



**PROPOSED REPLACEMENT
DWELLING AND BASEMENT
LEVEL AT NUMBER 18A
FROGNAL GARDENS,
CAMDEN, LONDON**

FLOOD RISK ASSESSMENT

SEPTEMBER 2019

REF: 2351/RE/08-19/01 REVISION A

Evans Rivers and Coastal Ltd

T: 07896 328220

E: Enquiries@evansriversandcoastal.co.uk

W: www.evansriversandcoastal.co.uk

CONTRACT

Evans Rivers and Coastal Ltd has been commissioned by Stephen Buss Environmental Consulting Ltd to carry out a Flood Risk Assessment for a proposed redevelopment at number 18A Frognal Gardens, Camden, London.

QUALITY ASSURANCE, ENVIRONMENT AND HEALTH AND SAFETY

Evans Rivers and Coastal Ltd operates a Quality Assurance, Environmental, and Health and Safety Policy.

This project comprises various stages including data collection; depth analysis; and reporting. Quality will be maintained throughout the project by producing specific methodologies for each work stage. Quality will also be maintained by providing specifications to third parties such as surveyors; initiating internal quality procedures including the validation of third party deliverables; creation of an audit trail to record any changes made; and document control using a database and correspondence log file system.

To adhere to the Environmental Policy, data will be obtained and issued in electronic format and alternatively by post. Paper use will also be minimised by communicating via email or telephone where possible. Documents and drawings will be transferred in electronic format where possible and all waste paper will be recycled. Meetings away from the office of Evans Rivers and Coastal Ltd will be minimised to prevent unnecessary travel, however for those meetings deemed essential, public transport will be used in preference to car journeys.

The project will follow the commitment and objectives outlined in the Health and Safety Policy operated by Evans Rivers and Coastal Ltd. All employees will be equipped with suitable personal protective equipment prior to any site visits and a risk assessment will be completed and checked before any site visit. Other factors which have been taken into consideration are the wider safety of the public whilst operating on site, and the importance of safety when working close to a water source and highway. Any designs resulting from this project and directly created by Evans Rivers and Coastal Ltd will also take into account safety measures within a "designers risk assessment".

Report carried out by:

Rupert Evans, BSc (Hons), MSc, CEnv, C.WEM, MCIWEM, PIEMA

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1. INTRODUCTION

1.1 Project Scope

1.1.1 Evans Rivers and Coastal Ltd has been commissioned by Stephen Buss Environmental Consulting Ltd to carry out a Flood Risk Assessment for a proposed redevelopment at number 18A Frogna! Gardens, Camden, London.

1.1.2 It is understood that this Flood Risk Assessment will be submitted to the Planning Authority as part of a planning application. Specifically, this assessment intends to:

- a) Review any literature and guidance specific to this area;
- b) Assess the risks to people and property and propose mitigation measures accordingly;
- c) Review existing evacuation and warning procedures for the area;
- d) Carry out an appraisal of flood risk from all sources as required by NPPF;
- e) Report findings and recommendations.

1.1.3 This assessment is carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) dated 2019. Other documents which have been consulted include:

- DEFRA/EA document entitled *Framework and guidance for assessing and managing flood risk for new development Phase 2 (FD2320/TR2)*, 2005;
- DEFRA/Jacobs 2006. *Groundwater flooding records collation, monitoring and risk assessment (ref HA5)*.
- National Planning Practice Guidance – Flood Risk and Coastal Change.
- Woods-Ballard., et al. 2015. *The SUDS Manual, Report C753*. London: CIRIA.
- National SUDS Working Group. 2004. *Interim Code of Practice for Sustainable Drainage Systems*.
- London Borough of Camden Preliminary Flood Risk Assessment (PFRA) Version 0.2 dated 2011.
- London Borough of Camden Strategic Flood Risk Assessment (SFRA) dated 2014.
- London Borough of Camden Surface Water Management Plan (SWMP) Version 1 dated 2011.
- London Borough of Camden flood risk management strategy (FRMS) dated 2013.
- *Camden Planning Guidance – Water and Flooding* dated 2018.
- *Camden Planning Guidance – Basements* dated 2018.

