled fluvial scenario, the flood depth at the proposed extension reaches 36.88mOAD. The lowest elevation within the area of the proposed extension is 36.60mAOD. The greatest depth of flooding across the extension is indicated to be 280mm. This flood depth has been assumed across the entire extension.

The proposed 21.2m^2 extension will therefore cause 5.9m^3 of flood plain storage displacement.

This affected area will require Compensatory Flood Storage (CFS) via level for level compensation to ensure storage capacity of the flood plain is retained.

The mapping in Figure 3 shows the proposed development and the 1% AEP plus 35% CC. The flood level has been imposed onto the 1m DTM LiDAR data and is shown by those areas which are in a shaded blue (i.e. areas at elevations of 36.88mAOD of less).

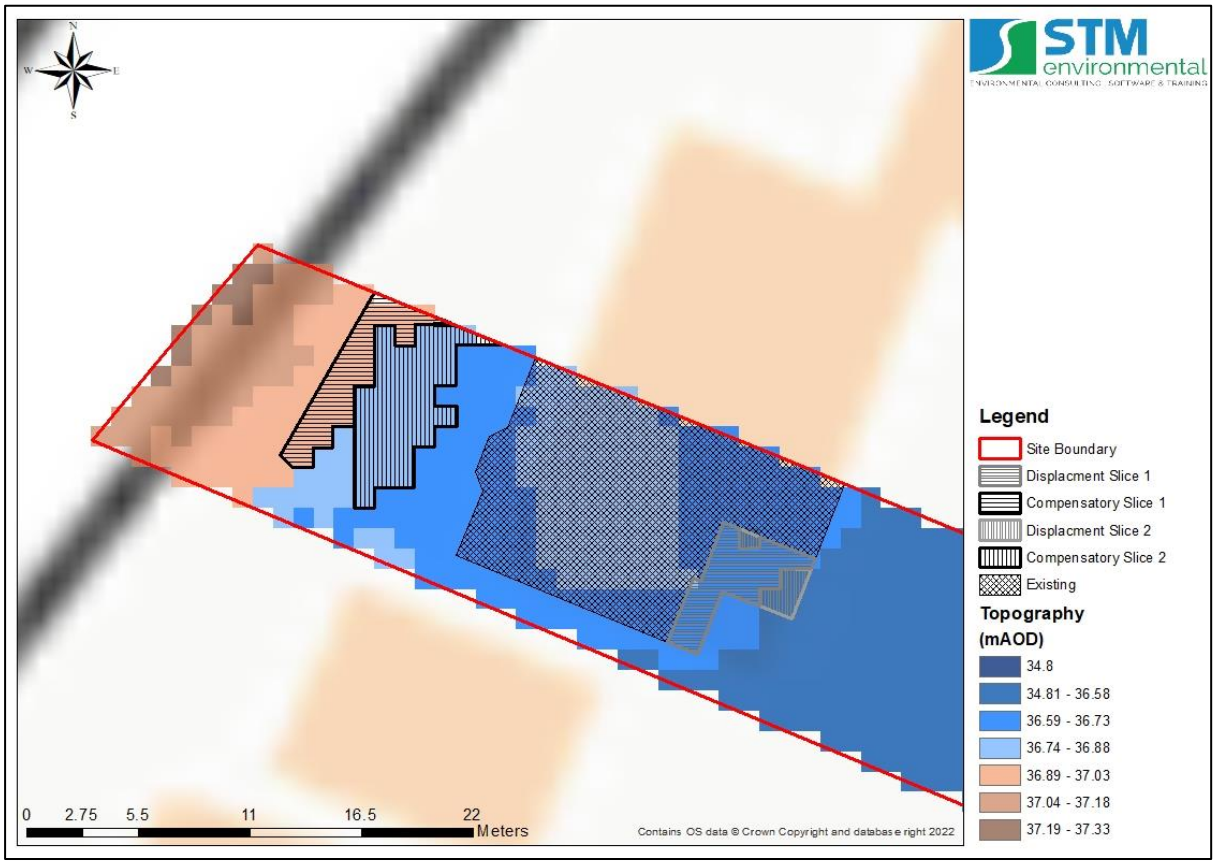


Figure 3: Areas on site affected by the modelled 1% AEP + 35% CC shown in Blue (areas at or below 36.88mAOD).

Table 6: Flood displacement and compensatory slice calculation. It should be noted that slice 2 runs under the full extent of slice 1 and all slice depths are 150mm.

Slice	Area (m^2)	Slice Depth (mAOD)	Compensatory Storage Requirement (m^3)
Displacement slice 1	16.4	36.59 – 36.73	-2.5
Displacement slice 2	20.8	34.81 – 36.58	-3.1
TOTAL			**-5.6**
Compensatory Slice 1	18.5	36.74 – 36.88 (-150mm)	+2.8
Compensatory Slice 2	32.1	36.59 – 36.73 (-150mm)	+4.8
TOTAL			**7.6 (+2)**

It is proposed that two areas are lowered by 150mm to provide the additional flood plain volume required.

It should be noted that true level for level is not attainable at this site as there is no available area to compensate for at the same depths as the displacement slices.

As such, the compensation slices have been placed in an area on the edge of the 1% AEP + 35% CC flood extent to ensure it is hydraulically connected to the existing flood extent.

The CFS scheme will provide 7.6m^3 of flood plain storage. The proposal will provide a betterment of 2m^3 of flood plain storage.

14.2.3 Flood Resilience Construction Measures

In terms of achieving resilience, there are two main strategies, whose applicability is dependent on the water depth the property is subjected to. These are:

- Water Exclusion (Flood Resistance) Strategy - should be employed where predicted flood depths are less than 0.3m and are likely to be for short duration. Emphasis is placed on minimising water entry and giving occupants time to relocate ground floor contents, maintaining structural integrity, and on using materials and construction techniques to facilitate drying and cleaning;
- Water Entry (Flood Resilience) Strategy - Flood resilience measures are designed to allow water in but to limit damage and allow rapid re-occupancy. Resilience measures should be employed where flood depths are greater than 0.6m and where it is likely that structural damage will occur due to excessive water pressure.

Given that flood depths less than 0.3m are predicted in extreme scenarios, the water exclusion is considered most applicable for this site.

Water Exclusion Strategy:

There are a range of flood protection devices/methods that can be used in the Water Exclusion Strategy including:

- Using materials and construction with low permeability;
- Landscaping e.g. creation of low earth bunds (subject to this not increasing flood risk elsewhere);
- Raising thresholds and finished floor levels (e.g. porches with higher thresholds than main entrance);

- Flood gates with waterproof seals;
- Sump and pump for floodwater to remove waste water faster than it enters;
- Door guards and airbrick covers.

Flood resilience design and measures that will be implemented are outlined below. Water-resistant and resilient materials will be utilized throughout the construction to minimize the flood risk and potential impacts.

Floor construction:

- Use of resilient flooring materials as ceramic tiles or stone floor finishes;
- Use of a concrete slab 150mm thick;
- Use of ceramic tiles or stone floor finishes is recommended;
- Maintain existing under floor ventilation by UPVC telescopic vents above 400 mm to external face of extension;
- Damp proof membrane of impermeable polythene at least 1200 gauge;
- Avoid the use of MDF carpentry.

Wall construction:

- Include in the external face of the extension a damp – proof course, 250 mm above ground level, to prevent damp rising through the wall;
- Use rigid closed – cell material for insulation above the DPC;
- Spread hardcore over the site within the external walls of the building to such thickness as required to raise the finished surface of the site concrete. The hardcore should be spread until it is roughly level and rammed until it forms a compact bed for the oversite concrete. This hardcore bed will be 100 mm thick and composed by well compacted inert material, blinded with fine inert material.

