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Flood Risk Assessment

36 Redington Road, Hampstead, London NW3 7RT

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1 INTRODUCTION

1.1 The Existing Site

The proposed development site is located at 36 Redington Road in Hampstead, north west London (Figure 1.1). The rectangular site covers approximately 500m^2 and contains a two storey semi-detached house with a single storey extension and garage to the side (Figure 1.2). The front garden is lawn with a concrete path and driveway and the rear garden is mainly lawn with established hedges and trees along the boundaries and as shown on an aerial photograph of the site (Figure 1.3). The adjacent semi-detached property (No 38) has been recently redeveloped to provide a large three storey building (Figure 1.3) with a double basement.

A DTM topographical survey (Figure 1.4) shows the site is relatively flat and between 94.5m and 94.7m OD with a slight slope towards to a low point to the north east corner of the rear garden at 94.28m. The area around the dwelling at 94.75m OD and front garden fall towards Redington Road at 94.10m OD. The survey also shows that the land to the east of the site, along Redington Gardens and Heath Road, forms a shallow valley of a former watercourse and this is described in more detail in Section 2.

1.2 The Proposed Development

The proposals are to demolish the existing dwelling and to construct a new three storey residential property with a single level basement (Figure 1.5). The ground level footprint of the new building will be slightly larger than the existing building and will also extend below part of the existing front and rear gardens (Figure 1.6).

1.3 Requirements for a Flood Risk Assessment

Under the National Planning Policy Framework (NPPF) and the National Planning Policy Guidance (NPPG) a Flood Risk Assessment (FRA) is often required as part of a planning application depending on the nature of a development, its size and the anticipated flood risk as defined by the Environment Agency's flood risk zones. In England flood risk is divided into three zones:

- Zone 1 areas have low or no risk with an annual probability of tidal and fluvial flooding of less than 0.1% per year, above the 1000 year flood level.
- Zone 2 areas have a fluvial risk of flooding of between 0.1 and 1% a year, between the 100 year (the 200 year in tidal areas) and 1000 year, and
- Zone 3 areas are at high risk with a fluvial risk of greater than 1% a year, inside the 100 year flood extent or the 200 year in tidal areas.

The Environment Agency's flood map (Figure 1.7) shows the site is located in Flood Zone 1 with a low risk of fluvial and tidal flooding and there are no visible surface watercourses within 500m of the site. As the site is less than 1ha and in Flood Zone 1 under NPPF, NPPG, the EAs Guidance and the local Strategic Flood Risk Assessment (SFRA) a FRA is not required with the planning application.

However the Basement Impact Assessment (BIA) undertaken in May 2015 indicates that nearby areas have historically been at risk from pluvial flooding and hence Camden Council's engineers have requested that a FRA is provided. The main issue is to consider the risk of surface water flooding but flooding from all other potential sources, including the former watercourse, are considered in this FRA.

1.4 Report Structure

For this FRA the potential sources of fluvial, tidal and other sources of flooding are given in Section 2 and the implications of these sources on the proposed development considered in Section 3. The conclusions are given in Section 4.

2 FLOOD RISK

NPPF emphasises the need to consider all potential sources of flooding, not just rivers and the sea, when planning a development as these could be important considerations for managing flood risk. For this site these sources of flooding are considered below.

2.1 Fluvial Flooding

The site is located in Flood Zone 1 (Figure 1.7) and there are no visible surface watercourses within 500m of the site and no historical records of any fluvial or tidal flooding in the local area. The nearest surface watercourse or water body is the Leg of Mutton pond 750m to the north of the site but this drains through Golders Green to the River Brent catchment to the west. The ponds on the east side of Hampstead Heath are 1.5km east of the site and form part of The Fleet catchment which drains to the south east through Kentish Town and Holbourn. Flooding from these water bodies would therefore not affect this site.

The BIA identified that the River Westbourne, one of the Lost Rivers of London, flows close to the site (Figure 2.1). Whilst detailed layout maps, plans and dimensions of this culverted watercourse are not available the "London's Lost Rivers" (Tim Boltons, 2014) suggests this watercourse runs along the west side of Redington Gardens and Heath Road although other maps (Figure 2.1) suggest it is located on the east side of the road. It is understood this underground watercourse can be heard at Oak Tree House at the north end of Redington Gardens under a square drain cover which suggests that when it was culverted in Victorian times the obvious location would have been under the road rather than adjacent gardens or properties. It is therefore assumed that the River Westbourne follows the line of Redington Gardens and Heath Road to the south.

The basement will therefore not intercept this culverted stream and provided measures to ensure this basement would not be affected by this overflowing watercourse then the risk of flooding from this source is low. Whether the Westbourne is a likely source of flooding will depend on its course, elevation, it capacity and the likelihood of blockage compared to the level of the basement and ground levels on the site. The estimated flood flows and likely flow route if this culvert capacity is exceeded or it becomes blocked are considered below.

2.1.1 Flood Flows

The Flood Estimation Handbook (FEH) catchment descriptors have been derived from the FEH CD ROM version 3 for the River Westbourne assuming the FEH catchment delineation and watercourse flow paths are correct. This catchment delineation (Figure 2.2) confirms this watercourse does not drain the ponds on Hampstead Heath but the nearest location for which a catchment can be defined is at the A41 Finchley Road further downstream.