2. DATA COLLECTION

2.1 To assist with this report, the data collected included:

- 1:250,000 *Soil Map of South East England* (Sheet 6) published by Cranfield University and Soil Survey of England and Wales 1983.
- Ordnance Survey 1:10,000 street view map obtained via Promap (Evans Rivers and Coastal Ltd OS licence number 100049458).
- 1:625,000 *Hydrogeological Map of England and Wales*, published in 1977 by the Institute of Geological Sciences (now the British Geological Survey).
- Filtered LIDAR data at 1m resolution.
- British Geological Survey, *Online Geology of Britain Viewer*.
- British Geological Survey, *Groundwater Susceptibility Map*.
- Borehole logs undertaken by Soil Consultants.
- Topographical survey of the site as shown on Drawing Number 5594-14JAN19-01.

3. SITE CHARACTERISTICS

3.1 Existing Site Characteristics and Location

3.1.1 The site is located at number 18A Frogna! Gardens, Camden, London. The approximate Ordnance Survey (OS) grid reference for the site is 520773 183953 and the location of the site is shown on Figure 1.

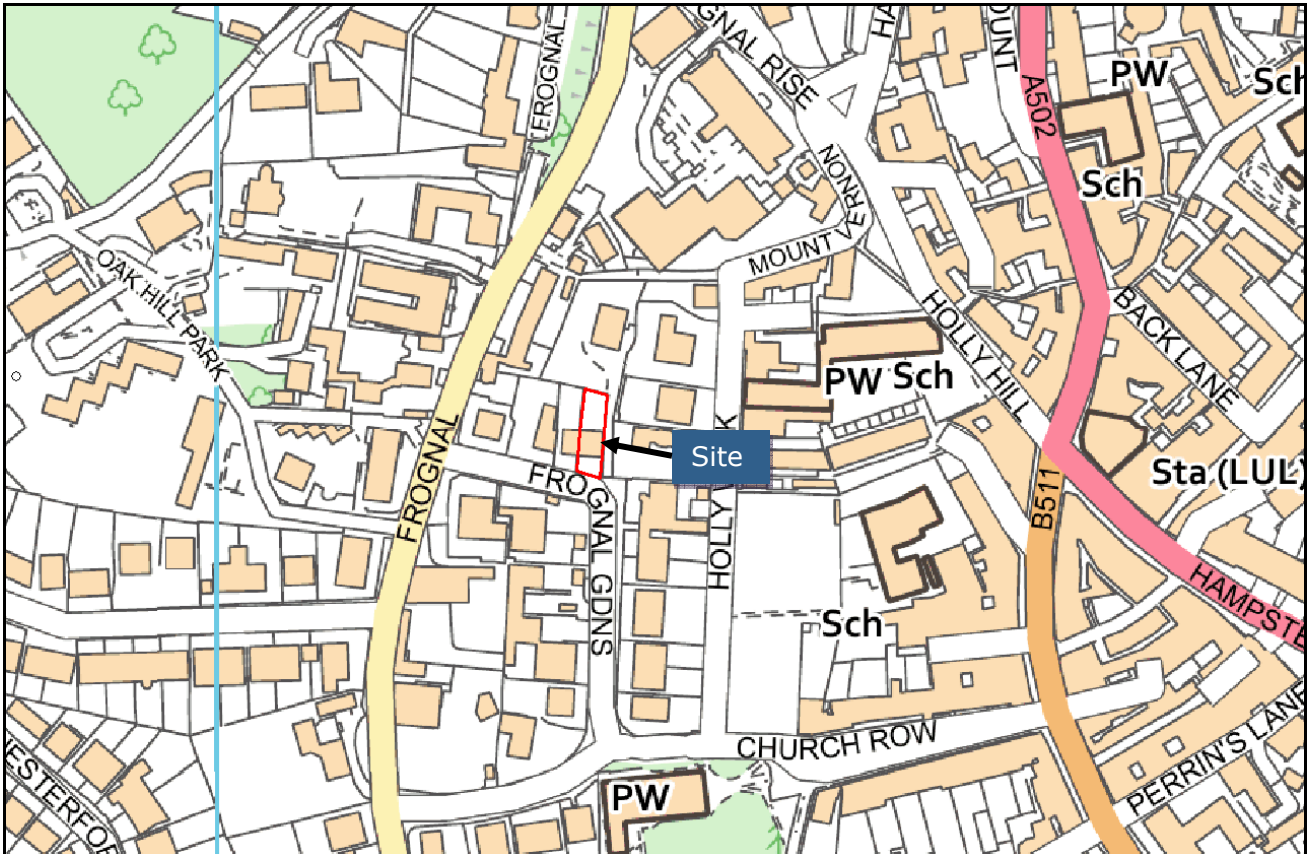


Figure 1: Site location plan (Source: Ordnance Survey)

3.1.2 The site comprises a three-storey dwelling with garage, bedroom, utility and boiler room across lower ground floor areas and living/sleeping areas across upper floors. As the site rises in a northerly direction the ground floor is cut into the ground slope which provides level access onto the rear garden from the upper ground floor.

3.1.3 The rear garden is partially paved and a driveway exists at the front of the property which leads onto Frogna! Gardens. The existing site layout can be seen on Drawing Numbers 5594-14JAN19-01, 5594-14JAN19-02 and 5594-14JAN19-08.

3.1.4 A topographical survey of the site is shown on Drawing Number 5594-14JAN19-01. Filtered LIDAR data at 1m resolution has also been obtained to determine and illustrate the topography of the site and surrounding area (Figure 2).

