FLOOD RISK ASSESSMENT

Site Address
59 Petersham Road
Richmond
TW10 6UT

Client
Jonathan Earle

Date
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1 Document Control

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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
RTLC	Richmond upon Thames local council
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

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 Jonathan Earle (Client). Any party other than the Client using or placing reliance upon any information contained in this report, do so at their own risk.

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.

4 Executive Summary

SECTION	SUMMARY
Location	59 Petersham Road, Richmond, TW10 6UT Grid Reference: 517958, 174296
Area	291m^2
Proposed Development	Stepped access to lower ground level, forming a lightwell for garden level and minor internal refurbishment works.
Flood Zone	The site is located in Flood Zone 3, however the proposed development is located fully within Flood Zone 1.
Topography	The site slopes downwards from Petersham Road from an elevation of 11.05mAOD to 4.48mAOD. The upper ground floor of the existing dwelling sits at approximately 12.00mAOD.
Sequential and Exception Tests	The development is minor and more vulnerable and should not require the Sequential test to be undertaken. An Exception test might be required by the LLFA;
Main Sources of Flooding	Main source of fluvial flooding is the River Thames, 10m west of the site.
Flood Defences	The site benefits from an embankment along the western edge of the property.
Records of Historic Flooding	The EA Historic Flood Map contains no records of historic fluvial or pluvial flooding on or in the vicinity of the site. There is one record of recorded incident of combined sewer flooding in the area, however the location is not specified.
Fluvial (River) and Tidal (Sea) Flood Risk	Medium – The site witness a maximum flood level of 6.68mAOD during the 2125 Modelled Breach tidal event. These flood depths are set to be witnessed at the lowest points of elevation in the rear garden. However, the proposed lightwell remains dry during any event.
Pluvial (Surface Water) Flood Risk	Very Low – The site remains dry during all modelled pluvial events.
Flood Risk from Artificial (Canals and Reservoirs) Sources	Low - No significant artificial sources identified
Groundwater Flood Risk	Low – According to the BGS, the site is potentially susceptible to groundwater flooding, no recorded incidents have been identified.
Development Impacts on Local Flood Risk	The development is located within the existing building footprint, which will not impact the sites impermeable or built up areas. As such, the impact on the flood plain storage area and runoff rates can be considered negligible.

SECTION	SUMMARY
Proposed Flood Risk Mitigation Measures	• The proposed lightwell will be situated at the existing elevation of 7.3mAOD; • All internal floor levels will remain as existing. • Flow routes will be protected by raised threshold steps ground level at lower ground level; • Drainage to be introduced within the base of the lightwell; • Emergency access ladder & hatch to be introduced within metal grill lightwell structure; • 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 available via exiting the front door and walking west on Petersham Road (2-minute walk) and safe refuge is available on upper floors.
Surface Water Management (SuDS)	SuDS would reduce current surface water runoff rates but given the outlines of the development, there is likely limited potential for implementation at room level and would require their incorporation elsewhere into the development plans. 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) were appointed by Jonathan Earle (Client) to provide a Flood Risk Assessment (FRA) at a site located at 59 Petersham Road, Richmond, TW10 6UT.

6 Development Proposal

The FRA is required to support a planning application for the removal of the existing garden level gym and bathroom with the proposed creation of the new ground level lightwell and associated grille. A glazed wall is to be introduced between the utility room and store along with the proposed lowering of the existing window sill to allow for the introduction of new doors accessing the lightwell.

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 – Richmond upon Thames Council

Policy LP 21 of the Richmond upon Thames Local Plan addresses Flood Risk and Sustainable Drainage. It states that:

"All developments should avoid, or minimise, contributing to all sources of flooding, including fluvial, tidal, surface water, groundwater and flooding from sewers, taking account of climate change and without increasing flood risk elsewhere. Unacceptable developments and land uses will be refused in line with national policy and guidance [and] the Council's Strategic Flood Risk Assessment (SFRA)".

Sustainable drainage

The Council will require the use of Sustainable Drainage Systems (SuDS) in all development proposals. Applicants will have to demonstrate that their proposal complies with the following:

1. A reduction in surface water discharge to greenfield run-off rates wherever feasible.
2. Where greenfield run-off rates are not feasible, this will need to be demonstrated by the applicant, and in such instances, the minimum requirement is to achieve at least a 50% attenuation of the site's surface water runoff at peak times based on the levels existing prior to the development.

Also relevant is policy S1 12 of the London Plan (2020) which outlines Flood Risk Management, it states that:

- Current and expected flood risk from all sources 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.

Also relevant are the London Plan (2020) policies S1 12 'Flood Risk Management'; Policy SI 13 'Sustainable Drainage' and the London Regional Flood Risk Appraisal (2018).

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 59 Petersham Road, Richmond, TW10 6UT and is centred at national grid reference 517958, 174296. The site has an area of 291m^2.

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

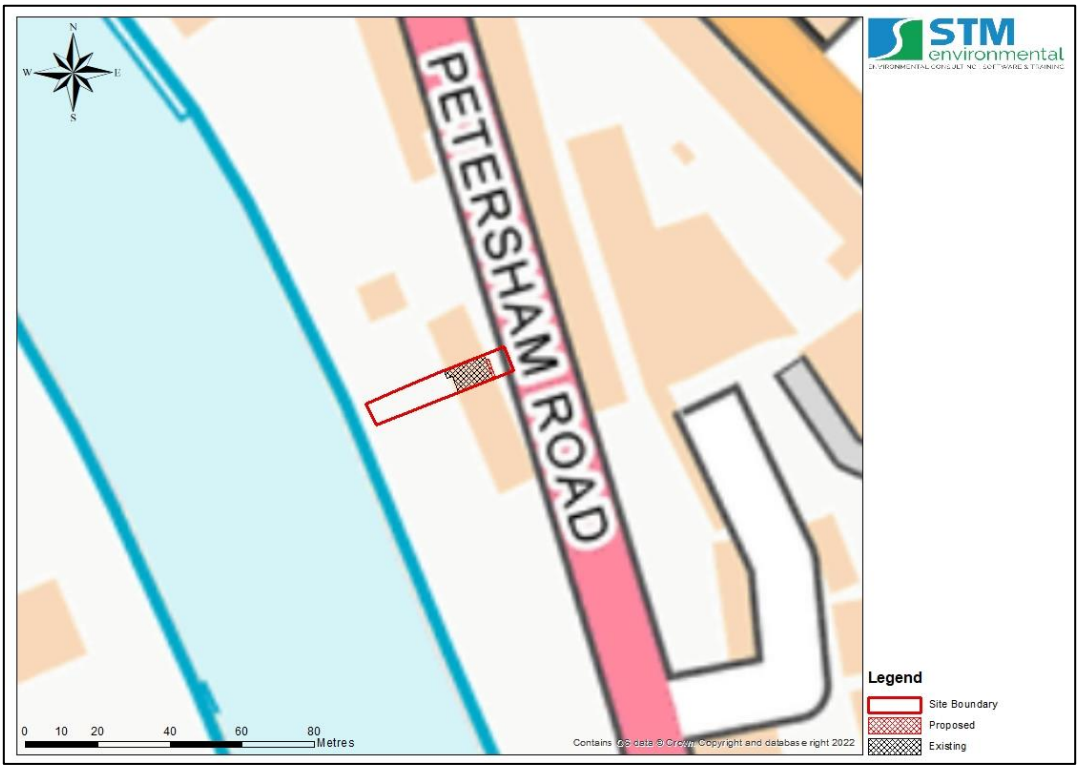


Figure 1: Site Location Map

Figure 2: Site Aerial Map

10.2 Site Access

The site is accessed via Petersham Road.

10.3 Local Planning Authority

The site falls within the jurisdiction of Richmond Upon Thames local council in terms of the planning process.

10.4 Lead Local Flood Authority

Richmond Upon Thames local council is also the Lead Local Flood Authority (LLFA).

10.5 Flood Zone

For planning purposes, the site is located in Flood Zone 2 and 3 as defined by the EA and LLFA. The proposed underground development however, is located in Flood Zone 1.

10.6 Site and Surrounding Land Uses

10.6.1 Site Current Land Use

The site is currently used as residential dwelling.

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 (Within 25 – 250m)**
Northern	Residential/ Commercial	Residential/ Commercial
Eastern	Residential/ Commercial	Residential/ Commercial
Southern	River Thames	Residential/ Commercial
Western	River Thames	Residential/ Commercial

10.7 Hydrology

The nearest main watercourse is the River Thames which is located 10m West of the site.

10.8 Geology

Data from the British Geological Survey indicates that there is no underlying superficial geology for most of the site, the Western edge is underlain by Alluvium. The underlying bedrock geology is characterized as London Clay formation (Clay and Silt).

10.9 Hydrogeology

The site lies upon a Secondary (undifferentiated) superficial aquifer and an unproductive poorly draining bedrock aquifer.

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

10.10 Topography

A LIDAR DTM map showing the topography of the site and surrounding area is available in Appendix 3. A topographic survey was available and site levels were estimated using this.

The site slopes downwards from Petersham Road from an elevation of 11.05mAOD (NE) to 4.48mAOD (SW) which forms the rear garden.

The upper ground floor of the development is currently situated at an elevation of 12.00mAOD, whilst the lower ground floor is situated at 9.53mAOD and the garden level at 7.16mAOD.

The overall elevation of the proposed lightwell is set to be situated at the same level as the base of the external steps, at an elevation level of 7.3mAOD.

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.

As the main dwelling is located within Flood Zone 3, the Exception Test maybe required. However, the proposed development is located in Flood Zone 1.

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 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.

12.1.4 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.

12.1.5 Main Potential Sources of Local Fluvial and Tidal Flooding

The nearest potential source of fluvial and tidal flooding to the site is the River Thames located 10m West of the site.

12.1.6 Records of Historic Fluvial and Tidal Flooding Incidents

The EA's historic and recorded flood outline maps show the locations and extents of historic flooding. These maps do not indicate that there has been historic flooding at or in the vicinity of the site.

The Historic Flood Map which is available in Appendix 11 indicates that the last time the borough suffered a significant fluvial and tidal flooding event. The date of the flooding was not available; however, the extent of the outline did not impact the site.

12.1.7 Designated Fluvial Flood Risk Zone for the Site

The site is considered to be located within Flood Zone 3a as defined by the Environment Agency and the LLFA indicating that it has over a 1% annual probability of fluvial flooding.

12.1.8 Designated Tidal Flood Risk Zone for the Site

The site is considered to be located within Flood Zone 3a as defined by the Environment Agency and the LLFA indicating that it has over a 0.5% annual probability of tidal flooding.

12.1.9 Flood Defences

The EA's flood defence map which is available in Appendix 7 shows that the site benefits from flood defences. These include an embankment on the East bank of the Thames, which protects the development and runs across the site boundary.

12.1.10 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 London 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 17% should be used.

12.1.11 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 model node points close to the site. These are summarised in Table 3 below. The values for the 2125 scenario were extrapolated from the data from the 2100 scenario, using the recommended yearly sea level allowance provided by the EA for the 2100-2125 epoch. The data for the 2005 scenario was also reviewed; however, as the site remains dry in this scenario and as such was excluded from analysis.

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

				Thames Tidal Upriver Breach Inundation Modelling 2017			
Node	Easting	Northing	Topo Survey	**2100 - Breach Depth**	**2100 - Breach Elevation**	(Extrapolated) **2125 - Breach Depth**	(Extrapolated) **2125 - Breach Elevation**
			Level (mAOD)	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)
1	517975	174305	11.17	0.95	6.35	1.28	6.68
2	517969	174299	12.00	0.95	6.35	1.28	6.68
3	517958	174300	6.39	1.08	6.35	1.41	6.68
4	517951	174291	5.28	***No Data***	***No Data***	***No Data***	***No Data***
5	517940	174291	5.14	***No Data***	***No Data***	***No Data***	***No Data***

During the ***2005 – Breach Depth*** the modelled tidal data displays that the site does not flood and remains unaffected.

The Breach Elevations provided in the EA P6 data model appear to be inaccurate at nodes 1 and 2. The indicative flood elevation are significantly lower than the elevations witnessed at these location in the LiDAR and Topographical survey provide.

During the modelled tidal data for the extrapolated ***2125 - Breach Depths***, the site is indicated to witness a flood level of 6.68mAOD, with a potential flood depth of up to 1.45m. These most extreme depths are witnessed within the lower elevated areas of the garden.

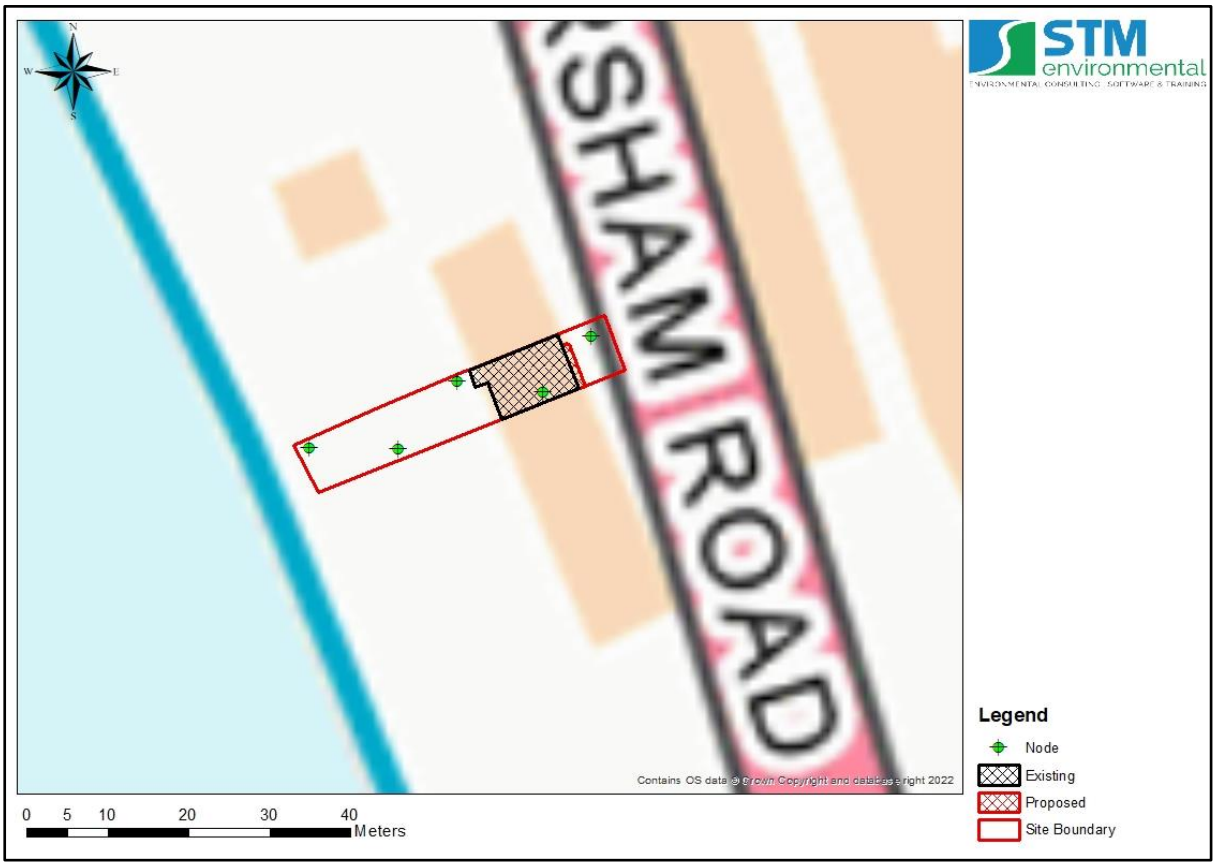


Figure 2: Node Map

The existing FFL of the garden level is 7.16mAOD and as such would remain dry during these events.

Fluvial data provided form the EA P6 data for the Thames (Hammersmith) domain indicates that the rear garden will witness a flood level of 6.46mAOD during the 0.1% AEP flooding event. As such flooding will only be witnessed within the garden and

therefore the proposed lightwell and associated internal developments would remain dry in all fluvial and tidal scenarios.