These FEH descriptors (Table 2.1) indicate that the catchment at this location is small (0.56km^2), with no lakes or reservoirs (FARL = 1.0), with a high percentage runoff (SPRHOST = 44.9%) and is very heavily urbanised with URBEXT1990 of greater than 0.5. A full definition of the parameters in Table 2.1 is given in the FEH volume 5 but the catchment descriptors suggest no obvious reasons for not using FEH methods apart from the small catchment area and high level of urbanisation.

Table 2.1 FEH Catchment Descriptors for the Westbourne at Hampstead

Parameter	Westbourne at Hampstead
Grid Ref	TQ 25400 85200
AREA	0.56
FARL	1.000
PROPWET	0.29
ALTBAR	96.0
BFIHOST	0.302
DPLBAR	0.80
DPSBAR	71.60
SAAR	658
SPRHOST	44.9
URBEXT1990	0.520

These catchment descriptors are used to define the median annual flood (QMED) with no adjustment from a donor gauging station based on the FEH Revised Statistical Method[1]. The EAs FEH guidelines recommend the use of urban adjusted Revised Method QMED which is 0.372 m^3/s. (Table 2.2).

Table 2.2 QMED from Catchment Descriptors at Subject Sites

Site	AREA (km^2)	Revised Method QMED (m^3/s)	Revised Method QMED URBAN (m^3/s)
Westbourne	0.56	0.222	0.372

The calculation of a flood frequency curve and more extreme flood flows requires the construction of a pooling group and the fitting of an extreme value distribution to the pooled group data using WINFAP. Two extreme value distributions are often used on the pooled group data (i) the Generalised Logistic (GL), and (ii) the General Extreme Value (GEV) distribution both fitted to the annual maximum data by the method of L-Moments. FEH indicates that the GL distribution can often provide the best fit to extreme value flood series and in this case WINFAP confirms that the GL provides the most acceptable distribution for this site.

The results of the frequency analyses (Table 2.3) are based on the QMED donor ratio of 1.0, with URBEXT1990 adjusted to 2016 according to methods detailed in the FEH and using the GL distribution as recommended by WINFAP. Recent research (Kjeldsen, 2010) has led to a revision of the urban adjustment factor (UAF) which is used only for the adjustment of QMED and unlike earlier methods the growth curve does not include the UAF. This suggests the 100 year flow is 1.21 m^3/s (Table 2.3) which is based on a larger catchment area downstream rather than the site at Redington Gardens and hence this will be an overestimate of flood flows but these are adopted as a conservative estimate.

Table 2.3 Westbourne Flood Flows (m^3/s)

Site	Return Period (Years)					
	2	5	10	20	50	100
Westbourne	0.37	0.54	0.66	0.80	1.01	1.21

[1] Improving the FEH statistical procedures for flood frequency estimation. CEH Science Report SC050050, July 2008

2.1.2 Flood Levels

The conversion of flood flows to flood levels is based on Manning's equaton which is applied to the road along Redington Gardens, assuming the Westbourne culvert is 100% blocked and that all flood water will flow along this road, which is a worst case assumption. The topographical survey (Figure 1.4) shows the road falls from 97.51m OD at its north end adjacent to Oak Tree Cottage to 93.25m OD at the junction with Heath Road over a distance of 105m. Assuming the road is 8m wide and adopting a relatively high Manning's roughness of 0.03 this suggests the 100 year flood flow of 1.21m^3/s would have a depth of 104mm and flood to 93.354m OD (Table 2.4). This compares to the ground level at the entrance to the site of 94.21m OD and the front garden level of 94.70m OD which is 1.35m above the estimated flood level. It is therefore unlikley that the site would flood from the Westboune culvert on Redington Gardens even if this was 100% blocked.

Table 2.4 Estimated Flood Levels and Depths at Remington Gardens

Return Period (yrs)	Flow (m^3/s)	Flood Depth (m)	Flood Level (m OD)
2	0.37	0.051	93.301
5	0.54	0.064	93.314
10	0.66	0.072	93.322
20	0.80	0.081	93.331
50	1.01	0.093	93.343
100	1.21	0.104	93.354

2.2 Storm Water Runoff

This can occur when excess water runs off the surface of a site particularly during short but intense storms. Flooding occurs because the ground is unable to absorb the high volume of rain water or because the amount of water is greater than the capacity of the drainage system or soils to take it away. This can particularly occur on developed impermeable sites such as concrete, tarmac or buildings or where the soils are impermeable.

The BIA indicates that the increase in the hard surface area may change the volume and peak flow of site runoff and the basement will extend into the garden area to the front and back and this too will increase site runoff. The proposals are to connect the new site drainage network to the existing storm water sewer on Redington Road as existing which has adequate capacity to handle these flows.

There are no records of the existing site, the local area or nearby properties having suffered from storm water flooding and with the new drainage system designed to handle extreme storm events the risk of flooding from this source will be managed. The EAs pluvial flood risk map shows the site is at high risk (Figure 2.3) but this relates to the area of lower ground located to the north of the garden (Figure 1.4) at 94.10m OD which is below the rear garden adjacent to the property at 94.55m OD and flood water from this lower area would drain towards and along Redington Gardens rather than across the site. To prevent any storm water ponding on the garden from entering the new building the entrances to the basement including all windows, doors and services, should be protected by a raised ramp, rim or ground levels to reduce the risk to the property.