3.1.5 By reviewing the site layout and LIDAR data it can be seen that ground levels rise in a northerly direction.

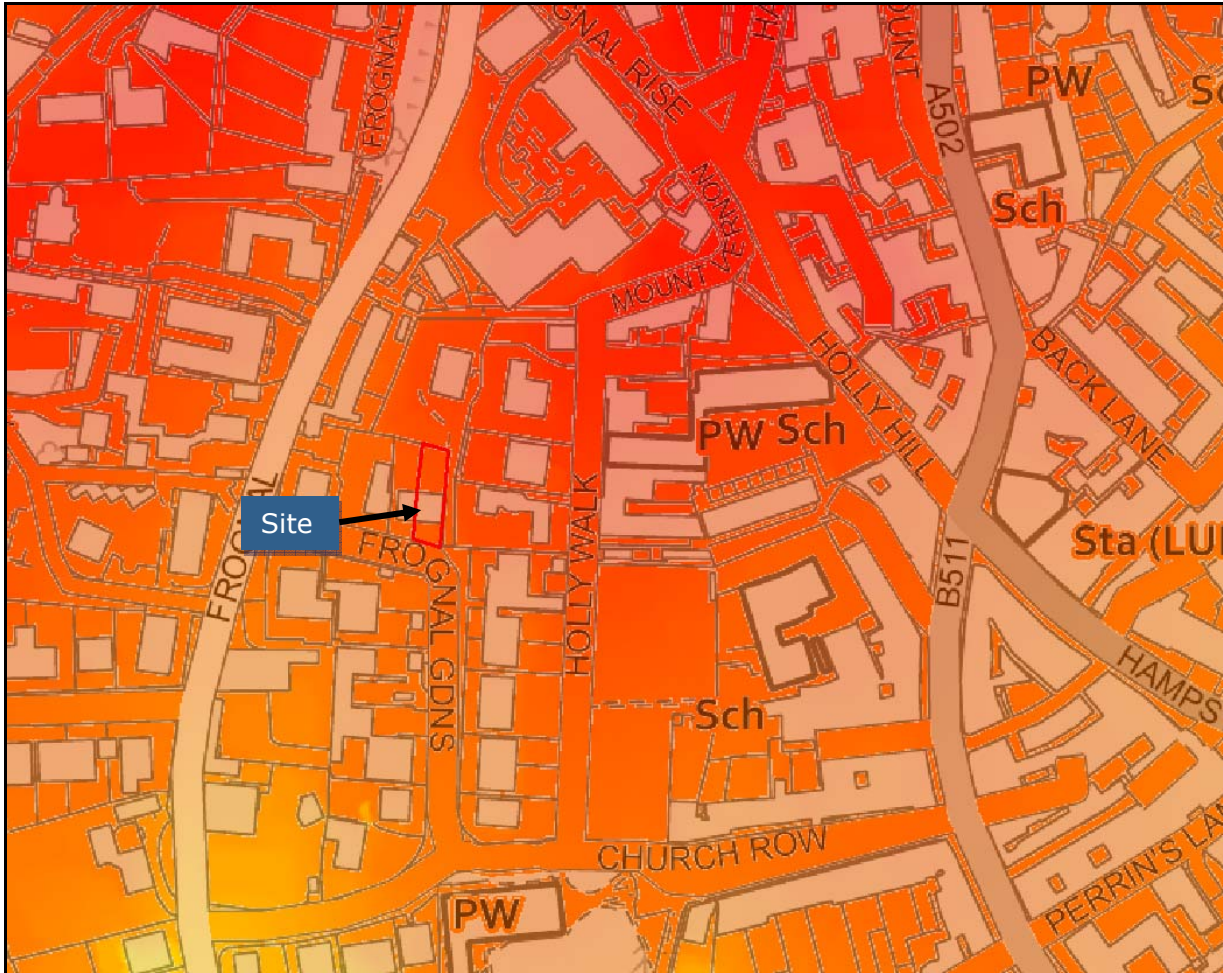


Figure 2: LIDAR survey data where higher ground is denoted as red, orange and yellow colours and lower areas denoted by blue and green colours

3.2 Site Proposals

- 3.2.1 It is the Client's intention to redevelop the site by demolishing the existing building and erecting a new dwelling together with a lower ground floor which will extend further below ground level into the rear garden and front driveway.
- 3.2.2 The site proposals can be seen on Drawing Number ABA-2473-20-023 and ABA-2473-20-099.

4. SOURCES OF FLOODING

4.1 Fluvial

- 4.1.1 The Environment Agency Flood Map shows that the site is located within the NPPF Flood Zone 1, 'Low Probability' which comprises land as having less than a 1 in 1000 year annual probability of fluvial or tidal flooding (i.e. an event more severe than the extreme 1 in 1000 year event). NPPF states that all uses of land are appropriate in this zone.
- 4.1.2 The SFRA also states that there has been no historical flooding within the Borough from fluvial or tidal sources.
