STM environmental

ENVIRONMENTAL CONSULTING , SOFTWARE & TRAINING

FLOOD RISK ASSESSMENT

Site Address

44 Frays Avenue
West Drayton
UB7 7AG

Client

Malkit Madhang

Date

13/08/2024

1 Document Control

FLOOD RISK ASSESSMENT

Site Address:	44 Frays Avenue West Drayton UB7 7AG
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Prepared for:	Malkit Madhang
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2 Contents

3 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
AEP	Annual Exceedance Probability
CC	Climate Change
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

4 Disclaimer

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5 Executive Summary

SECTION	SUMMARY
Location	44 Frays Avenue, West Drayton, UB7 7AG Grid Reference: 505574, 179710
Area	1051m^2
Proposed Development	Demolition and re-building of a residential dwelling.
Flood Zone	The site is located in Flood Zone 2.
Topography	The ground level at the site ranges from 24.93mAOD to 25.36mAOD. The approximate ground level of the proposed development is 25.16mAOD.
Sequential and Exception Tests	The proposal is classified a non-minor development located within a flood zone, as such the sequential test may be applied. However as it is for like for like, replacement development, a pragmatic view should be undertaken by the LPA; The exception test should not be required;
Main Sources of Flooding	The River Colne and Fray's River, located approximately 80m west and 90m east of the site respectively.
Flood Defences	EA mapping indicates that the site benefits from high ground along both banks of the River Colne and Fray's River.
Records of Historic Flooding	Examination of EA mapping and the LLFA's SWMP indicates that the last significant flood event occurred in October 1987 when channel capacity was exceeded; the site was not affected.
Fluvial (River) and Tidal (Sea) Flood Risk	Low – The site and dwelling witness flooding to depths of up to 0.11m and 0.01m to a level of 25.17mAOD in the 1% AEP + 20% CC. In the 0.1% AEP this level rises to 25.26mAOD.
Pluvial (Surface Water) Flood Risk	Low – The site remains dry during the 1 in 100-year pluvial event. In the 1 in 1000-year event, the site witnesses flood depths of up to 300mm, with the proposed dwelling remaining dry.
Flood Risk from Artificial (Canals and Reservoirs) Sources	Low – There are 2no. reservoirs within 5km of the site. However, the West London SFRA states that the probability of a structural breach is low.
Groundwater Flood Risk	Medium - According to the BGS, the site has potential for groundwater flooding to occur at the surface and a water table depth of less than 3mbgl, no recorded incidents have been identified.
Development Impacts on Local Flood Risk	The development will increase impermeable area by 143m^2, but will decrease the built-up area of the site by 12m^2. As such, the proposal is likely to increase surface water runoff rates, but positively impact local flood flow and storage.
Proposed Flood Risk Mitigation Measures	• The finished floor level will be set no lower than 25.47mAOD, which is 300mm above the highest flood level during the 1% AEP + CC modelled event; • Construction will utilise flood resistant materials and services will be placed as high as practicable to reduce impact of flooding; • Occupants will sign up for EA Emergency Flood Warning Direct Service; • Safe egress to Flood Zone 1 is an 8-minute walk northeast to Station Road and safe refuge is available on upper floors.
Surface Water Management (SuDS)	SuDS would reduce current surface water run off rates. Given the size of the site (1051m^2), there is good potential for implementation. Consideration should be given to water butts, rainwater harvesting and infiltration techniques.
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.

6 Introduction

STM Environmental Consultants Limited (STM) were appointed by Malkit Madhang of (Client) to provide a Flood Risk Assessment (FRA) at a site located at 44 Frays Avenue, West Drayton, UB7 7AG.

7 Development Proposal

The FRA is required to support a planning application for the demolition and re-building of a residential dwelling onsite. Further details including drawings of the development plans are available in Appendix 2.

8 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.

9 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.

10 Legislative and Policy Context

10.1 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.

10.2 Policy Context

10.2.1 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's economic, environmental and social planning policies for England. The policies set out in this framework apply to the preparation of local and neighbourhood plans and to decisions on planning applications.

The latest version of the NPPF can be view online here. The below text it extracted from the online document from paragraphs 165 – 179.

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.

Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

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); and
- 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 aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

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.

Paragraph 173 of the National Planning Policy Framework (NPPF) states that:

When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment (See Note 1) 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
- the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;
- 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 some minor development and changes of use (See Note.2) 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 (See Note 1).

Paragraph 175 states that:

Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

- take account of advice from the lead local flood authority;
- have appropriate proposed minimum operational standards;
- have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
- where possible, provide multifunctional benefits.

A major development is defined as:

- a residential development: 10 dwellings or more or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known
- a non-residential development: provision of a building or buildings where the total floor space to be created is 1000 square metres or more or where the floor area is not yet known, a site area of 1 hectare or more.

Note. 1 - 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.

Note. 2 - This includes householder development, small non-residential extensions (with a footprint of less than 250m^2) and changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.

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

- Be clear as to what development will be appropriate in such areas and in what circumstances; and
- Make provision for development and infrastructure that needs to be relocated away from Coastal Change Management Areas.

- 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.

10.2.2 Local Planning Policy – London Borough of Hillingdon

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.

Policy DMEI 10: Water Management, Efficiency, and Quality

A) Applications for all new build developments (not conversions, change of use, or refurbishment) are required to include a drainage assessment demonstrating that appropriate sustainable drainage systems (SuDS) have been incorporated in accordance with the London Plan Hierarchy (Policy 5.13: Sustainable drainage).

B) All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100 year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification.

C) Rain Gardens and non householder development should be designed to reduce surface water run-off rates to Greenfield run-off rates.

D) Schemes for the use of SuDS must be accompanied by adequate arrangements for the management and maintenance of the measures used, with appropriate contributions made to the Council where necessary.

E) Proposals that would fail to make adequate provision for the control and reduction of surface water run-off rates will be refused.

F) Developments should be drained by a SuDs system and must include appropriate methods to avoid pollution of the water environment. Preference should be given to utilising the drainage options in the SuDS hierarchy which remove the key pollutants that hinder improving water quality in Hillingdon. Major development should adopt a 'treatment train' approach where water flows through different SuDS to ensure resilience in the system.

Water Efficiency

G) All new development proposals (including refurbishments and conversions) will be required to include water efficiency measures, including the collection and reuse of rain water and grey water.

H) All new residential development should demonstrate water usage rates of no more than 105 litres/person/day.

I) It is expected that major development proposals will provide an integrated approach to surface water run-off attenuation, water collection, recycling and reuse.

Water and Wastewater Infrastructure

J) All new development proposals will be required to demonstrate that there is sufficient capacity in the water and wastewater infrastructure network to support the proposed development. Where there is a capacity constraint the local planning authority will require the developer to provide a detailed water and/or drainage strategy to inform what infrastructure is required, where, when and how it will be delivered.

10.2.3 Regional Planning Policy - London Plan

Policy SI 12 Flood Risk Management:

- Current and expected flood risk from all sources (as defined in paragraph 9.2.12) across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers and infrastructure providers.
- Development Plans should use the Mayor's Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Local Flood Risk Management Strategies, where necessary, to identify areas where particular and cumulative flood risk issues exist and develop actions and policy approaches aimed at reducing these risks. Boroughs should cooperate and jointly address cross-boundary flood risk issues including with authorities outside London.
- Development proposals should ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.
- Developments Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan. The Mayor will work with the Environment Agency and relevant local planning authorities, including

- authorities outside London, to safeguard an appropriate location for a new Thames Barrier.
- Development proposals for utility services should be designed to remain operational under flood conditions and buildings should be designed for quick recovery following a flood.
- Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Unless exceptional circumstances are demonstrated for not doing so, development proposals should be set back from flood defences to allow for any foreseeable future maintenance and upgrades in a sustainable and cost-effective way.
- Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat

Policy SI 13 Sustainable Drainage:

Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed.

Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

- rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
- rainwater infiltration to ground at or close to source
- rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
- rainwater discharge direct to a watercourse (unless not appropriate)
- controlled rainwater discharge to a surface water sewer or drain

- controlled rainwater discharge to a combined sewer.

Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.

10.3 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.

11 Site Description and Environmental Characteristics

11.1 Site Location and Area

The site is located at 44 Frays Avenue, West Drayton, UB7 7AG and is centred at national grid reference 505574, 179710. The site has an area of 1051m^2.

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

11.2 Site Access

The site is accessed via Frays Avenue.

11.3 Local Planning Authority

The site falls within the jurisdiction of the London Borough of Hillingdon (LBH) in terms of the planning process.

11.4 Lead Local Flood Authority

LBH is also the Lead Local Flood Authority (LLFA).

11.5 Flood Zone

For planning purposes, the site is located in Flood Zone 2 as defined by the EA and LLFA. The map of the Flood Zones is available in Appendix 5.

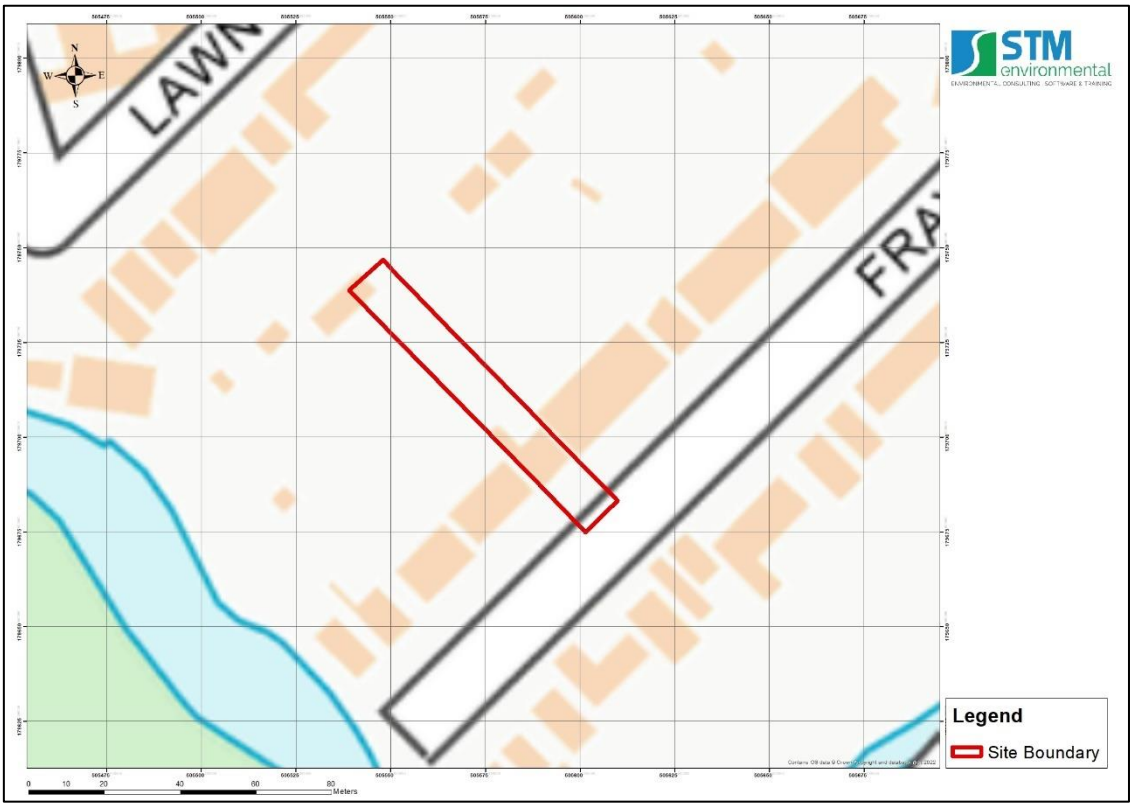


Figure 1: Site Location Map

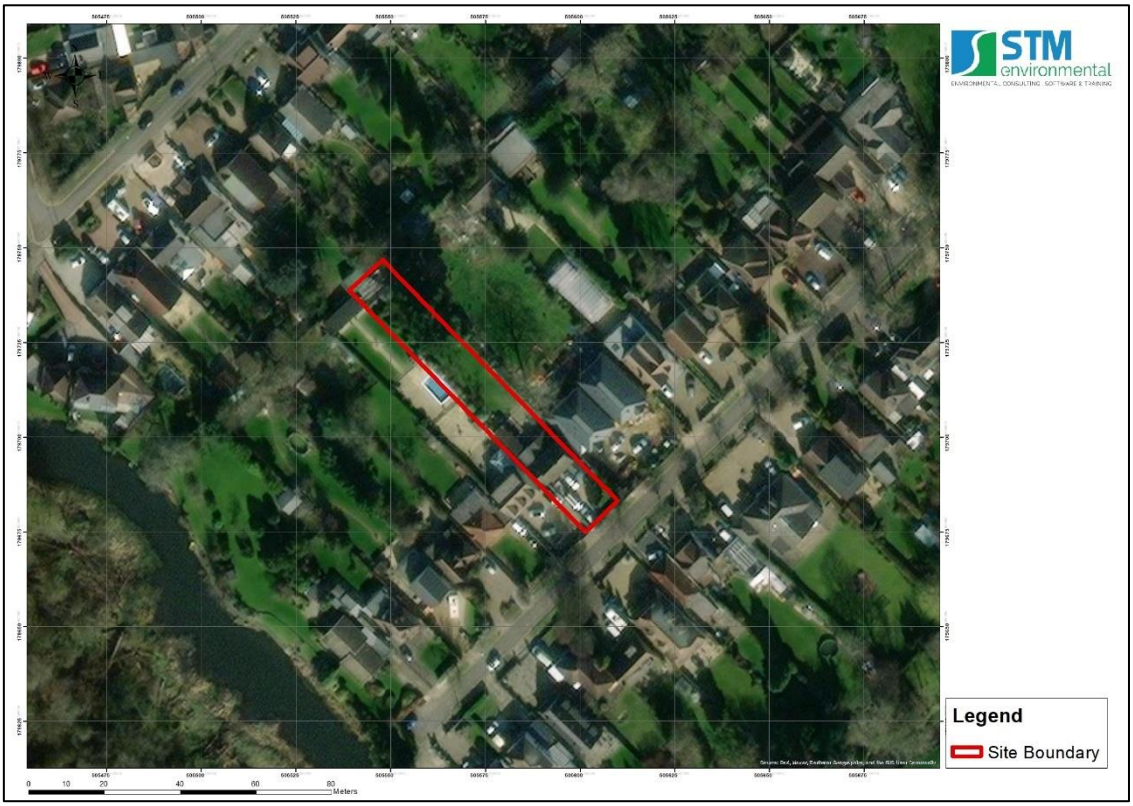


Figure 2: Site Aerial Map

11.6 Site and Surrounding Land Uses

11.6.1 Site Current Land Use

The site is currently used as a residential property.

11.6.2 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 (Within 25 – 250m)**
Northern	Residential	Residential
Eastern	Residential	Residential, River (Fray's River)
Southern	Road (Frays Avenue), Residential	Residential, River (Fray's River)
Western	Residential	Residential, River (River Colne), Nature Reserve (Mabey Meadows and Frays Island Nature Reserve), Business Park (Link Park Heathrow), Infrastructure (Railway)

11.7 Hydrology

The nearest main watercourses are the River Colne, located approximately 80m west of the site, and Fray's River, located approximately 90m east of the site. A map of the nearby hydrological features is present in Appendix 2.

11.8 Geology

Data from the British Geological Survey indicates that the underlying superficial geology is characterised as unlithified Alluvium (Clay, Silt, Sand and Gravel). The underlying bedrock geology is characterized as London Clay Formation (Clay, Silt and Sand).

11.9 Hydrogeology

The site lies upon a Secondary A superficial aquifer and a Unproductive bedrock aquifer.

Appendix 3 provides BGS mapping showing the hydrogeology at the site location.

11.10 Topography

A LIDAR DTM map showing the topography of the site and surrounding area is available in Appendix 3. As a topographic survey was not available, site levels were estimated using this. All values are approximate.

There is an overall change of 0.43m within the site boundary. The lowest elevation is 24.93mAOD northwest within the long elongated gardens. Ground elevations rise to 25.36mAOD to the southeast, forming the location of the existing dwelling and driveway, that adjoins to Frays Avenue.