12.1.12 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 very low to high.

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

There is limited potential for pluvial flooding to the site.

12.2.3 Records of Historic Pluvial Flooding Incidents

Examination of the LLFA's Level 1 SFRA revealed no evidence of historic 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 .

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

An examination of OS mapping and the EA's mapping revealed no indications of significant reservoirs or canals in the area of the site.

The EA's reservoir flood risk map indicates that the site lies within an area that is at risk of reservoir flooding when rivers are in flood.

12.2.5 Sewer Flooding

Examination of the LLFA's Level 1 SFRA revealed evidence of sewer flooding on or in the vicinity of the site. One incident of combined sewer flooding occurred in the area, however the location is not specified.

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

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 1000-year rainfall return period provided by the EA is available in Appendix 6.

During all pluvial events the site and surrounding area remain dry.

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 very low.

12.3 Risk of Flooding from Multiple Sources (ROFMS)

The Environment Agency provides a map which gives an indication of the overall flood risk to a site from fluvial, tidal and surface water sources after considering the presence of flood defences. This map indicates that there is between 3.3% and 0.1% 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

Examination of the LLFA's Level 1 SFRA 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.

12.4.2 Susceptibility to Groundwater Flooding

No Groundwater Flood Susceptibility Map was provided by BGS. Groundwater Depth map also provided by BGS indicates that the groundwater level may be at between 3-5mbgl, however the north east of the site indicates that groundwater maybe more than 5mbgl.

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".

The site not located within a Critical Drainage Area.

13 Potential Impacts of the Development on Local Flood Risk

13.1 Changes to Impermeable Area and Building Footprint

Changes in ground cover arising from the development are presented in Table 4 and Table 5 below.

Table 4: Existing and proposed site ground cover.

	Impermeable Area		Permeable Area		Total Area
	m²	%	m2	%	m²
Existing Site	121	42	170	58	291
Proposed Site	139	48	170	58	291
Difference	18	6	0	0	

Table 5: Break down of existing and proposed site uses

Ground Cover	Existing Development Area		Proposed Development Area		Difference (m2)
	m²	%	m²	%	
Buildings	77	26	95	33	26
Driveways/Patio	44	15	44	15	0
Gardens/ Soft landscaping	170	58	170	58	26
Total	291	100	291	106%	

As the development will have a negligible increase on the impermeable area as the proposed development is situated under the driveway, it is considered unlikely that it will impact upon flood flow and surface water runoff rates due to the scale of change implemented.

13.2 Impacts on Flood Storage and Flood Flow Routes

The development will not increase the sites built up area and therefore will have no impact on flood storage or flood flow rates.

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 6 below to reduce surface water discharges from the site.

Table 6: 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.

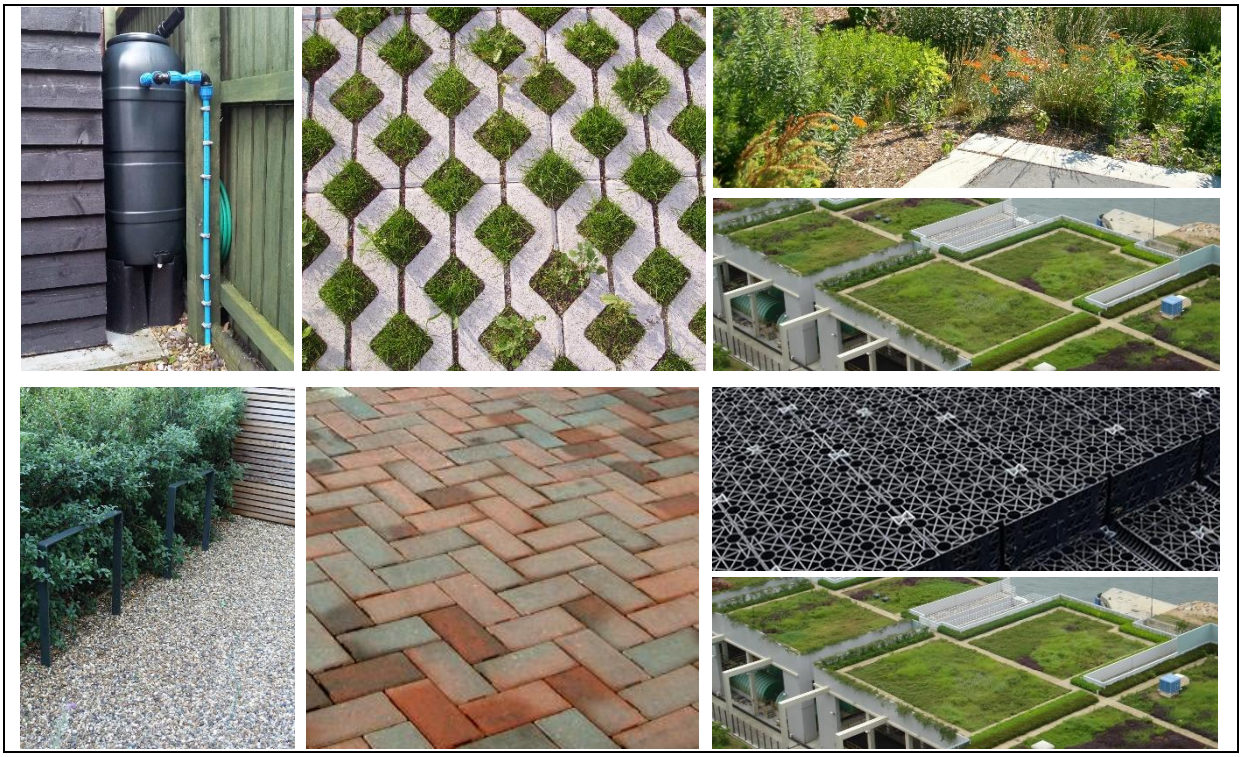


Figure 3: Surface water storage facilities and potential SuDS features - rainwater harvesting, on-site tank storage, rain garden soak-away and green roofs. (Source: UK SuDS Manual)

Given the nature of the development and the size of the site, it is considered that there are limited opportunities for implementation of SuDs at room level and would require their incorporation elsewhere into the development plans. Measures such as rainwater harvesting and permeable paving 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 proposed ground level of the lightwell is set to match the base of the existing stairs, currently situated at an approximate level of 7.3mAOD. The grille is set to be situated at lower ground level.

For **vulnerable developments**, the EA's Standing Advice states that the finished floor level of the lowest habitable room in any building, Finished Floor Levels (FFL) should be a minimum of 300mm above one of the following, whichever is higher;

- Average Ground level; Or
- Estimated flood level 1% AEP plus CC; Or
- The Adjacent roadway;

During the ***2125 Modelled Breach*** tidal event the site witnesses a maximum flood level of 6.68mAOD.

The proposed lightwell will therefore be situated above the indicative flood line and as such will pose no increased flood risk.

14.2.2 Compensatory Flood Storage (CFS)

The proposal is situated under the driveway and therefore will not require CFS to be undertaken.

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 the proposed developments would witness flood depths of less than 0.3m, the water exclusion strategy 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.

Basement walls, windows, doors and construction:

- The width of any visible basement wall should not dominate the original building;
- Windows should relate to the façade above and be aligned to the openings above; Moreover, their size must be subordinate to the higher-level openings;

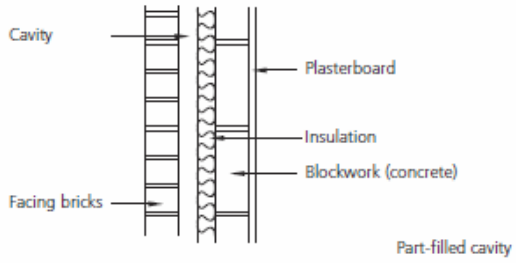
- The basement development should provide an appropriate proportion of planted material to allow for rain water to be absorbed and/or to compensate for the loss of biodiversity caused by the development;
- A minimum of 1 metre of soil be provided above basement development that extends beyond the footprint of the building, to enable garden planting and to mitigate the effect on infiltration capacity.

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.

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.

The EA Product 6 data indicates that the maximum depth of flooding at the site in the 2125 – (extrapolated) Breach Depth would be 6.68mAOD while the depth witnessed on site would be 0.29m.

A flood hazard rating can be extrapolated from the hazard map provided though the EA data and can be found in Appendix 13.

The hazard rating for the site is calculated to be ***HR = 1.62.*** This hazard score indicates a significant flood hazard and a risk level of danger for most.

However as the proposed lightwell remains dry during the 2125 (extrapolated) scenario, the hazard rating for the development can be considered to be very low.

The use of a flood emergency plan is therefore not deemed to be sufficient for the proposed development.

Based on the Breach model flood level of 6.68mAOD and the elevation of Petersham Road of 11.7mAOD, the hazard score is does not relate to the residents escape route.

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

Safe egress to Flood Zone 1 is available by exiting the front door of the residential dwelling and walking west on Petersham Road (2-Minute Walk). 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 more vulnerable, minor development and is therefore unlikely to require a sequential test, however an exception test may be required to be undertaken;
- The main source of potential flooding to the site is considered to be the River Thames;
- The EA define the site as being within Flood Zone 3, however the proposed development lies in Flood Zone 1;
- The indicative flood level during the 2125 breach level, including and allowance for Climate Change, is 6.68mAOD;
- The existing artificial floor will be removed and the original floor accessed;
- The existing garden level will remain as existing, 480mm above the indicative flood level, at 7.16mAOD.
- The lightwell will be set to match the existing staircase base elevation of 7.3mAOD.
- Drainage to remove any excess surface water from the lightwell will be introduced;
- CFS is not required as the proposal is situated under the driveway and therefore will not require CFS to be undertaken.

- EA mapping indicates that the site benefits from an embankment which protects the development and runs across the site boundary;
- No records of fluvial, tidal, surface water or artificial flooding incidents were identified at or in the vicinity of the site;
- The site is not within a CDA.
- One incident of combined sewer flooding occurred in the area, however the location is not specified;
- No records of groundwater flooding incidents were identified at or in the vicinity of the site;
- The development will not result in an increase in impermeable area which will have a negligible impact on runoff rates;
- The development will not change the site's built-up area and will therefore have a negligible impact on flood storage or flood flow rates;
- There is a limited opportunity for implementing SuDS mitigation measures.
- 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 is easily accessible by exiting the front door of the dwelling and walking west on Petersham Road (2-minute walk).
- 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 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. Strategic Flood Risk Assessment, Richmond local council, 2021
4. Local Plan, Richmond local council, 2018
5. Surface Water Management Plan, Richmond local council, 2011
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.

NOTES:

1. Dimensions are in millimetres unless stated otherwise
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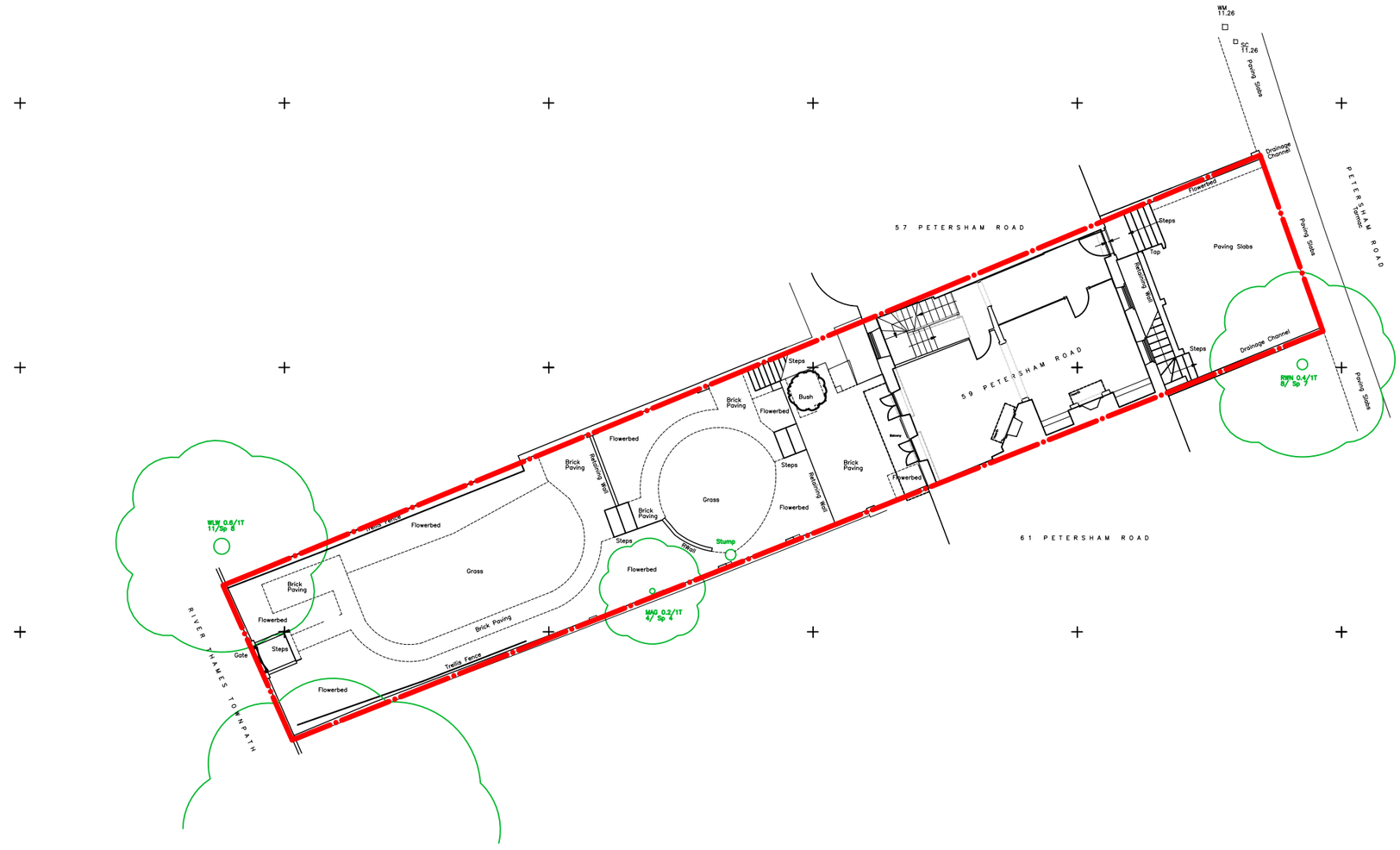