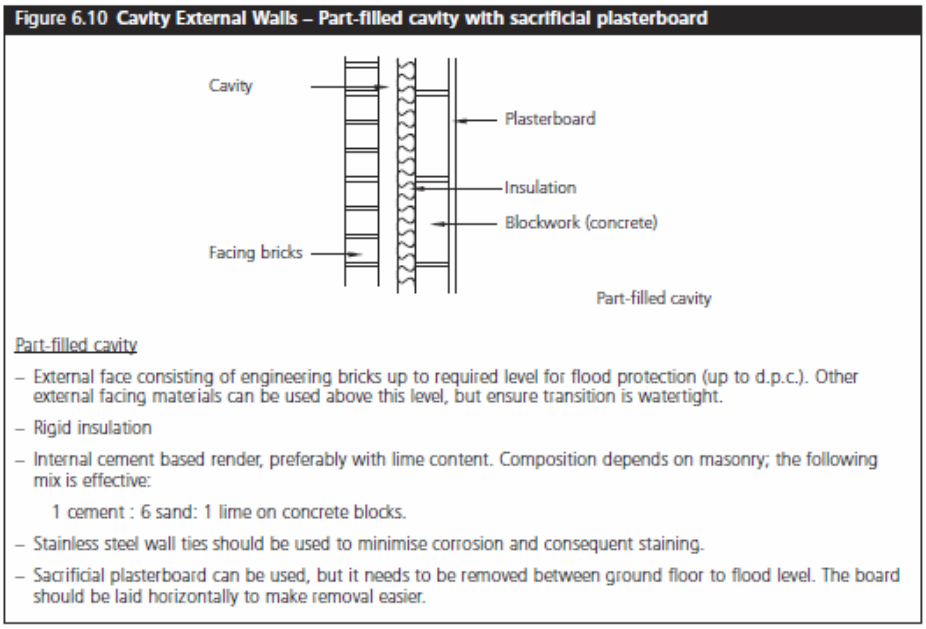
Doors:

- Seal doors around edges and openings. UPVC or composite material will be used with passive protection meaning that minimal intervention will be required in the event of flooding.

Underground drainage:

- Avoid use of metal for any underground piping;
- Use closed cell insulation for pipes that are below the predicted flood level;
- Provide non – return valves for the drainage system to prevent back water flow;
- Use UPVC or clay pipework for fouls and surface water drainage.

Figure 3: Cavity External Walls



As well as the above the following flood resilience features should be applied as part of the development:

- Electrical sockets should be installed above flood level for the ground floor;
- Utility services such as fuse boxes, meters, main cables, gas pipes, phone lines and sockets will be positioned as high as practicable;

- All external openings for pipes or vents below 400mm to be sealed around pipe or vent with expanding foam and mastic.

14.3 Emergency Plan

14.3.1 Assessment of Danger to People

The dangers associated with flood water to people are possible injury and/or death. This can occur as a result of drowning or being carried along by the waters into hard objects or vice versa. The risk to life is largely a function of the depth and velocity of the floodwater as it crosses the floodplain. Fast flowing deep water that contains debris would represent the greatest hazard.

The assessment of danger to people from walking in floodwater is described in the Flood Risks to People guidance documents (FD2321_TR1 and FD2321_TR2) by DEFRA/EA.

Danger can be estimated by the simple formula:

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

where, HR = (flood) hazard rating; d = depth of flooding (m); v = velocity of floodwaters (m/sec); and DF = debris factor.
The scoring methodology and calculation matrix for this is summarised in Appendix 13.

As the EA only provided in-channel modelled flows, hazard rating cannot be assessed on site.

14.3.2 EA Flood Warnings Direct Service Subscription

The occupants will subscribe to the EA Flood Warnings Direct Service which is a free service offered by the EA providing flood warnings direct to people by telephone, mobile, email, SMS text message and fax. The EA aims to provide 2 hours' notice of flood, day or night, allowing timely evacuation of the site.

The agency operates a 24-hour telephone service on 0345 988 1188 that provides frequently updated flood warnings and associated floodplain information. In addition, this information can also be found at https://fwd.environment-agency.gov.uk/app/olr/home along with recommendations on what steps should be taken to prepare for floods, what to do when warnings are issued, and how best to cope with the aftermath of floods.

14.3.3 Access and Safe Egress

Access to and egress from the site is via Thornhill Road. LIDAR data indicates that the ground levels along Thornhill Road range from 36.8mAOD to 37.8mAOD.

Safe egress to Flood Zone 1 is available by a one-minute walk north up Thornhill Road. Directions of this route are presented in Appendix 12 .

14.3.4 Safe Refuge

The proposed development will have internal connections to upper floors in the property which will act to provide sufficient safe refuge in the event of an extreme flood event.

15 Conclusions and Recommendations

This assessment has considered the potential risks to the application site associated with flooding from fluvial, tidal, surface water, artificial and groundwater sources and the potential impacts of climate change.

A review of LLFA's PFRA and SFRA as well as data provided by the EA was undertaken. The main findings of the review and assessment are provided below:

- The site is classified as a less vulnerable minor development and is therefore unlikely to require sequential and exception tests to be undertaken;
- The main sources of potential flooding to the site are from the River Pinn and surface water;

- The EA defines the site as being within Flood Zones 2 and 3;
- The EA data identifies two fluvial flooding events from 1977 and 1988. The flood extents did impact the area of the existing and proposed development; however, no flood depth was indicated;
- EA mapping indicates that the site is not in an area that benefits from flood defences;
- No records of surface water or artificial flooding incidents were identified at or in the vicinity of the site;
- The site is not within a CDA. It is in an area that has had a 11 - 15 sewage flooding incidents between 2011 and 2017;
- No records of groundwater flooding incidents were identified at or in the vicinity of the site;
- The Finished Floor Level will be no lower than the existing at approximately 36.85mAOD;
- The development will result in a 21.2m^2 increase in impermeable area;
- The proposal will displace approximately 5.9m^3 of flood plain storage;
- The CFS scheme will provide 7.6m^3 of flood plain storage. As a result, the proposal will provide a betterment of 2m^3 of flood plain storage;
- There is good opportunity for implementing SuDS mitigation measures. Consideration should be given to use of rainwater harvesting, infiltration (soakaways, permeable paving, rain gardens) or attenuation storage tanks;
- Flood resilient materials and construction methods will be used so as to ensure that the impacts of any potential flooding are minimised as much as possible;
- Occupants will subscribe to the EA Flood Warnings Direct Service;
- Safe egress routes to flood zone 1 are easily accessible;
- In the event that evacuation is not possible, safe refuge is available in the upper floors of the building which are accessible via an internal staircase.