- 4.1.3 The SFRA and SWMP states that all main rivers historically located within the Borough are now culverted and incorporated into the sewer network. The SWMP discusses the River Fleet which is one of London's "lost rivers" and which historically originates from springs on Hampstead Heath and drains to the Thames through the Borough. The Fleet is entirely incorporated within the sewer network.
- 4.1.4 The SFRA continues to discuss the Borough's historic rivers and in addition to the Fleet, the Tyburn, Kilburn and Brent were also located in the area of Hampstead Heath. All of these "lost rivers" are also now incorporated into the local sewer system maintained by Thames Water. It is for these reasons that the Borough is located entirely within Flood Zone 1.

4.2 Critical Drainage Areas (CDA)

- 4.2.1 Despite the site being located within Flood Zone 1, it is understood from Figure 6/Rev 2 of the SFRA and Figure 3.1 of the SWMP, that the site is located within the Group3-010 Critical Drainage Area (CDA).
- 4.2.2 The SWMP defines the CDA 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."
- 4.2.3 The site is also located adjacent to, and possibly partially within, the Frognaal Lane Local Flood Risk Zone (LFRZ).
- 4.2.4 The SWMP defines the LFRZ as:

"...discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area' but still affect houses, businesses or infrastructure. A LFRZ is defined as the actual spatial extent of predicted flooding in a single location."