The site lays on relatively flat land. Frays Avenue, immediately adjacent to the southeast of the site, witnesses an increase from a low of 24.95mAOD to the southwest, to a high of 25.19mAOD to the northeast.

On a regional level the site is in an area with variable topography. There is a general trend, going from lower elevations of 24mAOD to the southwest where the river Colne lies, to 26mAOD to the northeast along Frays Avene towards West Drayton.

12 The Sequential and Exception Tests

12.1 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:

- development of an existing dwellinghouse, or development within the curtilage of a dwellinghouse, for any purpose incidental to the enjoyment of the dwellinghouse
- an extension to an existing building used for non-domestic purposes where the floor space created by the development does not exceed 250 square metres
- alterations to an existing building which do not increase the size of the building

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:

- Providing 10 or more dwellinghouses defined in article 2 of the DMPO or, where the number of dwellinghouses is not known, the site area is 0.5 hectares or more;
- Providing a building or buildings where the floor space to be created by the development will be 1,000 square metres or more;
- Development on a site of 1 hectare or more;
- The winning and working of minerals or the use of land for mineral - working deposits;
- Waste development

The proposal is considered to be a non-minor and as such the Sequential Test maybe be applied.

However, given that the development is for a like for like (replacement residential dwelling) that will reduce the overall built up area, we believe that a pragmatic view should be taken by the local planning authority and the sequential test should not be applied.

12.2 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 should be demonstrated that:

- development that has to be in a flood risk area will provide wider sustainability benefits to the community that outweigh flood risk; and
- the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

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.

Given that the development is more vulnerable and located in Flood Zone 2, an Exception Test should not be required by the LLFA.

13 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.

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

13.1.1 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.

13.1.2 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.

13.1.3 Main Potential Sources of Local Fluvial Flooding

The nearest potential sources of fluvial flooding to the site are considered to be the River Colne and Fray's River.

13.1.4 Records of Historic Fluvial Flooding Incidents

The EA's historic and recorded flood outline maps indicate that there has been historic flooding in the vicinity of the site in October 1987 when the channel capacity was exceeded. The site was not affected. Copies of these maps are available in Appendix 4.

13.1.5 Designated Fluvial Flood Risk Zone for the Site

The site is considered to be located within Flood Zone 2 as defined by the Environment Agency and the LLFA indicating that it has between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of fluvial flooding.

13.1.6 Mechanisms for Tidal Flooding

Tidal flooding may be described simply as the inundation of low-lying coastal areas by the sea, or the overtopping or breaching of sea defences. Tidal flooding may be caused by seasonal high tides, storm surges and where increase in water level above the astronomical tide level is created by strong on shore winds or by storm driven wave action.

13.1.7 Definition of EA Tidal Flood Risk Zones

As with fluvial flood risk, tidal flood risk is assessed using flooding maps produced by the Environment Agency. The difference is in the probability return periods used to define tidal flood zones. The EA tidal Flood Zones are defined as:

- Flood zone 1: Less than 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 2: Between 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of tidal flooding;
- Flood zone 3: Greater 1 in 200 (0.5%) annual probability of tidal flooding.

13.1.8 Designated Tidal Flood Risk Zone for the Site

Inspection of the West London SFRA revealed that the area in which the site is located is considered unlikely to be affected by tidal flooding.

13.1.9 Flood Defences

The EA's flood defence map which is available in Appendix 7 shows that the site benefits from flood defences, including high ground along both banks of both the River Colne and Fray's River.

13.1.10 Peak River Flow Climate Change Allowances

The EA's climate change allowances for peak river flow maps show that the site is considered to be in the Colne Management Catchment. The climate change allowances for this catchment are available in Appendix 11.

In flood zones 2 or 3a for:

- essential infrastructure – use the higher central allowance
- highly vulnerable – use central allowance (development should not be permitted in flood zone 3a)
- more vulnerable – use the central allowance
- less vulnerable – use the central allowance
- water compatible – use the central allowance

In flood zone 3b for:

- essential infrastructure – use the higher central allowance
- highly vulnerable – development should not be permitted
- more vulnerable – development should not be permitted
- less vulnerable – development should not be permitted
- water compatible – use the central allowance

The central allowance for more vulnerable developments indicates that a climate change allowance of 21% should be used.

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

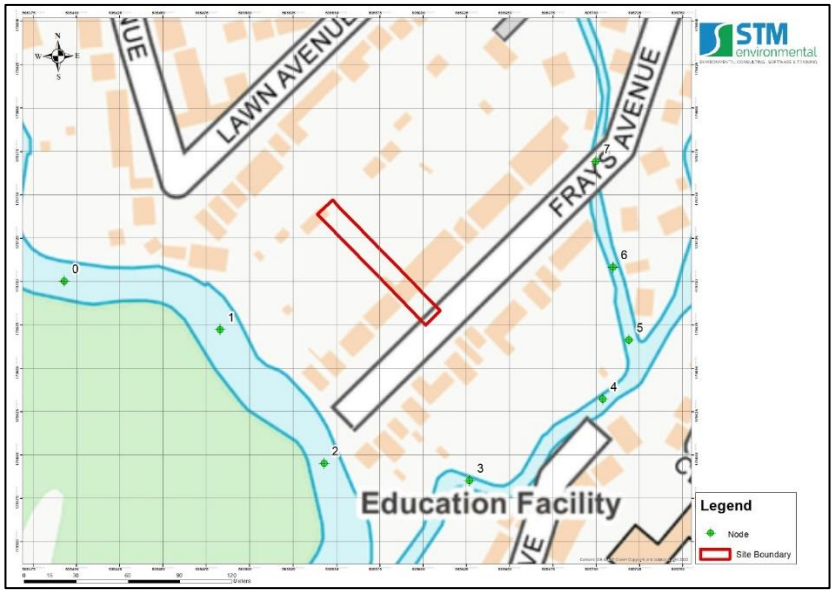
The EA Product 6 dataset which is presented in Appendix 11 provides modelled flood levels and flows for 1D in channel-node points is the vicinity of the site; these are summarised in Table 3 below.

Table 3: EA modelled expected flood depths (m) and levels (mAOD) for different defended scenarios.

Lower Colne Modelling and Mapping Study (Mott MacDonald, 2012) - Defended											
Node		Easting	Northing	DTM LiDAR Topography (mAOD)	1% AEP		1% AEP + 20% CC	1% AEP + 21% CC		0.1% AEP	
Report	EA				Depth (m)*	Level (mAOD)	Level (mAOD)	Depth (m)*	Level (mAOD)**	Depth (m)*	Level (mAOD)
0	D037	505393	179700	24.79	0.34	25.13	25.20	0.41	25.20	0.52	25.31
1	D034	505483	179672	24.72	0.37	25.09	25.17	0.45	25.17	0.54	25.26
2	D033	505543	179595	24.64	0.41	25.05	25.12	0.48	25.12	0.57	25.21
3	J010	505627	179585	24.21	0.58	24.79	24.86	0.65	24.86	0.79	25.00
4	J011	505704	179632	24.09	0.88	24.97	25.01	0.92	25.01	1.00	25.09
5	J011A	505719	179666	24.09	0.83	24.92	24.97	0.88	24.97	0.97	25.06
6	J012A	505710	179708	24.77	0.16	24.93	24.97	0.20	24.97	0.29	25.06
7	J013A	505700	179769	25.78	-	24.96	25.00	-	25.00	-	25.09

* Depths were calculated by subtracting the levels provided from the DTM LiDAR Topography values

** The 1% AEP + 21% CC was extrapolated i.e. 1% AEP + 21% CC = 1% AEP + 20% CC + ((1% AEP + 20% CC / 20) * 21)



The closest in-channel node point, Node 1, has been used to estimate the flood depth on site and in the immediate vicinity through comparing the flood level to the DTM LiDAR levels. These depths are summarised in Table 4.

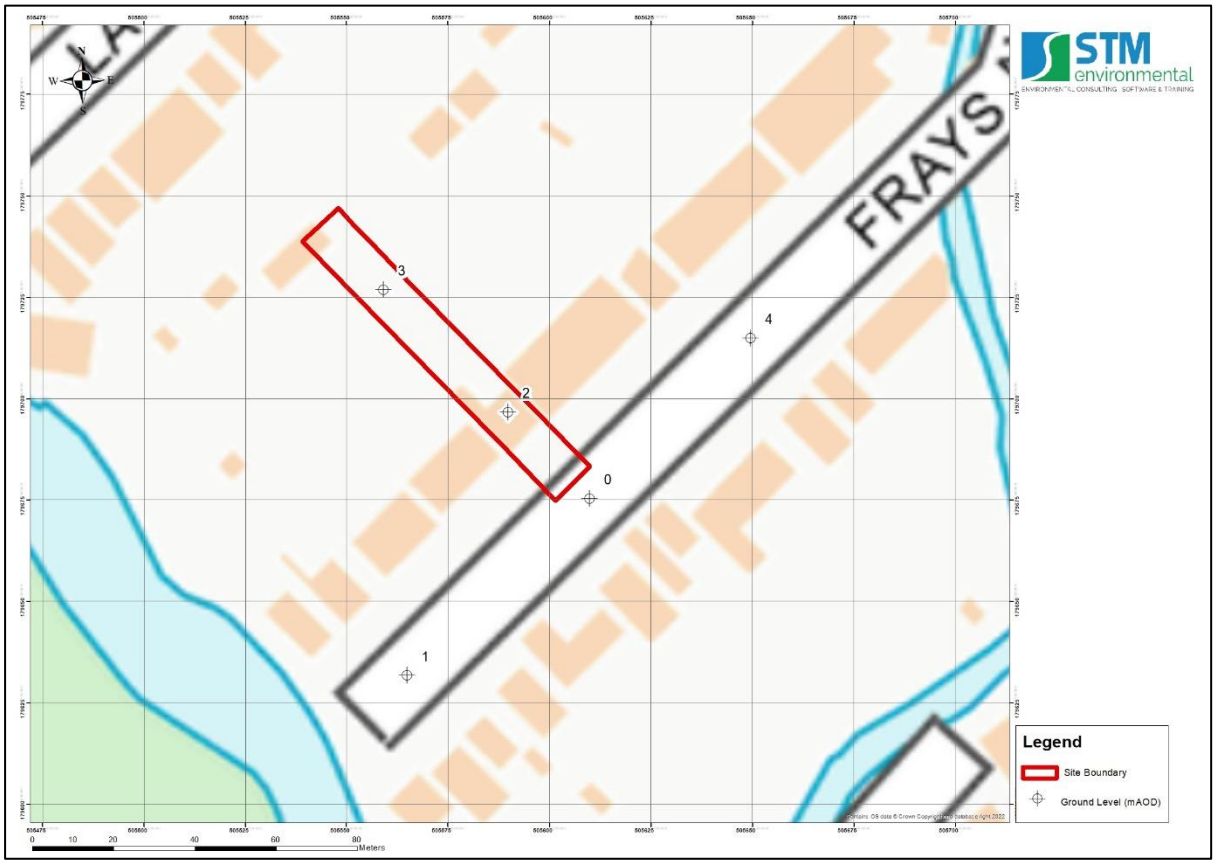


Table 4: EA modelled expected flood depths (m) and levels (mAOD) for different defended scenarios.

Lower Colne Modelling and Mapping Study (Mott MacDonald, 2012) - Defended									
Ground Level Node	Easting	Northing	DTM LiDAR Topography (mAOD)	1% AEP		1% AEP + 21% CC		0.1% AEP	
				Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)
0	505610	179675	25.07	0.02	25.09	0.10	25.17	0.19	25.26
1	505565	179632	24.95	0.14	25.09	0.22	25.17	0.31	25.26
2	505590	179697	25.16	-	25.09	0.01	25.17	0.10	25.26
3	505559	179727	25.06	0.03	25.09	0.11	25.17	0.20	25.26
4	505650	179715	25.19	-	25.09	-	25.17	0.07	25.26

Defended

During the 1 in 100-year modelled fluvial event, the development does not witness flooding. However, the site does witness flooding of depths of up to 0.03m to a level of 25.09mAOD within the gardens at node point 3.

During the 1 in 100-year + 21%CC modelled fluvial event, the development and site witness flood depths of up to 0.01m and 0.11m respectively to a level of 25.17mAOD.

During the 1 in 1000-year modelled fluvial event, the development and site witness flood depths of up to 0.10m and 0.20m respectively to a level of 25.26mAOD.

Undefended

The undefended scenario was also reviewed; however, it was found that the flood level was the same, or very similar to all defended EA node points in the vicinity of the site.

13.1.12 Long Term Fluvial/Tidal 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.

13.2 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.

13.2.1 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.

13.2.2 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.

13.2.3 Records of Historic Pluvial Flooding Incidents

Examination of the LLFA's SWMP revealed no evidence of pluvial flooding on or in the vicinity of the site.

A map showing the location of surface water flooding incidents is available in Appendix 4 .

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

An examination of OS mapping and the EA's mapping revealed that there are significant reservoirs in the area of the site. Details of these reservoirs are outlined in Table 5.

Table 5: Nearby significant reservoirs.

Reservoir	Distance (km)	Direction
The Queen Mother Reservoir	4.60	SW
Wraysbury Reservoir	4.84	SW

The EA's reservoir flood risk map indicates that the site does lie within an area that is at risk of reservoir flooding when there is also flooding from rivers. However, the West London SFRA states that the probability of a structural breach is low.

13.2.5 Sewer Flooding

Examination of the West London SFRA revealed no evidence of sewer flooding in the vicinity of the site.

A map showing recorded incidents of sewer flooding is available in Appendix 4.

13.2.6 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 30-year, 1 in 100-year, and 1 in 1000-year rainfall return periods provided by the EA are available in Appendix 6.

During the 1 in 30-year pluvial event, the site is not impacted.

During the 1 in 100-year pluvial event, the site is not impacted. However, Frays Avenue, immediately adjacent to the site, witnesses flooding of up to 300mm.

During the 1 in 1000-year event, the site witnesses flooding of depths of the up to 300mm, with the proposed dwelling not being impacted. Frays Avenue, immediately adjacent to the site, also witnesses flooding of depths of up to 300mm.

13.2.7 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 low.

13.3 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.

13.3.1 Historic Records of Groundwater Flooding

Examination of the LLFA's SWMP revealed no records 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.

13.3.2 Susceptibility to Groundwater Flooding

The Groundwater Flood Susceptibility Map provided by BGS and presented in Appendix 10 indicates that the site has potential for groundwater flooding to occur at

the surface. The Groundwater Depth Map also provided by BGS indicates that the groundwater level may be less than 3mbgl.

13.4 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”.

The site is not located within a Critical Drainage Area.

14 Potential Impacts of the Development on Local Flood Risk

14.1 Changes to Impermeable Area and Building Footprint

Changes in ground cover arising from the development are presented in Table 6 and Table 7 below.

Table 6: Existing and proposed site ground cover.

	Impermeable Area (m^2)	Permeable Area (m^2)	Total Area (m^2)
Existing	346	705	1051
Proposed	489	562	1051

Table 7: Break down of existing and proposed site uses

Use	Existing (m^2)	Proposed (m^2)	Difference (m^2)
Building	177	165	-12
Impermeable Paving	169	324	155
Garden	705	562	-143
Total	1051	1051	-

The proposed development will increase the impermeable area of the site by 155m^2 through the introduction of new hard standing, it is considered that it will impact upon flood flow rates and runoff rates without mitigation measure being introduced.

14.2 Impacts on Flood Storage and Flood Flow Routes

As the development will decrease the site's built-up area by 12m^2, it is likely to have a positive impact on local flood storage and flood flow pathways.

15 Flood Risk Mitigation Measures

15.1 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 8 below to reduce surface water discharges from the site.

Table 8: 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.