Based on the information reviewed and taking into account the proposed mitigation measures, it is considered that overall flood risk to the proposed development is

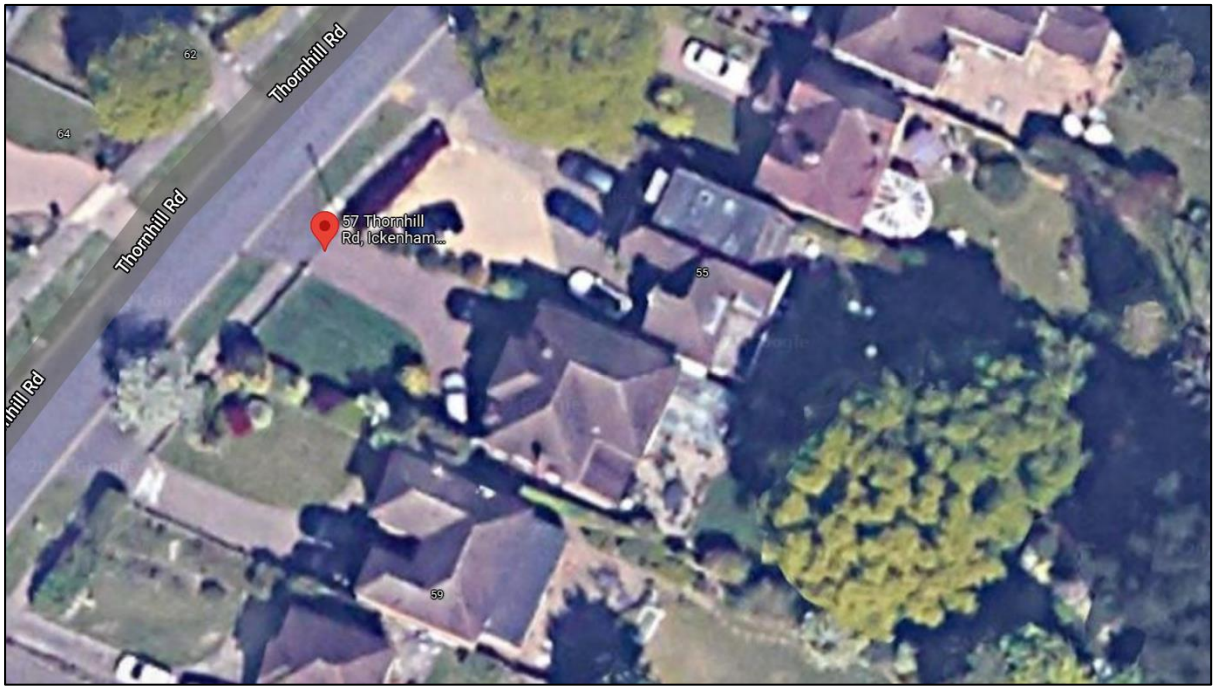
acceptable and that it will not increase local flood risk. As such, the development is considered to be in general compliance with local planning policy and the NPPF.

16 References

1. Communities and Local Government - National Planning Policy Framework NPPF, July, 2021.
2. Communities and Local Government - Planning Practice Guidance: Flood Risk and Coastal Change, Updated 06 March 2014.
3. West London Strategic Flood Risk Assessment
4. London Borough of Hillingdon Local Plan – Sept 2020
5. Surface Water Management Plan Hillingdon
6. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.
7. Greater London Authority – London Sustainable Drainage Action Plan, 2015.
8. London Plan (2021) - Mayor of London
9. London Regional Flood Risk Appraisal (2018) - Mayor of London

17 Appendices

17.1 Appendix 1 – Site Photographs

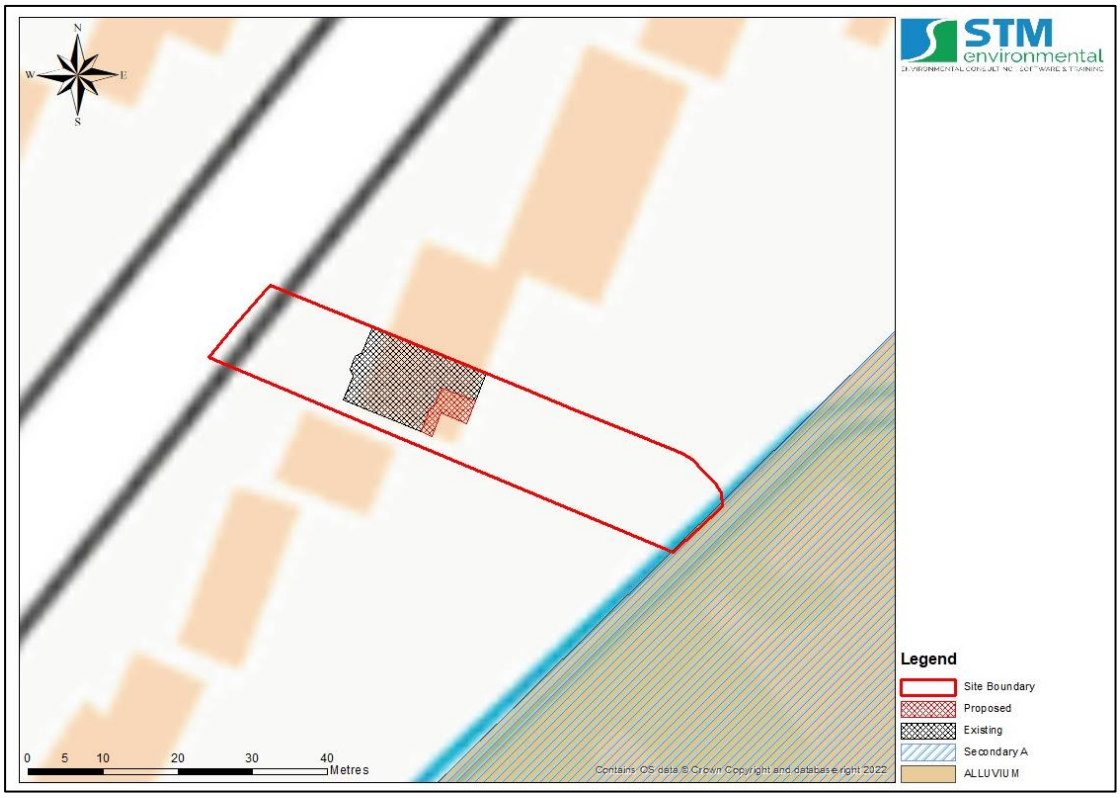


17.2 Appendix 2 – Development Plans

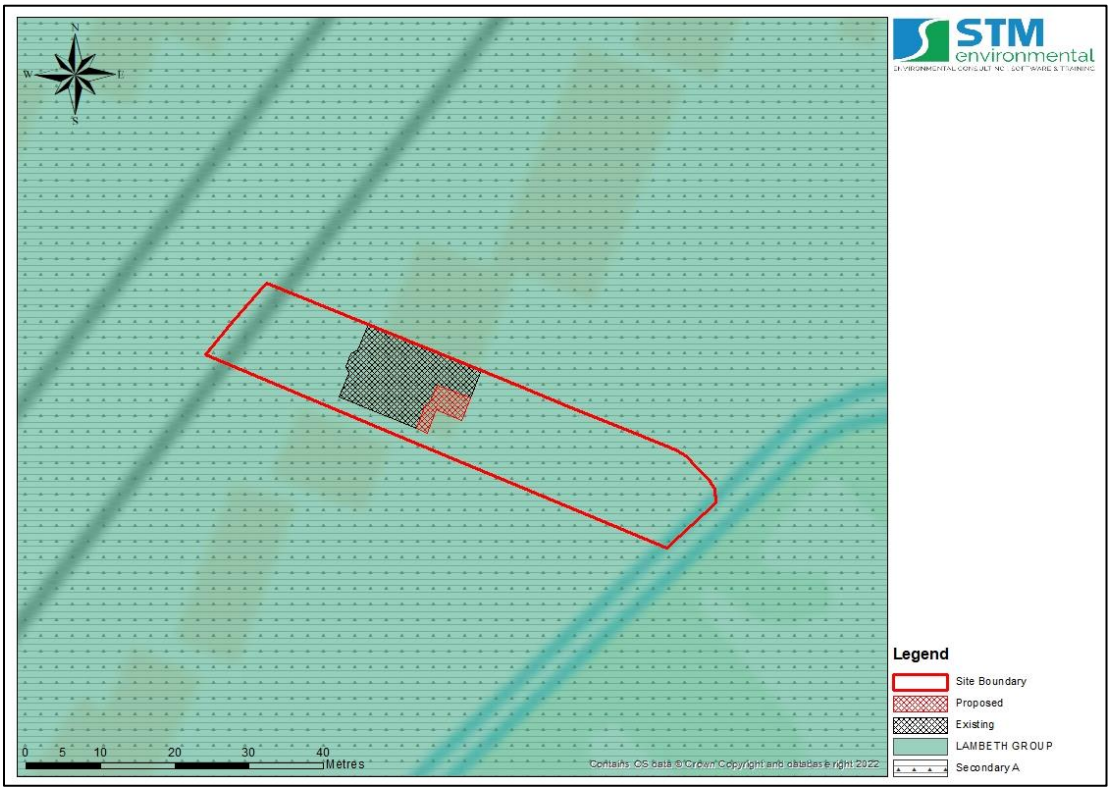
See next page.

