GeoSmart Information

Environmental Thinking

FloodSmart Standard

Site address	106 Highgate Road Fitzroy Terrace London NW5 1PB
Site coordinates	528714, 185665
Report prepared for	Dr. Susan Michie 106 Highgate Road Fitzroy Terrace London NW5 1PB
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1. Executive summary

The National Planning Policy Framework (2012) and Planning Practice Guidance (2015) requires that flood risk assessments review flooding from all potential sources. A review has been undertaken of national environmental data sets to assess the potential flood risk to the Site. The review is provided within this concise interpretative report written by an experienced GeoSmart flood risk consultant. GeoSmart have assessed the best available data to determine the potential risk from flooding at the Site, based on professional judgment with recommendations where applicable. An explanation of the various risk categories is provided in the report.

Site analysis

Source of Flood risk	Baseline	After Mitigation
River and coastal	Low	n/a
Surface water (Pluvial) flooding	Negligible	n/a
Groundwater flooding	Negligible	n/a
Other flood risk factors present	Yes	n/a
Is any other further work recommended?	Yes	Yes (Please see below)

N/A = mitigation not required

The proposals are to extend the existing subterranean development. The majority of the Site is at negligible risk of fluvial, pluvial and groundwater flooding. The Site has been identified at risk of Reservoir Flooding however it is noted that the risk is related to the failure of a large reservoir and is based on the worst case scenario. Reservoir flooding is extremely unlikely to occur.

Next steps

A Sustainable Drainage strategy may be required by London Borough of Camden due to the slight extension of the proposed basement development outside the building footprint. In accordance with advice from Thames Water and to protect against flooding the Council are likely to require the basement extension is protected from sewer flooding by the installation of a positive pumped device. Confirmation should be sought with the London Borough of Camden Council as to their exacting requirements.

Additional mitigation for reservoir flooding has been suggested within Section 7.

2. Introduction

Background and purpose

This assessment has been undertaken by firstly compiling information concerning the Site and the surrounding area. The information which is gathered is then used to construct a 'conceptual site model', including an understanding of the appropriateness of the development as defined in the NPPF (2012) and the source(s) of any flood risk present. Finally, a preliminary assessment of the steps that can be taken to manage any flood risk to the development is undertaken.

This report has been prepared with reference to the National Planning Policy Framework (NPPF, 2012).

"*The National Planning Policy Framework set out the Government's planning policies for England and how these are expected to be applied"* (NPPF, 2012).

The National Planning Policy Framework promotes a sequential, risk based approach to the location of development.

"This general approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim should be to keep development out of medium and high risk flood areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible" (NPPG, 2014).

The purpose of this report is to provide clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at the Site.

Report scope

A thorough review of a commercially available flood risk report and Environment Agency supplied data indicating potential sources of flood risk to the Site from rivers and coastal sources, surface run-off (pluvial), groundwater and reservoirs, including historical flood information and modelled flood extent. Appropriate measures are recommended to manage and mitigate the flood risk to the property.

Local rainfall data for the 1 in 100 year rainfall event is used to support site run-off calculations if there is an increase in impermeable area as a result of the development. The effects of climate change are also included in these calculations, using industry standard advice.

Information obtained from the Environment Agency and a review of the London Borough of Camden Strategic Flood Risk Assessment (SFRA) (July 2014) is used to ascertain local flooding issues and, where appropriate, identify information to support a Sequential and/or Exception test required as part of the National Planning Policy Framework (NPPF, 2012).

Using the available data the existing and future flood risks to and from the Site from all flood sources will be assessed in line with current best practice.

An indication of potential flood risk from the Site to downstream receptors is provided where the proposed development increases run-off from the Site.

Report limitations

It is noted that the findings presented in this report are based on a desk study of information supplied by third parties. Whilst we assume that all information is representative of past and present conditions we can offer no guarantee as to its validity and a proportionate programme of site investigations would be required to fully verify these findings.