2.3 Roads

Flooding on roads can occur when the amount of water arriving on the road is greater than the capacity of the local drainage network to take it away resulting in ponding. Exceptional rainfall, a road being in a low lying area, changes in runoff from adjacent land can all lead to road flooding even when the drainage system is in a good working order particularly if drains become blocked with silt or leaves. The EAs pluvial flood risk map shows local roads are at low or very low risk (Figure 2.3). The BIA identified that road flooding occurred in 2002 from the Arup report (Figure 2.4) and this may have been due to inadequate road drainage during this very intense storm but Redington Road and Redington Gardens were not affected. This type of flooding is difficult to predict at any location but the raised ground levels in the front garden, which is above the local road level, will reduce the risk of flooding from this source which is considered to be low.

2.4 Sewers

Sewer flooding can occur when a storm sewer or combined sewer network becomes overwhelmed and its maximum capacity is exceeded. Higher flows are likely to occur during periods of prolonged rainfall, the autumn and winter months, when the capacity of the sewer system is most likely to be reached. During summer periods sewers can become susceptible to blockage as the low flows are unable to transport solids which leads to the gradual build up of solid debris. The Water Companies maintain a register of properties/areas which are at risk of flooding from the public sewerage system, shown on the DG5 Flood Register. There are no records of sewer flooding in this area although this type of flooding is difficult to predict with any certainty. However the raised ground level on the site will provide protection and the risk of flooding from this source is considered to be low.

2.5 Impounded Water Bodies

The potential risk associated with artificial sources of flooding has been investigated by the EA. Their mapping indicates there are no reservoirs and/or water storage facilities near the site that may potentially pose a potential risk of flooding either directly or in case of failure (Figure 2.5) and the risk of flooding from this source is considered to be low.

2.6 Tidal Flooding

The site is far inland and at 92m OD and above hence the impact of rising sea levels and tidal flooding is very low.

2.7 Groundwater

Groundwater flooding is most likely in low-lying areas underlain by permeable rocks (e.g. Chalk or Sandstone) and occurs as water rises up through the underlying rocks or from water flowing from abnormal springs after long periods of sustained high rainfall. This can cause the water table to rise above normal levels and the risk will depend on local ground conditions.

BGS records show the site is underlain by the Claygate Member over London Clay (Figure 2.6) with no drift deposits in the area (Figure 2.7) and this has been confirmed by the Site Investigation undertaken as part of the BIA. This showed that the site is comprised of made ground over 5m of sandy clay with the London Clay at around 5m depth. Groundwater levels were shallow influenced by the permeability of the Claygate soils which are prevented from infiltrating vertically by the impermeable London Clay below. Groundwater monitoring on the site has provided levels of 1.04m to 1.11m bgl in BH1 in the front garden and 0.97m to 8.82m

bgl in BH2 in the rear garden and these reflect the perched water table in the Claygate Member. Although restricted vertical drainage and water logging may be a issue there are no recorded incidents of groundwater flooding in the area or on the site and it is likely that if groundwater levels reach the ground surface this would drain via the surface water drainage network.

The BIA assessed the impact of the proposed basement in relation to groundwater movement and indicated a very small change is likely and this would have little effect on neighbouring properties. The basement will extend to below the water table within the Claygate member and it is proposed to provide piled walls around the basement cut into the London Clay and this will prevent groundwater ingress to the new basement.

In summary the risk of flooding to the site from various sources is considered to be low due to the limited pathways to which water from these various identified sources could reach the site. The risk of flooding is therefore considered to be low subject to certain provisions which are detailed in Section 3.

3 IMPLICATIONS FOR THE PROPOSED DEVELOPMENT

3.1 Ground Floor Levels and Thresholds

The new dwelling and basement will be located on slightly raised ground above the local road and garden levels. However to avoid accumulation of surface water from an extreme rainfall event on the adjacent garden area from draining into the basement, it is usual to specify raising ground levels, a rim or ramp at the entrances to the basement, including all windows, doors and services.

3.2 Safe Escape

As the site is in Zone 1 there will always be a dry safe route to allow escape from the site to Redington Road and this leads to an area wholly outside of the flood plain where services and facilities exist.

3.3 Flood Resistance and Resilience Measures

In Flood Zone 1 the raising of floor levels or basement entrances will provide protection against pluvial and storm water flooding and is recommended at this site. There is no requirement to consider any other flood resistant or resilient measures. As a precaution the basement could include raised sockets, switches, circuits and services which are wired down from the ceiling rather than up from the floor.

3.4 Flood Storage Compensation

As the site is in Zone 1 there will be no displaced water and no change in the flooding potential for adjacent sites and hence there is no requirement for flood storage compensation.

3.5 Sump and a Pump

It is a often recommended that any new basements are fitted with a positive pumped device to ensure it can deal with any unforeseen drainage, groundwater or sewer flooding problems. A sump and a pump will be installed in the lowest part of the basement and fitted with a non-return valve to deal with any unforeseen internal or external sources of flood water.

4 CONCLUSIONS

- The proposals are to demolish the existing dwelling at 36 Redington Road, Hampstead and to construct a new three storey residential property with a single level basement. The middle part of the site lies between 94.5m and 94.7m OD with a slope down to the north east corner of the rear garden at 94.28m OD and to Redington Road at 94.10m OD.