17.3 Appendix 3 – Environmental Characteristics

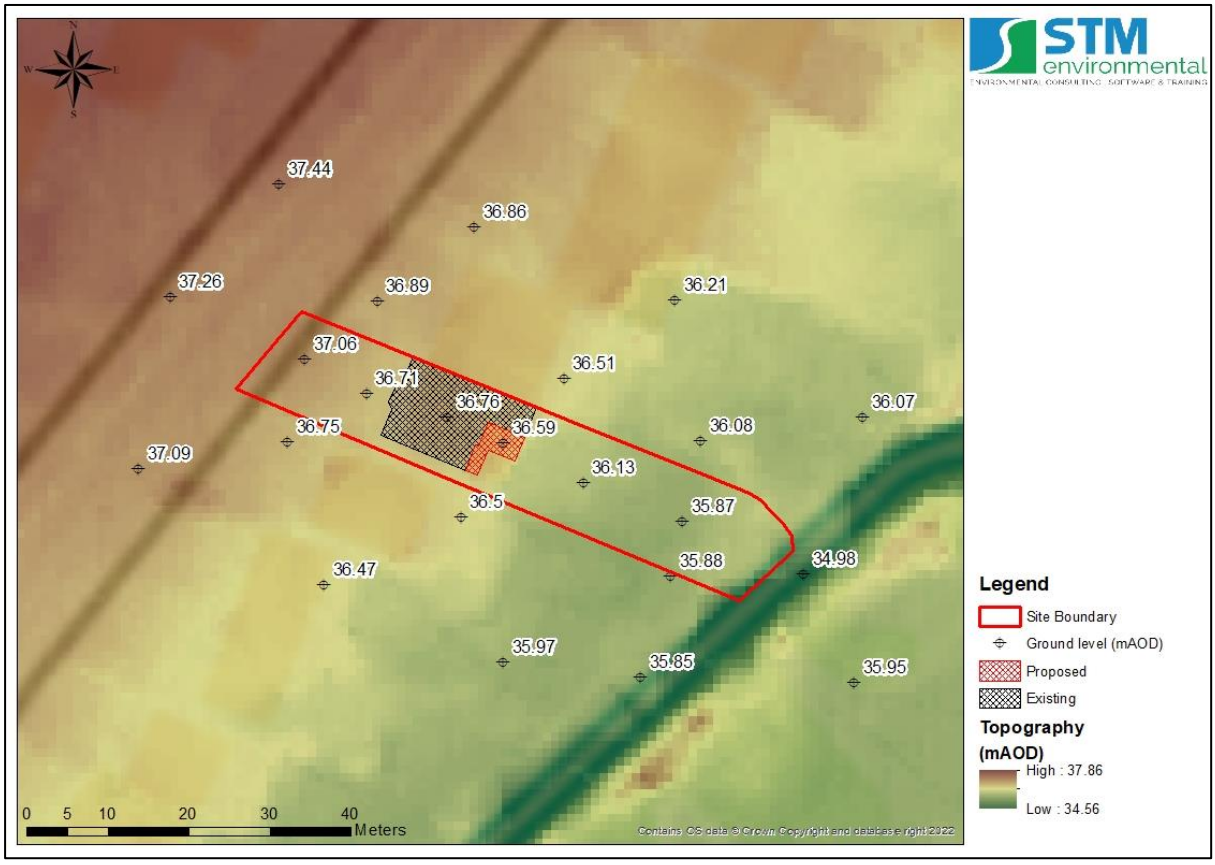
17.3.1 Superficial Hydrogeology Map



17.3.2 Bedrock Hydrogeology Map

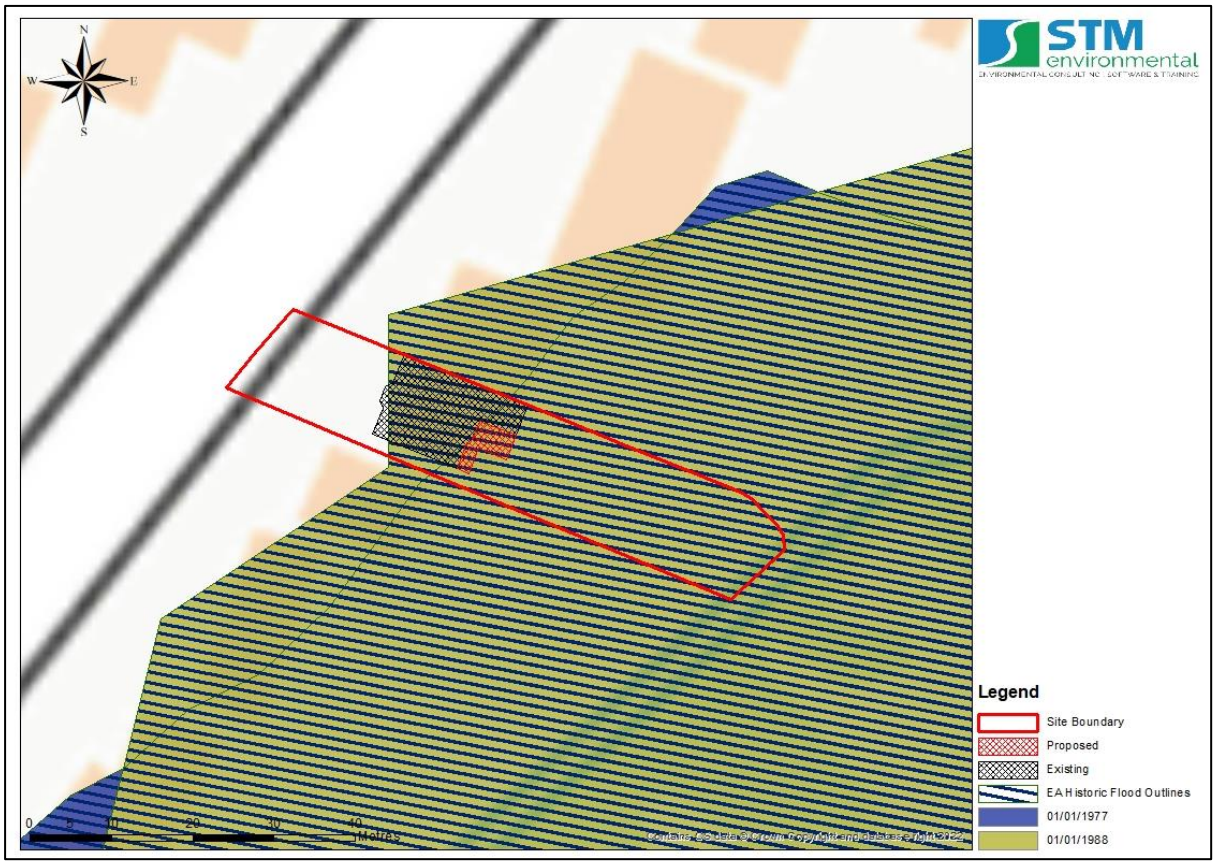


17.3.3 Topology Map



17.4 Appendix 4 – Historical Flood Incident Maps