This report excludes consideration of potential hazards arising from any activities at the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

Datasets

The following table shows the sources of information that have been consulted as part of this report:

Source of flooding	Datasets consulted					
	Commercial Flood Report (Appendix B)	SFRA*[1]	SWMP*[2]	Environment Agency	Thames Water (Appendix C)	OS Data
Historical	X	X		X		
Fluvial/tidal	X	X		X		
Surface water (pluvial)	X	X	X	X		
Groundwater	X	X				
Sewer		X	X		X	
Culvert/bridges		X	X			X
Reservoir		X		X		

*[1]London Borough of Camden Strategic Flood Risk Assessment (SFRA) (July 2014)
*[2]London Borough of Camden Surface Water Management Plan (SWMP) (2011)
(Supporting information on the datasets used is provided in the relevant appendix)

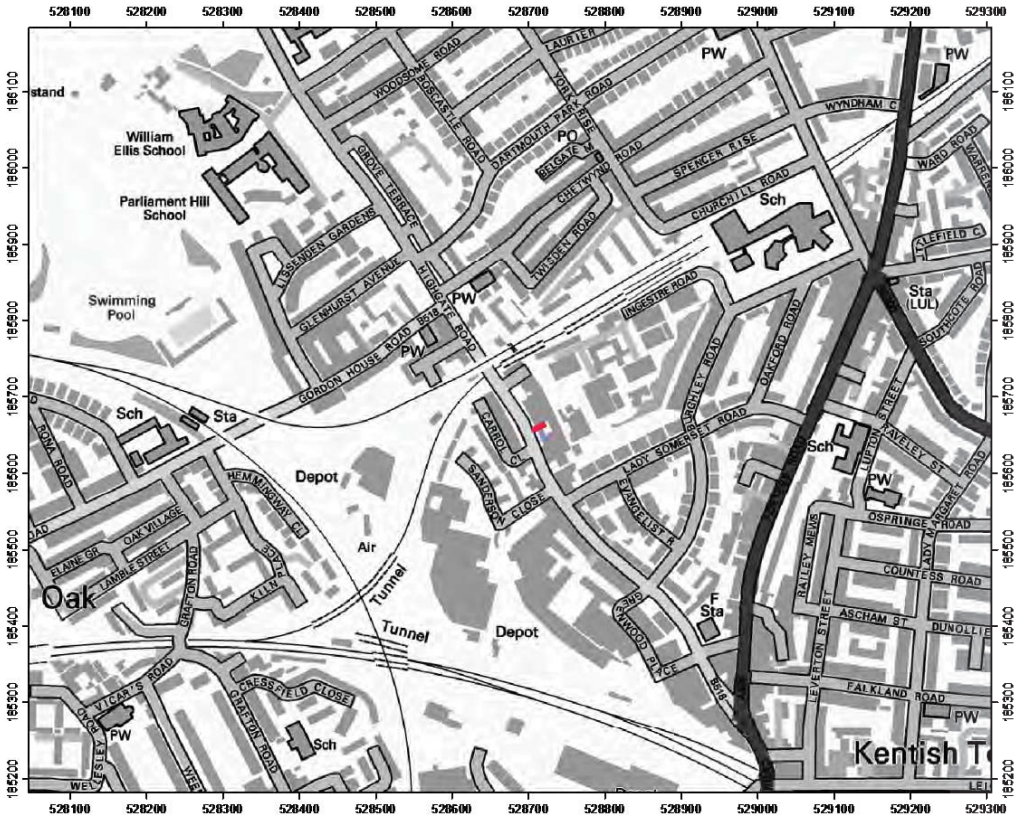
3. Site analysis

Site information

The Site is located in Camden in a setting of predominately residential land use, National Grid Reference TQ 28714 85665 (see Figure 1). According to OS data the immediate area surrounding the Site is located on a gentle slope between 40-45 mAOD. Using a 1 km buffer around the Site, it is noted that to the north land rises to c.65 mAOD. To the west land rises to c. 55 mAOD, to the east land remains around 40 mAOD and to the south falls to c. 30 mAOD.