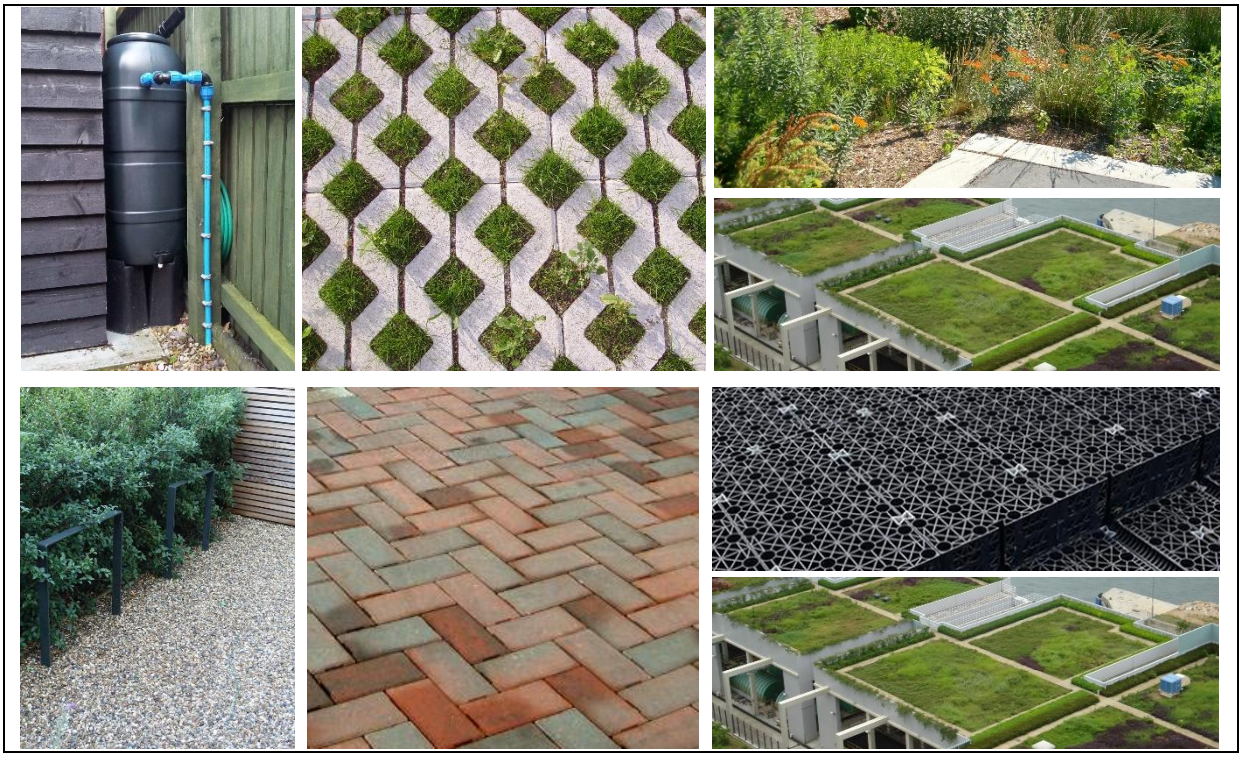


Figure 3: Surface water storage facilities and potential SuDS features - rainwater harvesting, on-site tank storage, rain garden soak-away and green roofs. (Source: UK SuDS Manual)

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 water butts, rainwater harvesting and infiltration techniques should be considered. A full SuDS strategy is outside the scope of works of this FRA.

15.2 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.

15.2.1 Finished Floor Levels

Advice for Vulnerable Developments;

The EA's Standing Advice states that the Finished Floor Level of any vulnerable development should be at set at whichever is highest, 600 millimetres (mm) above the;

- Average ground level of the site; 25.11mAOD
- Ground level of the access road(s) next to your building; 25.07mAOD
- Fluvial - 1 in 100 AEP + Climate Change; 25.17mAOD
- Tidal - 1 in 200 AEP + Climate Change; NA

This can be reduced to 300mm if there is a high level of certainty about your estimated flood level. If there is a particularly high level of uncertainty it may need to be increased.

Table 8: FFL Requirements

	Level (mAOD)	Level + 600mm (mAOD)	Possible	Level + 300mm (mAOD)	Possible
Average Ground	25.11	25.71	No *	25.31	Yes
Roadway/s	25.07	25.67	No *	25.37	Yes
Estimate Flood Level (River / Tidal / Breach)	25.17	25.77	No *	25.47	Yes – Highest chosen;

* Ceiling / Ridge Heights

Based upon the most up to date EA P6 data, the site floods to a maximum level of 25.17mAOD during the 1% AEP + 21% CC modelled event. The proposal should therefore be raised 300mm above this to approximately 25.47mAOD.

The finished flood level will be set no lower than 25.47mAOD which is 300mm above the highest flood level during the 1% AEP + 20% CC modelled event.

If you cannot raise floor levels to meet the minimum requirement, you will need to:

- raise them as much as possible
- consider moving vulnerable uses to upper floors
- include extra flood resistance and resilience measures
- Internal flooding of new vulnerable development like residential dwellings is unlikely to be considered appropriately flood resistant and resilient.

If you cannot raise the floor levels in this way, you will also need to include extra flood resistance and resilience measures. These measures should protect the property to at least 600mm above the estimated flood level.

15.2.2 Resilience Construction Measures

Flood water can put pressure on buildings, causing structural issues. If your design aims to keep out a depth of more than 600mm of water, you should get advice from a structural engineer.

Only use resistance measures that will not cause structural stability issues during flooding. It may not be possible to safely exclude the full estimated flood level. If this is the case, you will need to exclude it to the structural limit then allow additional water to flow through the property.

The design should be appropriately flood resistant and resilient by:

- You should also use construction materials that have low permeability up to at least the same height as finished floor levels;
- Using flood resistant materials that have low permeability to at least 600mm above the estimated flood level;
- Making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level;
- Using flood resilient materials (for example lime plaster) to at least 600mm above the estimated flood level;
- Raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level;
- Making it easy for water to drain away after flooding such as installing a sump and a pump
- Making sure there is access to all spaces to enable drying and cleaning
- Making sure that soil pipes are protected from back-flow such as by using non-return valves;

15.2.3 Water Exclusion or Water Entry Strategy

There are two main strategies, whose applicability is dependent on the water depth the property is subjected to and the potential for structural damage it may cause.

- 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.

The indicative flood depths are less than 0.3m in extreme scenarios and as such 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;
- Door guards and airbrick covers.

15.2.4 Flood resilience design and measures

Flood resilience design and measures that may be implemented are outlined below. Water-resistant and resilient materials that should 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:

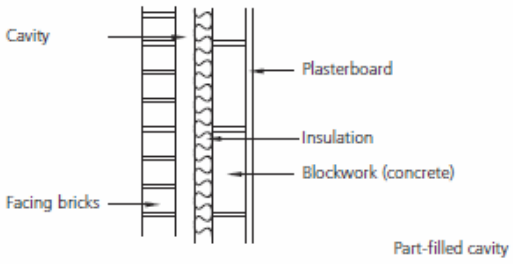
- Seal doors around edges and openings. UPVC or composite material will be used with passive protection meaning that minimal intervention will be required in the event of flooding.

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 4: Cavity External Walls

Figure 6.10 Cavity External Walls – Part-filled cavity with sacrificial plasterboard



Part-filled cavity

- External face consisting of engineering bricks up to required level for flood protection (up to d.p.c.). Other external facing materials can be used above this level, but ensure transition is watertight.
- Rigid insulation
- Internal cement based render, preferably with lime content. Composition depends on masonry; the following mix is effective:

  1 cement : 6 sand: 1 lime on concrete blocks.
- Stainless steel wall ties should be used to minimise corrosion and consequent staining.
- Sacrificial plasterboard can be used, but it needs to be removed between ground floor to flood level. The board should be laid horizontally to make removal easier.

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.

15.2.5 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.

As the development is reducing the built-up area of the site, it will have a positive impact of flood flow routes and storge. Therefore, CFS is not required.

16 Emergency Plan

16.1.1 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.

Table 9: Hazard Rating Values during the 1% AEP + 21% CC fluvial event

Depth (m)	Velocity (m/s)	Debris Factor	Hazard Rating
0.20	0.25*	0	0.15
0.20	0.25*	1	1.15

** minimum of 0.25 m/s velocity applied as no data provided*

The EA Product 6 data does not provide Flood Hazard Rating (HR) scores. Therefore, a HR score was estimated using the values in Table 8.

The HR score was calculated to range between 0.15 and 1.15, which constitutes flood waters ranging between where caution should be exercised and danger for some. The flood hazard rating would therefore range between Low and Moderate.

The use of a flood emergency plan is therefore sufficient for the proposed development. The key elements of the emergency plan are described below.

16.1.2 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.

16.1.3 Access and Safe Egress

Safe egress to Flood Zone 1 is available via an 8-minute walk northeast to Station Road. Directions of this route are presented in Appendix 12 .

16.1.4 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.

17 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 more vulnerable, non-minor development located in Flood Zone 2. Therefore, a sequential test may be required, but an exception test should not;
- The main sources of potential flooding to the site are the River Colne and Frays River, located approximately 80m west 90m east of the site respectively;
- The EA define the site as being within Flood Zone 2;
- The finished floor level will be set at no lower than 25.47mAOD which is 300mm above the maximum 1%AEP + 21% CC modelled fluvial flood level (25.17mAOD); Raising the FFL further is not possible due to ceiling an ridge hights.
- CFS was not required because the development decreases the built-up area of the site and would therefore have a positive impact on local flood routes and storage;
- EA mapping indicates that the site does benefit from flood defences which include high ground along both banks of both nearby rivers;
- EA mapping indicates that a flood event occurred in October 1987 when channel capacity was exceeded, the site was not affected;
- The site is not within a CDA;
- The development will result in an increase of impermeable area of 143m^2, but will decrease built up area by 12m^2. As such, the site and is therefore likely to increase surface water runoff rates, but positively impact local flood flow and storage;

- There is good opportunity for implementing SuDS mitigation measures. Consideration should be given to use of water butts, rainwater harvesting and infiltration techniques;
- 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 accessible via an 8-minute walk northeast to Station Road;
- 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.

The proposed development is considered to be in general compliance with local planning policy and the NPPF.

18 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. London Borough of Hillingdon – Local Plan: Part 1 Strategic Policies, November 2012.
4. Metis Consultants - West London Strategic Flood Risk Assessment, no date. Available via: https://westlondonsfra.london/ (Accessed: 30 July 2024).
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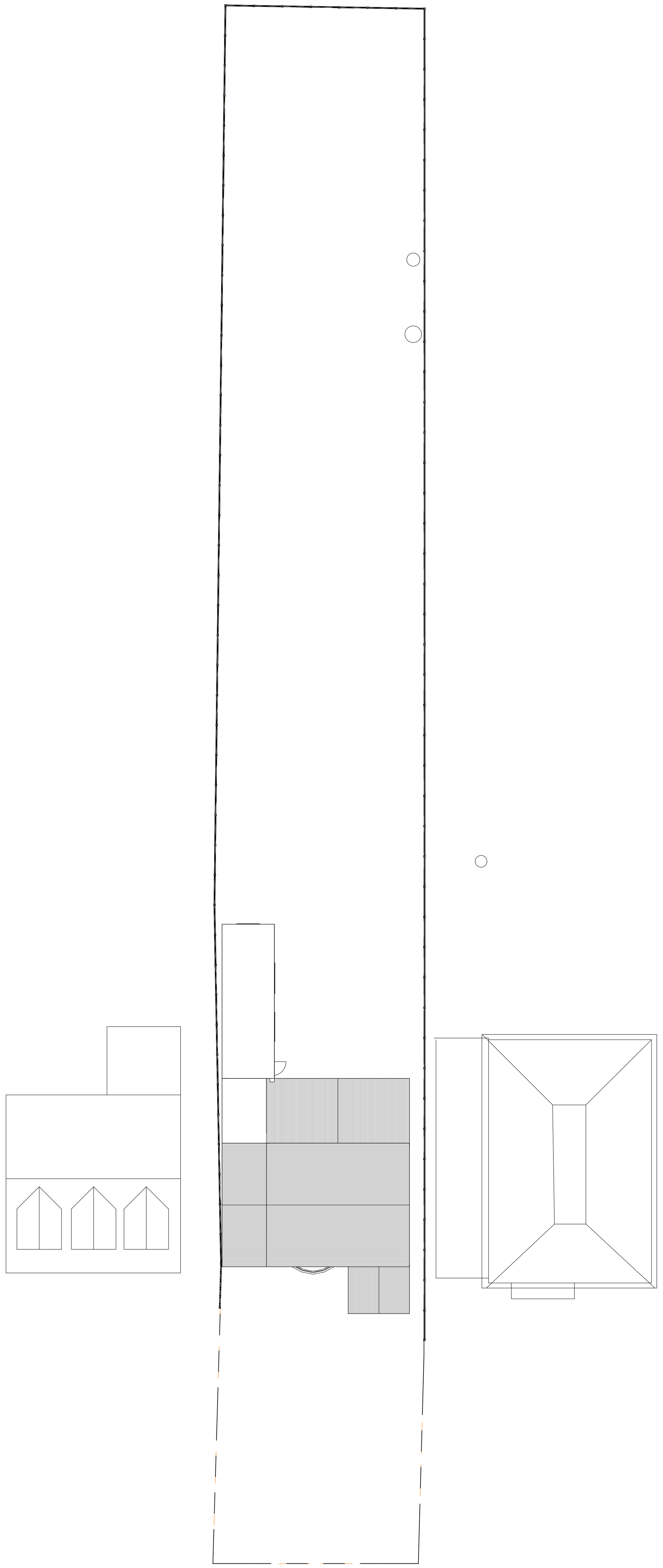
6. Metis Consultants – West London Strategic Flood Risk Assessment; Sewer, Groundwater & Artificial Flood Risk Interactive Map. Available via: https://metis.maps.arcgis.com/apps/webappviewer/index.html?id=dfaacee695f241bd80868152e1fbf5b9 (Accessed : 30 July 2024).
7. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.
8. Greater London Authority – London Sustainable Drainage Action Plan, 2015.
9. London Plan (2021) - Mayor of London
10. London Regional Flood Risk Appraisal (2018) - Mayor of London