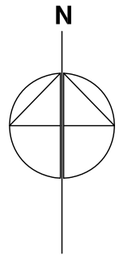

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EXISTING SITE BLOCK PLAN

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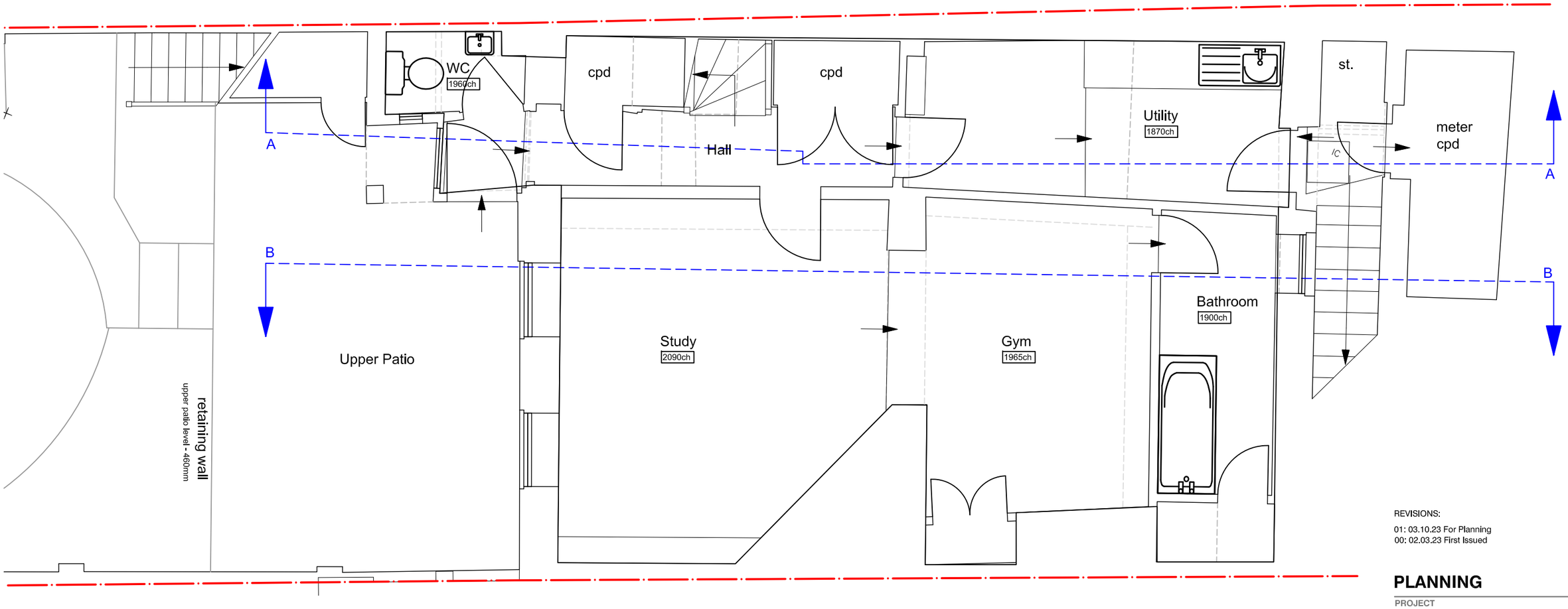

Existing Garden Level Plan
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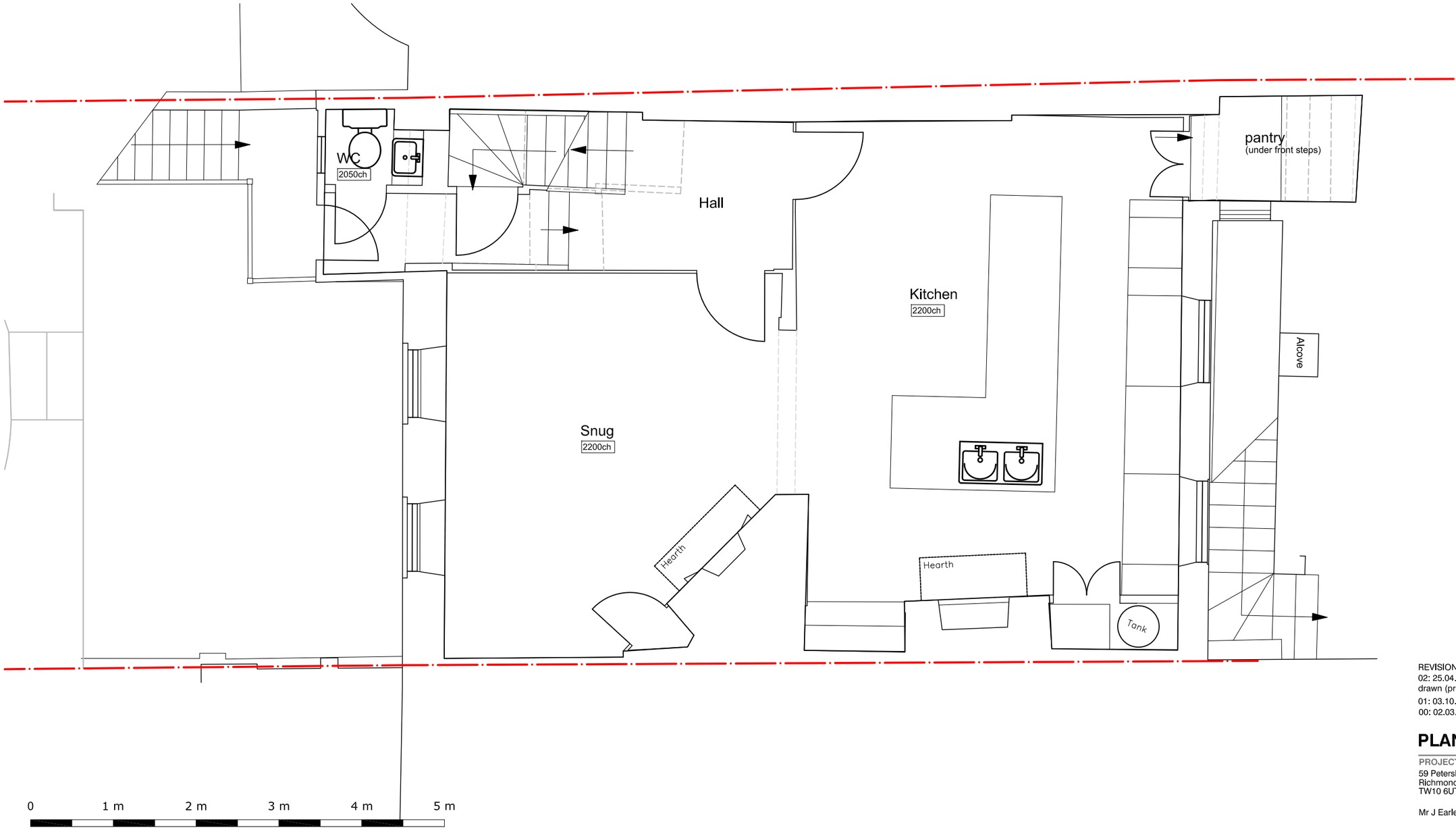

Existing Lower Ground Floor Plan
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EXISTING LOWER GROUND FLOOR PLAN

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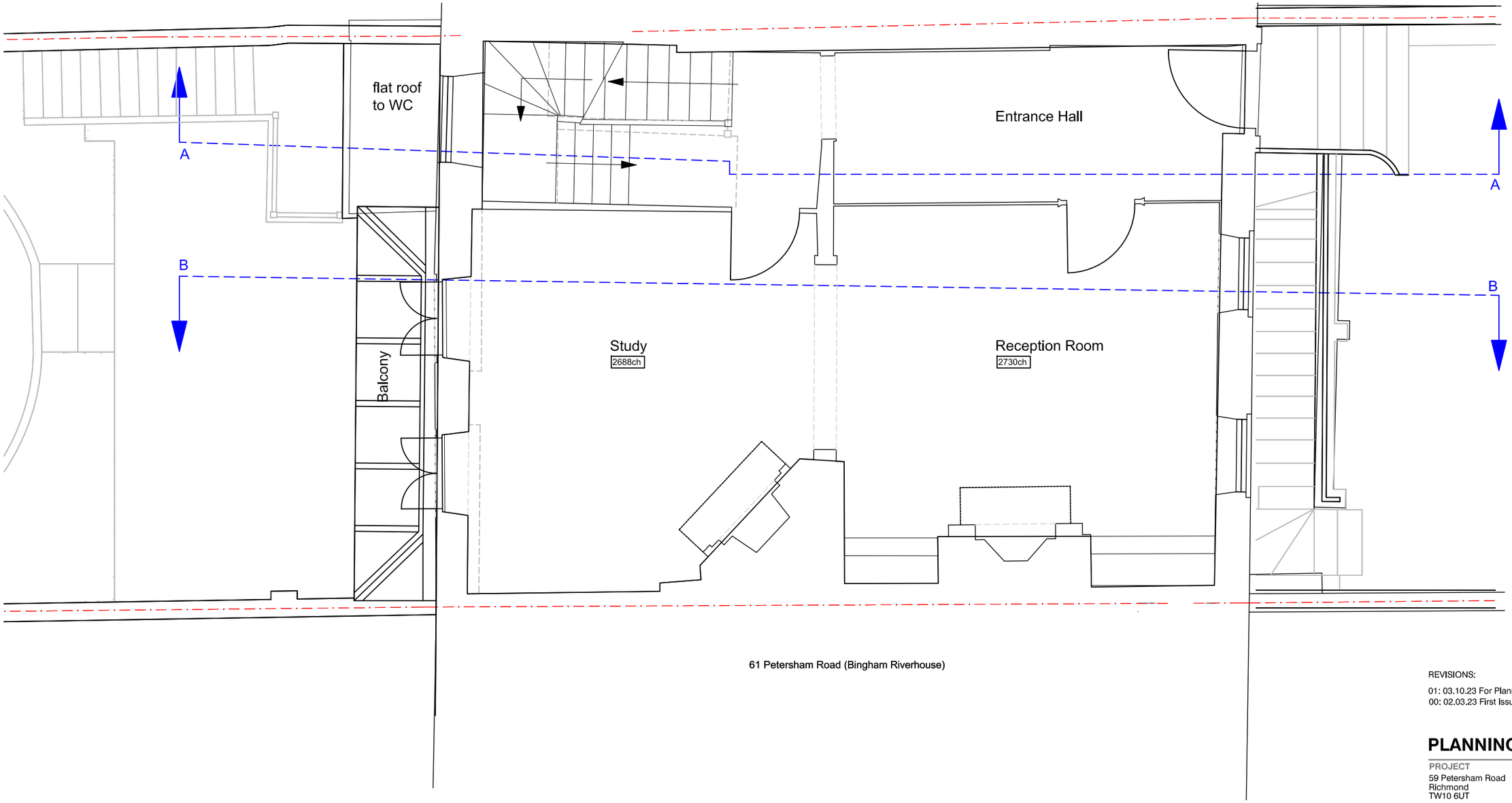

61 Petersham Road (Bingham Riverhouse)

Existing Upper Ground Floor Plan (front entrance level)
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EXISTING UPPER GROUND FLOOR PLAN

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Existing Front Elevation - East
1:100@A3

Existing Rear Elevation - West
1:100@A3

0 1 m 2 m 3 m 4 m 5 m

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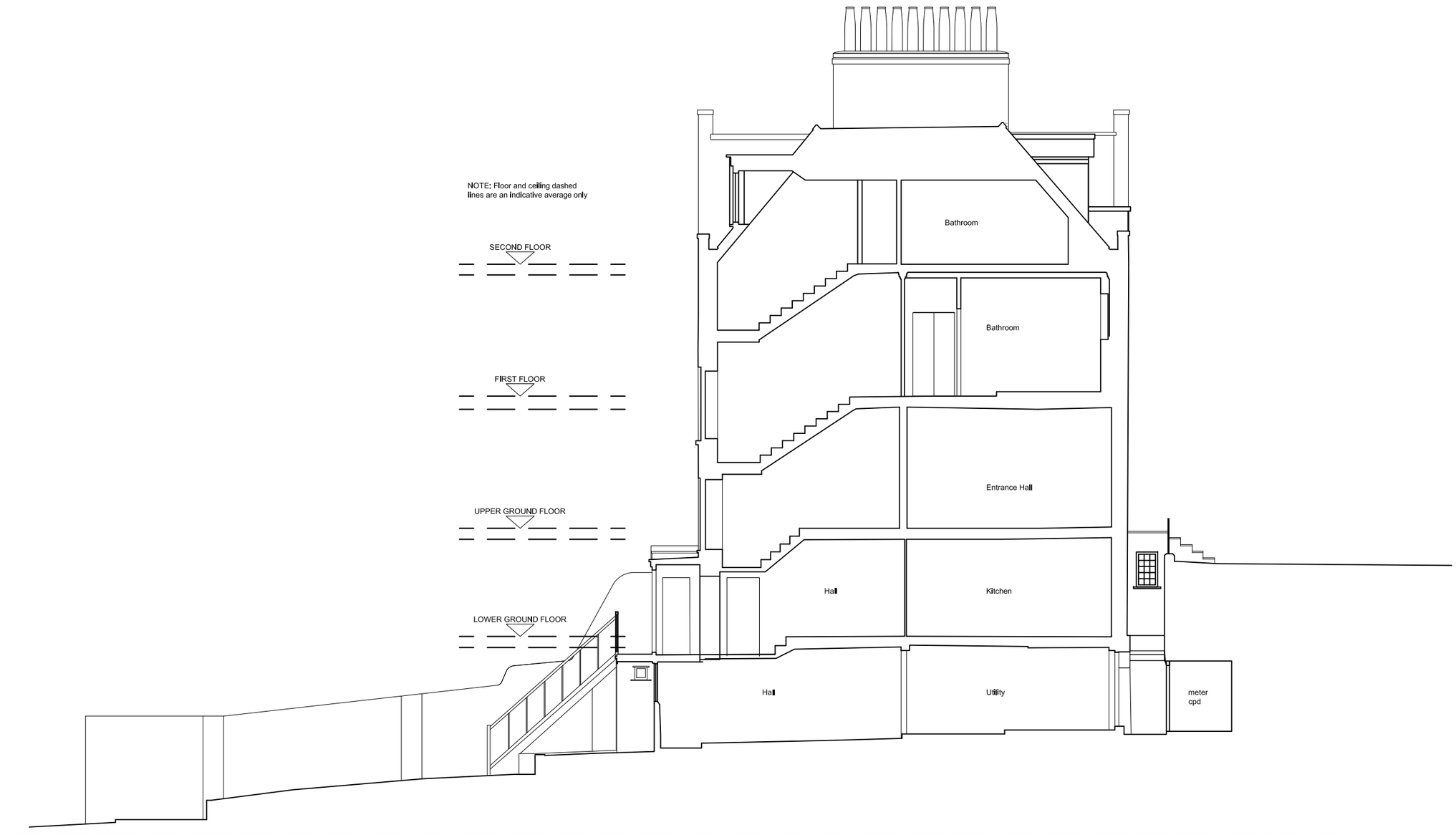

Existing Section AA
1:100@A3

0 1 m 2 m 3 m 4 m 5 m

NOTES:

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01: 25.04.24 window under front steps drawn (previously covered)
00: 03.10.23 For Planning

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TW10 6UT

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EXISTING SECTION AA

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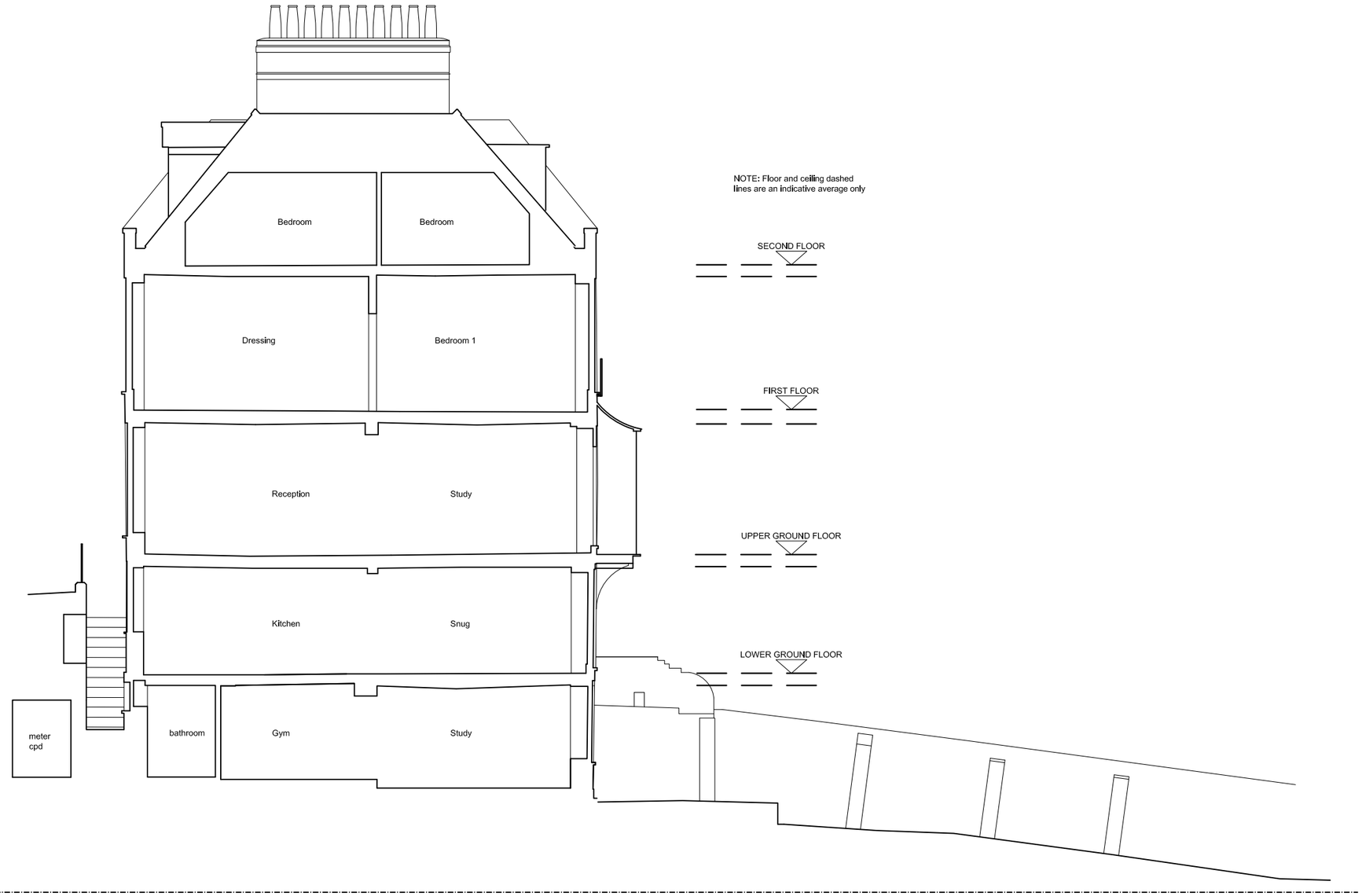