Site specific elevations could not be obtained for the Site as the EA 1 m and 2 m elevation data (ref: TQ_2785DTM) was not available. Based on Ordnance Survey DTM terrain 50 data, the Site has an elevation of 43.2 mAOD however it is aknowledged that this data has a 50m grid resolution. This data has been verified to be 4 m RMSE[1].

Figure 1 Site Location



Contains Ordnance Survey data © Crown copyright and database right 2016

[1]OS Terrain 50 has been compared with GPS points in a range of sample areas to provide a Route Mean Square Error (RMSE) value for the height points in each geographic area; urban and major communication routes, rural and mountain and moorland. OS Terrain 50 grid has been verified to be 4 m RMSE.

Development

The Site is currently used within a residential capacity. Development proposals comprise the extension of the existing basement floor level horizontally, into part of the existing garden, without increasing its depth. The proposed area of the basement extension will be 20.7 m^2 (see Appendix A). The effect of the overall development will not result in an increase in number of occupants and/or users of the building and will not result in the change of use, nature or times of occupation. The estimated lifespan of the development is 100 years.

Hydrological features

Watercourses/surface water features within 1km of the Site:

Two drainage channels are located 210m north east of the Site which run parallel to the railway line.

Highgate Ponds are located approximately 970m north west of the Site.

Potential overland flow routes to the Site could exist from the west.

Potential overland flow routes from the Site could exist to the south east.

Proximity to relevant infrastructure:

A culverted 'Lost River' watercourse flows south east from Highgate Ponds and is located approximately 290m south west of the Site at its closest point. All main rivers historically located within London Borough of Camden are now culverted and are classed as 'lost rivers' (URS, 2014).

Hydrogeological features

British Geological Survey mapping indicates that there is no record of superficial deposits recorded on the Site (BGS, 2016)

British Geological Survey mapping indicates that the underlying bedrock geology consists of the London Clay Formation (BGS, 2016) and is not classified as an aquifer (EA, 2016).

The Site is not located within a Source Protection Zone.

4. Flood risk to the development

Historical flood events

No historic flood events have been recorded at the Site (Landmark, 2016)(EA, 2016).

Guidance

The purpose of historic flood data is to provide information on where and why flooding may have occurred in the past. The absence of any recorded events does not mean that flooding has never occurred on Site or that flooding will never occur at the Site.

Fluvial/coastal flood risk

The Site is located within the Environment Agency's Flood Zone 1 and is classified as being at low risk of fluvial flooding (Figure 2). According to the SFRA, the Site is located within a Critical Drainage Area (CDA) (Group3_003), where it is located in close proximity to CDA Group3_001. It is not however located within a Local Flood Risk Zone (LFRZ) (URS Ltd, 2014), although LFRZ3034 is located approximately 80m to the north of the Site.