- The site is located in Flood Zone 1 with a low risk of fluvial and tidal flooding and as the site area is less than 1ha a FRA is not required with the planning application under NPPF and NPPG. However the Basement Impact Assessment (BIA) in May 2015 indicated that nearby areas have historically suffered from pluvial flooding and hence Camden Council's engineers have requested a FRA. The main issue is to consider the risk of surface water but flooding from all other potential sources are considered in this FRA.

- There are no visible surface watercourses within 500m of the site and no historical records of any fluvial flooding in the local area. The nearest surface watercourse or water bodies on Hampstead Heath drain to the east and south east and do not flow near the site. However the River Westbourne flows close to the site in a culvert presumably under Redington Gardens and as such the basement will not intercept this culverted stream.

- There are no plans or details of the dimensions of this culvert but the risk of flooding from this watercourse has been assessed assuming the culvert is 100% blocked and that all water would flow down Redington Gardens. The 100 year flood flow of 1.21m^3/s would reach a depth of 104mm and a level of 93.35m OD at the junction with Heath Road which compares to the site entrance at 94.21m OD and the front garden at 94.70m OD, well above the estimated flood level. It is therefore unlikley that the site would flood from the Westbourne culvert even if this was 100% blocked.

- Storm runoff may cause flooding on site during short but intense storms when the ground is unable to absorb the high volume of rain water or because the amount of water is greater than the capacity of the drainage system or soils to take it away. There are no records of the existing site having suffered from storm water flooding and with the new drainage system the risk of flooding from this source will be managed. Mitigation measures may be appropriate to reduce any risk.

- The local roads to the north flooded in 2002 presumably due to inadequate road drainage during this very intense storm but Redington Road and Redington Gardens were not affected. The raised ground levels in the front garden, which is above the local road level, will reduce the risk of flooding from this source which is considered to be low.

- There are no records of sewer flooding in this area although this type of flooding is difficult to predict with any certainty. However the raised ground level on the site will provide protection and the risk of flooding from this source is considered to be low. The potential risk associated with failure of reservoirs and rising sea levels is considered to be low.

- Although restricted vertical drainage may be a issue there are no recorded incidents of groundwater flooding in the area and it is likely that if groundwater levels reach the ground surface this would drain via the surface water drainage network. The BIA indicated the proposed basement would have little effect on neighbouring properties.

The basement will extend to below the water table within the Claygate member and it is proposed to provide piled walls around the basement cut into the London Clay and this will prevent groundwater ingress to the new basement.

- The new dwelling and basement will be located on slightly raised ground above the local road and garden levels. However to avoid accumulation of surface water from an extreme rainfall event on the adjacent garden area from draining into the basement, it is usual to specify raised floor at ground floor level, a rim or ramp at the entrances to the basement, including all windows, doors and services.

- There is no requirement to consider any other flood resistant or resilient measures but as a precaution the basement could include raised sockets, switches, circuits and services which are wired down from the ceiling rather than up from the floor.

- There will always be a dry safe escape from the site to Redington Road and this leads to an area wholly outside of the flood plain where services and facilities exist. As the site is in Zone 1 there will be no displaced water and no change in the flooding potential for adjacent sites and hence there is no requirement for flood storage compensation.

- It is a often recommended that new basements are fitted with a positive pumped device to ensure it can deal with any unforeseen drainage, groundwater or sewer flooding problems. A sump and a pump will be installed in the lowest part of the basement and fitted with a non-return valve to deal with any unforeseen internal or external sources of flood water.