19 Appendices

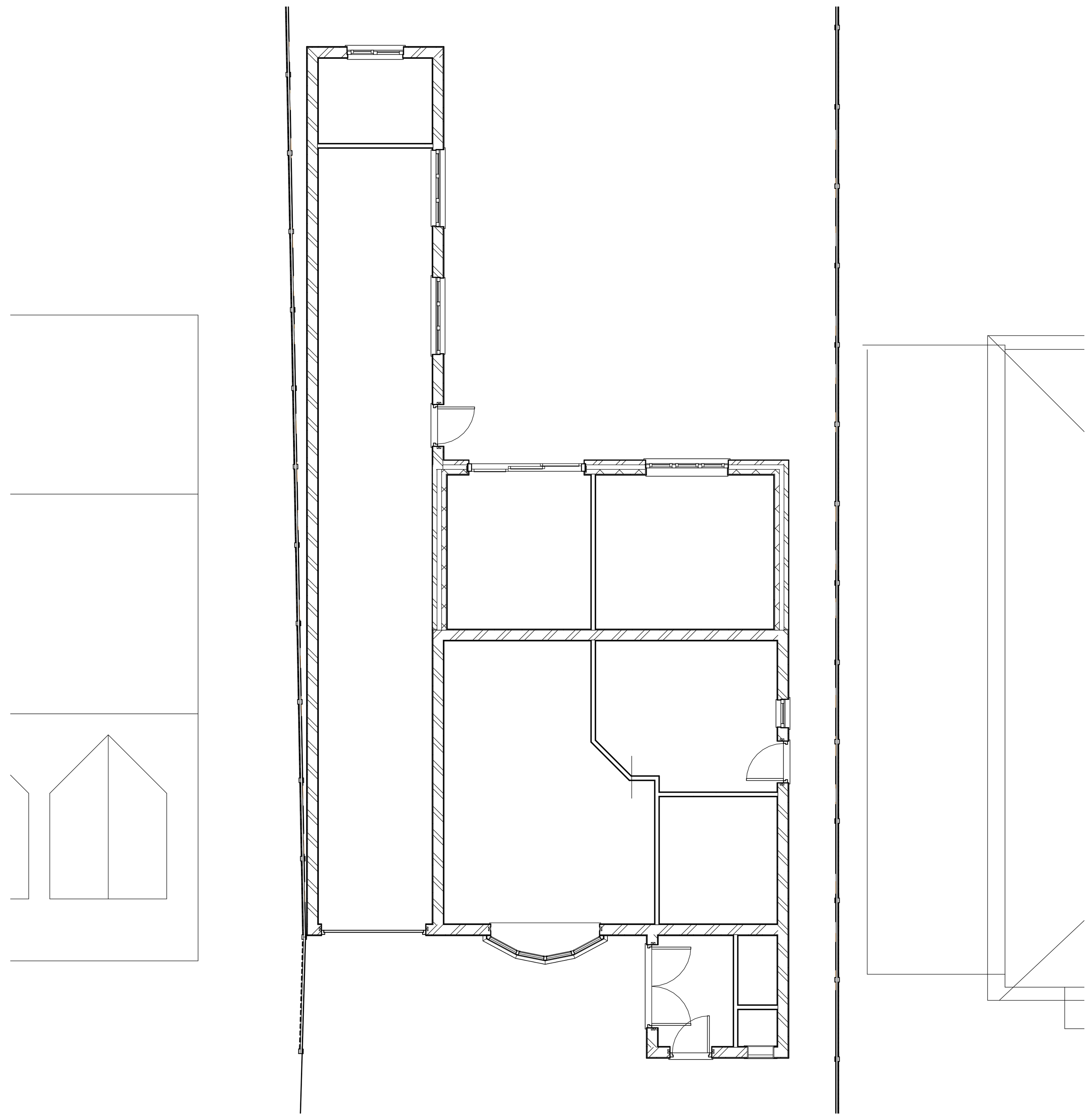
19.1 Appendix 1 – Site Photographs

19.2 Appendix 2 – Development Plans

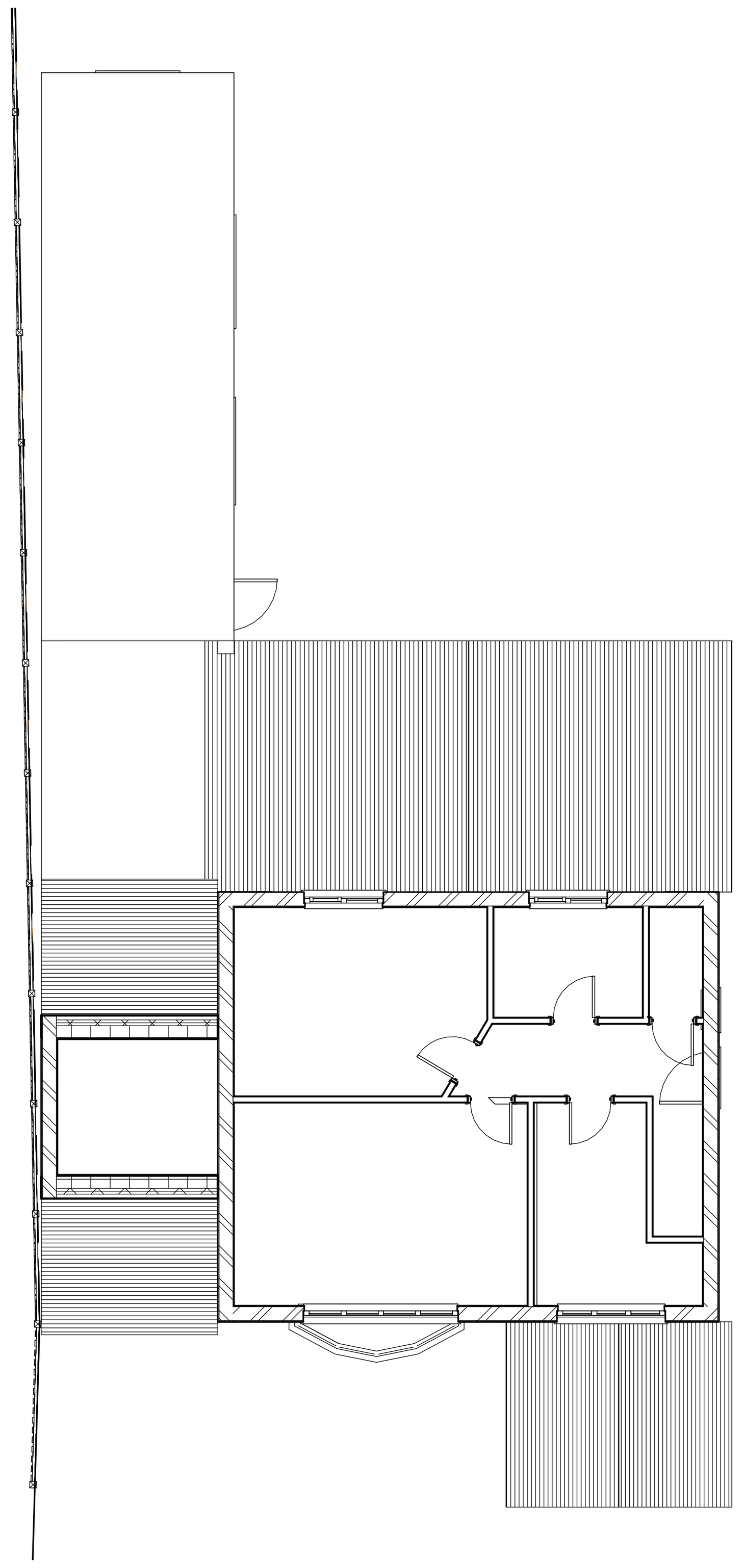
See next page.



1 **Site Plan**
1 : 200

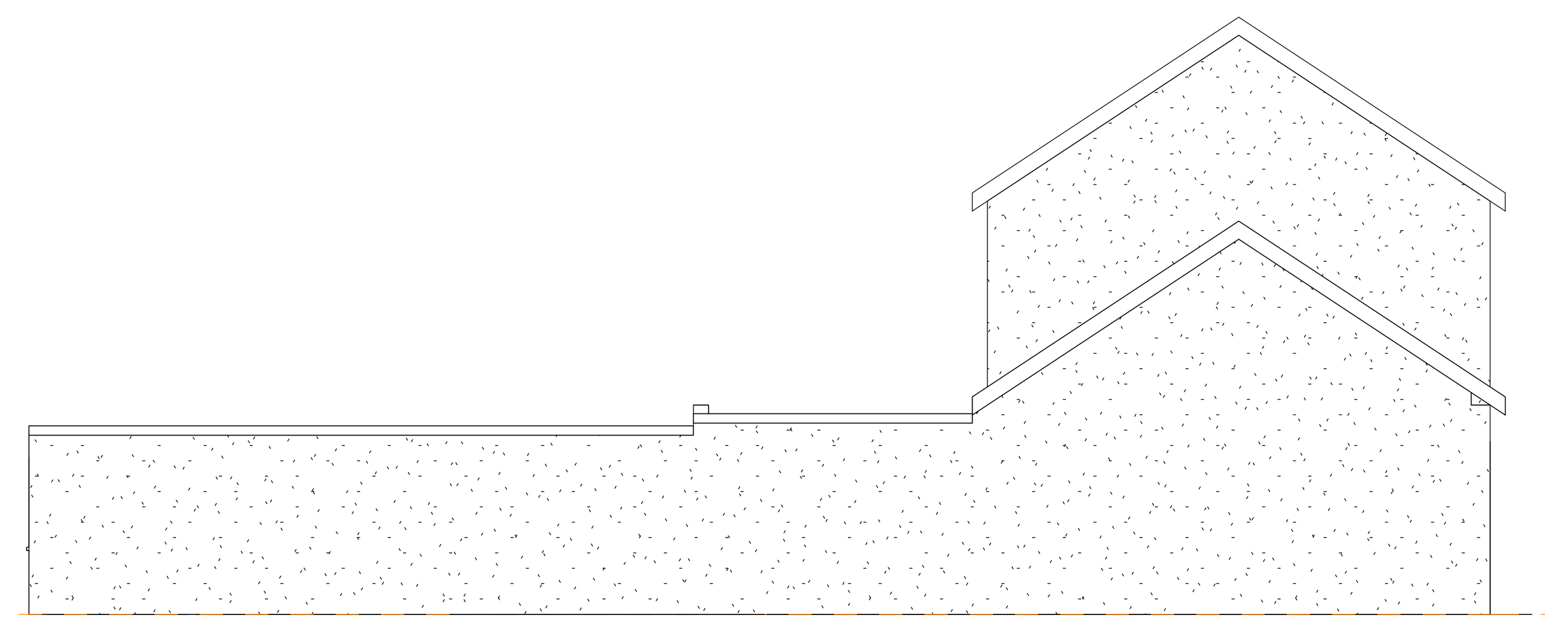


2 **Ground Floor - Existing**
1 : 100



3 **First Floor**
1 : 100

4 **Front Elevation**
1 : 100



5 **Left Elevation**
1 : 100

6 **Rear Elevatin**
1 : 100

7 **Right Elevation**
1 : 100

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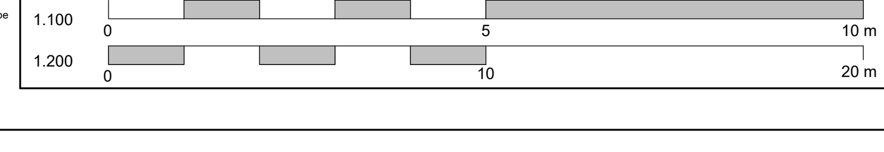
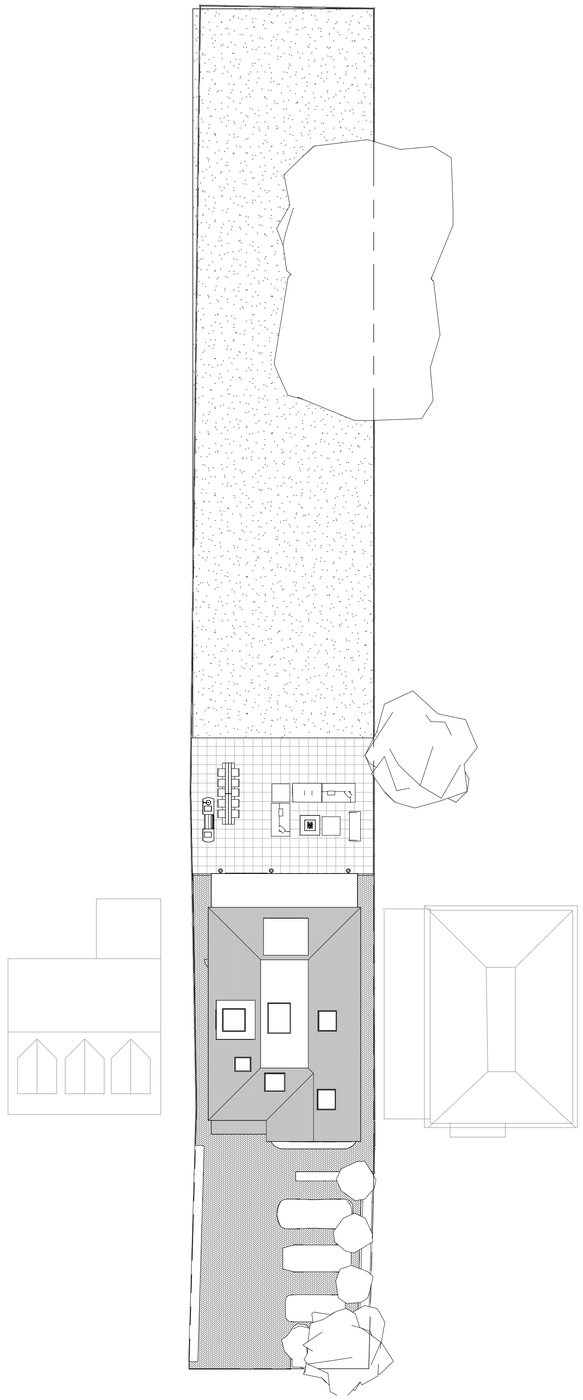
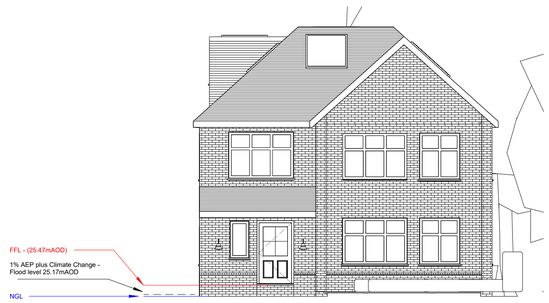
Scale (iso - A1)





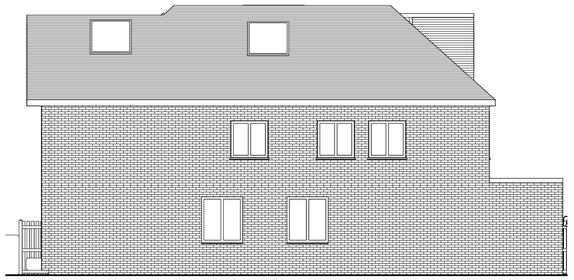
1 **Site Plan**
1 : 200



2 **Front Elevation**
1 : 100

3 **Left Elevation**
1 : 100

4 **Rear Elevation**
1 : 100



5 **Right Elevation**
1 : 100

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Proposed

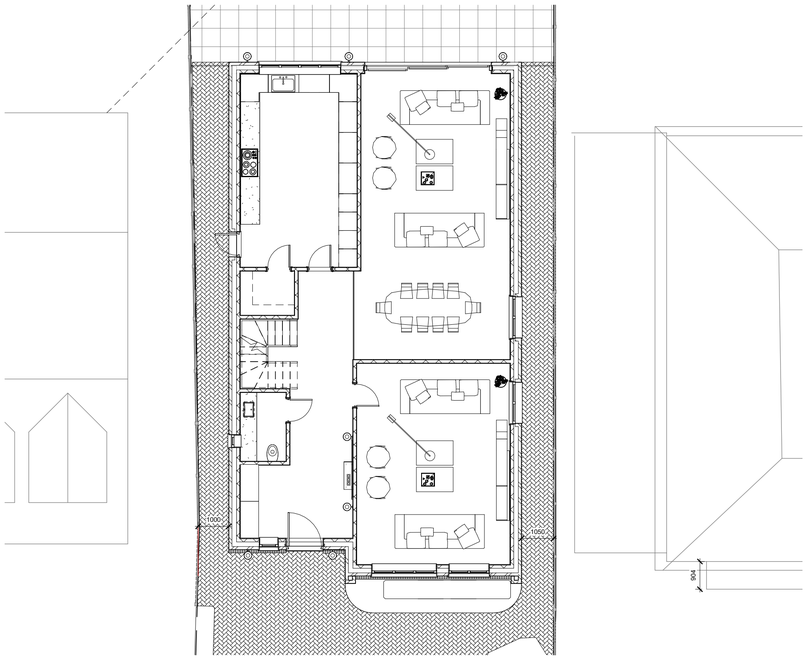
13/08/2024 03:43:43 PM A102

Scale (iso - A1)

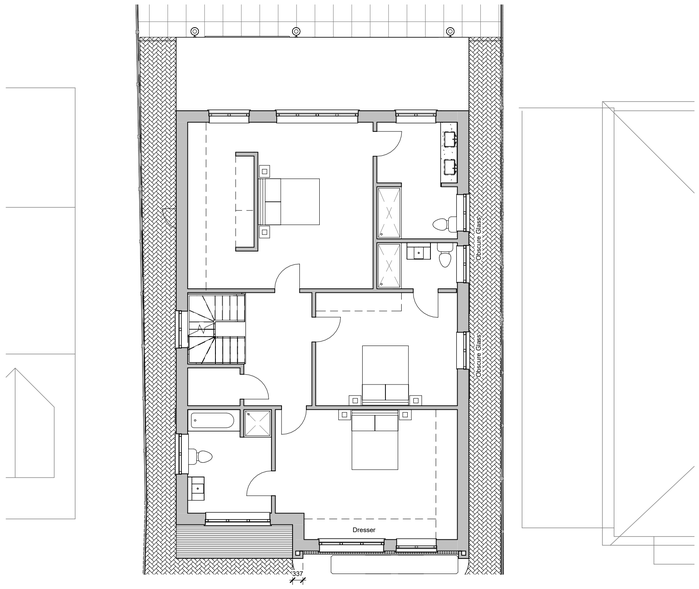
1:50 0 2.5 5 m

1:100 0 5 10 m

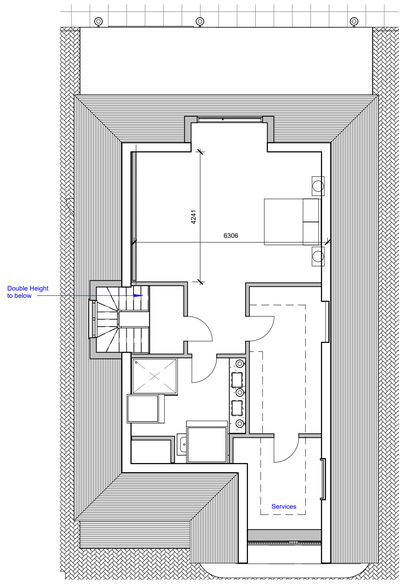
1:200 0 10 20 m



1 **Ground Floor**
1 : 100



2 **First Floor**
1 : 100



3 **Second Floor**
1 : 100

4 **Front Perspective**
1 : 1

5 **Rear Perspective**
1 : 1

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Proposed

13/08/2024 03:43:52 PM A103

Scale (iso - A1)