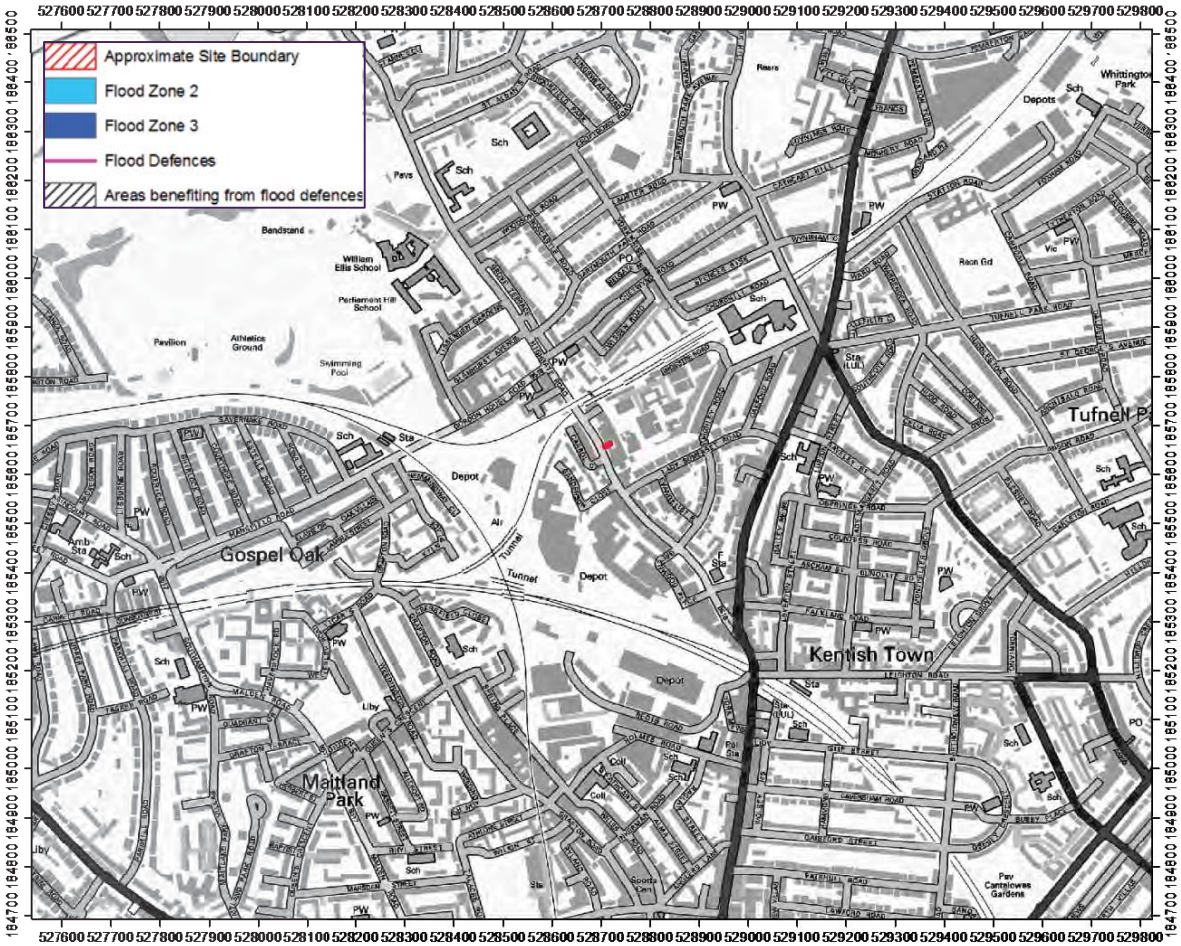
Guidance

As defined in the NPPF (2012):

Ignoring the presence of any defences, land located in a Flood Zone 1 is considered to be at low risk of flooding, with less than a 1 in 1000 annual probability of fluvial or coastal flooding in any one year.

Development of all uses of land is appropriate in this zone (see glossary for terminology).