17.4.1 EA Historic Flood Outlines



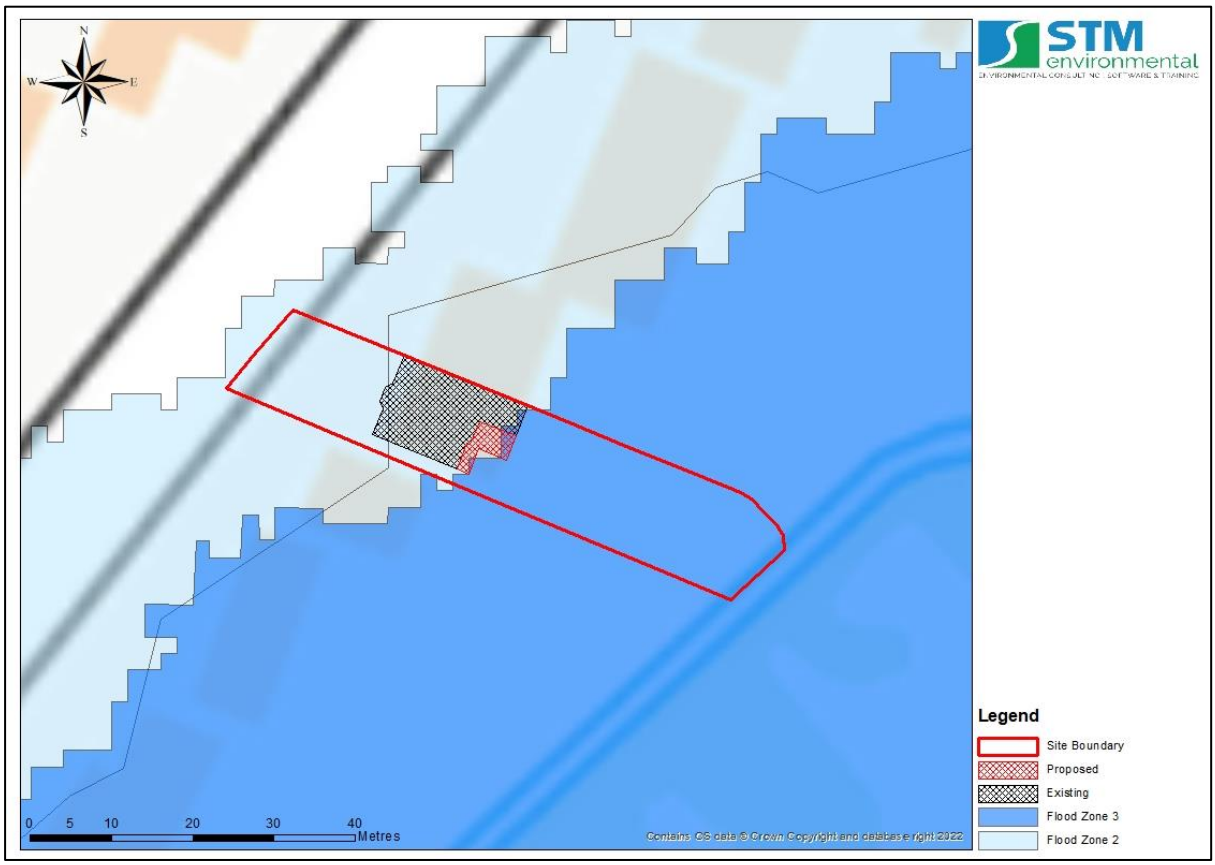
17.4.2 Map Recorded Sewer Flooding

See next page.

17.4.3 Map of Recorded Groundwater Flooding

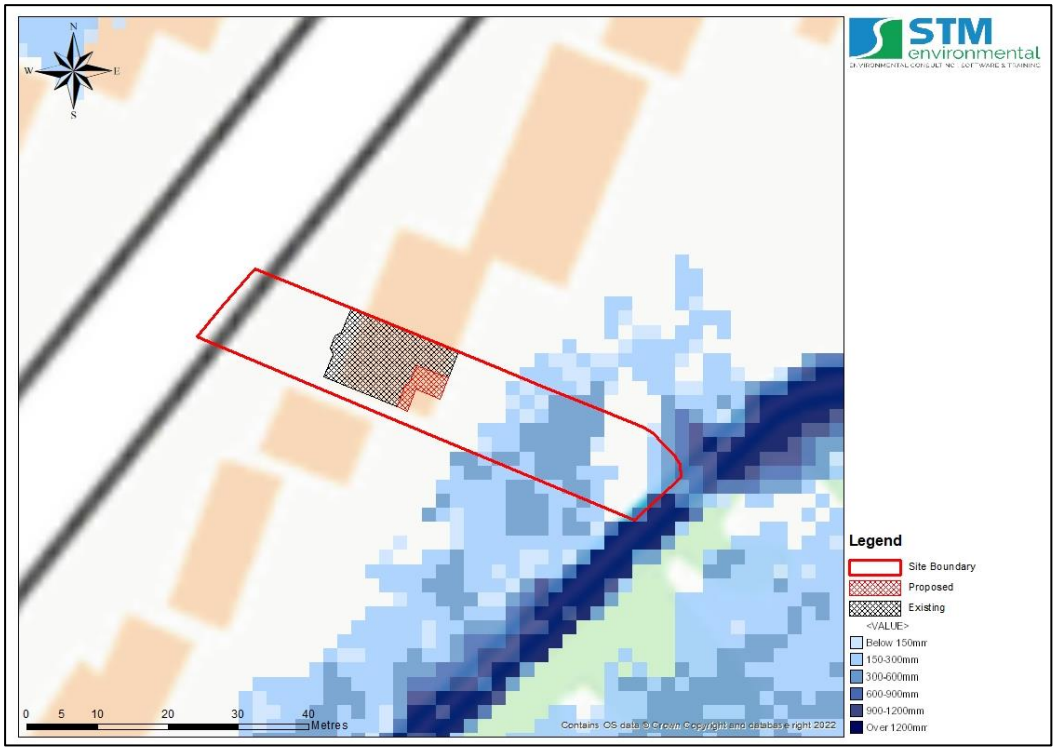
See next page.