Figures

Figure 1.1 Site Location

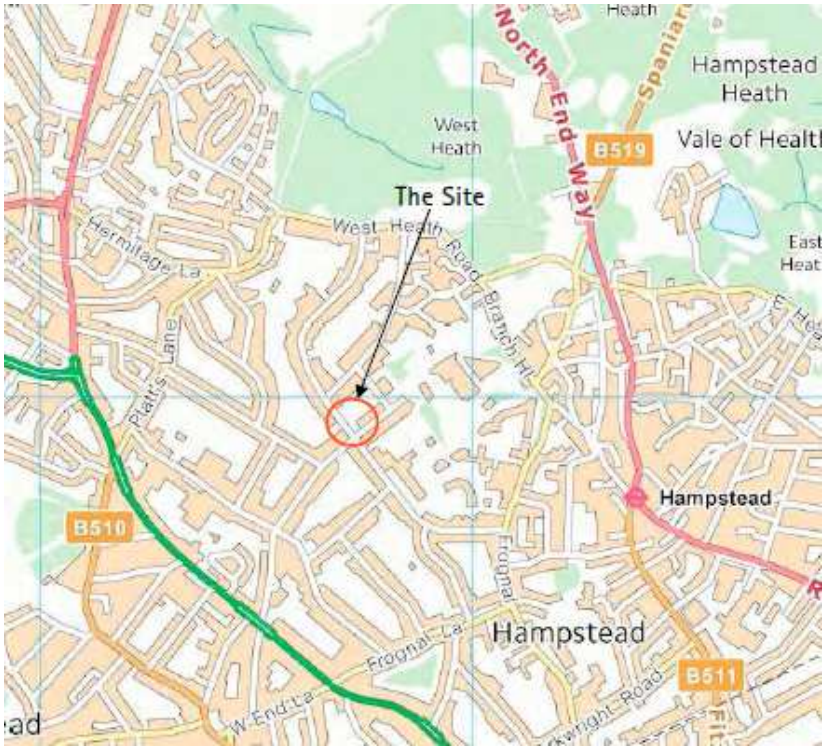

Figure 1.2 Existing Site Layout

Figure 1.3 Aerial Photograph

Figure 1.4 DTM Topographical Survey

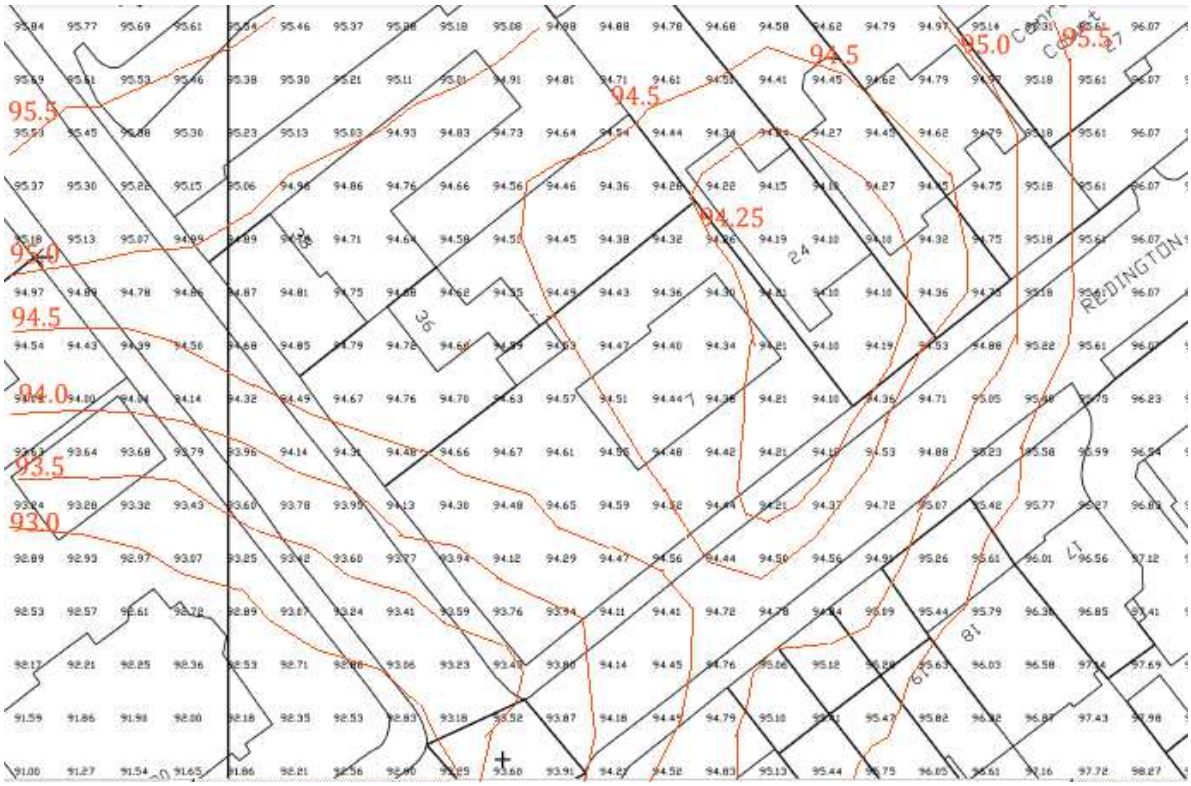