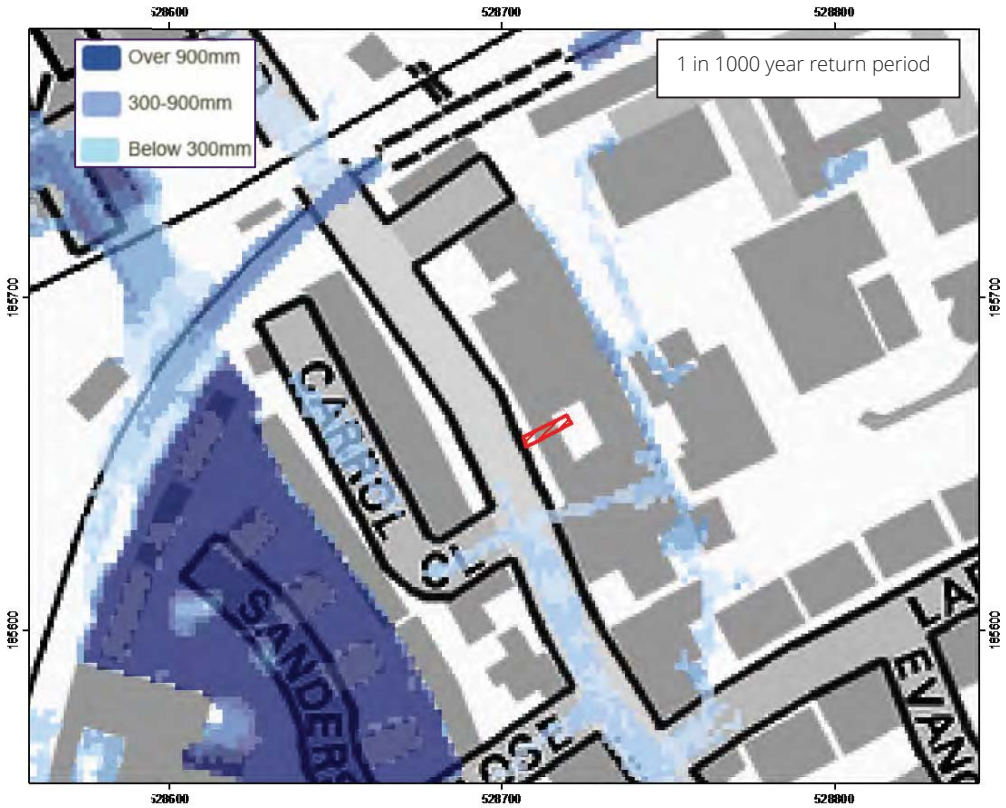
Figure 2 Environment Agency (EA) Flood Map for Planning Purposes (EA, 2016)



Surface water (pluvial) flooding

The Site is considered to be at very low risk of surface water pluvial flooding (Figure 3). As the 1 in 100 year surface water mapping does not consider climate change, the 1 in 1000 year mapping has been used to assess flood risk from surface water to reflect the potential increase in risk due to climate change. The Surface Water Management Plan (SWMP) does indicate reported incidents of surface water flooding within 100 m of the Site. The SWMP indicates that Highgate Road was flooded during events in 1975 and 2002. However, despite the 1975 flood event, the SFRA has not mapped the Site within a flood hazard area (URS Ltd, 2014).

Figure 3 Environment Agency (EA) Surface Water Flood Risk Map (EA, 2016)



Based on inspection of OS data, the Site is not located on a potential overland flow route and does not contain areas of low topography in relation to the surrounding area. Despite the Site's location within a Critical Drainage Area, the flood risk to the Site remains as very low.

Guidance

According to EA's surface water flood risk map, a site at very low risk has a chance of flooding of less than 1 in 1000 (0.1%)

Groundwater flooding

Based on GeoSmart's Groundwater Flood Risk Map (Figure 4) the Site is considered to be at negligible risk of groundwater flooding. The SFRA does not indicate reported incidents of ground water flooding within 100 m of the Site (URS Ltd, 2014).

The risks may be higher for basements and below ground structures and as such mitigation measures such as sumps and pumps may be required.

Figure 4 GeoSmart GW5 Groundwater Flood Risk Map (GeoSmart, 2016)

In line with London Borough of Camden's guidance on basements and light wells (CPG4, section 3.51), basement development should not displace ground water or surface water flow so it causes flooding on nearby sites or those further away. In order to assess the impacts of the proposed development, a Basement Impact Assessment (BIA) was undertaken for the Site in August 2016 by ESI Ltd (Report Ref: 65145R1). The report states that the Site and the proposed development has a low impact to groundwater floods, with relevant borehole records indicating a groundwater level of 9 metres below ground level.

Guidance

According to GeoSmart (2016) there is a negligible risk of groundwater flooding in this area and any groundwater flooding incidence will be less frequent that 1 in 100 years return period.