NOTE: Floor and ceiling dashed lines are an indicative average only

Datum 5.000m

Existing Section BB
1:100@A3

0 1 m 2 m 3 m 4 m 5 m

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EXISTING SECTION BB

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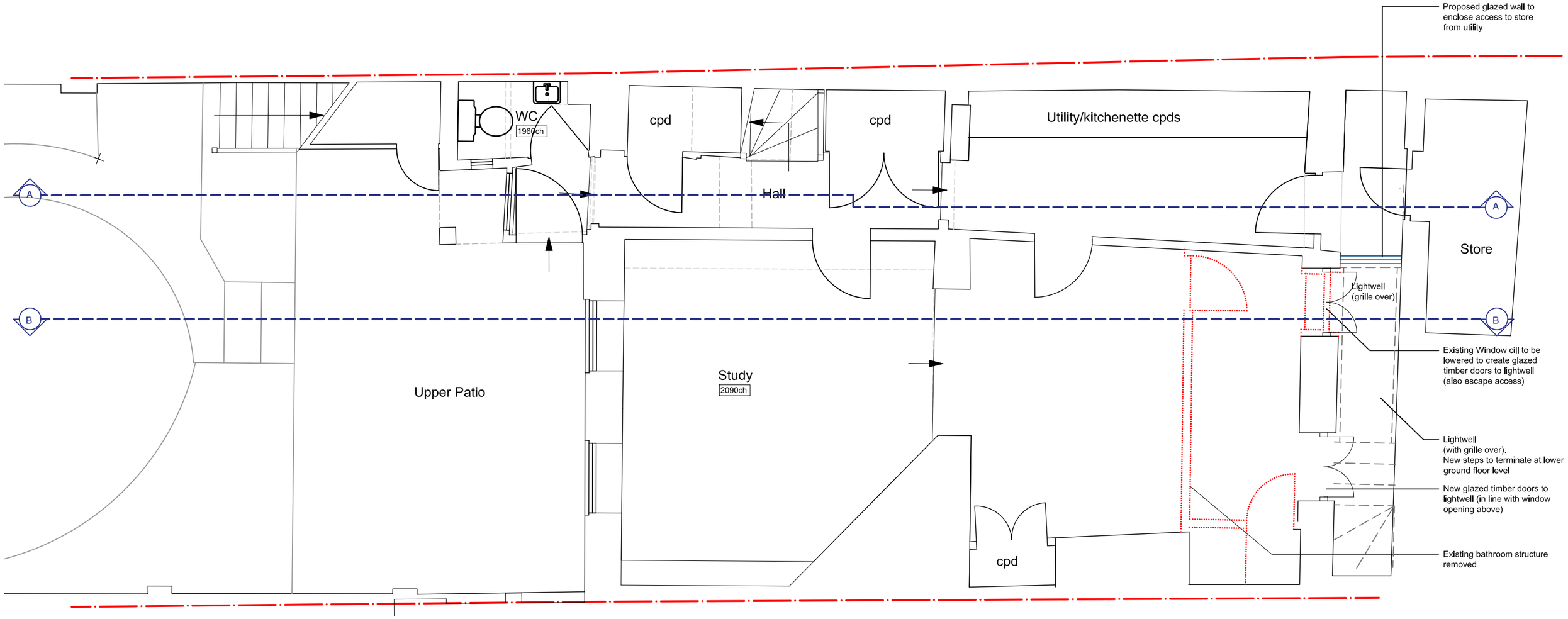
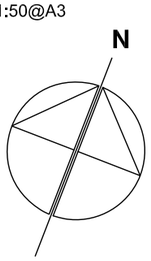


61 Petersham Road (Bingham Riverhouse)

Proposed Garden Level Floor Plan
1:50@A3



NOTES:

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02: 07.05.24 For Planning
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00: 25.04.24 First issued

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DRAWING

PROPOSED GARDEN LEVEL
FLOOR PLAN

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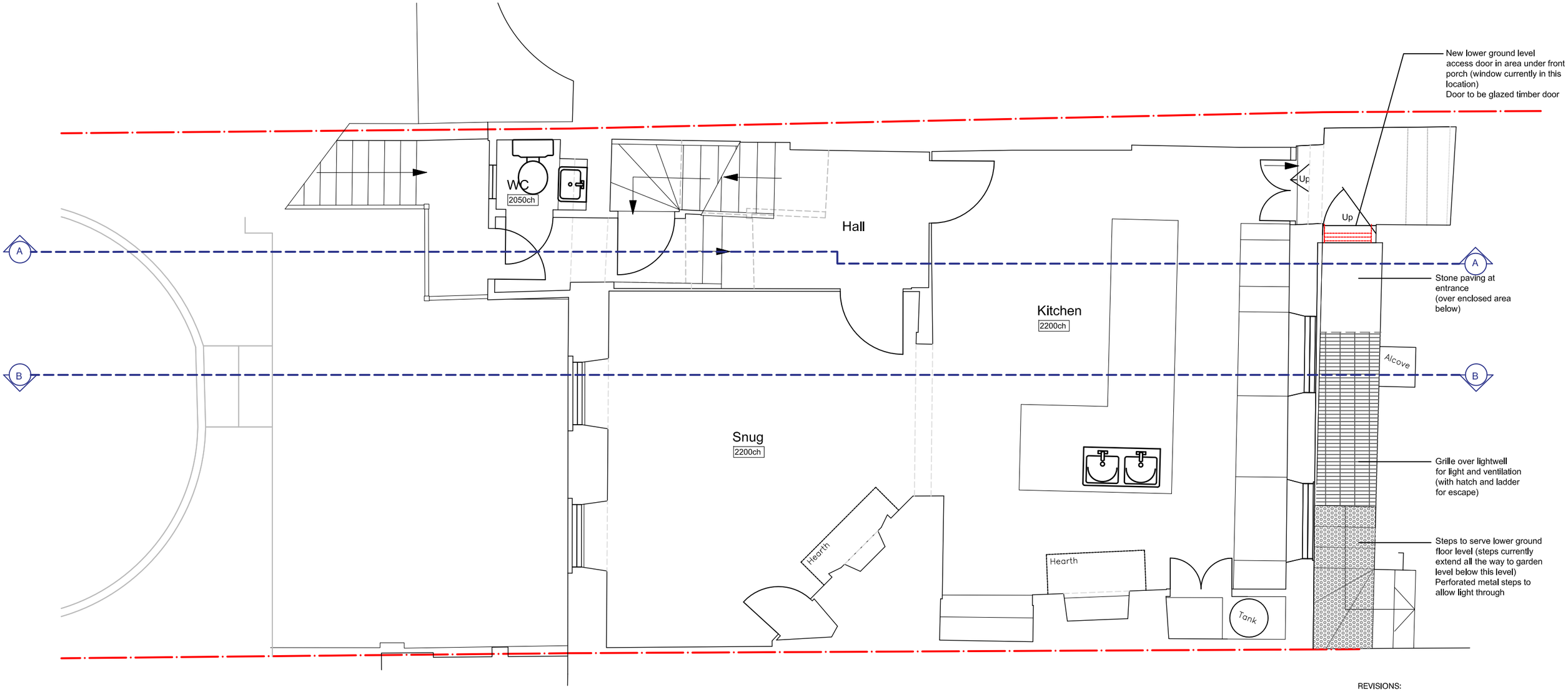
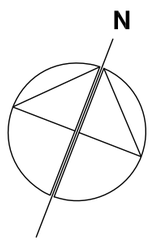


Proposed Lower Ground Level Floor Plan
1:50@A3



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PROPOSED LOWER GROUND LEVEL FLOOR PLAN

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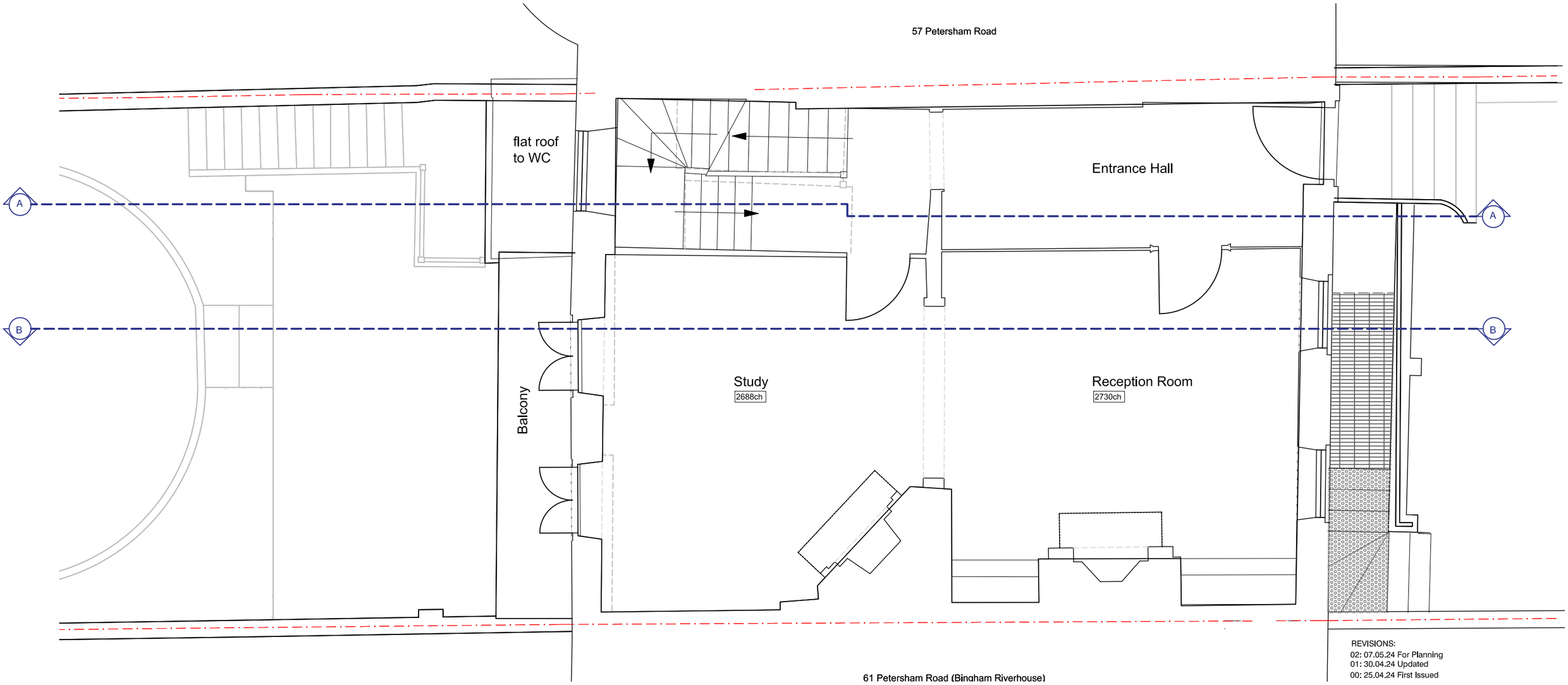
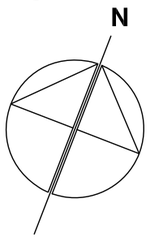


Proposed Upper Ground Level Floor Plan
1:50@A3



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PROPOSED UPPER GROUND LEVEL FLOOR PLAN

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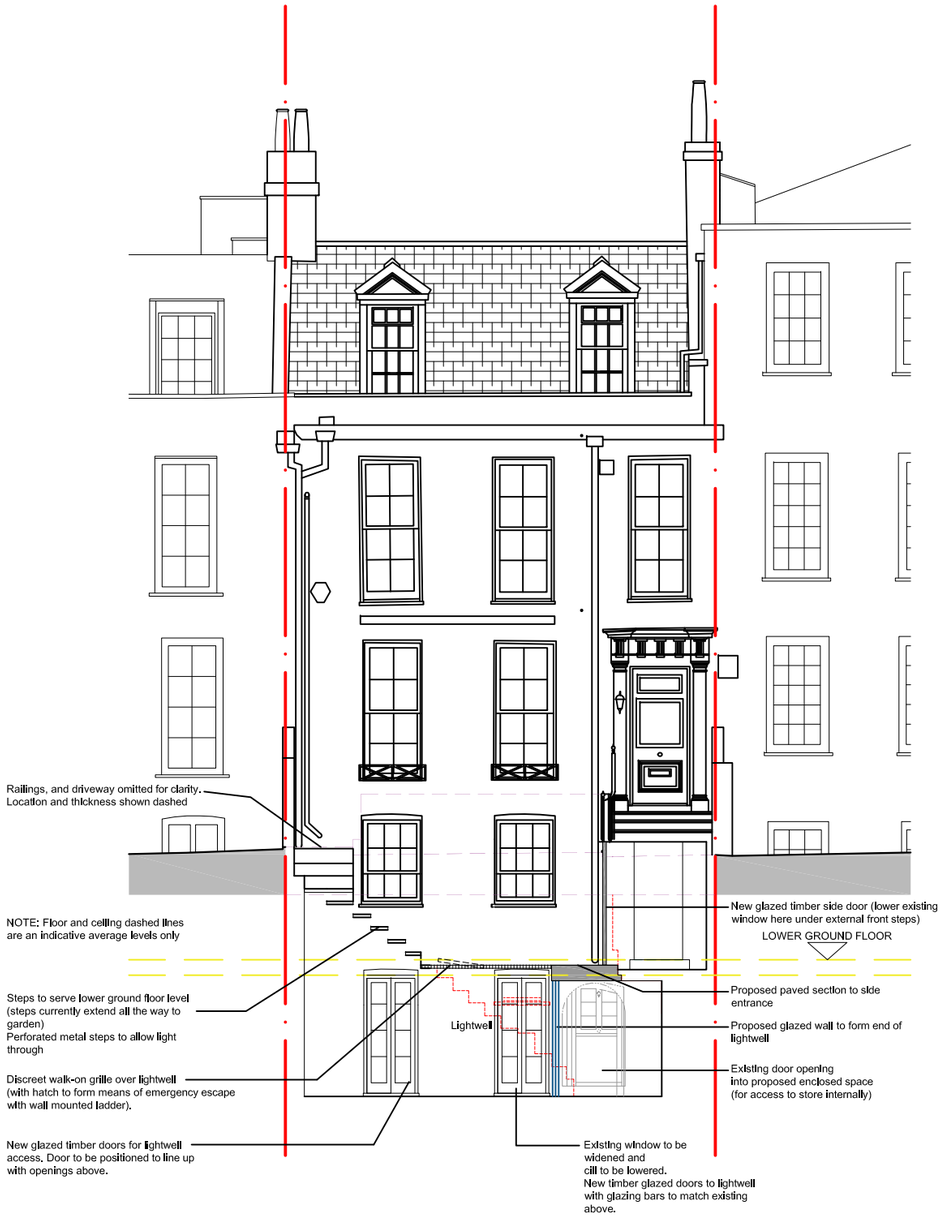