17.5 Appendix 5 - EA Flood Zone Map

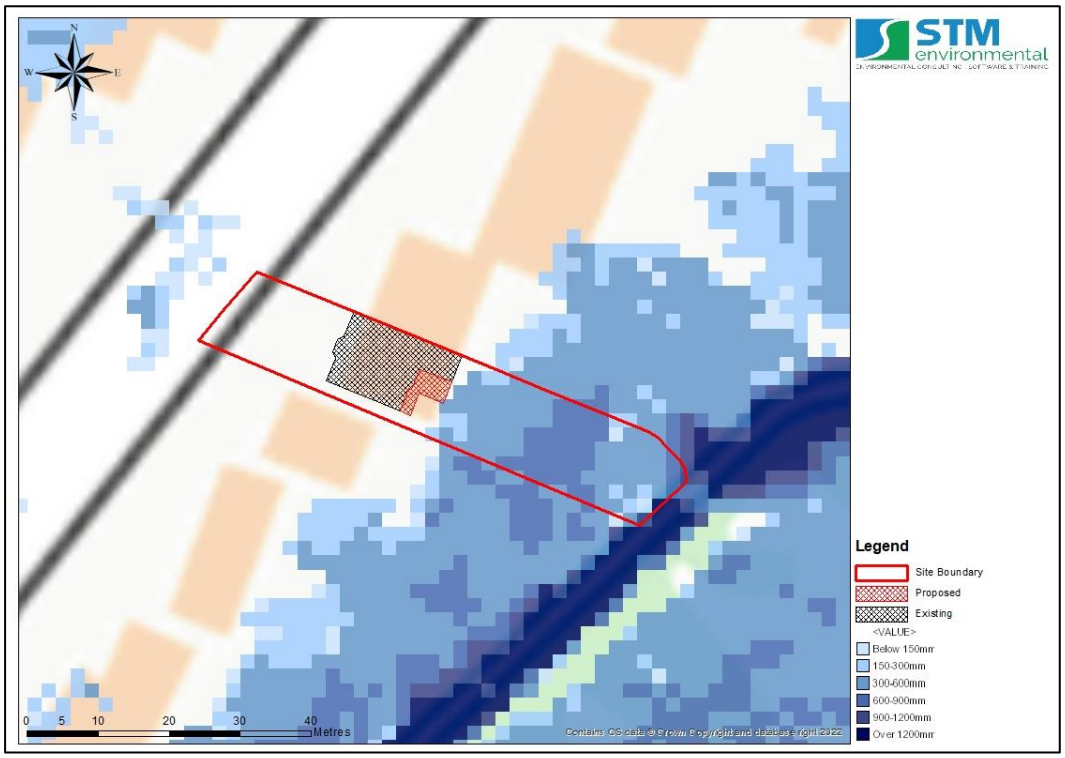


17.6 Appendix 6 – Surface Water Flood Extent and Depth Maps

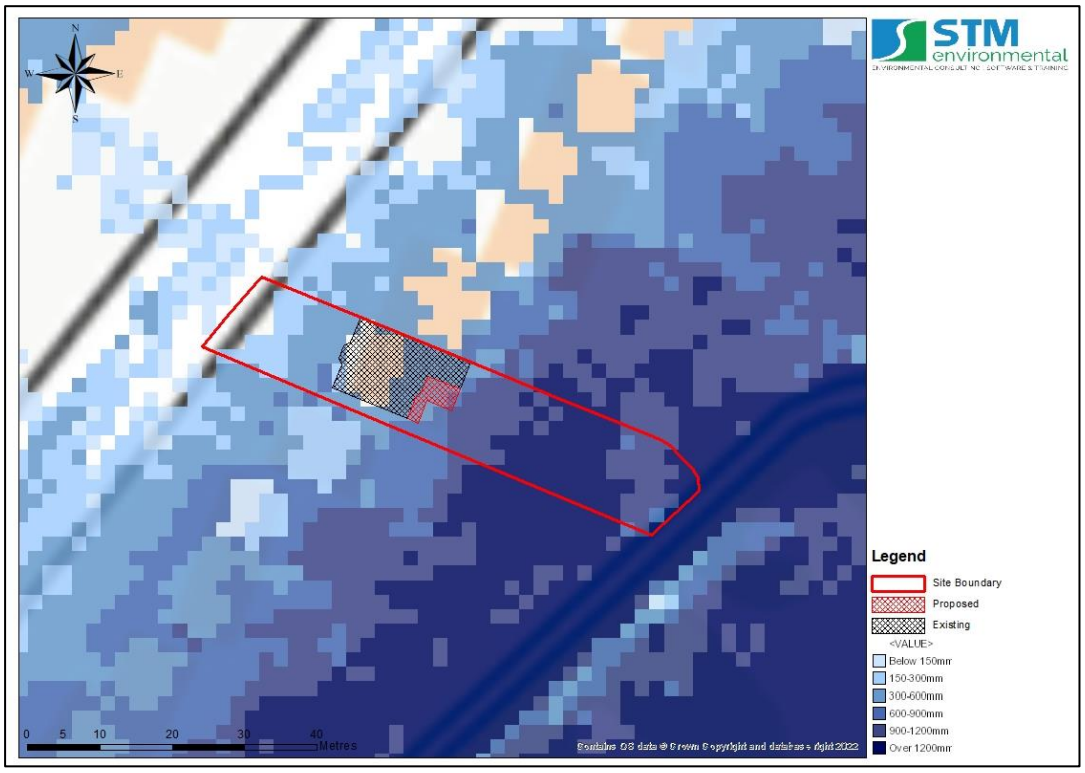
17.6.1 Predicted surface water flood depth for the 1 in 30-year return period (Source: EA, 2016).