Negligible Risk - There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Sewer flooding

The SWMP provides mapped evidence that during the 1975 and 2002 extreme rainfall events surcharging of the local sewer network occurred as its capacity was exceeded (Halcrow, 2011). This caused flooding to Highgate Road which is located immediately adjacent to the Site. However, records held by Thames Water indicate that there have been no incidences of flooding related to the surcharging of public sewers at the Site itself (Thames Water, 2016; Appendix C).

Guidance

Properties classified as "at risk" are those that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system either once or twice in the ten year reference period (Thames Water, 2016). Records held by Thames Water provide information relating to reported incidents, the absence of any records does not mean that the Site is not at risk of flooding.

It should be noted that as sewers are designed to surcharge to just below cover level, basement and other subterranean development is at risk of flooding with sewage. In accordance with advice from Thames Water and to protect against flooding the Council are required to ensure that all basement and other subterranean development is protected from sewer flooding by the installation of a positive pumped device.

Culverts and bridges

Culverts and bridges have been identified within 1 km of the Site. Historic 'lost rivers' were culverted and incorporated into the local sewer network in the 19th Century. There is evidence (contained within the SFRA and SMP) that during the 1975 and 2002 extreme rainfall events caused surcharging of the local sewer network as its capacity was exceeded (URS, 2014 and Halcrow, 2011). Flood risk from these 'lost rivers' and the sewer network they are now connected is likely to have been reduced due to upgrades in the network by Thames Water since this time and a larger integration of SuDS and the subsequent reduction in runoff from developed Sites.

Reservoir flooding

According to the Environment Agency mapping (2016c) the Site is potentially located within an area at risk of flooding from reservoirs. The Site is considered to be at risk of flooding from the Highgate Ponds No 2 and No 3, located 970m north west of the Site. (Figure 5 overleaf), with a flood depth of under 0.3m and speed of flooding between 0.5-2 m/s.

Figure 5 EA Risk of Flooding from Reservoirs (EA, 2016)

Guidance

The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m^3 of water) and is based on the worst case scenario. Reservoir flooding is extremely unlikely to occur (Environment Agency, 2016c).

5. Flood risk from the development

The proposed development involves an increase of impermeable surfaces at the Site (albeit, an extension to the existing basement). Therefore, an estimation of run-off may be required to permit effective site water management and prevent any increase in flood risk to off-site receptors from the Site.

London Borough of Camden's planning guidance on basements and lightwells CPG 4 (July, 2015) section 3.51, confirms basement development should not displace ground water or surface water flow so it causes flooding on nearby sites or those further away.

Drainage and run-off

Using rainfall data from the Flood Estimation Handbook (FEH) CD-ROM, developed by NERC (2009), the potential surface water run-off generated from the Site during a 1 in 100 year return period has been calculated. Guidance included within the National Planning Policy Framework (NPPF) recommends that the effects of climate change are incorporated into Flood Risk Assessments (Flood Risk Assessments: Climate Change Allowances Guidance, 2016).

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

The results for a 1 in 100 year 6 hour rainfall event at the Site are summarised in the table below.

Catchment	Rainfall (mm)	Rainfall (mm) inc. CC (+40% for Upper End +20% for Central)	Run-off from impermeable surfaces	
			m3/m2	m3/m2 incl. CC (+40% for Upper End +20% for Central)
Upper End	80.4	112.56	0.08	0.1
Central	80.4	96.48	0.08	0.1

A method of investigating the run-off due to the proposed development can be calculated by multiplying the run-off per square metre by the impermeable area within the proposed development plan.

It is recommended that attenuation of run-off is undertaken on site to compensate for proposed increases in impermeable surface areas. Attenuation may comprise the provision of storage within a sustainable drainage system.

A list of SuDS components that could be used to manage surface water run-off from the Site are listed in the following table. Alternative SUDs components may also be considered and more information can be found at http://www.susdrain.org/. Always seek expert advice on the selection and sizing of the SuDS components most suitable for your Site.