Figure 1.5 Proposed Development Section East to West

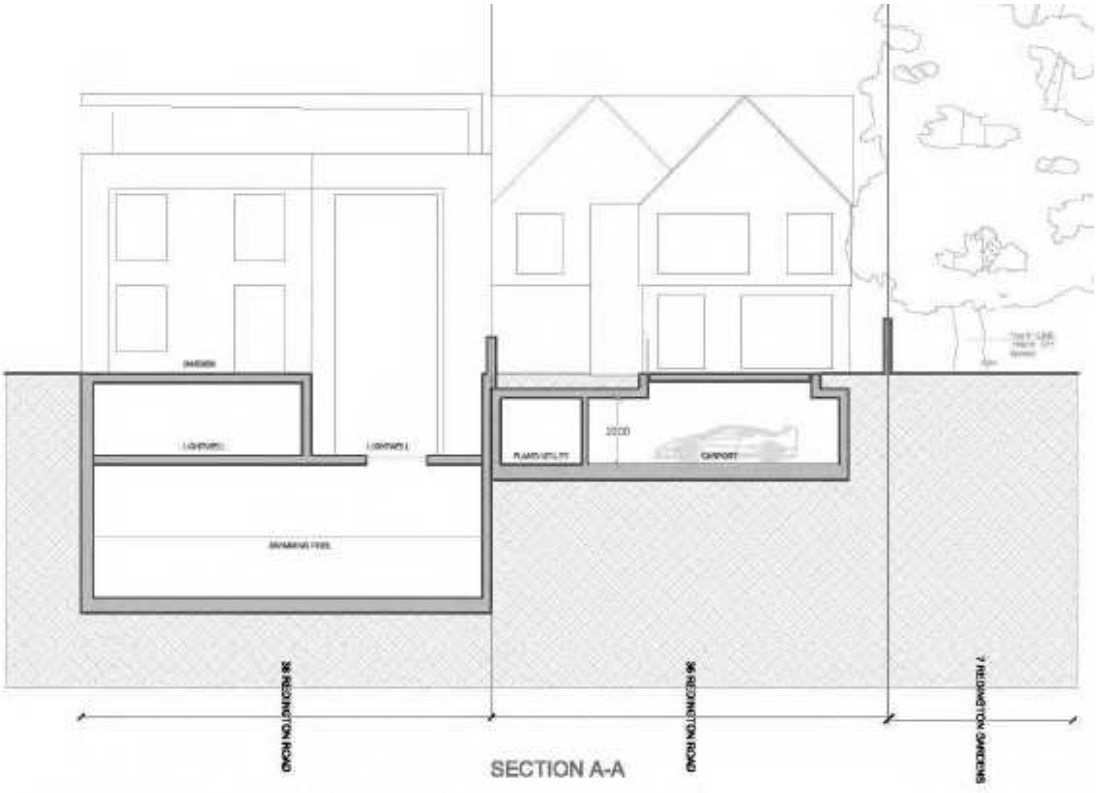

Figure 1.6 Proposed Development Section North to South

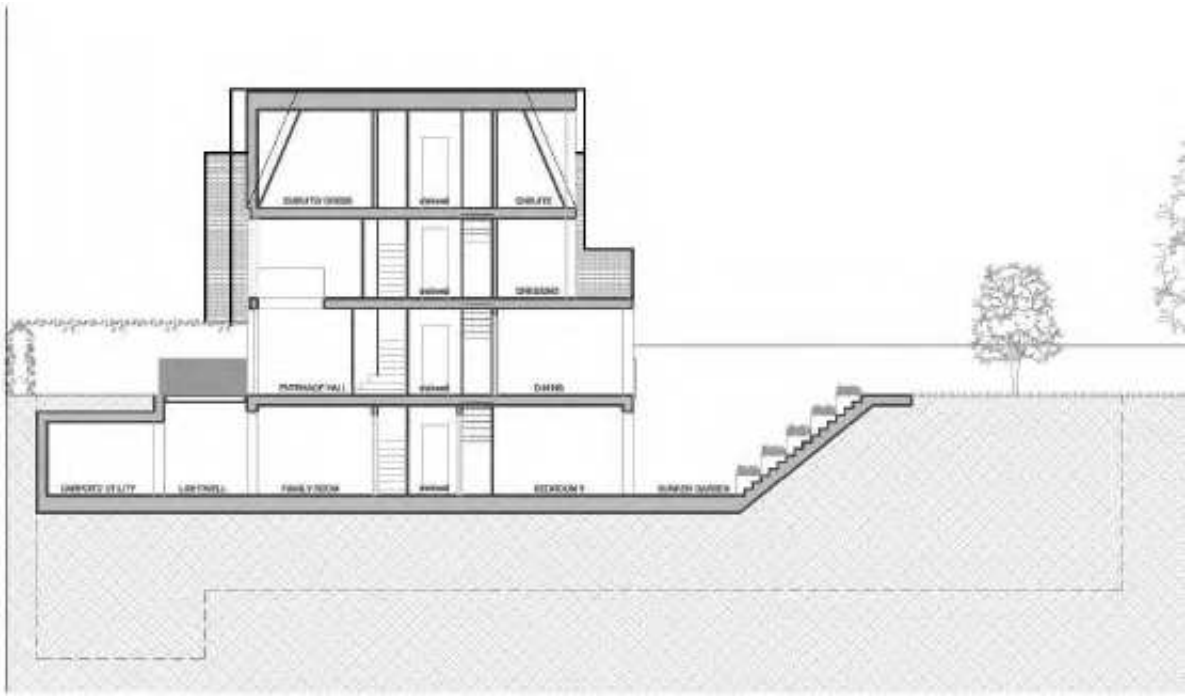

Figure 1.7 Environment Agency's Flood Map