17.6.2 Predicted surface water flood depth for the 1 in 100-year return period (Source: EA, 2016).

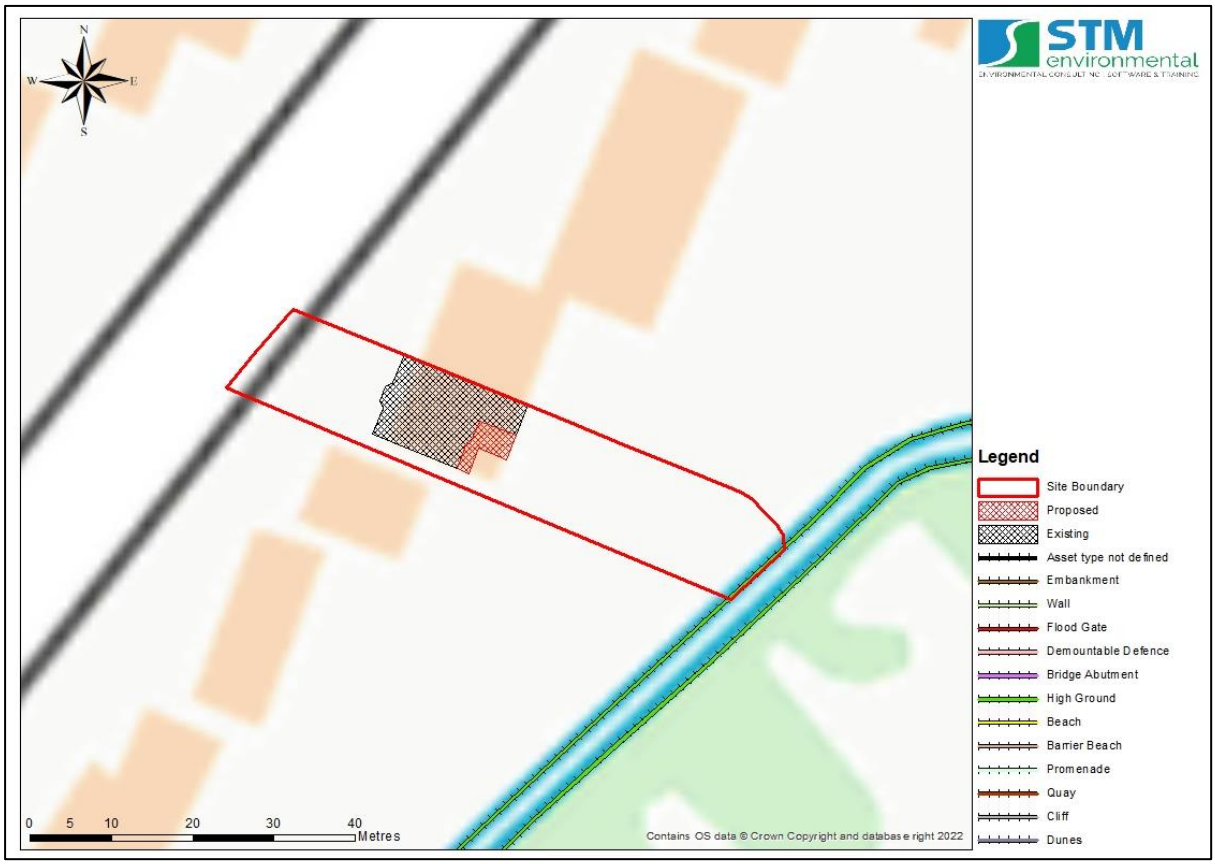


17.6.3 Predicted surface water flood depth for the 1 in 1000-year return period (Source: EA, 2016).

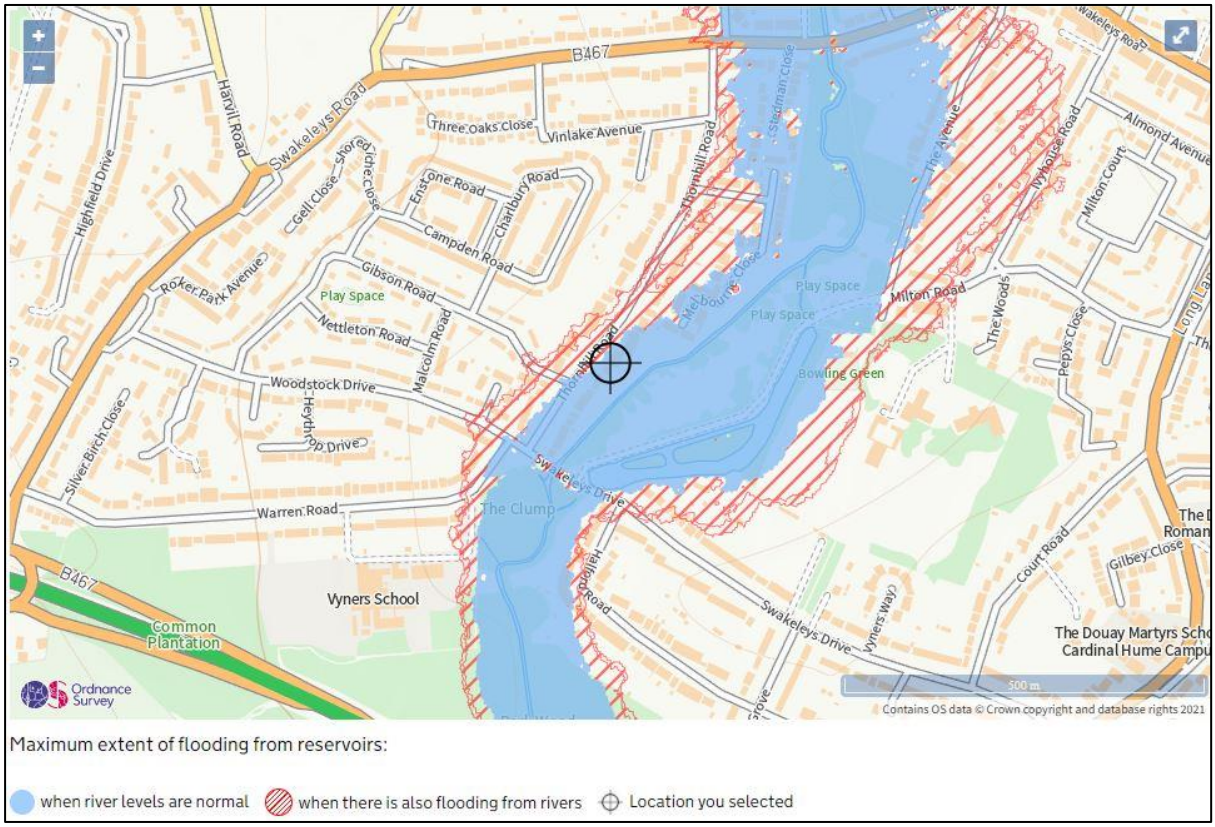


17.7 Appendix 7 –Flood Defence and Reservoir Flood Risk Maps

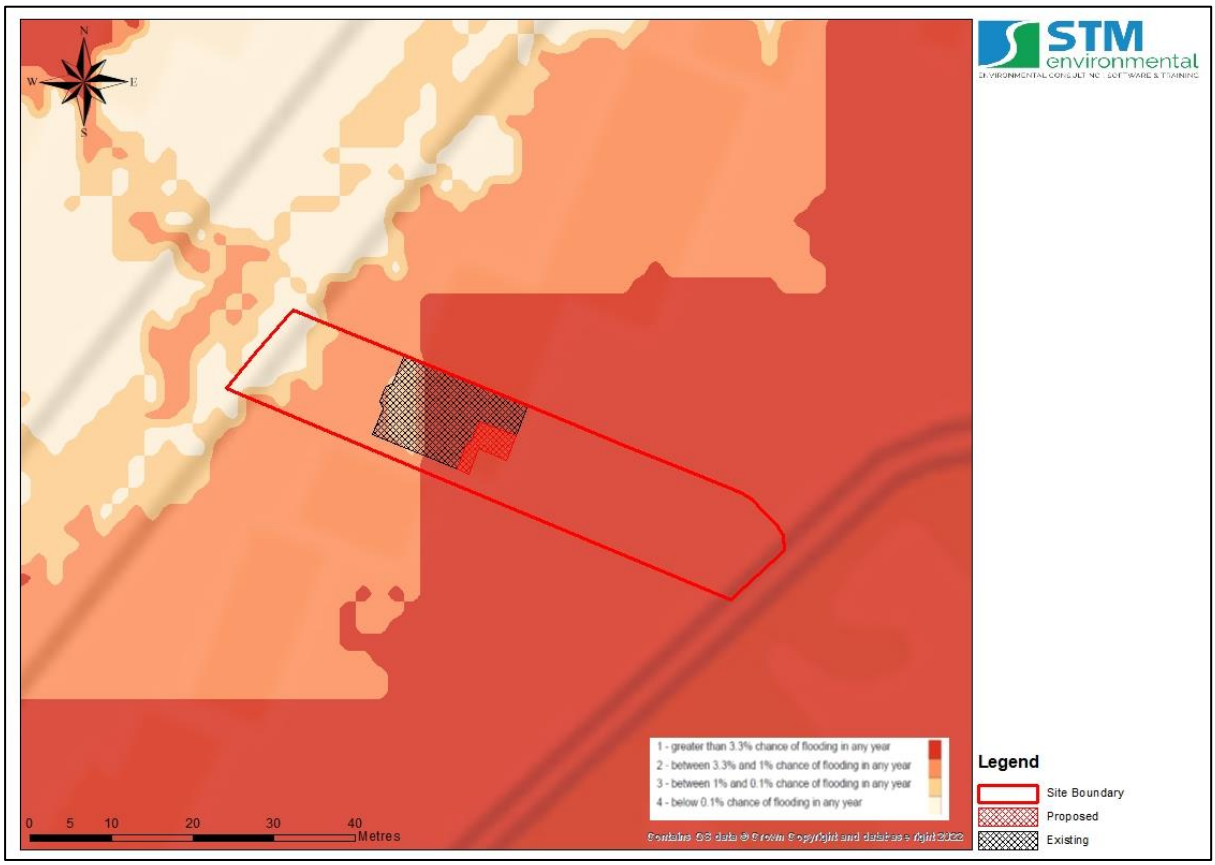
17.7.1 EA Map showing areas benefitting from flood defences