4.3 Groundwater Flooding

- 4.3.1 In addition to the information provided in the SFRA and SWMP, in order to assess the potential for groundwater flooding, the Jacobs/DEFRA report entitled *Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study*, published in May 2004, was consulted, together with the guidance offered within the document entitled *Groundwater flooding records collation, monitoring and risk assessment (ref HA5)*, commissioned by DEFRA and carried out by Jacobs in 2006.

- 4.3.2 The various soil and geological data outlined in Chapter 2, together with Figure 4b/Rev 1 of the SFRA indicates that the soils beneath the site comprise made ground overlying clay, silt and sand.
- 4.3.3 Figure 4e/Rev 1 of the SFRA shows that the site has not been affected in the past from groundwater flooding incidents (although there has been an incident 136m south east of the site), and that the site is not located within an area of increased susceptibility to elevated groundwater.
- 4.3.4 Paragraphs 2.10.4 and 2.10.6 of the SFRA states that the Claygate Member has a low permeability but is likely to permit moderate infiltration. The borehole logs indicate that perched water is present at a depth of between 2.78m bgl and 5.45m bgl with some seepage at 1.90m bgl.
- 4.3.5 The lower ground floor will need to be designed to achieve a Grade 3 level of waterproofing protection as outlined in BS8102:2009. A new reinforced concrete lining wall and ground-bearing concrete slab should be constructed using water resistant concrete to form the primary barrier. Appropriate groundwater control such as sump pumping may be required especially during the construction phase.

4.4 Surface Water Flooding and Sewer Flooding

- 4.4.1 Surface water and sewer flooding across urban areas is often a result of high intensity storm events which exceed the capacity of the sewer thus causing it to surcharge and flood. Poorly maintained sewer networks and blockages can also exacerbate the potential for sewer flooding.

Surface Water Flooding

- 4.4.2 It has been established that the site lies within the Group3-010 Critical Drainage Area. The SFRA notes that the surface water mapping indicates that the surface water flood extent broadly follows the natural topography of the borough and man-made features such as roads and rail lines. During extreme modelling scenarios, the SFRA states that there is increased ponding in areas of properties.
- 4.4.3 The SFRA discusses the two large surface water flooding events in the Borough, which occurred in 1975 and 2002 and caused widespread damage. It is understood that during these events the sewers reached maximum capacity. Figure 3iii/Rev 1 of the SFRA shows that Frogna! Gardens was affected during the 1975 event but not the site.
- 4.4.4 Figure 3iii/Rev 1 of the SFRA and the Agency's Surface Water Flooding Map (Figure 3) indicates that there is a very low surface water flood risk across the site and Frogna! Gardens (i.e. chance less than 1 in 1000 years).
- 4.4.5 It is generally accepted that the low risk flood event (i.e. between 1 in 1000 years and 1 in 100 years) on the Agency's map is used as a substitute for the climate change 1 in 100 year event to provide a worst-case scenario.
- 4.4.6 People should make a judgment on leaving or accessing the site before, during or after the event in relation to any external flood hazard. The data across the wider area indicates that the preferred evacuation route away from the site is in a southerly direction along Frogna! Gardens (Figure 4).