Proposed Front Elevation - East
1:100@A3

Proposed Rear Elevation - West (no change)
1:100@A3

0 1 m 2 m 3 m 4 m 5 m

NOTES:

1. Dimensions are in millimetres unless stated otherwise
2. Levels are in meters AOD unless stated otherwise
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PROPOSED ELEVATIONS

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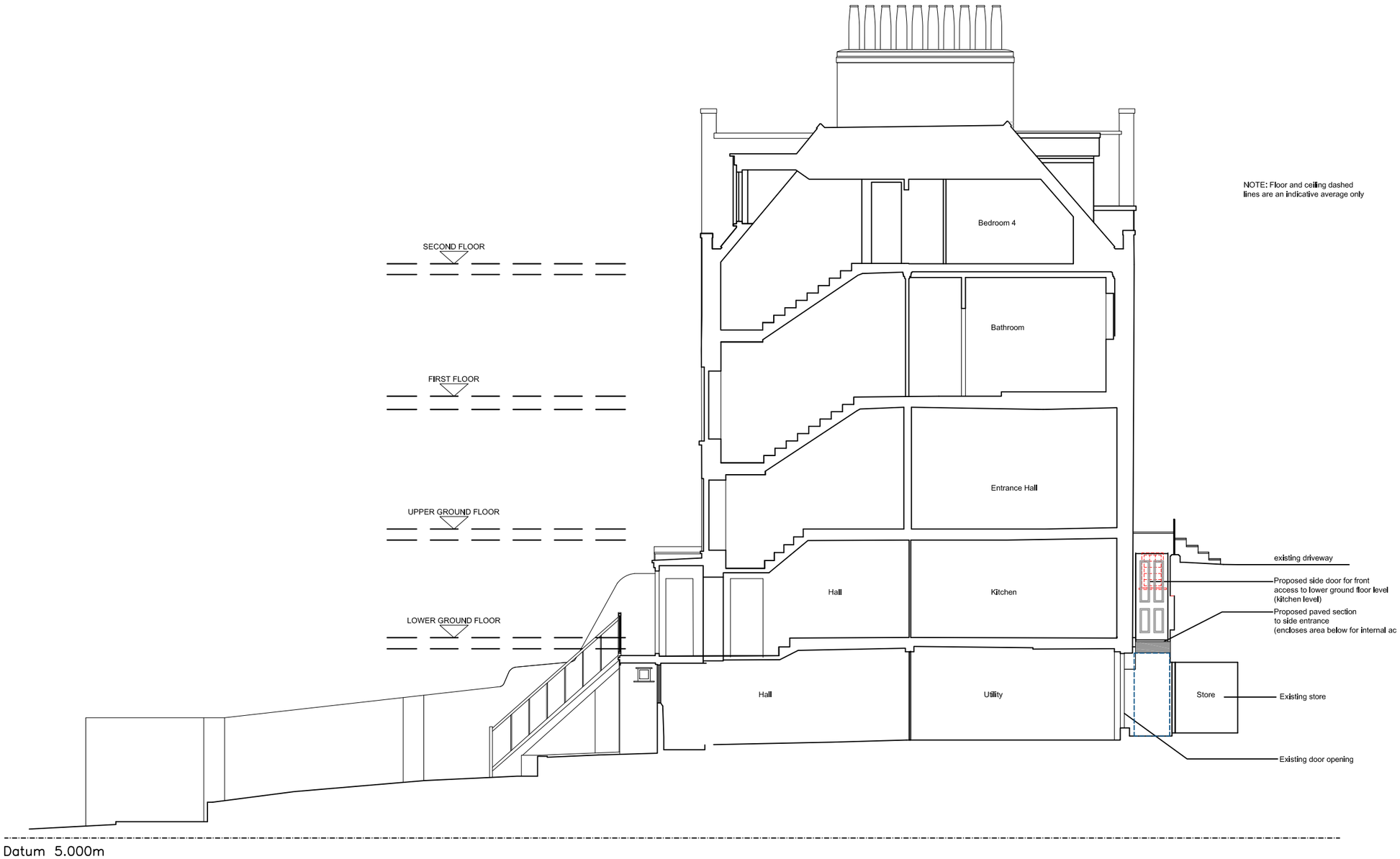

Proposed Section AA
1:100@A3

NOTE: Floor and ceiling dashed lines are an indicative average only

0 1 m 2 m 3 m 4 m 5 m

NOTES:

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PROPOSED SECTION AA

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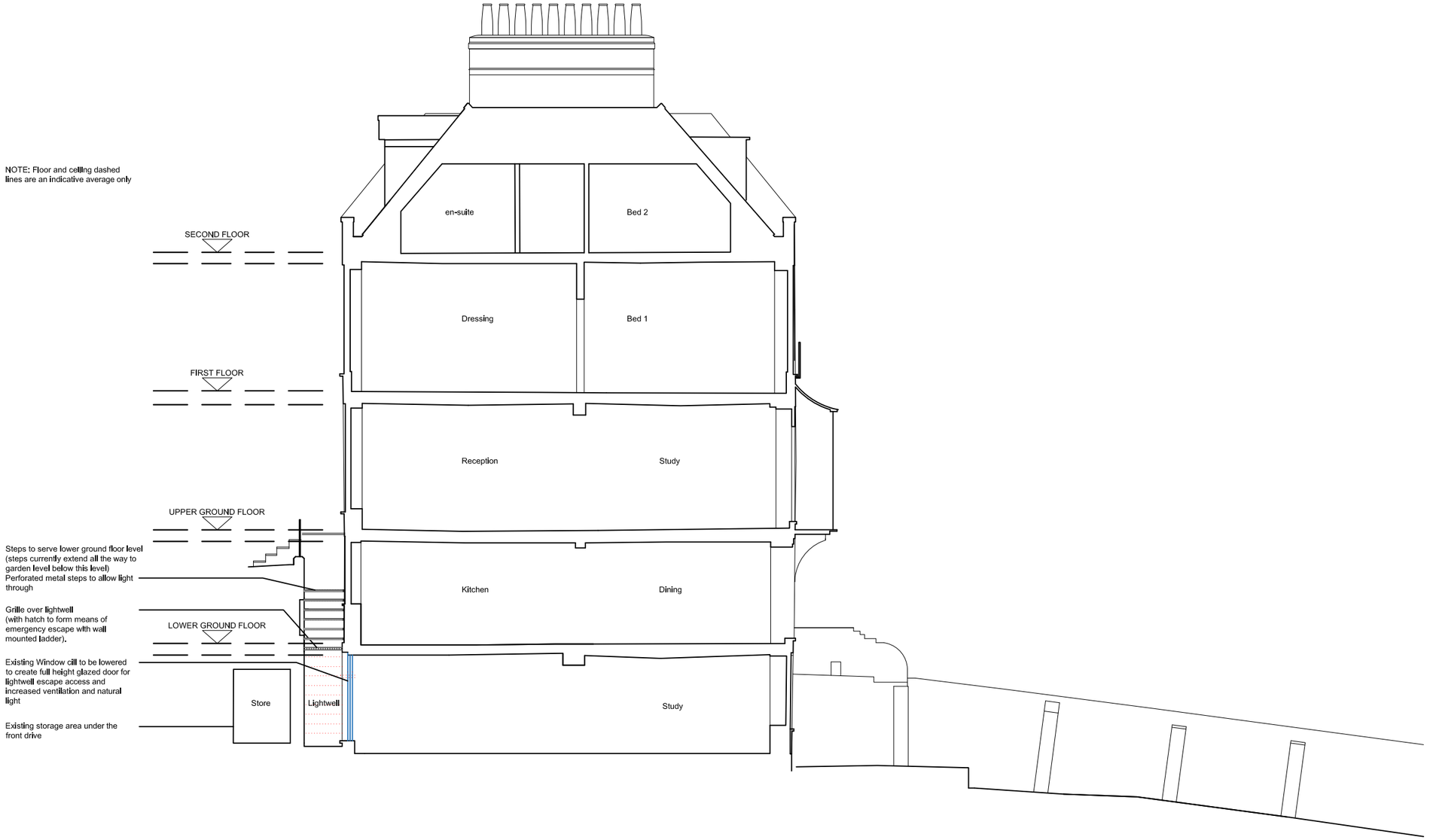

Proposed Section BB
1:100@A3

0 1 m 2 m 3 m 4 m 5 m

NOTES:

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PROPOSED SECTION BB

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Produced 15 Mar 2023 from the Ordnance Survey MasterMap (Topography) Database and incorporating surveyed revision available at this date.

The representation of a road, track or path is no evidence of a right of way. The representation of features as lines is no evidence of a property boundary.

Metres
0 10 20 30 40 50

1:1250

Supplied by: **Stanfords 15 Mar 2023**
Licence: © Crown Copyright and database rights 2023 OS100035409
Order Licence Reference: Ol1589038
Centre coordinates: 517962 174300

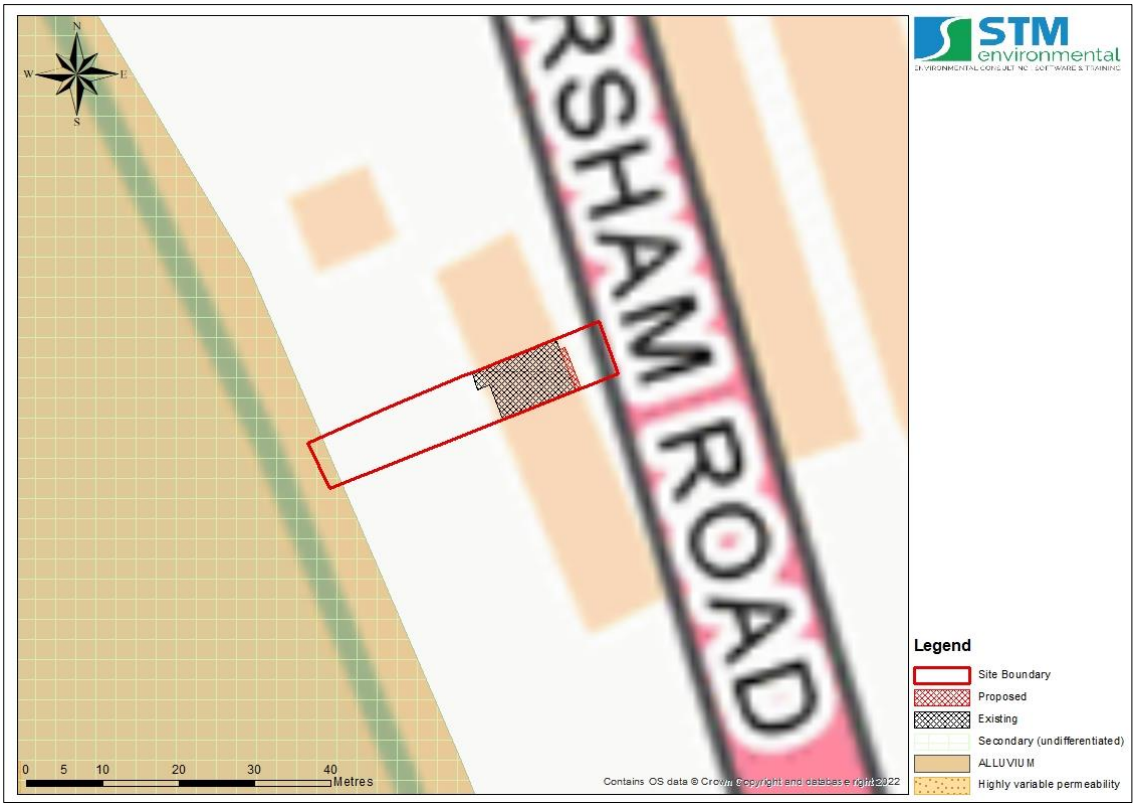
N

59, Petersham Road, Richmond
TW10 6UT

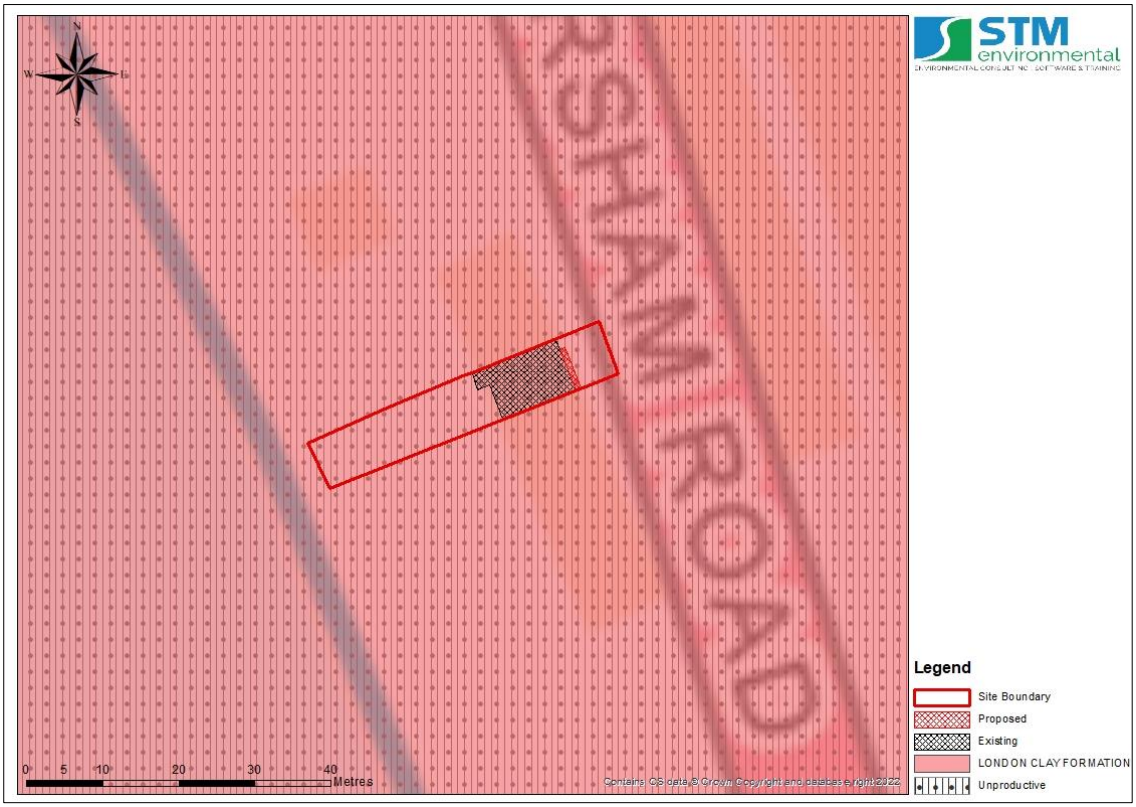
Red line denotes
site application boundary