Option	Description
Rainwater harvesting	Rain water harvesting can collect run-off from the roofs for use in non-potable situations, using water butts for example.
Permeable paving	Permeable pavements can be used for driveways, footpaths and parking areas to increase the amount of permeable land cover. Suitable aggregate materials (angular gravels with suitable grading as per CIRIA, 2007) will improve water quality due to their filtration capacity. Plastic geocellular systems beneath these surfaces can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles.
Swales	Shallow, wide and vegetated channels that can store excess run-off whilst removing any pollutants.
Soakaways	An excavation filled with gravel within the Site. Surface water run-off is piped to the soakaway.
Attenuation basins/pond	Dry basin or a permanent pond that is designed to hold excess water during a rainfall event.

GeoSmart would be happy to provide an outline design strategy as required through our SuDSmart Pro report.

It is assumed that any changes to the existing drainage system will be undertaken in accordance with best practice and that care will be taken to ensure the new development does not overload/block any existing drainage or flow pathways to/from the Site. Based on the topography and low surface water flood risk in the vicinity interference with overland flow paths is considered unlikely.

6. Suitability of the proposed development

The information below outlines the suitability of the proposed development in relation to national and local planning policy.

National

The aims of the national planning policies are achieved through application of the Sequential Test and in some cases the Exception Test.

Guidance

Sequential test: The aim of this test is to steer new development towards areas with the lowest probability of flooding (NPPF, 2012). Reasonably available sites located in Flood Zone 1 should be considered before those in Flood Zone 2 and only when there are no reasonably available sites in Flood Zones 1 and 2 should development in Flood Zone 3 be considered.

Exception test: In some cases this may need to be applied once the sequential test has been considered. For the exception test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that 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.

Suitability of the proposed development, and whether an Exception Test is required, is based on the flood zone the Site is located within and the flood risk vulnerability classification of the Site as indicated in the table below. This development is classified as 'more vulnerable' and is located in a Flood Zone 1. Therefore an Exception Test is not required. The Sequential Test can be considered to be passed as the Site is located in a Flood Zone 1.

Local

For this report, the London Borough of Camden SFRA has been consulted. The SFRA was undertaken by URS in July, 2014. Relevant information contained in this report for the Site area is outlined below:

- Historically the sources of the Rivers Fleet, Tyburn, Kilburn and Brent were located in the area of Hampstead Heath. In the present day no main rivers are located in the London Borough of Camden following the incorporation of the reaches into the Thames Water Utilities Ltd (TWUL) sewer network. The borough is located entirely in Flood Zone 1 (URS Ltd, 2014).

- The London Borough of Camden Surface Water Management Plan (SWMP) identified a number of Critical Drainage Areas (CDAs). Specific areas within a CDA are not necessarily at higher risk from surface water than an area outside of a CDA. However

the location of an area within a CDA indicates that it is within a catchment area which contributes to a flooding hotspot. Within CDAs, surface water management should be a particular focus of new developments. The majority of the borough is located within a CDA (URS Ltd, 2014).

- Mapping shows that for the model scenarios, the surface water flood extent broadly follows the natural topography of the borough, as expected. Potential flooding also follows man-made features such as roads and rail lines. Historic flood records indicate that LBC, particularly to the north of Euston Road, is prone to surface water flooding (URS Ltd, 2014).

- The EA's Risk of Flooding from Reservoirs Mapping identifies areas that could be flooded if a large reservoir were to fail. There are three water bodies designated as 'large' within LBC; Hampstead Pond Number 1 and Highgate Ponds Number 2 and 3. Reservoirs in the UK have an extremely good safety record. The EA is the regulatory authority for the Reservoirs Act 1975 in England and Wales and all large reservoirs must be inspected and supervised by reservoir panel engineers on an annual basis (URS Ltd, 2014).

Guidance

Strategic Flood Risk Assessments are carried out by local authorities, in consultation with the Environment Agency, to assess the flood risk to the area from all sources both now and in the future due to climate change. They are used to inform planning decisions to ensure inappropriate development is avoided (NPPF, 2012).