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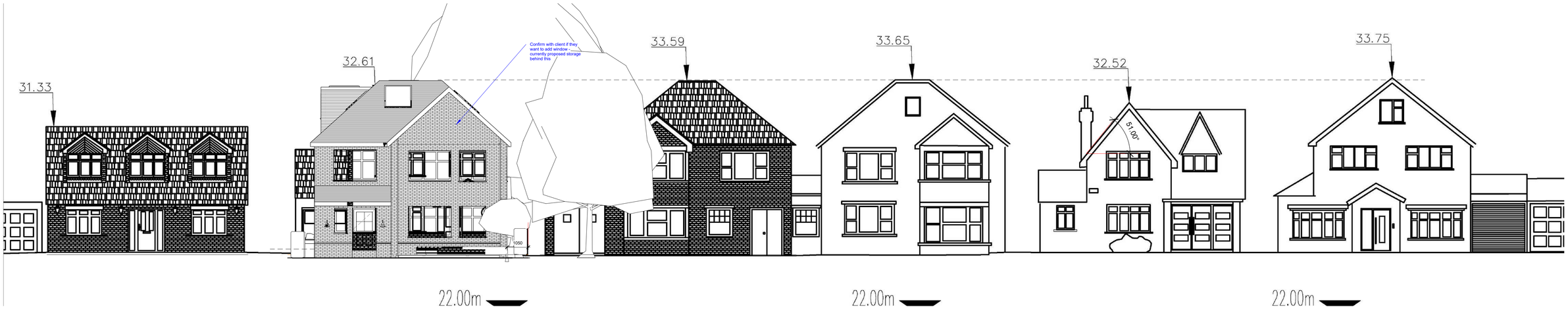
1.100 0 5 10 m

1.200 0 10 20 m



1 **Street Scene Elevation**
1 : 100

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Unnamed

13/08/2024 03:44:07 PM A104

Scale (iso - A1)

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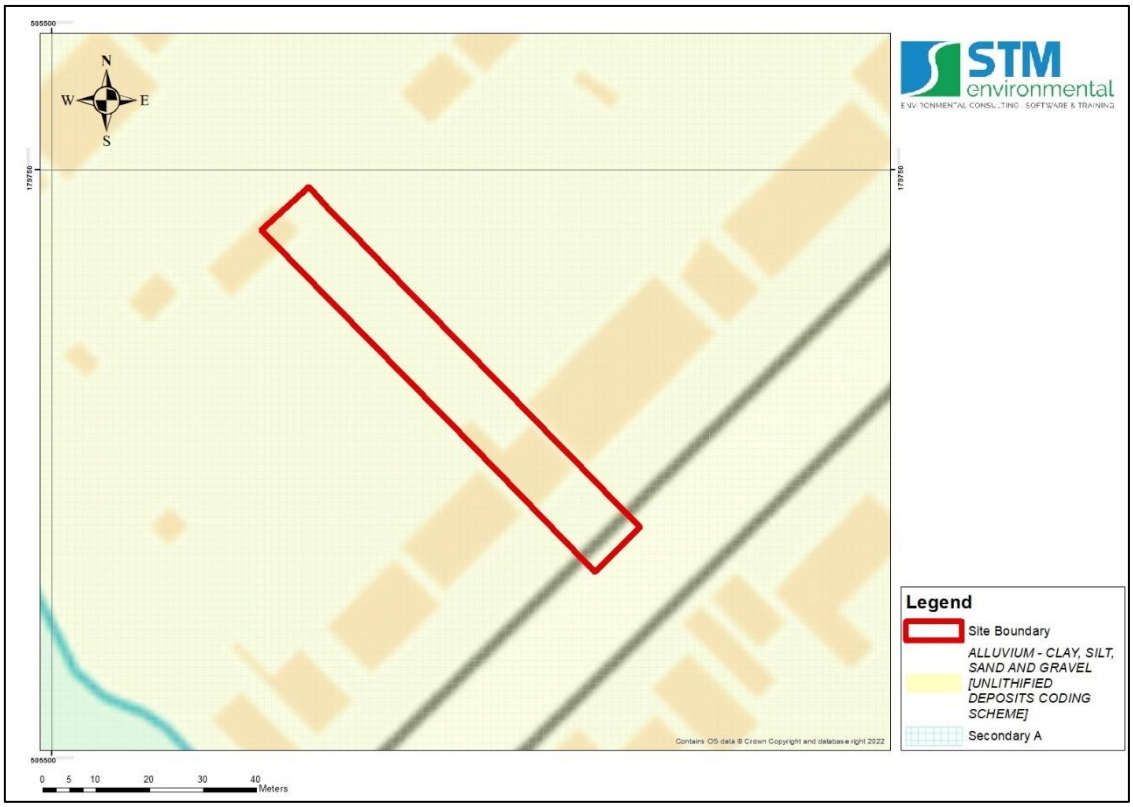
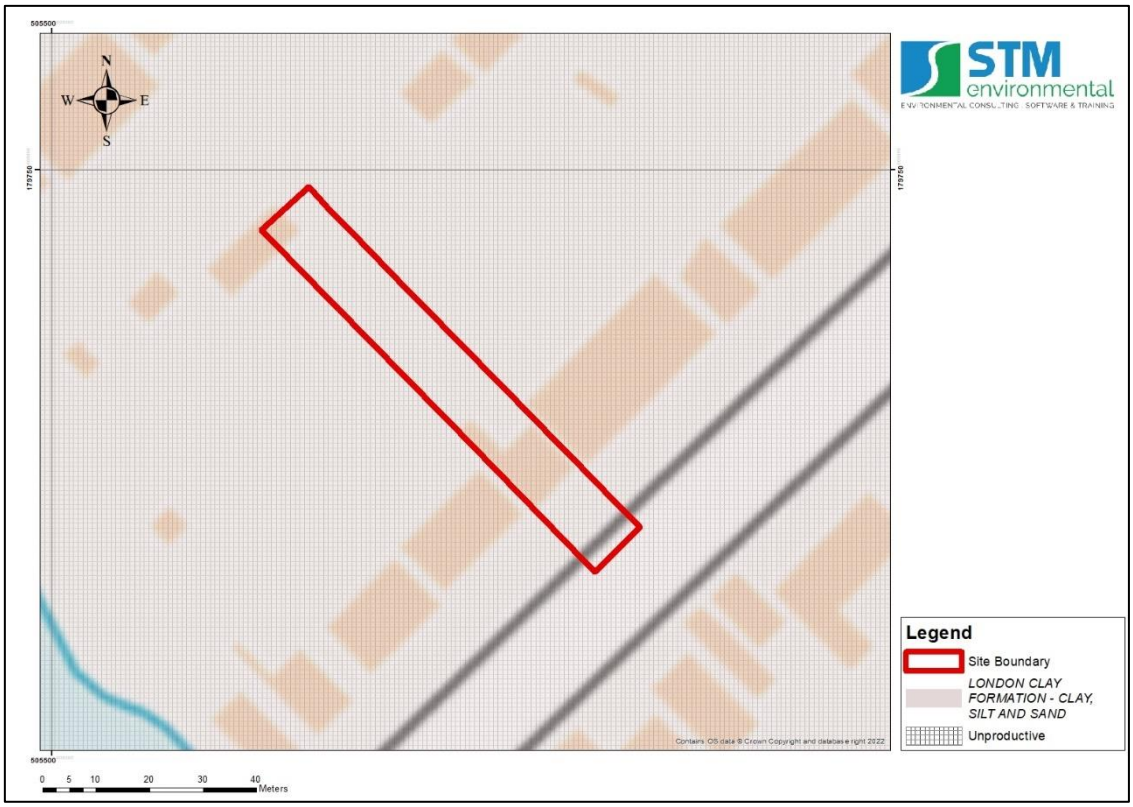
1.100 0 5 10 m
1.200 0 10 20 m