17.3 Appendix 3 – Environmental Characteristics

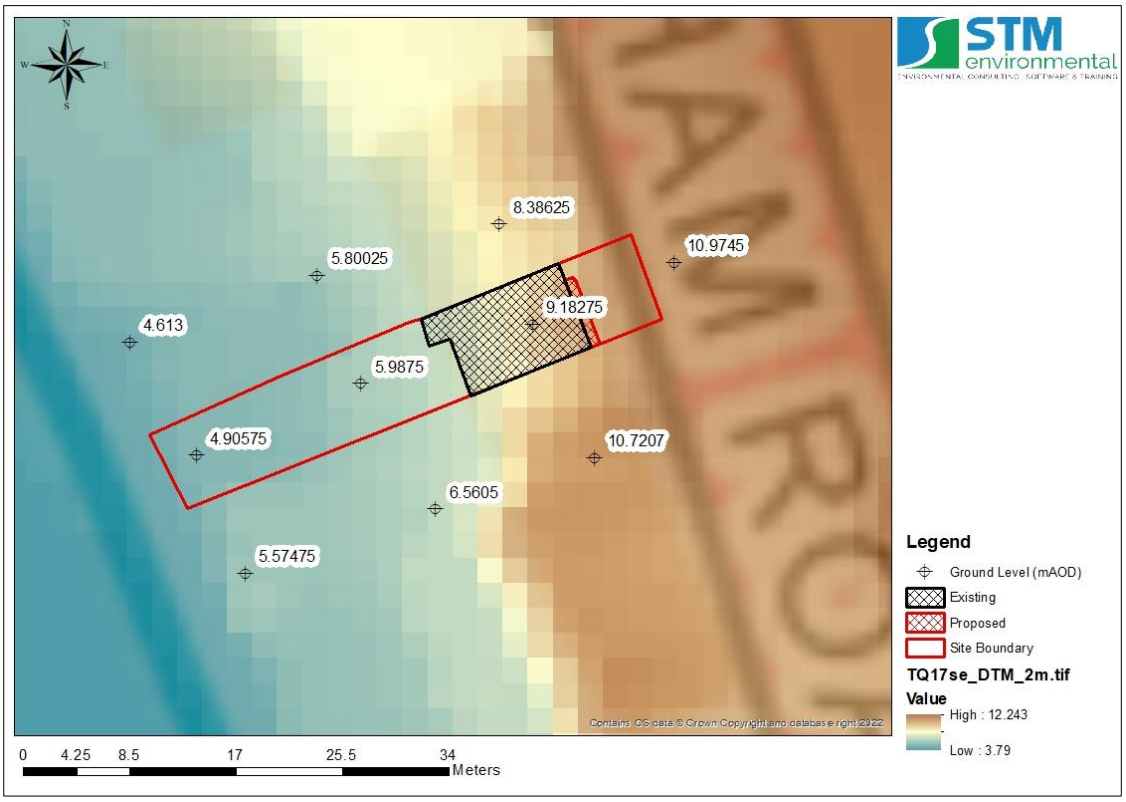
17.3.1 Superficial Hydrogeology Map

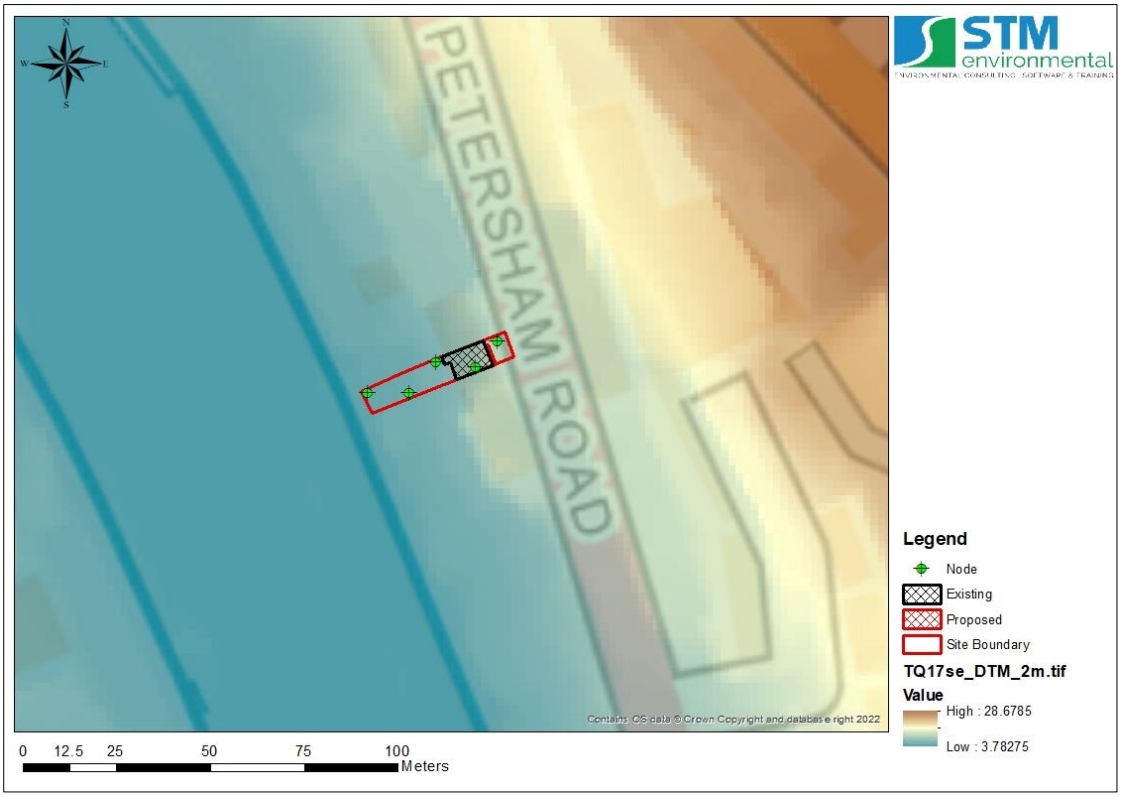


17.3.2 Bedrock Hydrogeology Map



17.3.3 Topography Map





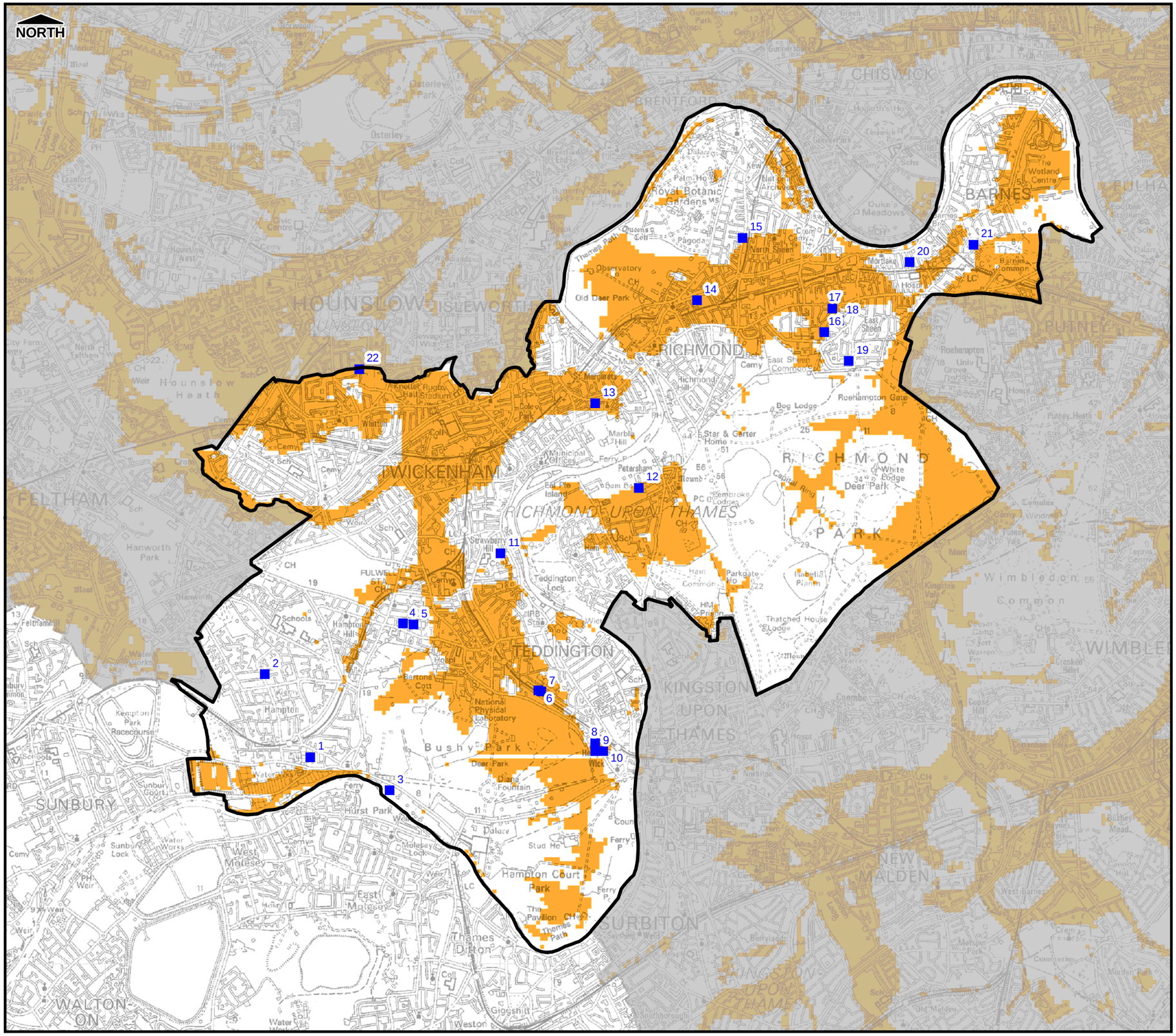
17.4 Appendix 4 – Historical Flood Incident Maps

17.4.1 EA Historic and Recorded Flood Outlines

No recorded flood outlines in the vicinity of the site.

17.4.2 Map Recorded Historic Flooding

See next page.



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Legend

- Richmond Borough Council
- Groundwater Flood Incident (EA Records)

Increased Potential for Elevated Groundwater in

- Permeable Superficial Deposits
- Consolidated Aquifers

Notes

1.The increased Potential for Elevated Groundwater map shows those areas within the London Boroughs where there is an increased potential for groundwater to rise sufficiently to interact with the ground surface or be within 2m of the groundsurface. Such groundwater rise could lead to the following:

-Flooding of basements of buildings below ground level;
-Flooding of buried services or other assets below ground level;
-Inundation of farmland, roads, commercial, residental and amenity areas;
-Flooding of ground floors of buildings above ground level; and Overflowing of sewers and drains

2.Incident records shown are generally unconfirmed and may include issues such as water main bursts or non-groundwater related problems.
3.Areas not shown to have increased potential for elevated groundwater should be considered to have a low potential for elevated groundwater - Lack of information does not imply 'no potential' of elevated groundwater in that area.
4.Includes groundwater flood mapping provided by JBA consulting, Copyright. Jeremy Benn Associates Limited 2008-2011, partially derived from data supplied by the Environment Agency.

London Borough Richmond

LONDON BOROUGH OF RICHMOND UPON THAMES

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:50,000	22/03/2011	C.Woolhouse	S.Cox

Increased Potential For Elevated Groundwater

Consultants

CAPITA SYMONDS Flood Risk Management
Scott Wilson

URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

Drain London Programme Board Members

Environment Agency
Thames Water
LONDON COUNCILS
GREATER LONDON AUTHORITY

FIGURE 3.5.1

Filepath: D:\34786 Drain London_Tier 2_Group 8\700 Technical\711 GIS\01 Layout\Richmond\Increased Potential for Elevated GW.mxd

17.4.3 Map of Recorded Sewer Flooding

See next page.

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NORTH

London Borough of Hounslow

TW8 0
TW9 3
TW9 4
TW9 2
TW9 1
TW3 2
TW7 7
TW1 1
TW4 5
TW2 7
TW1 2
TW106
TW1 3
TW2 6
TW1 4
TW2 5
TW107
TW105
TW136
TW121
TW123
TW118
TW119
TW110
TW165
TW122
KT1 4
KT8 1
KT8 9
KT2 5
KT2 7
KT7 0

SW138
SW139
SW130
SW151
SW147
SW148
SW156
SW155
SW154
SW153

London Borough of Wandsworth
London Borough of Merton
Royal Borough of Kingston upon Thames
Surrey County Council

0 0.25 0.5 1 2 Kilometres

Legend

Borough Administrative Boundary

No. of Sewer Flood Records

- None
- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 50
- 51 - 100
- 101+

Notes

1. Sewer flood records relate to internal and external flooding of properties
2. Data supplied by Thames Water Ltd and is correct as at June 2010

London Borough of Richmond upon Thames

LONDON BOROUGH OF RICHMOND UPON THAMES

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:45,000	20/07/2011	D.SKILTON	E.CRAVEN

Recorded Incidents of Sewer Flooding

Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

Drain London Programme Board Members

Environment Agency · Thames Water · LONDON COUNCILS · GREATERLONDONAUTHORITY

FIGURE D - 5

Filepath: N:\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS\WOR - General Figures

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NORTH

London Borough of Hounslow

London Borough of Wandsworth

London Borough of Merton

Royal Borough of Kingston upon Thames

Surrey County Council

0 0.25 0.5 1 2 Kilometres

Legend

- Borough Administrative Boundary
- Surface Water Flooding Incidents

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

Notes

1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.
2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

London Borough of Richmond upon Thames

LONDON BOROUGH OF RICHMOND UPON THAMES

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:45,000	20/07/2011	D.SKILTON	E.CRAVEN

Surface Water Flooding Incidents and Surface Water Depth (m) 1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