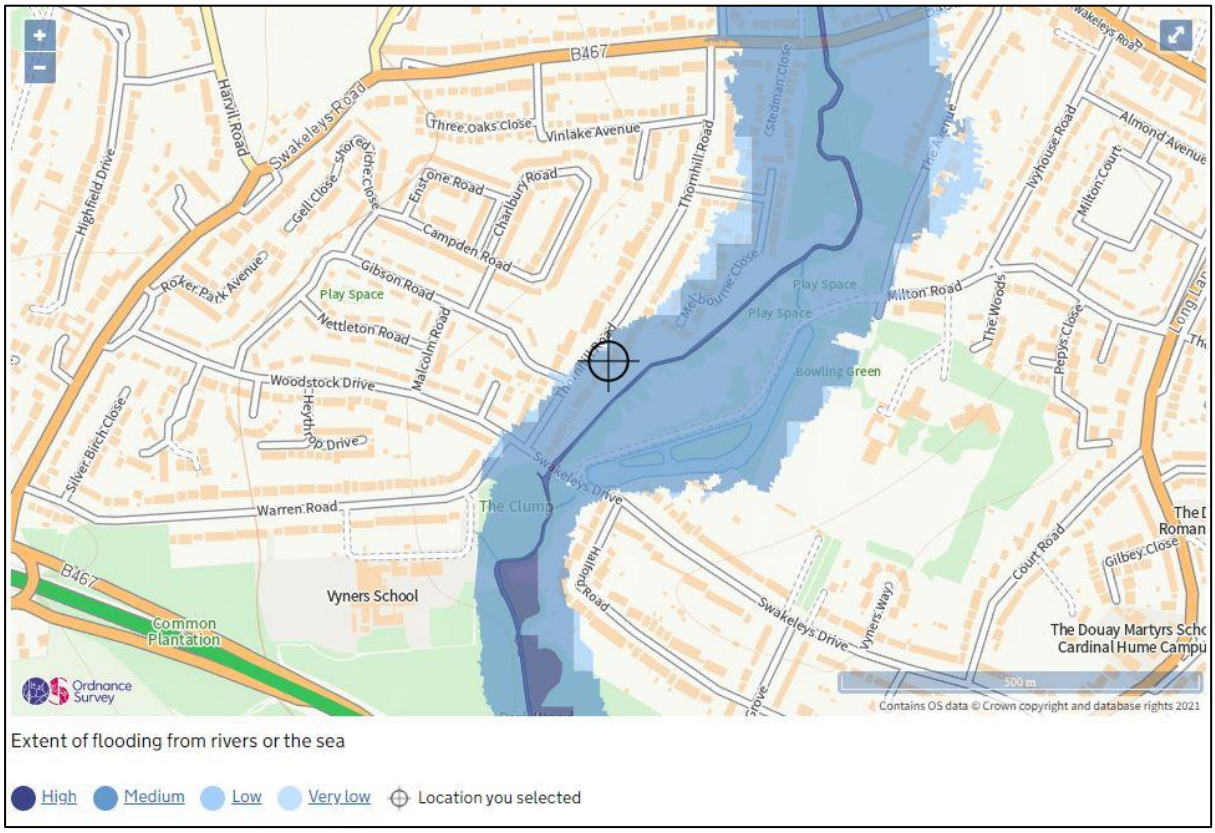
17.7.2 Reservoir Flood Risk Map

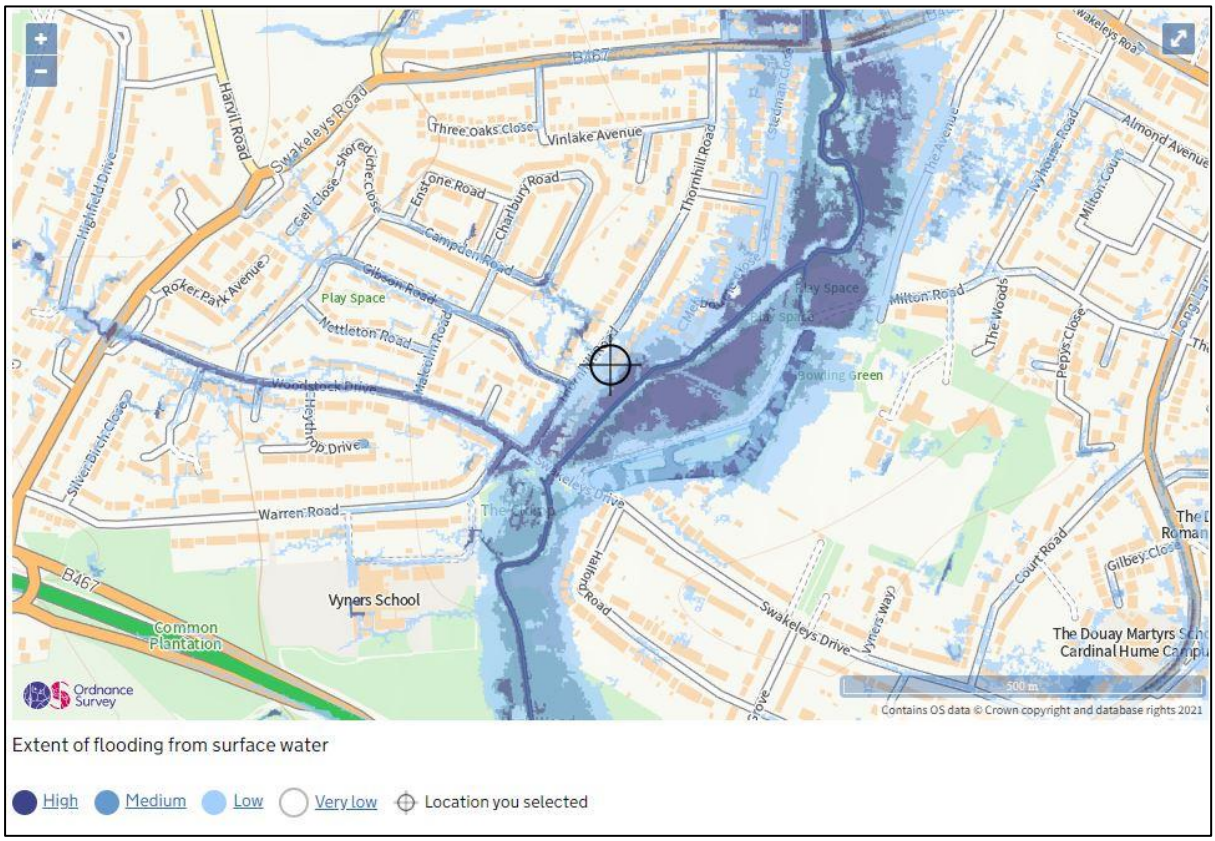


17.8 Appendix 8 – Risk of Flooding from Multiple Sources Map



17.9 Appendix 9 – EA's Long Term Flood Risk Maps





17.10 Appendix 11 - EA Product 4 (Detailed Flood Risk) Data

See next page.

17.11 Appendix 12 – Safe Egress to Flood Zone 1 Map

17.12 Appendix 13 – Calculation of Flood Hazard Rating

Table 6: Flood Hazard Rating Scores – based on DF score of 0

Velocity	Depth									
	0.25	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.0**	**2.25**	**2.50**
0.0	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25
0.5	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
1.0	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75
1.5	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
2.0	0.63	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25
2.5	0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50
3.0	0.88	1.75	2.63	3.50	4.38	5.25	6.13	7.00	7.88	8.75
3.5	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
4.0	1.13	2.25	3.38	4.50	5.63	6.75	7.88	9.00	10.13	11.25
4.5	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50
5.0	1.38	2.75	4.13	5.50	6.88	8.25	9.63	11.00	12.38	13.75

Table 7: Summary of Scores

	Score From	Score To	Flood Hazard	Description
	<0.75	0.75	Low	Exercise Caution
Class 1	0.75	1.5	Moderate	Danger for some
Class 2	1.5	2.5	Significant	Danger for most
Class 3	2.5	20.0	Extreme	Danger for all

Table 8: Values for Debris Factor for different flood depths

Depths	Pasture/Arable Land	Woodland	Urban
0 to 0.25	0	0	0
0.25 to 0.75	0.5	1	1
d>0.75 and/or v > 2	0.5	1	1

- The “danger to some” category includes vulnerable groups such as children, the elderly and infirm. “Danger: Flood zone with deep or fast
- flowing water”
- The “danger to most” category includes the general public.

- The danger to all category includes the emergency services.

A flood emergency plan is considered to be an acceptable way of managing flood risk where the flood hazard has been given a “very low hazard” rating. In some instances, flood emergency plans may also be acceptable where the rating is “danger for some”. However, it is unlikely to be an acceptable way of managing residual flood risk where the hazard to people classification is “danger for most” or “danger for all”.