Figure 2.1 River Westbourne Location

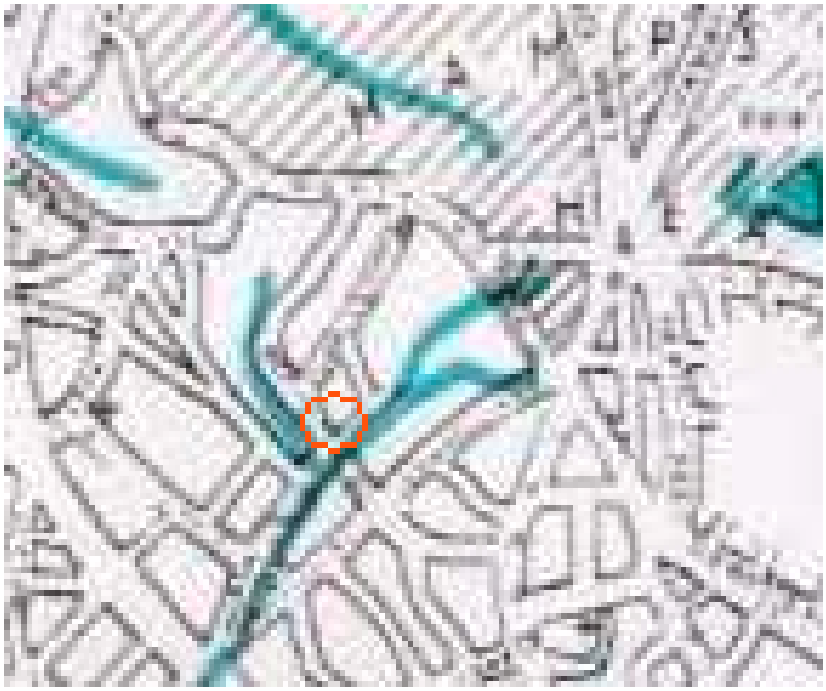

Figure 2.2 FEH Catchment Map

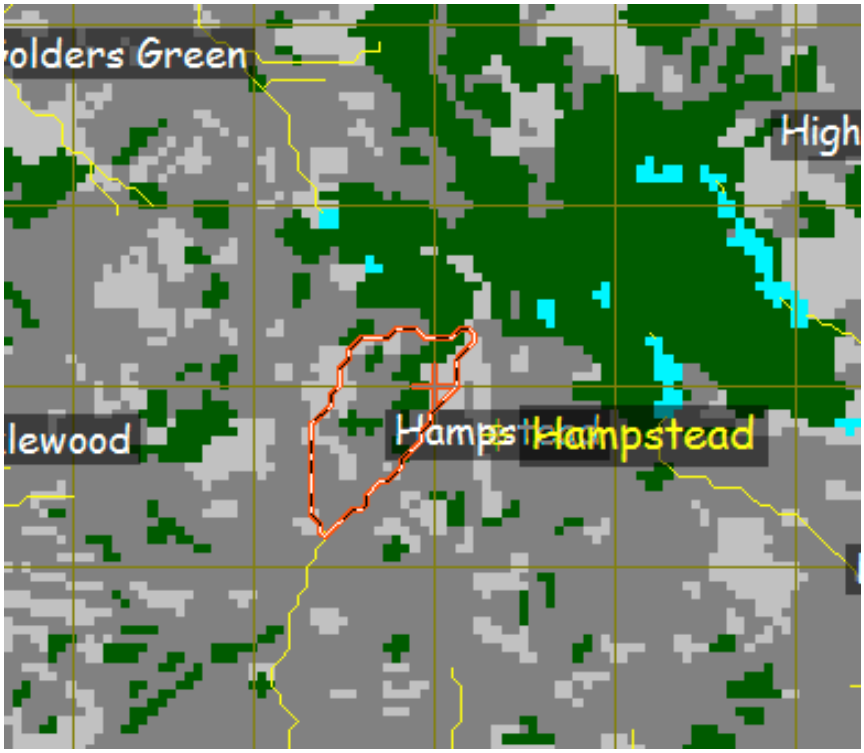

Figure 2.3 EA Pluvial Flood Risk Map

Figure 2.4 Historical Incidents of Road Flooding