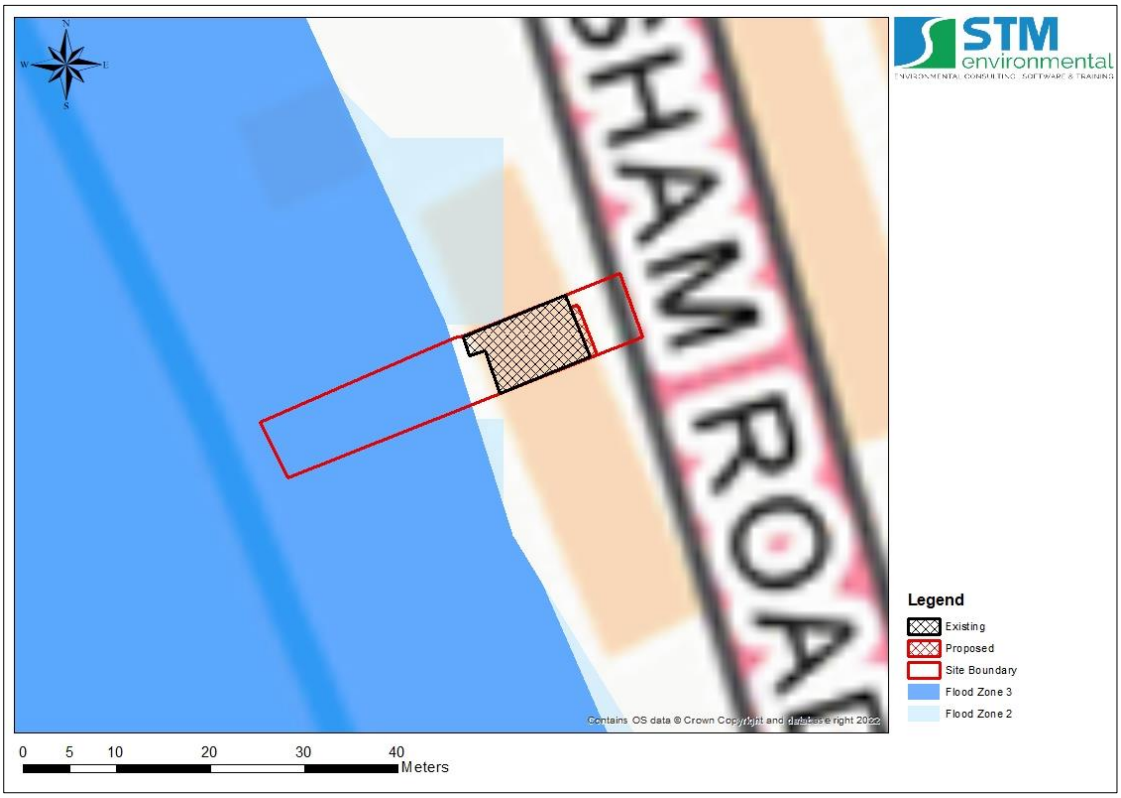
Drain London Programme Board Members

Environment Agency · Thames Water · LONDON COUNCILS · GREATERLONDONAUTHORITY

FIGURE D - 2

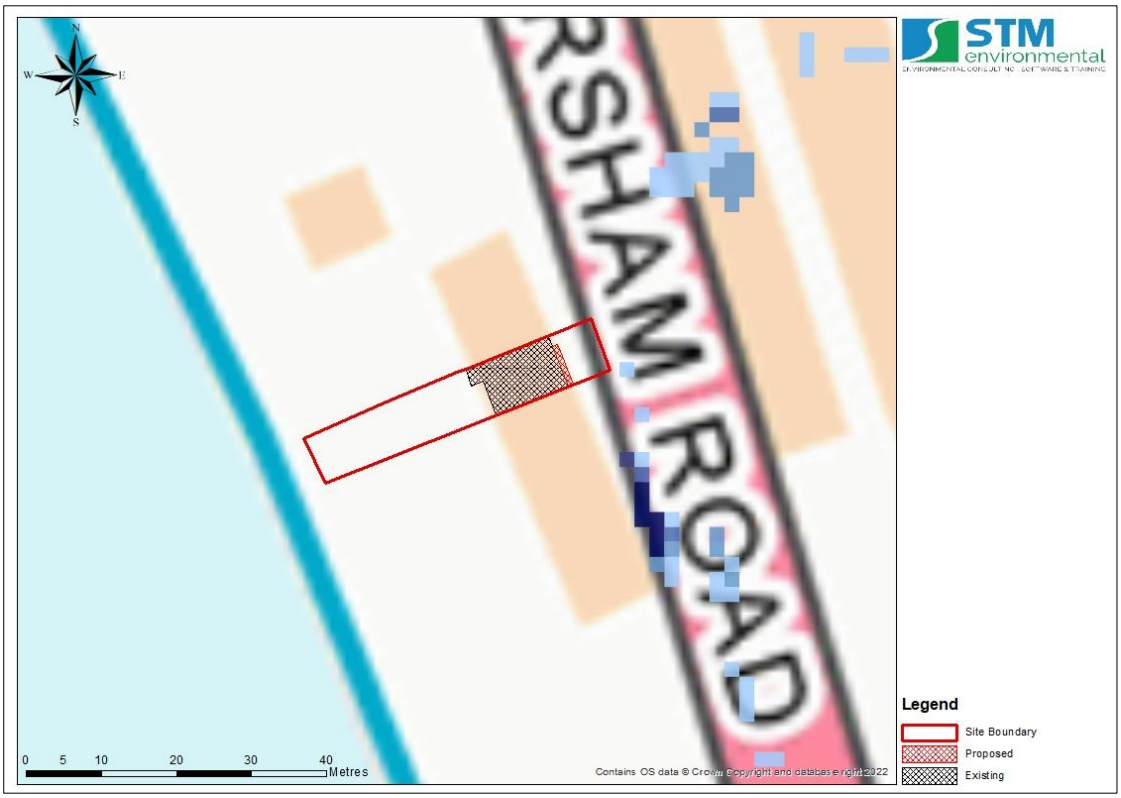
Filepath: N:\Current Projects\D1347785 D1347786 DRAIN LONDON Tier 2\02 Group 8 (D1347786)\05 GIS\WOR - General Figures

17.5 Appendix 5 - EA Flood Zone Map



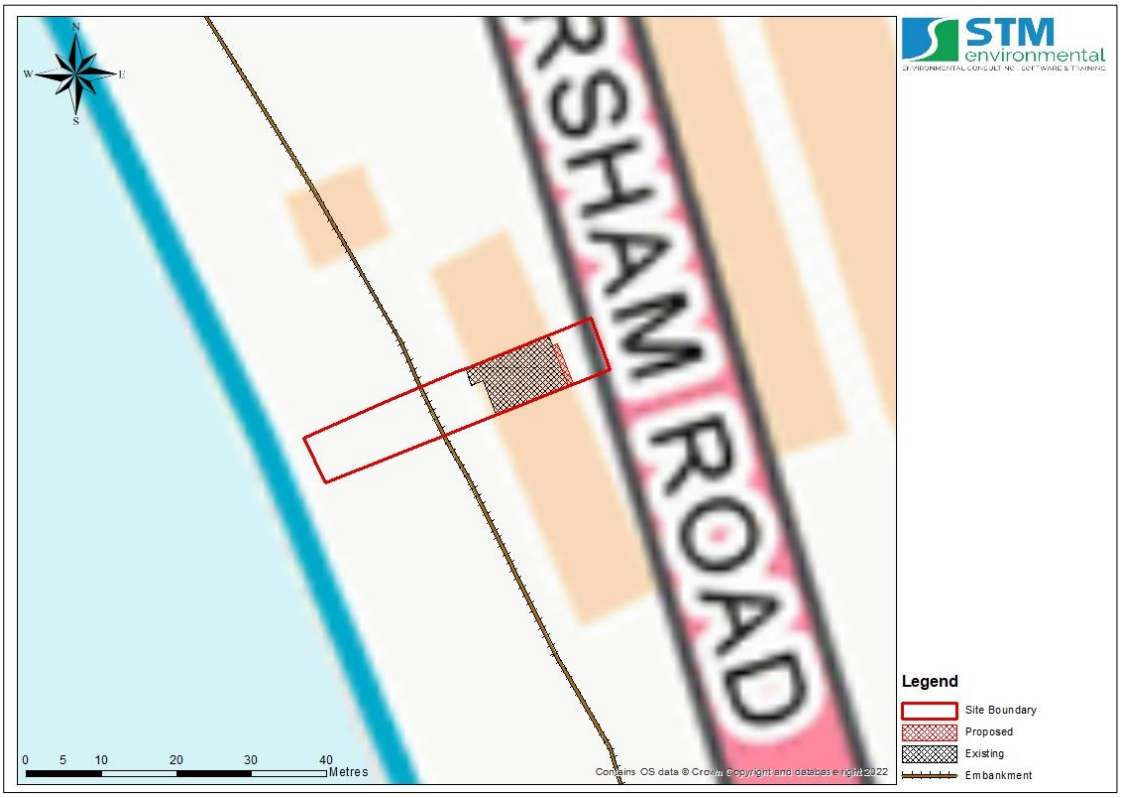
17.6 Appendix 6 – Surface Water Flood Extent and Depth Maps

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

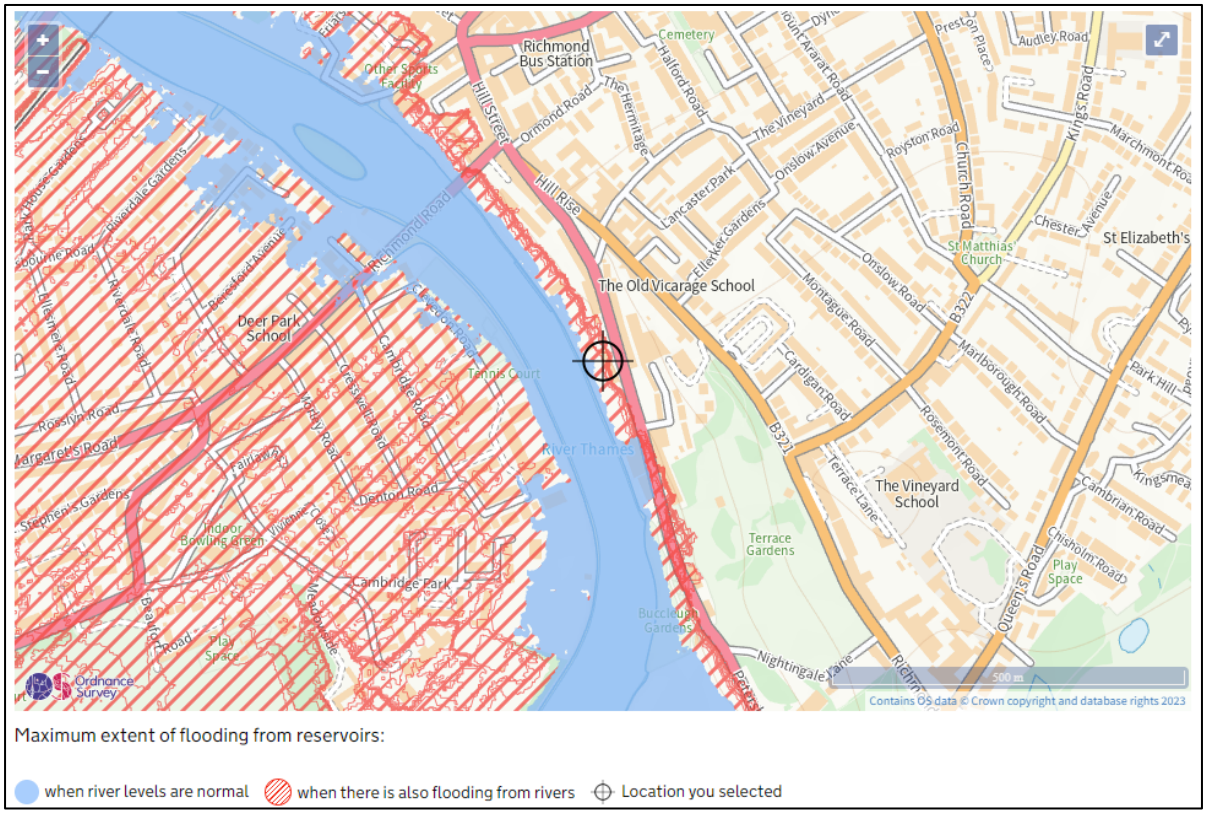


17.7 Appendix 7 –Flood Defence and Reservoir Flood Risk Maps

17.7.1 EA flood defence map



17.7.2 Reservoir Flood Risk Map



Maximum extent of flooding from reservoirs:

when river levels are normal | when there is also flooding from rivers | Location you selected

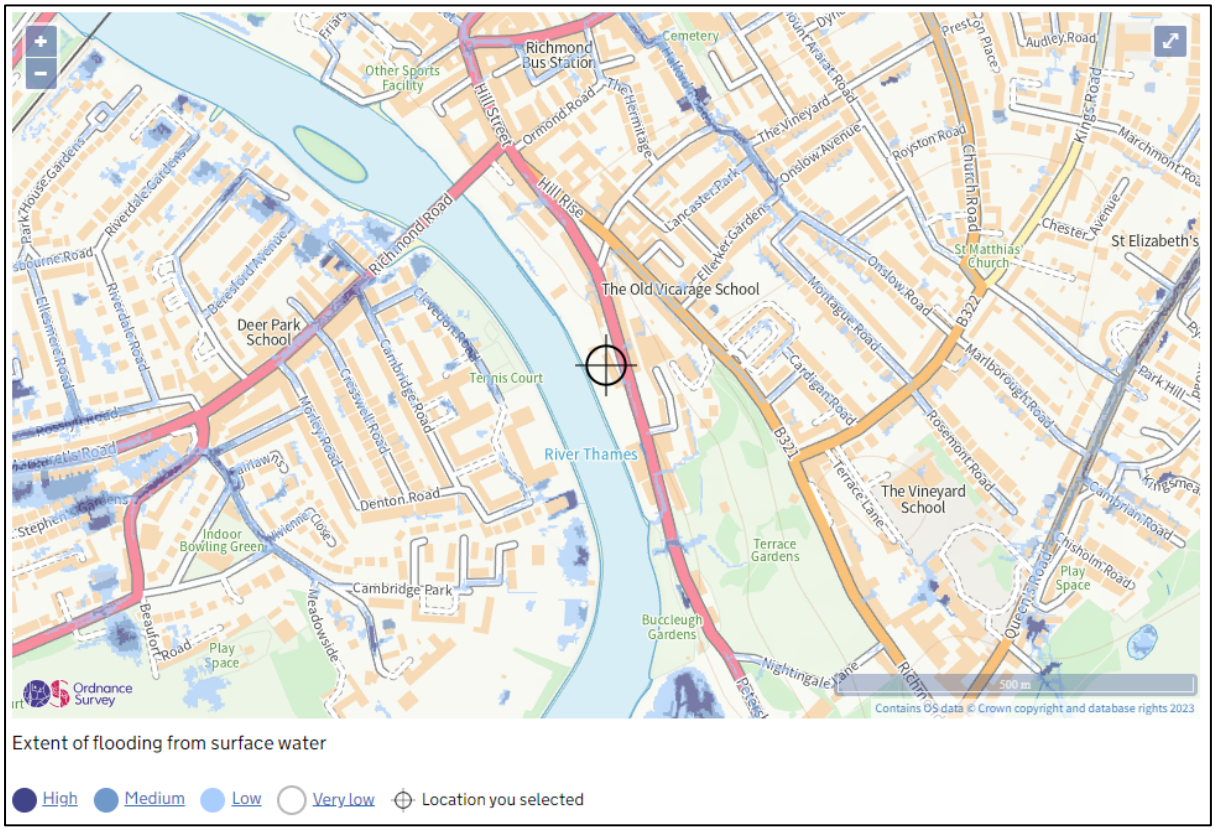
17.8 Appendix 8 – Risk of Flooding from Multiple Sources Map

Not available at the time of writing.

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

Extent of flooding from rivers or the sea

High Medium Low Very low Location you selected

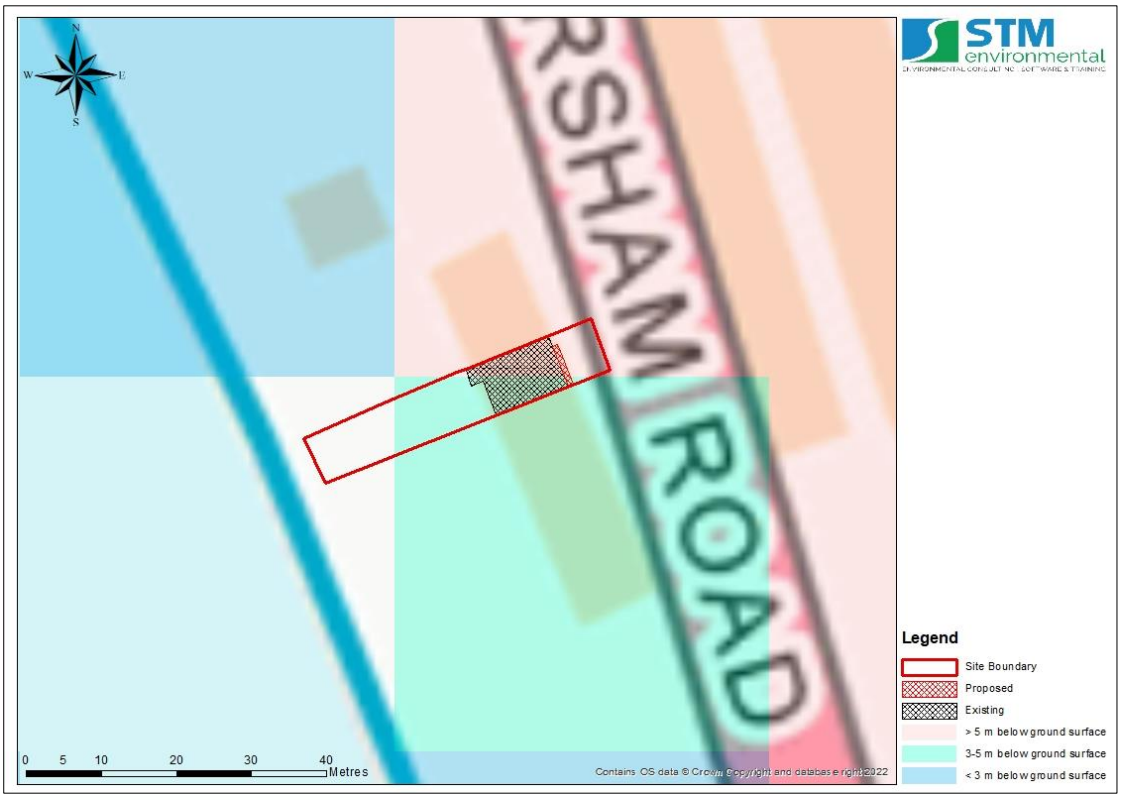


Extent of flooding from surface water

High Medium Low Very low Location you selected

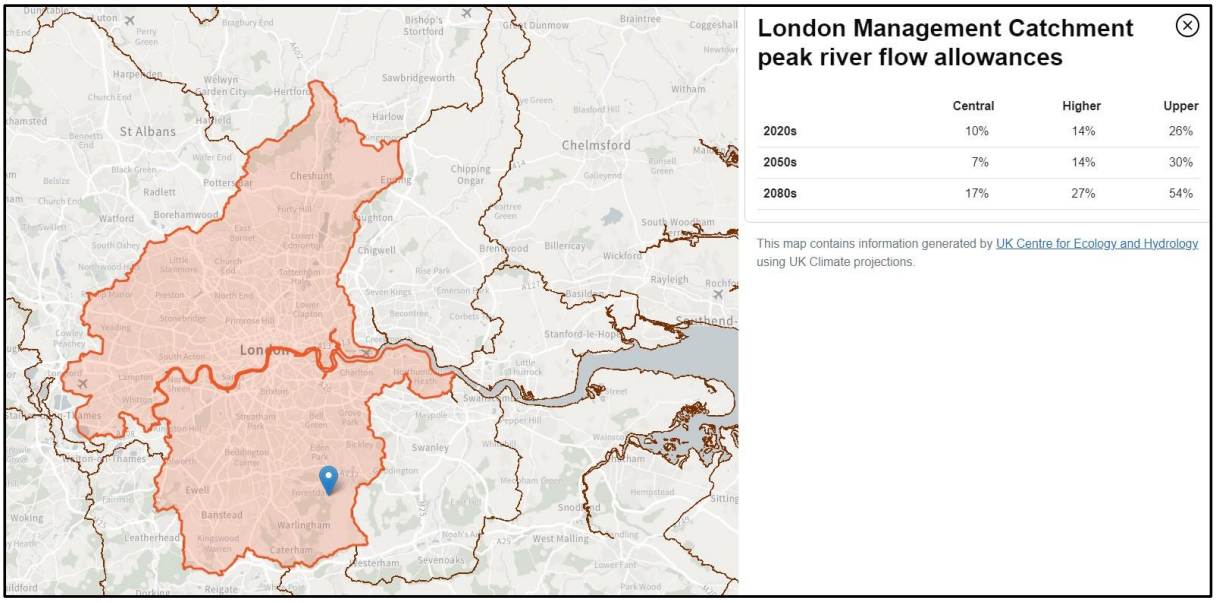
17.10 Appendix 10 – Groundwater Flood Maps