19.3 Appendix 3 – Environmental Characteristics

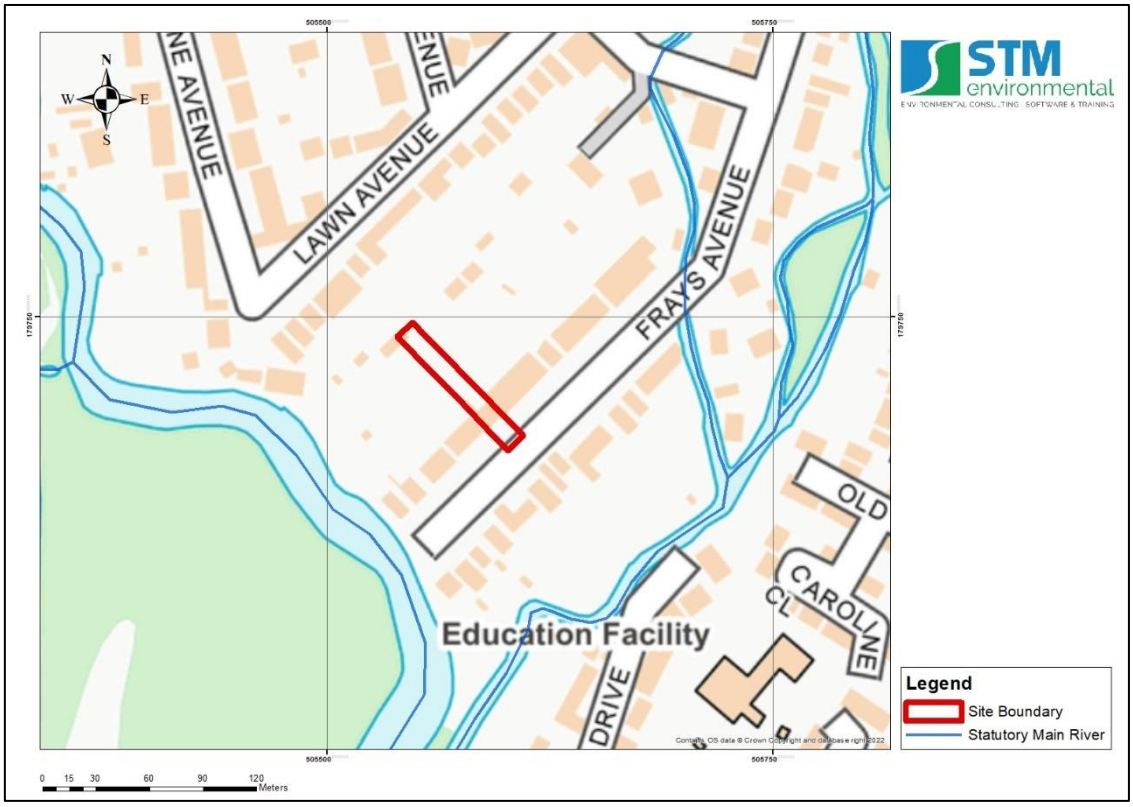
19.3.1 Superficial Hydrogeology Map



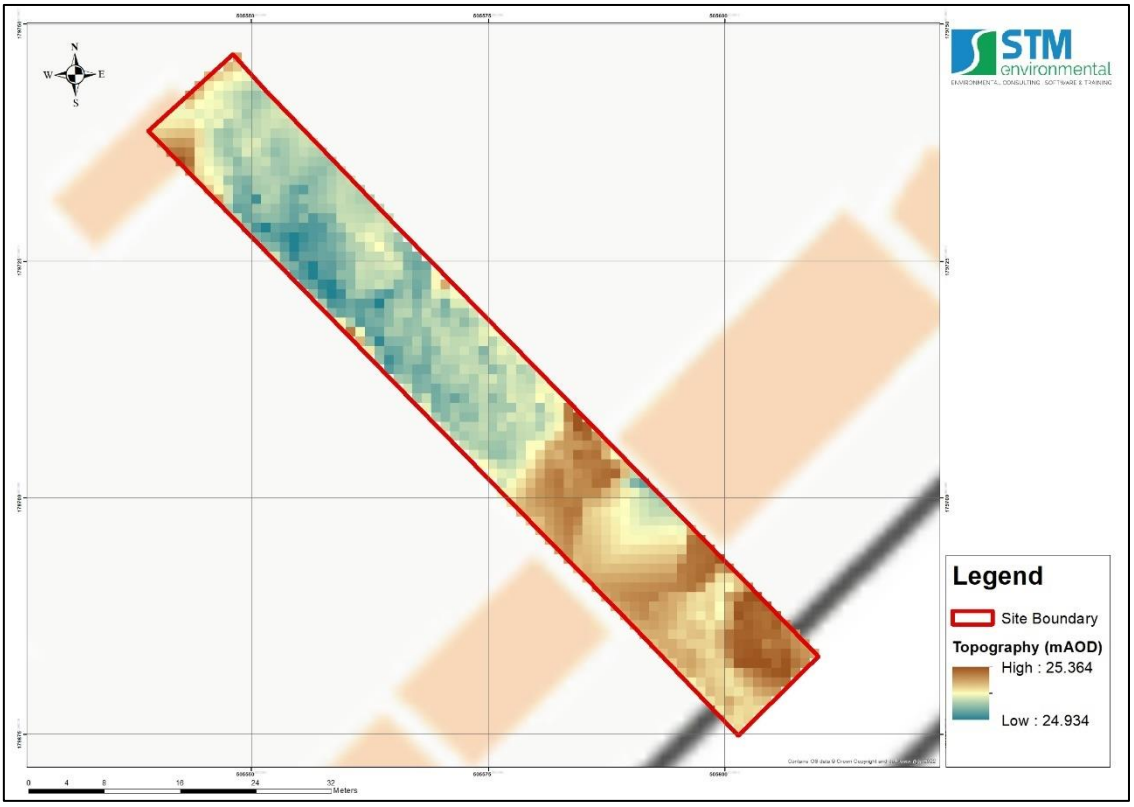
19.3.2 Bedrock Hydrogeology Map

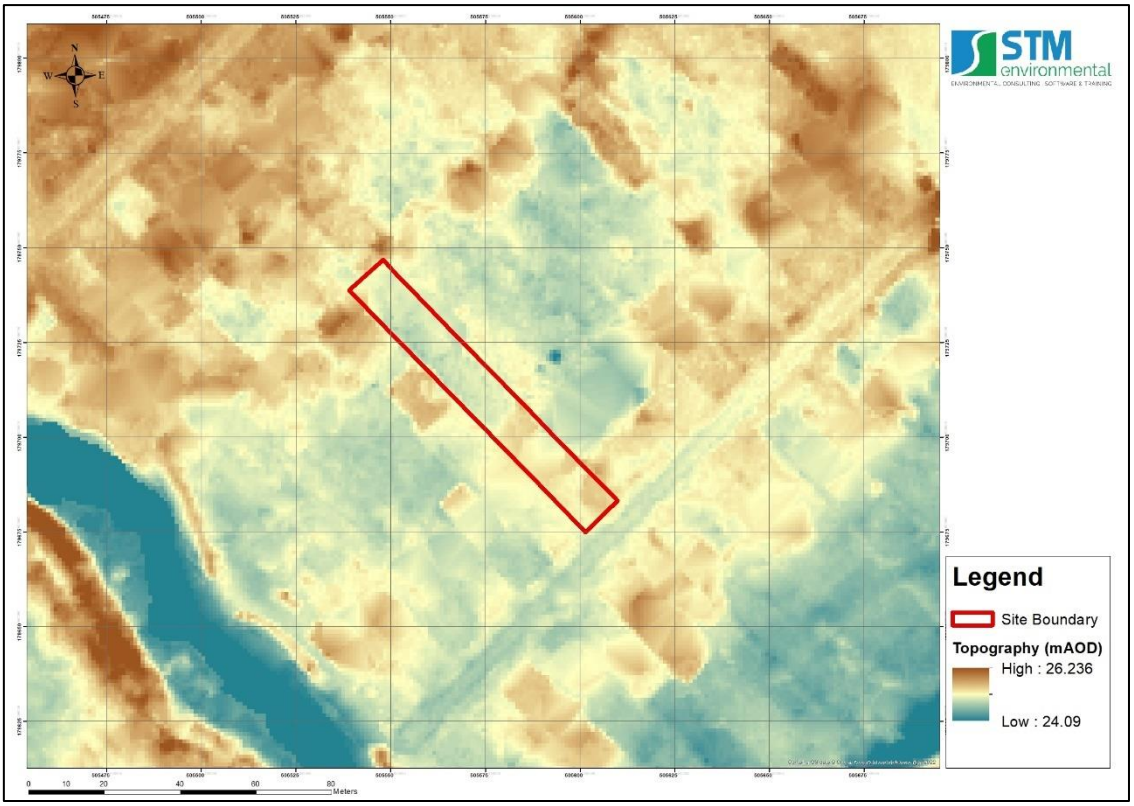


19.3.3 Hydrology Map

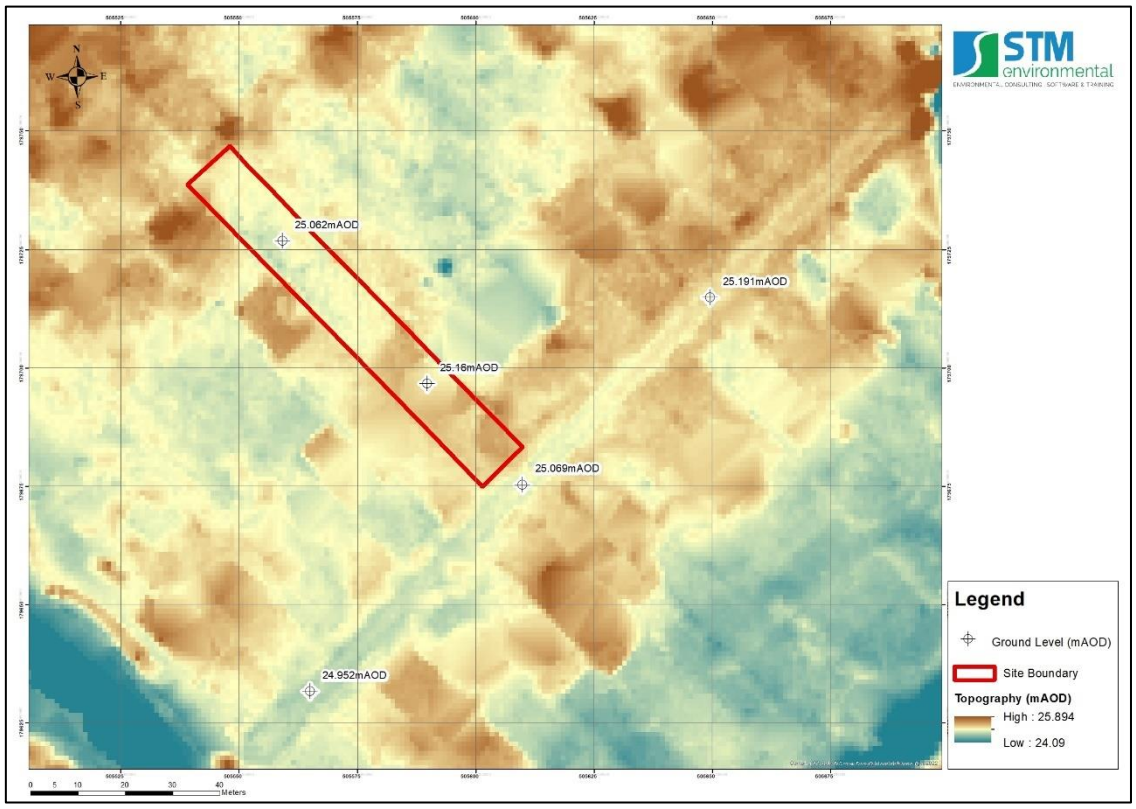


19.3.4 Topography Map



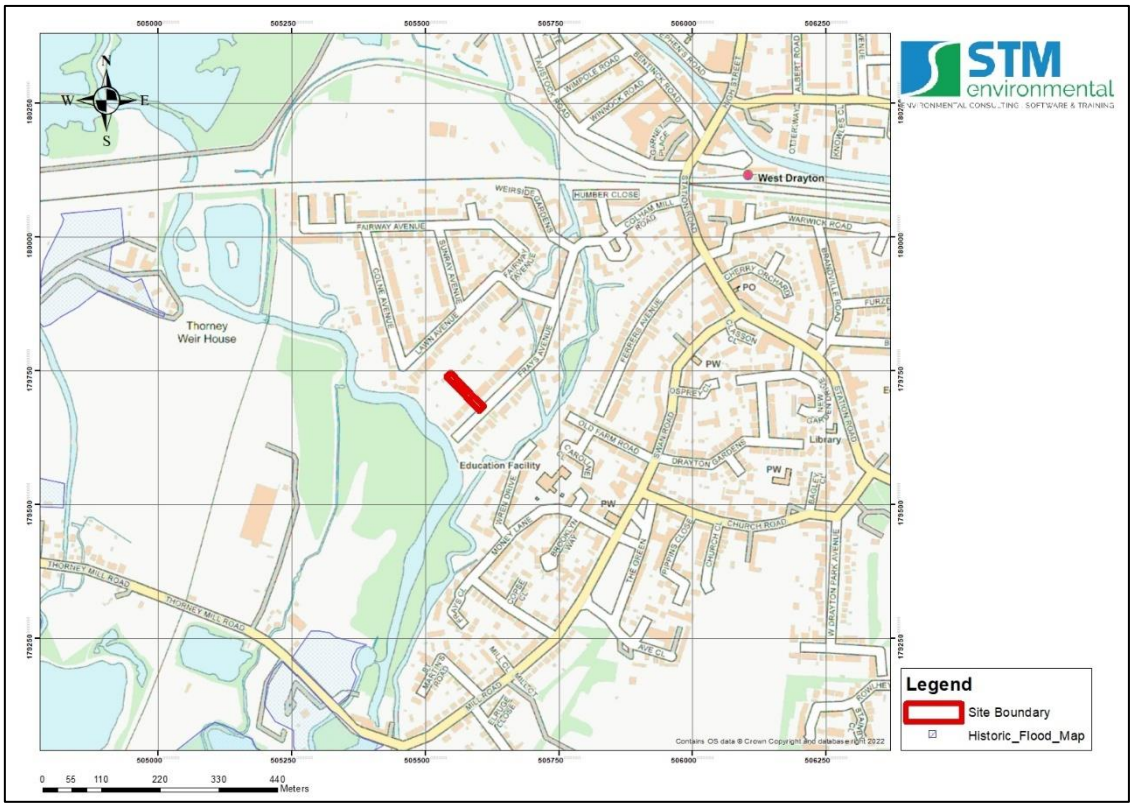


19.3.5 Topography Map – Spot levels

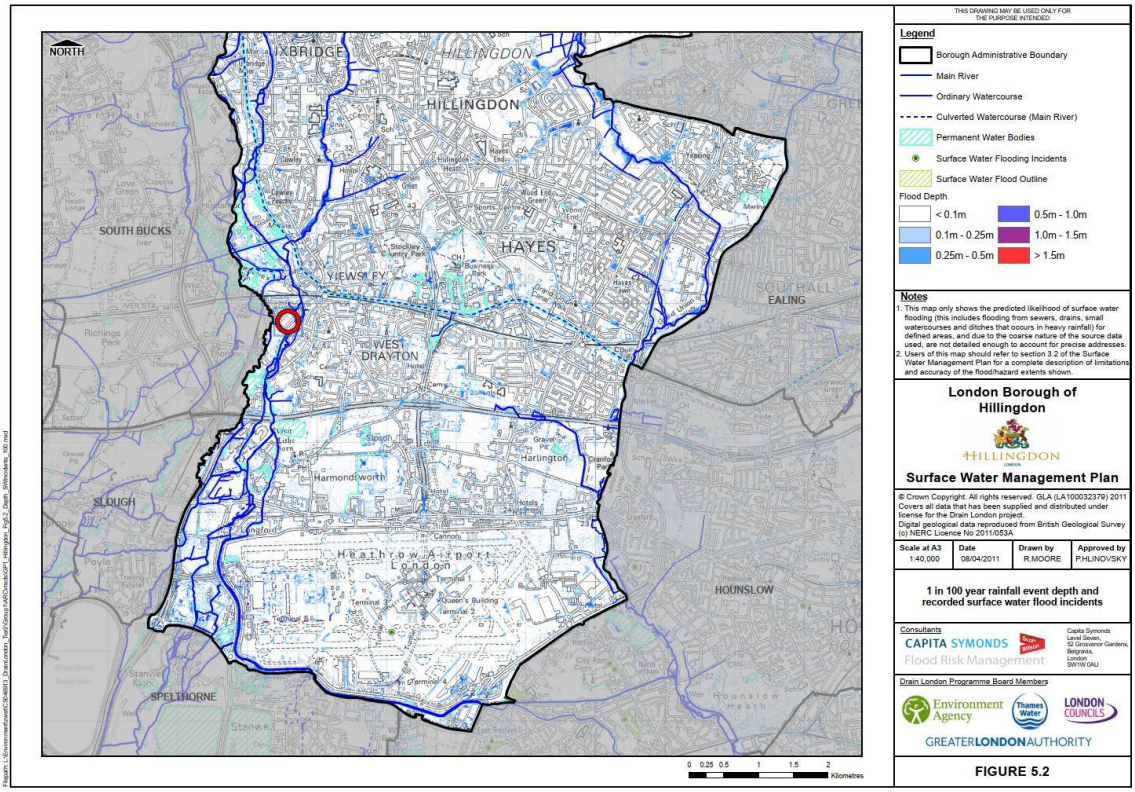


19.4 Appendix 4 – Historical Flood Incident Maps

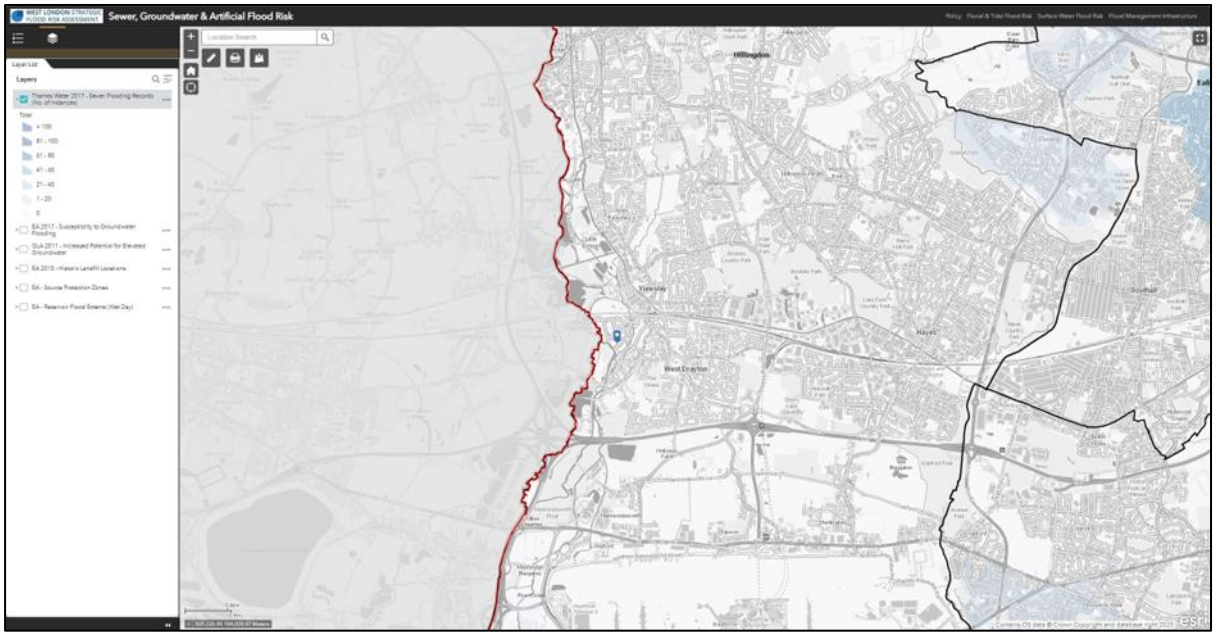
19.4.1 EA Historic and Recorded Flood Outlines



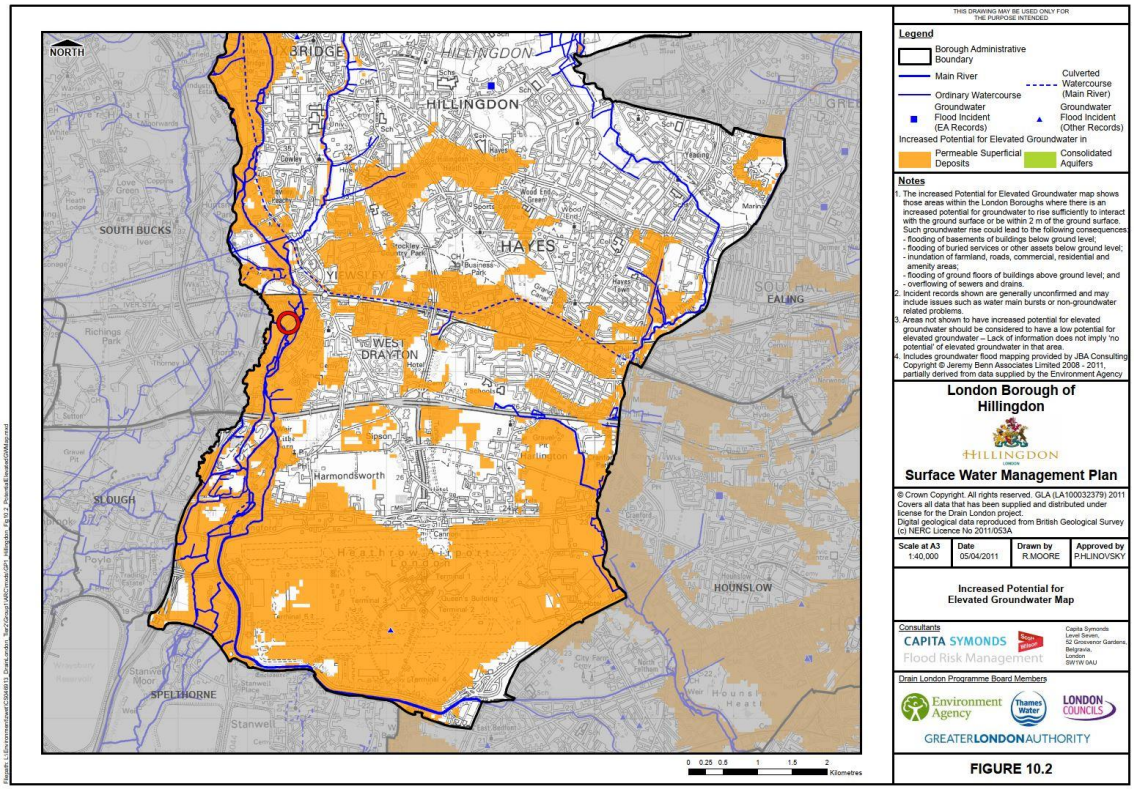
19.4.2 Map of Recorded Surface Water Flooding