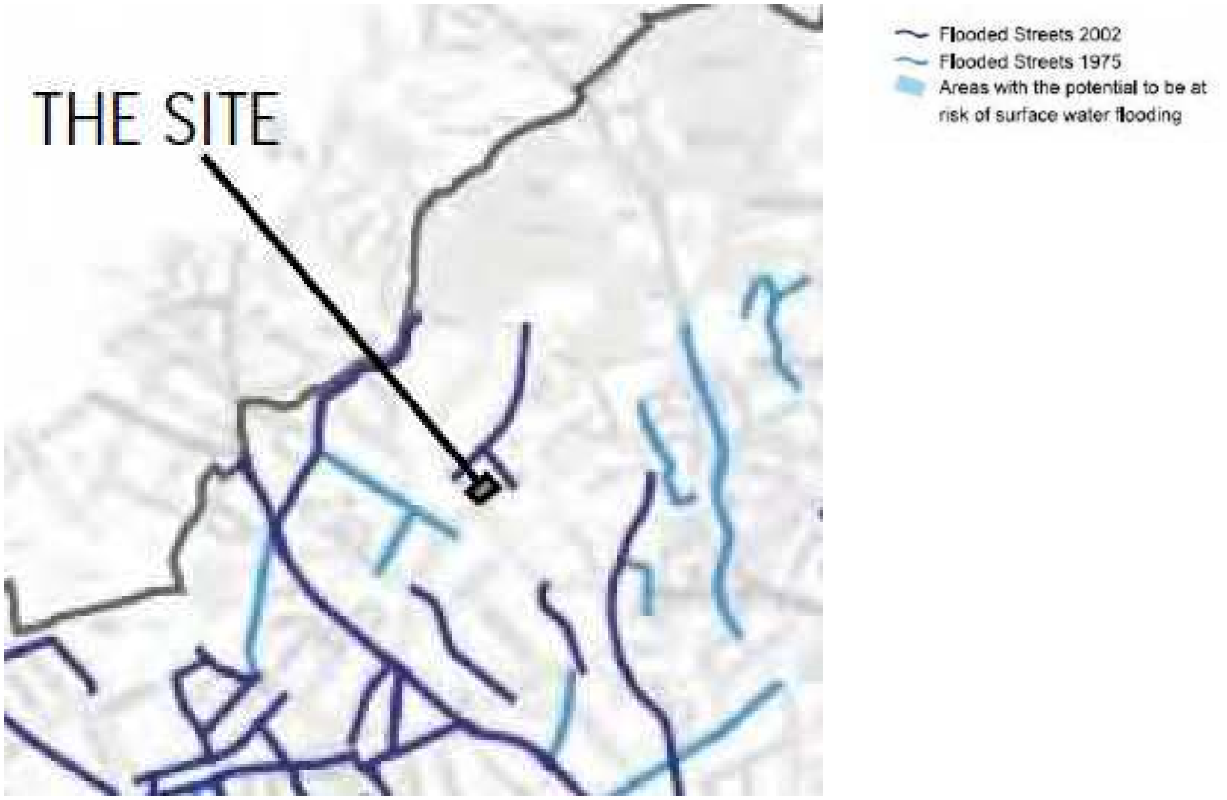

Figure 2.5 EA Reservoir Failure Flood Risk Map

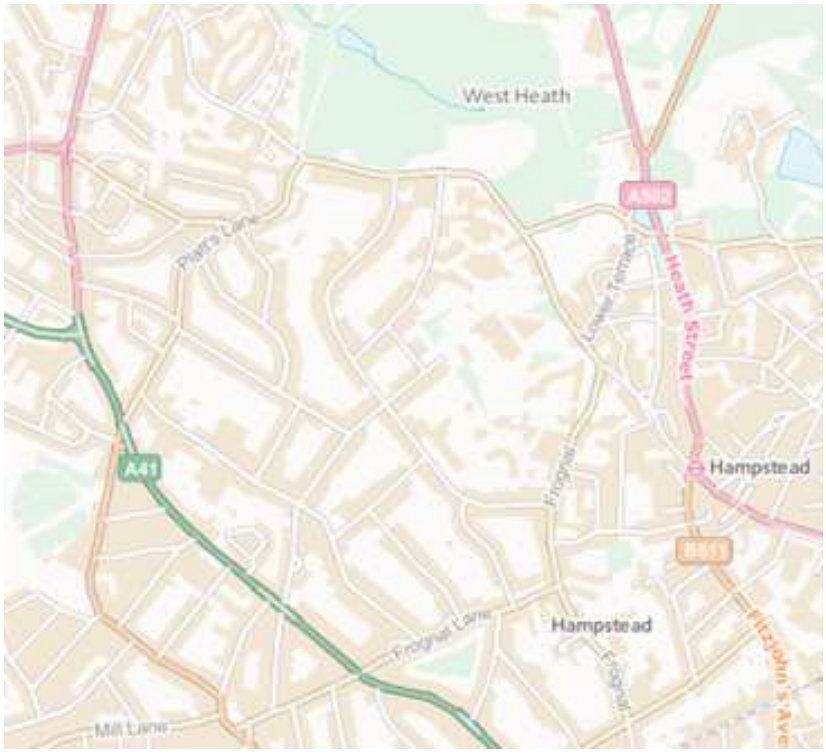

Figure 2.6 Bed Rock Geology

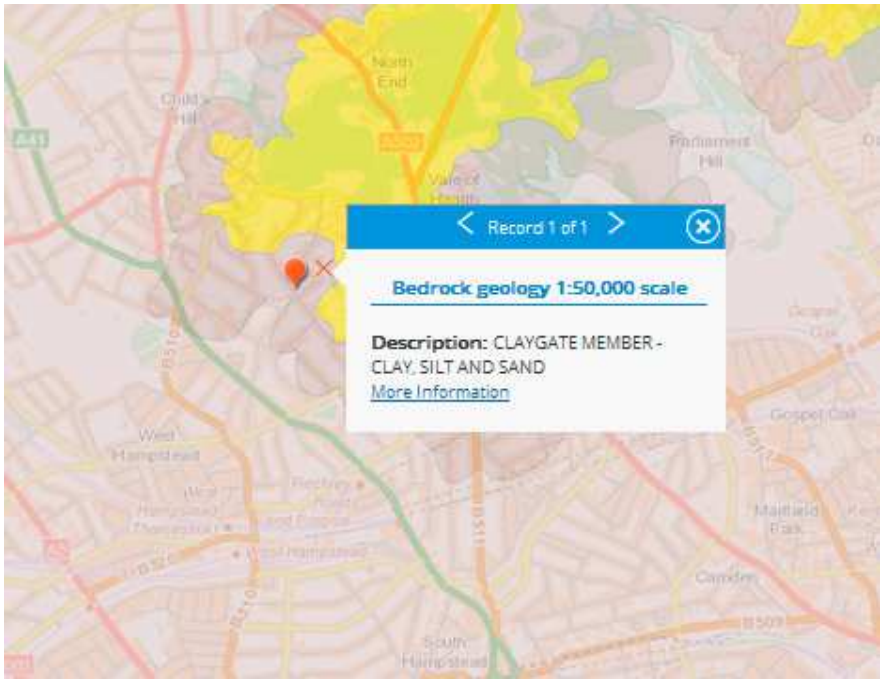

Figure 2.7 Drift Geology