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

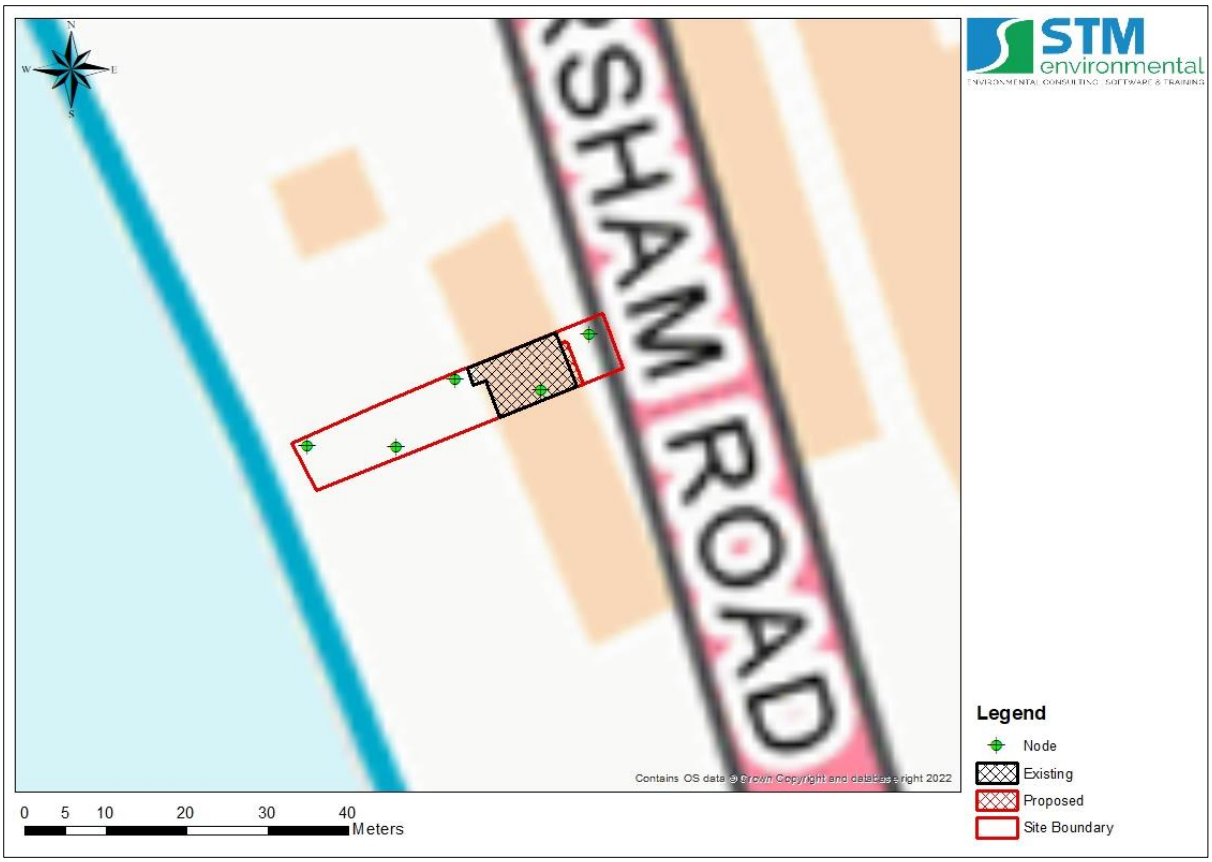


17.11 Appendix 11 - EA Product 6 (Detailed Flood Risk) Data

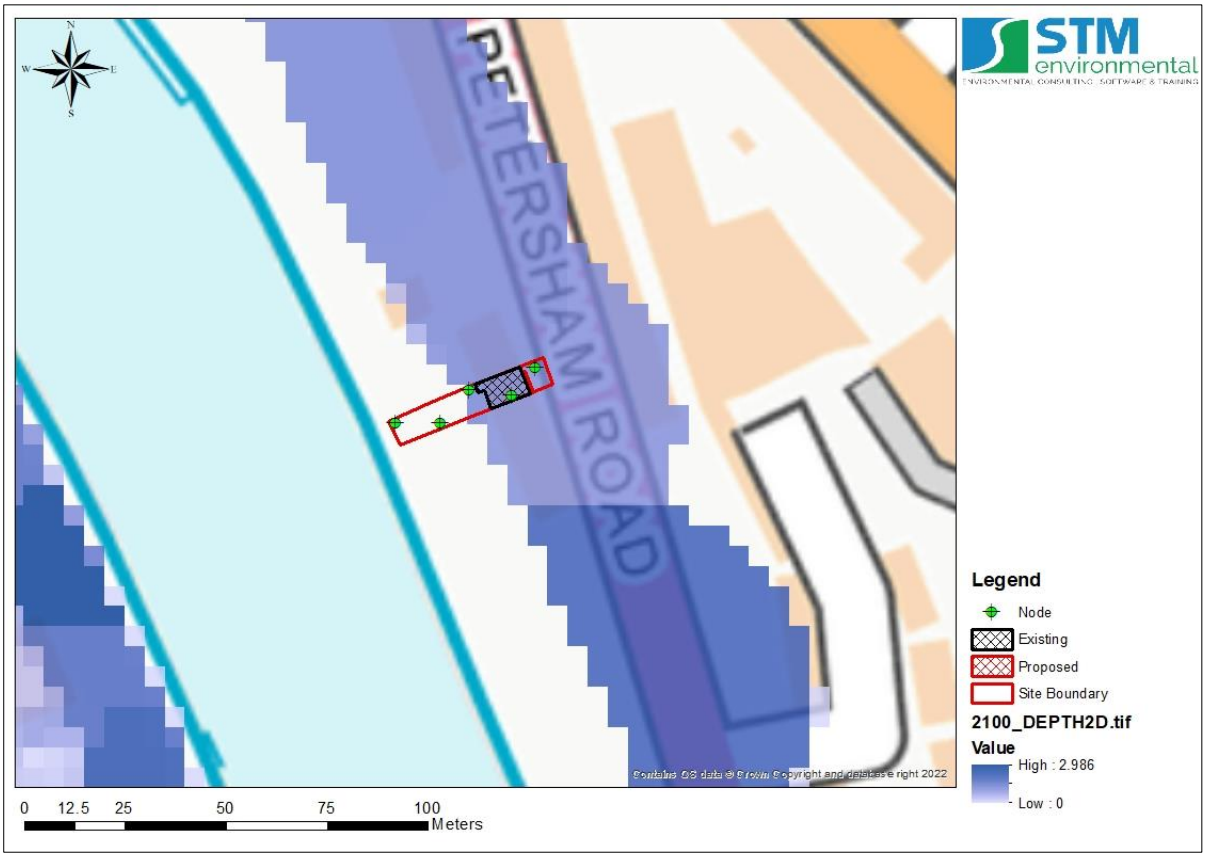
17.11.1 EA Climate Change Allowances for Peak River Flow



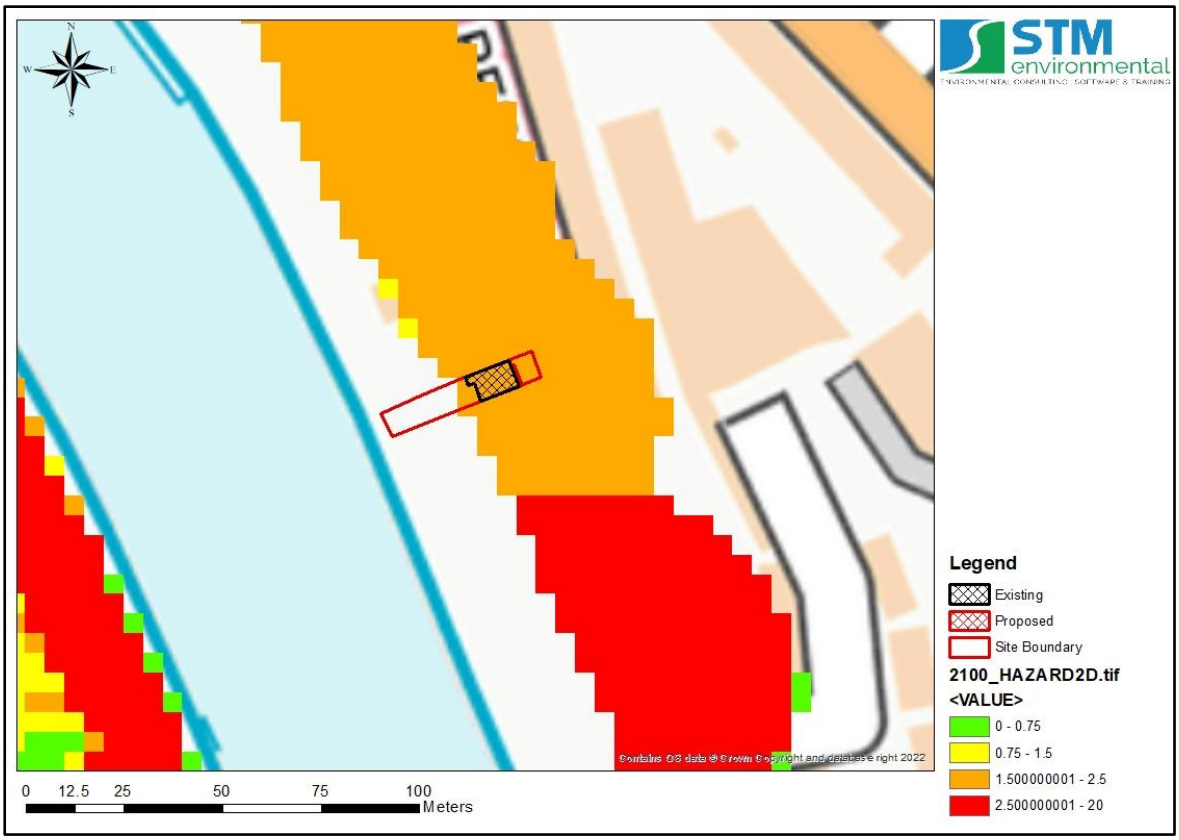
17.11.2 Node Location Map



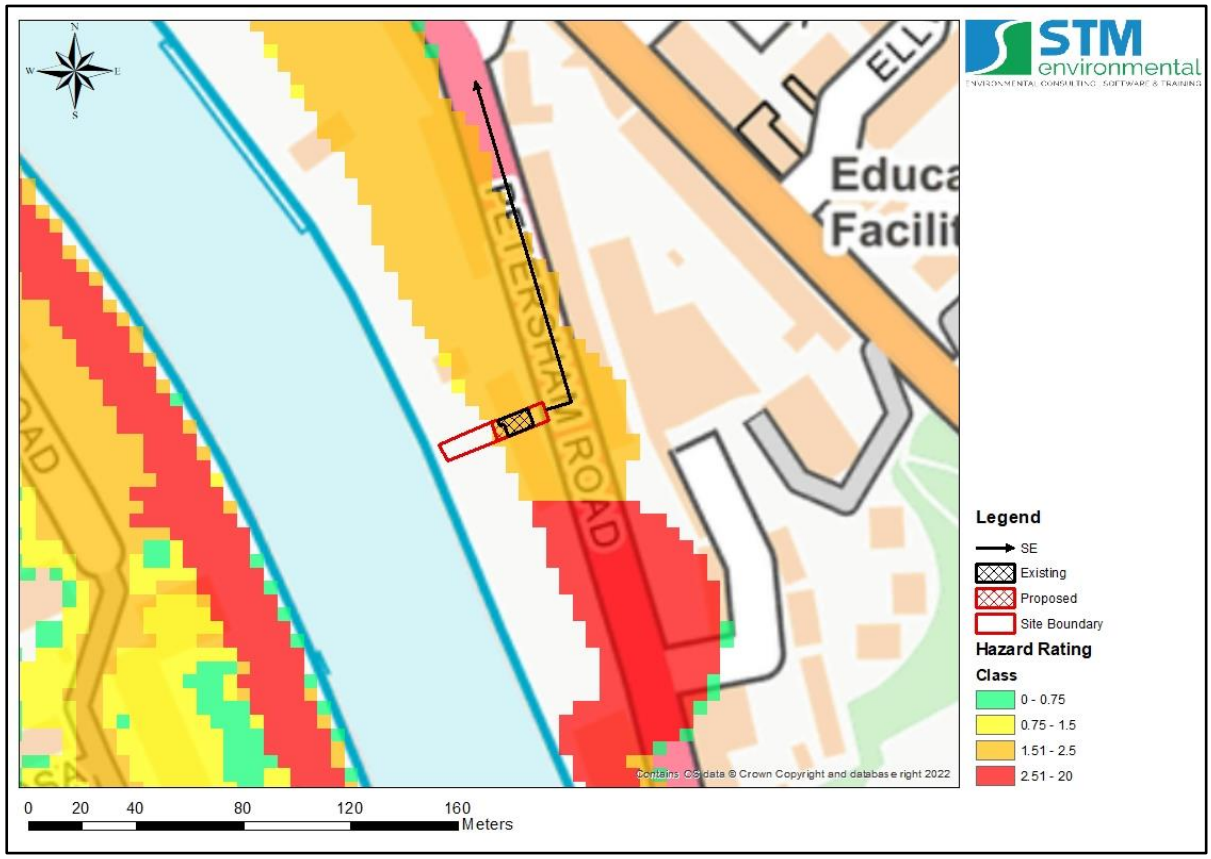
17.11.3 Tidal and Fluvial Flood Depths during the 2100 – Breach Depths Model and the Thames Hammersmith Domain (1 in 1000yr and 1 in 100yr + 35%)



17.11.4 Hazard Map



17.12 Appendix 12 – Safe Egress to Flood Zone 1 Map



17.13 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”.