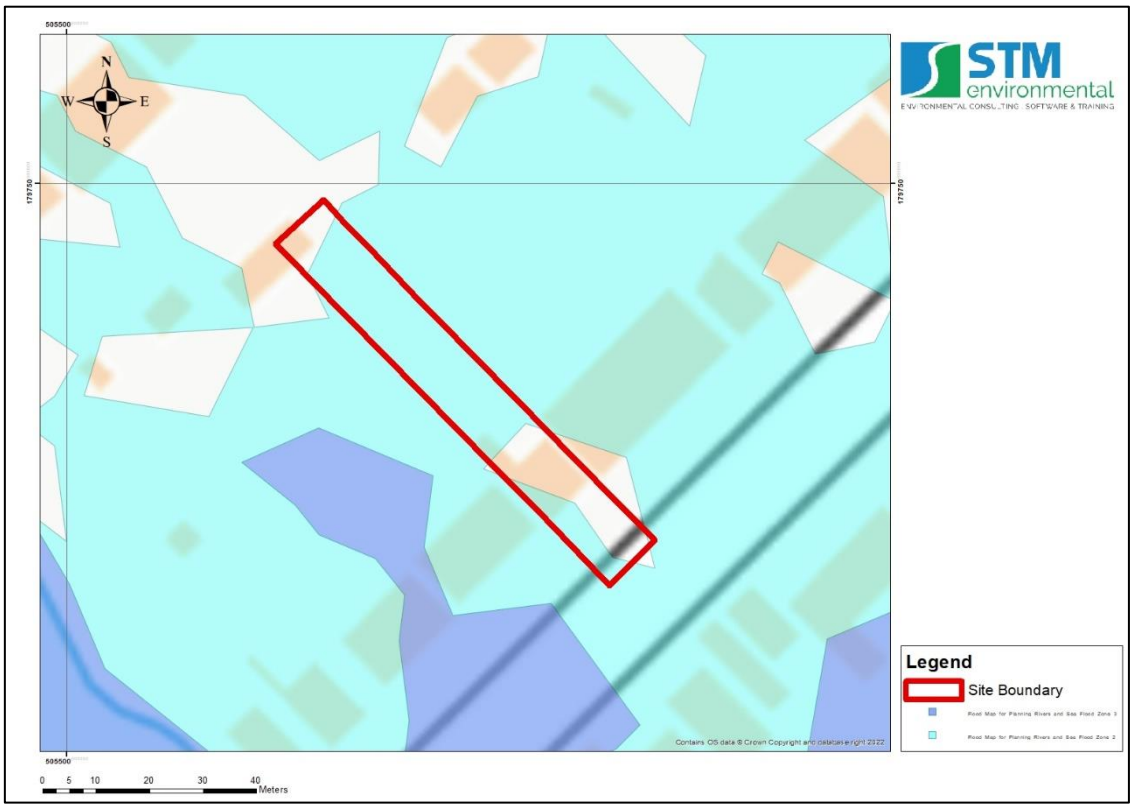
19.4.3 Map of Recorded Sewer Flooding



19.4.4 Map of Recorded Groundwater Flooding

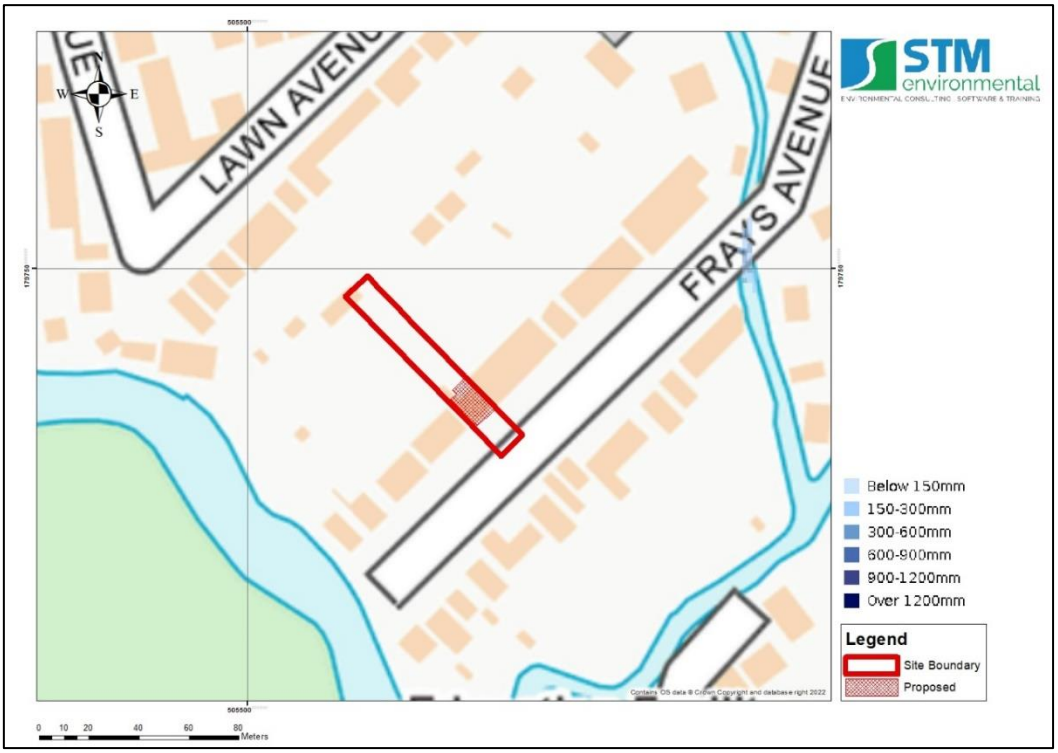


19.5 Appendix 5 - EA Flood Zone Map

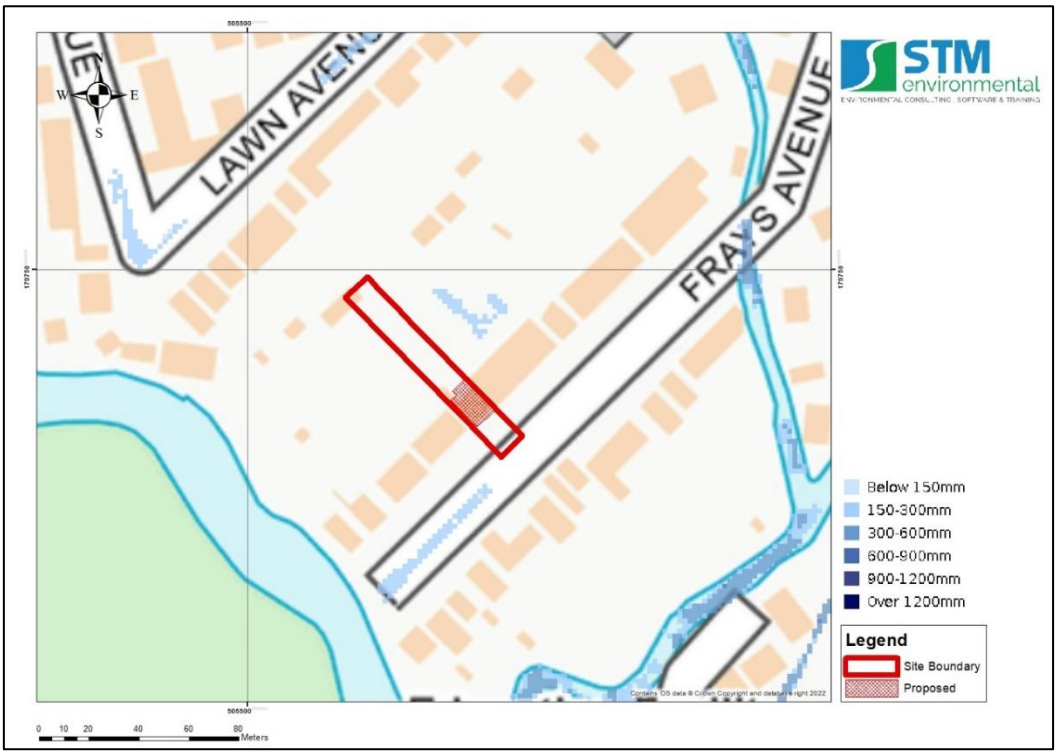


19.6 Appendix 6 – Surface Water Flood Extent and Depth Maps

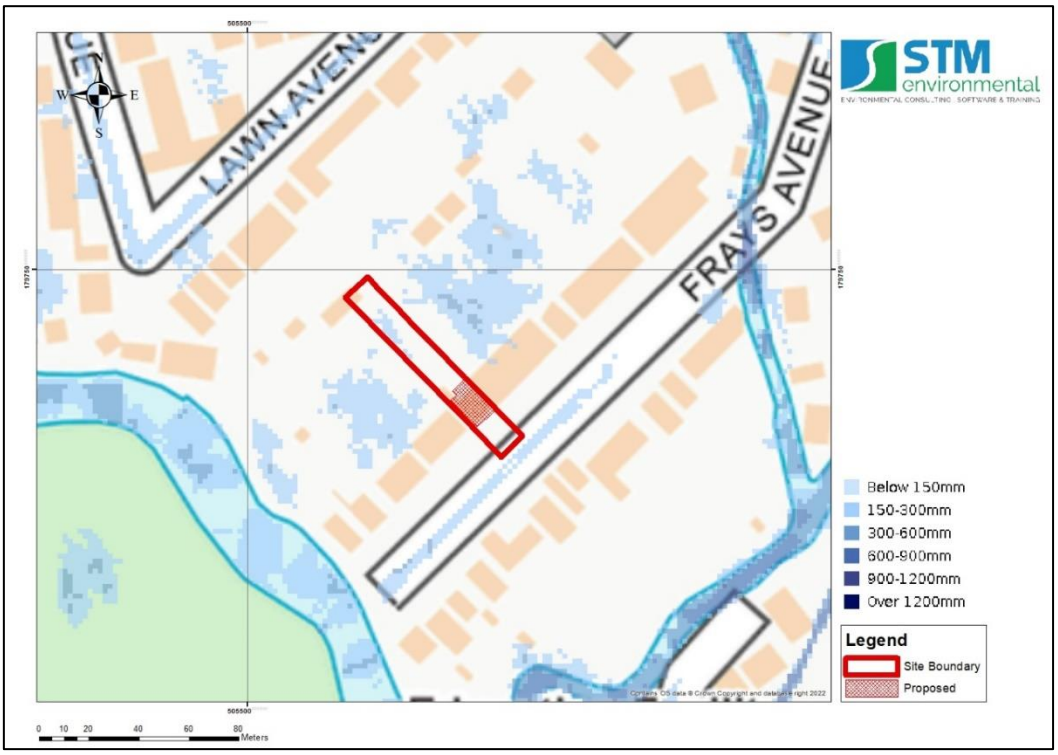
19.6.1 Predicted surface water flood depth for the 1 in 30-year return period (Source: EA, 2016).



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

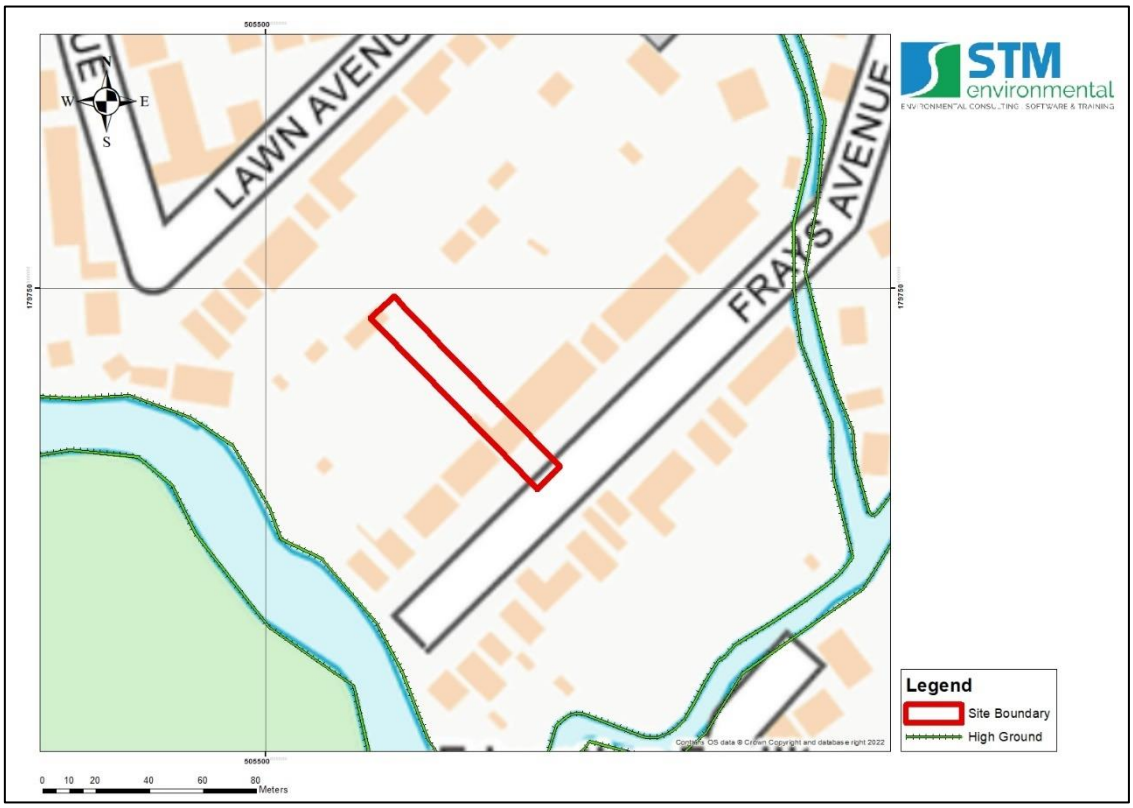


19.6.3 Predicted surface water flood depth for the 1 in 1000-year return period (Source: EA, 2016).



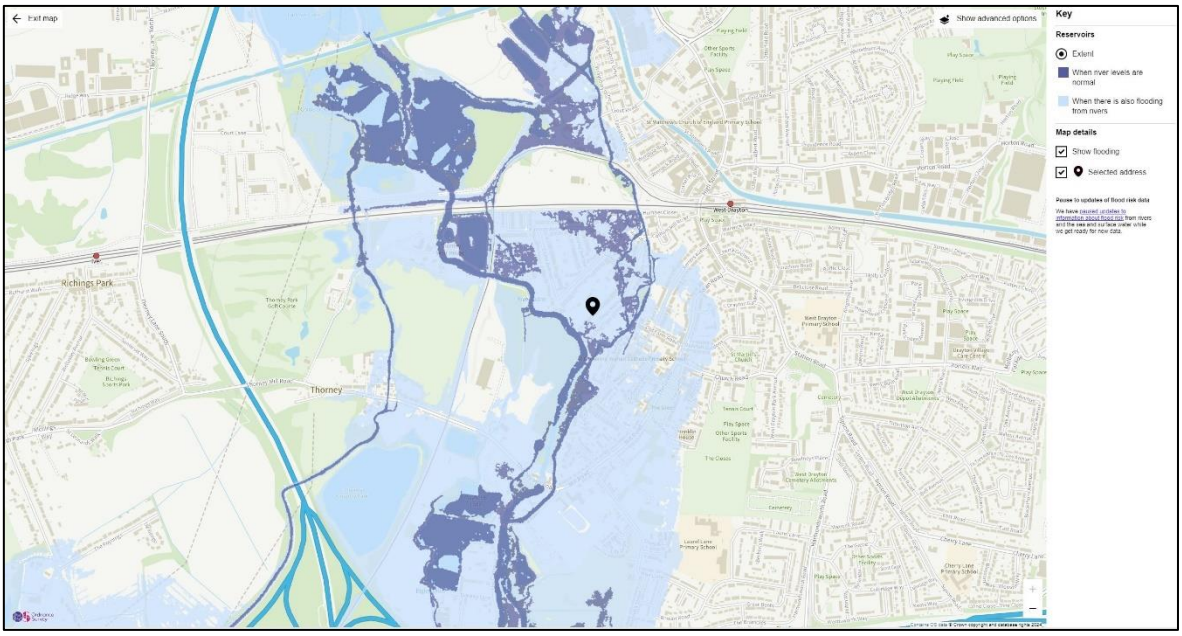
19.7 Appendix 7 – Flood Defence Mapping

19.7.1 EA flood defence map



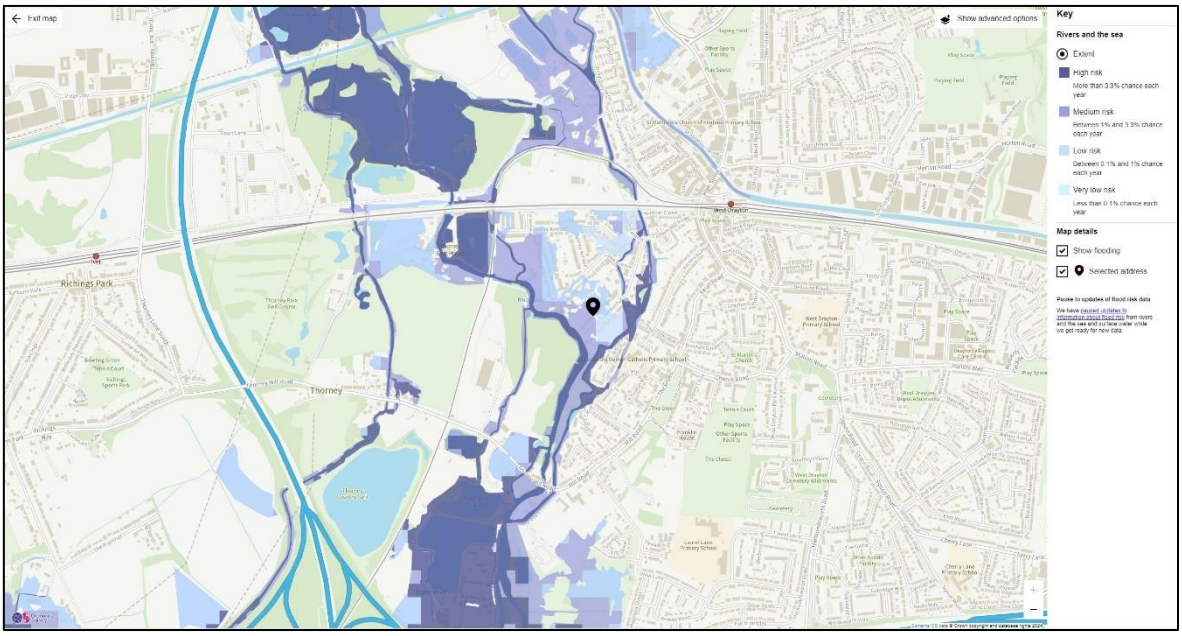
19.8 Appendix 8 – Risk of Flooding from Artificial Sources