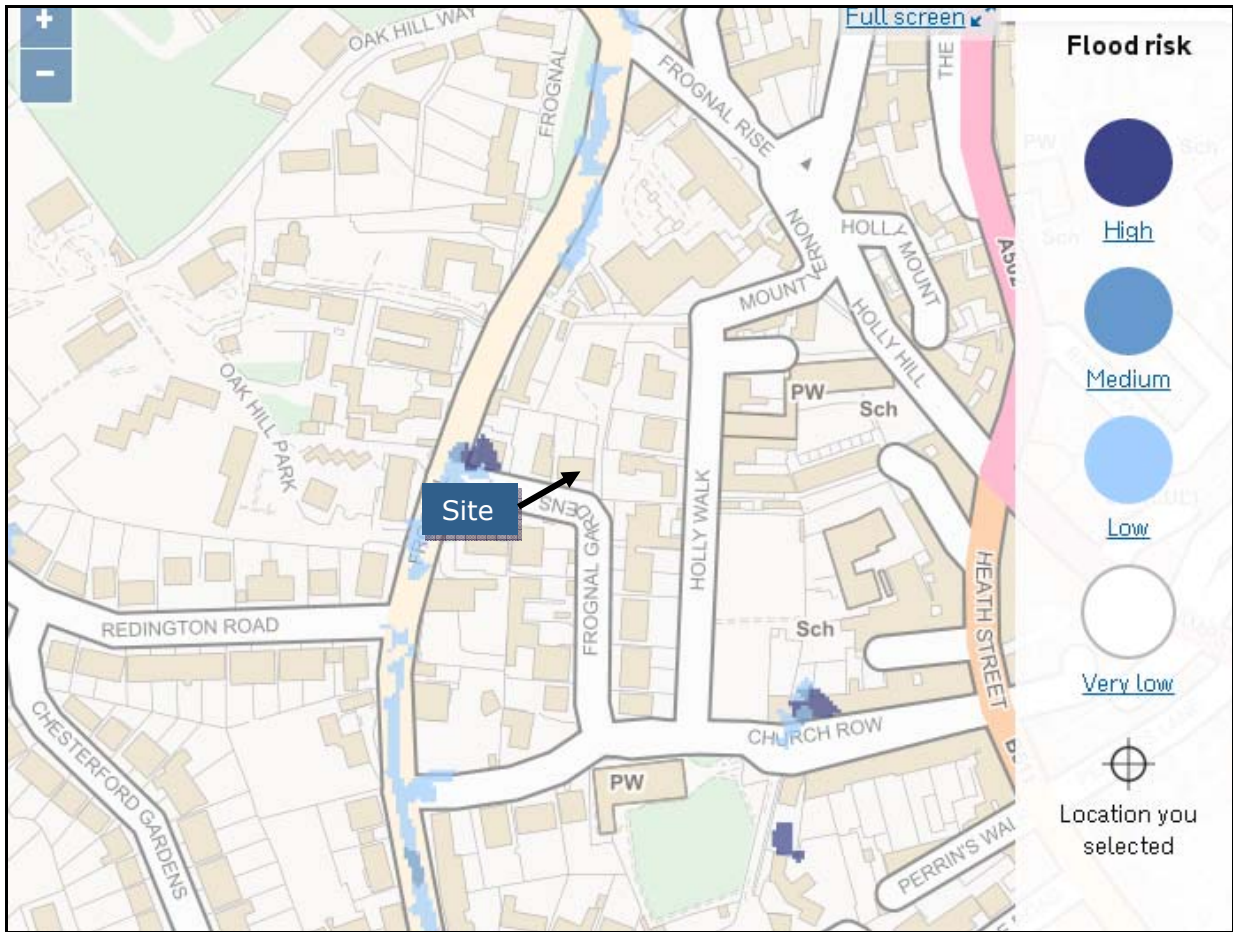


Figure 3: Environment Agency Surface Water Flooding Map (Source: Environment Agency, 2019)