Table: Flood risk vulnerability and flood zone 'compatibility (taken from NPPF, 2012)

Flood risk vulnerability classification		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood Zone	Zone 1 – low probability	✓	✓	✓	✓	✓
	Zone 2 – medium probability	✓	✓	Exception test required	✓	✓
	Zone 3 – high probability	Exception test required	✓	X	Exception test required	✓
	Zone 3 - – functional flood plain	Exception test required	✓	X	X	X

7. Resilience and mitigation

Based on the available information mitigation measures outlined in the following table are likely to help protect the development from flooding.

Emergency evacuation/safe egress routes

As the development is in a Flood Zone 1 a safe access route is not required as the Site is located outside the 1 in 100 year and 1 in 1000 year flood event extents.

Fluvial/coastal mitigation measures

As the Site is located in Flood Zone 1, fluvial mitigation measures are not required.

Surface water mitigation measures

As the Site is not identified as at risk of pluvial flooding, mitigation measures are not necessarily required. However, in accordance with advice from Thames Water and to protect against flooding the Council are likely to require the basement extension is protected from sewer flooding by the installation of a positive pumped device. Confirmation should be sought with the London Borough of Camden Council as to their exacting requirements.

A SuDS design may be requested by London Borough of Camden to mitigate any flood risk both to and from the Site.

Groundwater mitigation measures

As the Site is not identified as being at risk of groundwater flooding, mitigation measures are not required.

Other Flood Risk mitigation measures

According to the Environment Agency Risk of Flooding from Reservoir Map, the maximum predicted flood depths for the Site in the case of a breach of the nearest reservoir would be under 0.3m. There would be a relatively high rate and onset of flooding associated with a reservoir breach, and flood waters would pool within the basement development however it is acknowledged that the Site is very close to the edge of the risk area. In reality, flood risk to the site from reservoirs is low.

However specific measures that could be considered for the basement development includes:

- Waterproof tanking of the ground floor and basement
- Interceptor drains
- Automatic sump to extract flood water
- Non-return valve on the sewer lines

8. Conclusions and recommendations

A LOW fluvial flood risk has been identified.

A NEGLIGIBLE surface water flood risk has been identified

A NEGLIGIBLE groundwater flood risk has been identified.

A reservoir flood risk has been identified at the Site.

No other sources of flood risk have been identified to impact the Site, based on the data currently available.

The table below provides a summary of where the responses to key questions are discussed in this report.

Key sources of flood risks identified	Reservoir flood risk (see Section 3).
Are standard mitigation measures likely to provide protection from flooding to/from the Site?	Yes, see Section 7.
Is the development likely to satisfy the requirements of the Sequential Test?	N/A, see Section 6.
Is any further work recommended?	We recommend that mitigation measures that have been discussed within this report in section 7 regarding the basement are considered as part of the proposed development where possible and evidence of this is provided to the Local Authority as part of the planning application.

9. Further information and what to do next

The following table includes a list of products by GeoSmart:

Recommendations for next steps		
✓	Additional assessment: SuDSmart Report	The SuDSmart Report range assesses which drainage options are available for a Site. They build on technical detail starting from simple infiltration screening, and work up to more complex SuDS Assessments detailing alternative options and designs. Please contact info@geosmartinfo.co.uk for further information.
	Additional assessment: FloodSmart Report	The FloodSmart Report range provides clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at a site. Our consultants assess available data to determine the level of risk based on professional judgement and years of experience. Please contact info@geosmartinfo.co.uk for further information.
	Additional assessment: EnviroSmart Report	Provides a robust desk-based assessment of potential contaminated land issues, taking into account the regulatory perspective. Our EnviroSmart reports are designed to be the most cost effective solution for planning conditions. Each report is individually prepared by a highly experienced consultant conversant with Local Authority requirements. Ideal for pre-planning or for addressing planning conditions for small developments. Can also be used for land transactions. Please contact info@geosmartinfo.co.uk for further information.

10. References and glossary

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