19.8.1 Reservoir Flood Risk Map

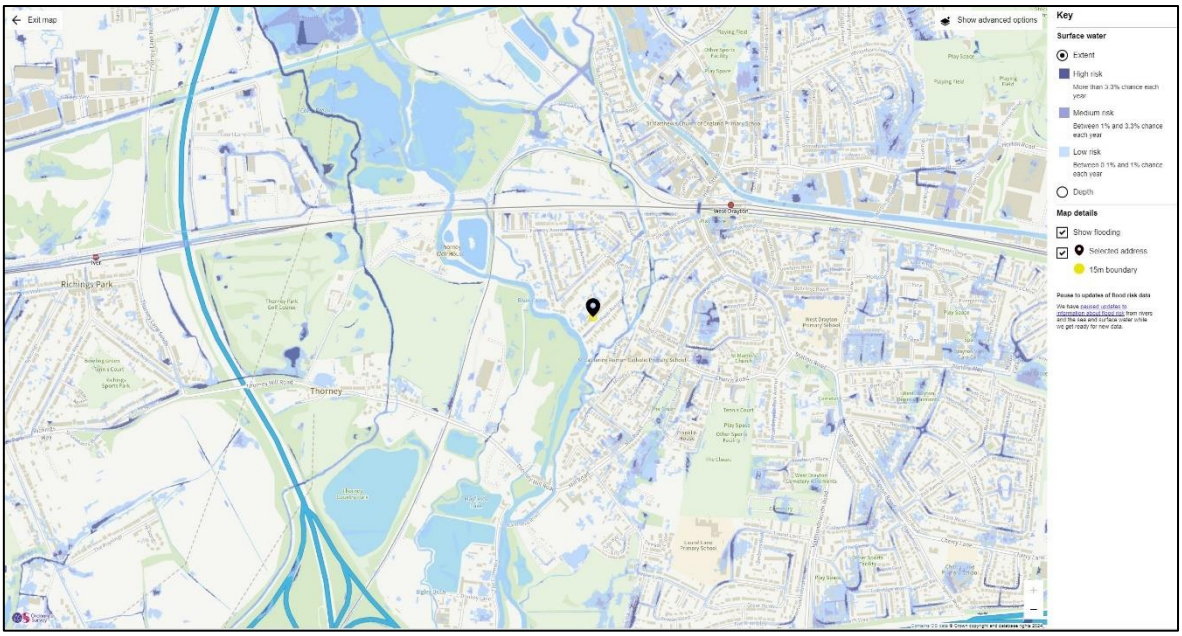


19.9 Appendix 9 – EA's Long Term Flood Risk Maps

19.9.1 Rivers and the Sea

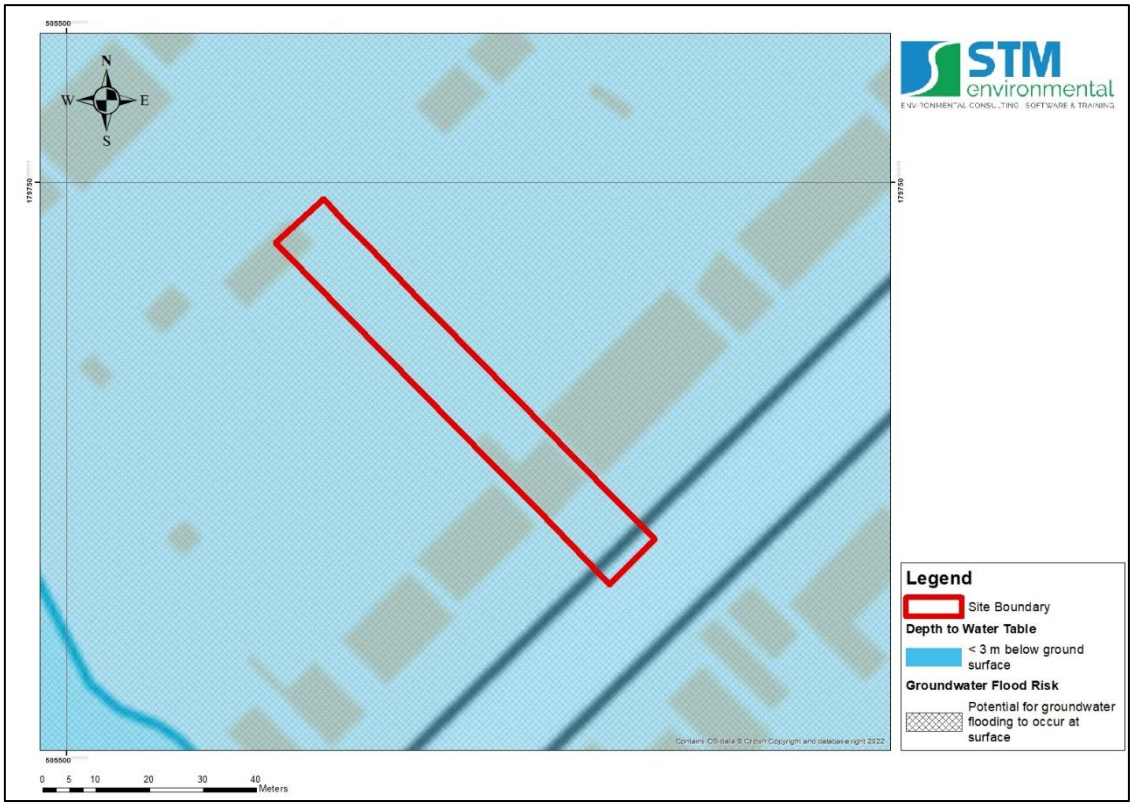


19.9.2 Surface Water



19.10 Appendix 10 – Groundwater Flood Maps

19.10.1 Groundwater Flooding (Susceptibility) Map (BGS) and Potential Depth to the Groundwater Water Map (BGS)

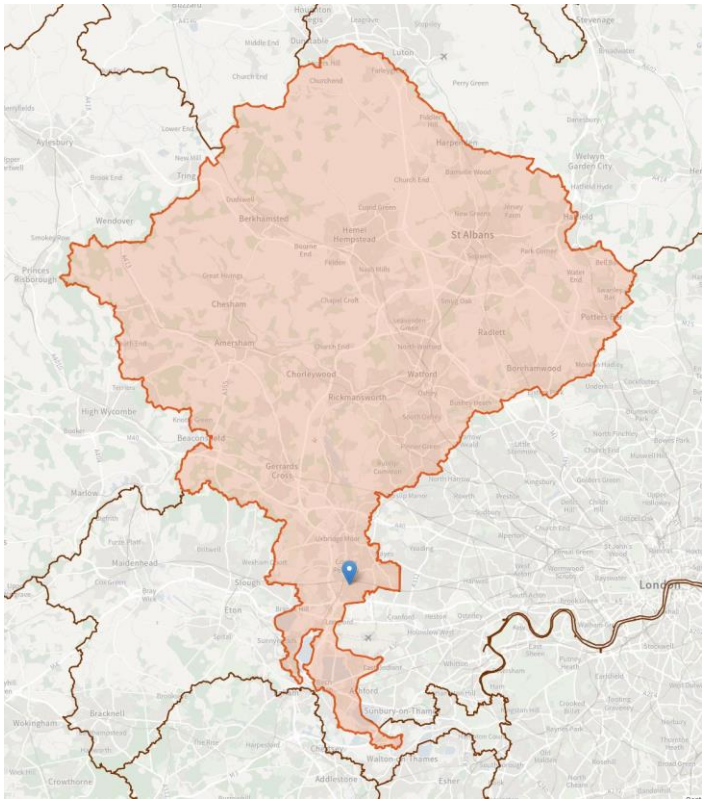


19.11 Appendix 11 - EA Product 6 (Detailed Flood Risk) Data

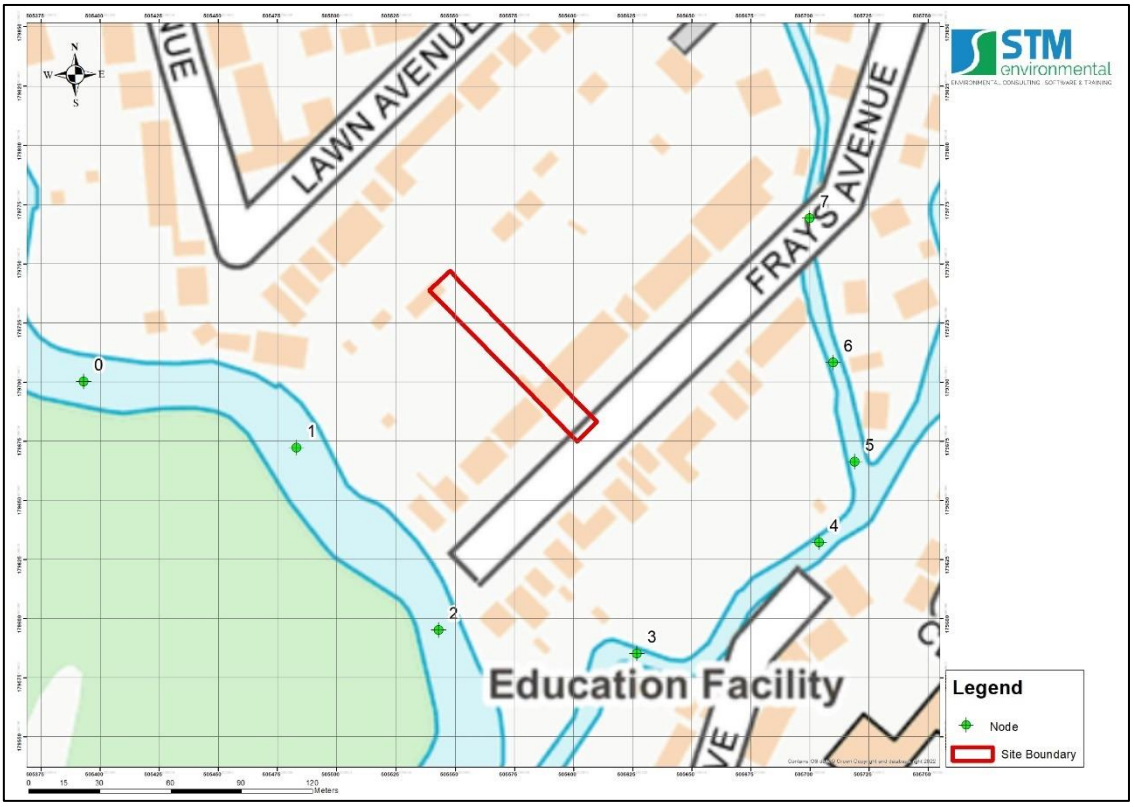
19.11.1 EA Climate Change Allowances for Peak River Flow

Colne Management Catchment peak river flow allowances

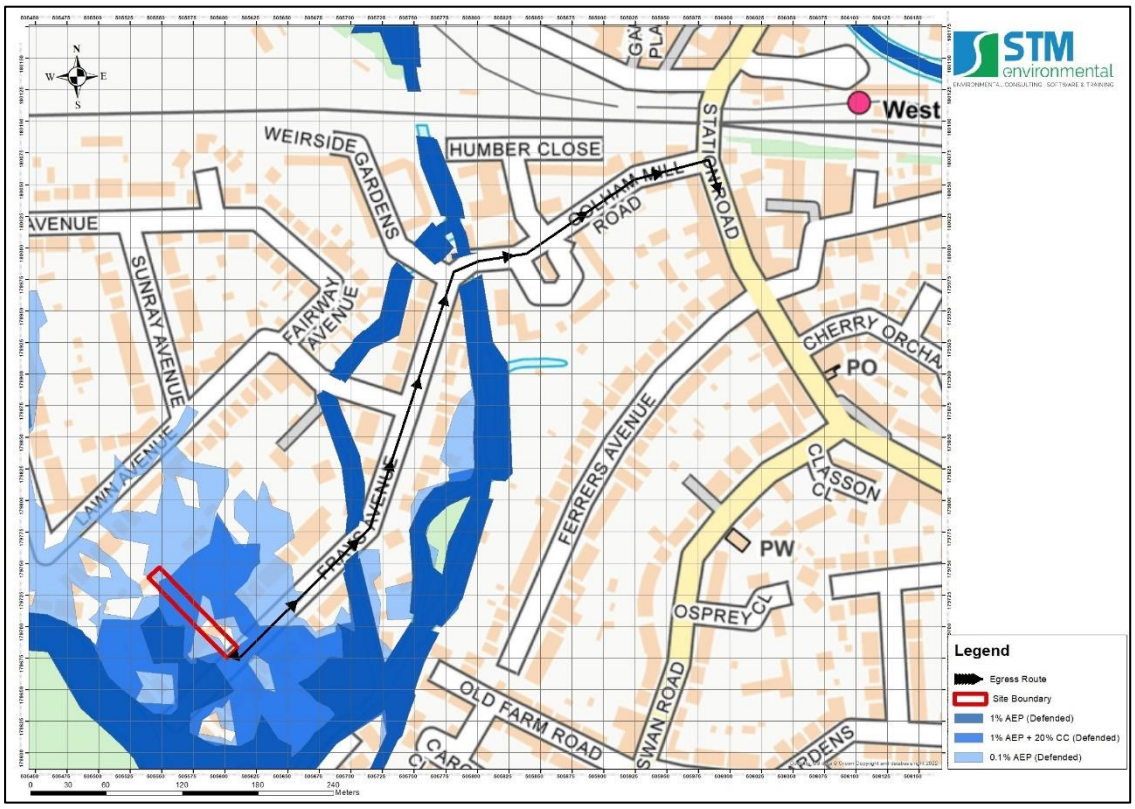
	Central	Higher	Upper
2020s	10%	16%	30%
2050s	8%	16%	38%
2080s	21%	35%	72%



19.11.2 Node Location Map



19.12 Appendix 12 – Safe Egress to Flood Zone 1 Map



19.13 Appendix 13 – Calculation of Flood Hazard Rating

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

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

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”.