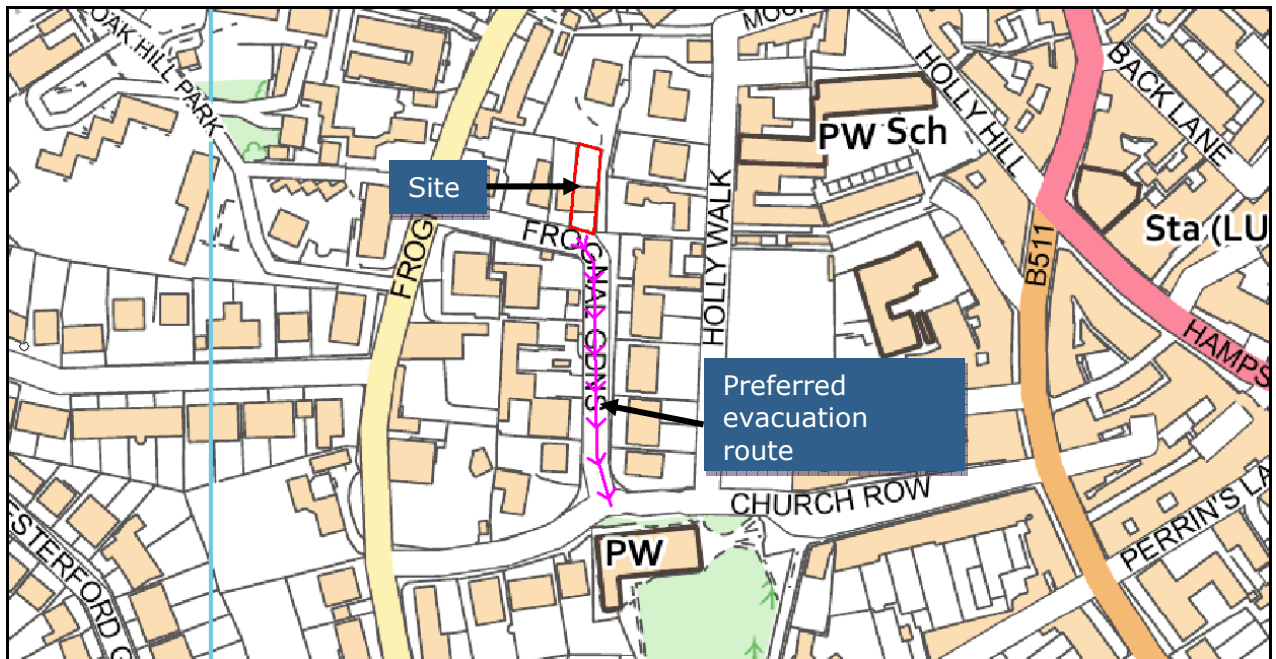


Figure 4: Preferred evacuation route

Sewer Flooding

- 4.4.7 Figure 5a/Rev 1 of the SFRA indicates that the site is located across an area which has had no internal recorded sewer flooding incidents. Figure 5b/Rev 1 of the SFRA that the site is located across an area which has had no external sewer flooding incidents.
- 4.4.8 It is considered that there is an overall low risk of sewer flooding at the site.
- 4.4.9 It is considered that the site should be fitted with a positive pumped device so that it will be protected further from sewer flooding.
- 4.4.10 In addition to the pumped device there should be a non-return valve (e.g. <http://www.forgevalves.co.uk/>) installed so that if the sewers become completely full during a heavy storm, foul water does not backflow into the property.
- 4.4.11 This approach is recommended in section 6.16 of the *Camden Planning Guidance – Basements* dated 2018.

4.5 Reservoirs, Canals And Other Artificial Sources

- 4.5.1 The failure of man-made infrastructure such as flood defences and other structures can result in unexpected flooding. Flooding from artificial sources such as reservoirs, canals and lakes can occur suddenly and without warning, leading to high depths and velocities of flood water which pose a safety risk to people and property.
- 4.5.2 The Environment Agency's "Risk of flooding from reservoirs" map suggests that the site is not at risk from reservoirs.

5. SURFACE WATER DRAINAGE AND SUDS

- 5.1 Policy 5.13 in Chapter 5 of the London Plan dated March 2015, requires sustainable drainage systems (SUDS) to be installed where appropriate and in line with the drainage hierarchy in order for runoff to be managed as close to its source as possible. The London Plan states that SUDS should be utilised unless there are practical reasons for not doing so.
- 5.2 There will be a slight increase in impermeable area as a result of the proposed lower ground floor extending into the rear garden.
- 5.3 Opportunities for incorporating SUDS across the site have been identified and consist of the replacement of existing impermeable surfaces at the front of the site with permeable paving (i.e. across the driveway), together with additional planting across part of the lower ground roof area at the front of the property.
- 5.4 This will result in an overall net reduction in impermeable area across the site. Therefore, there will not be an increase in runoff rate or runoff volume as a result of the proposed development.

6. CONCLUSIONS

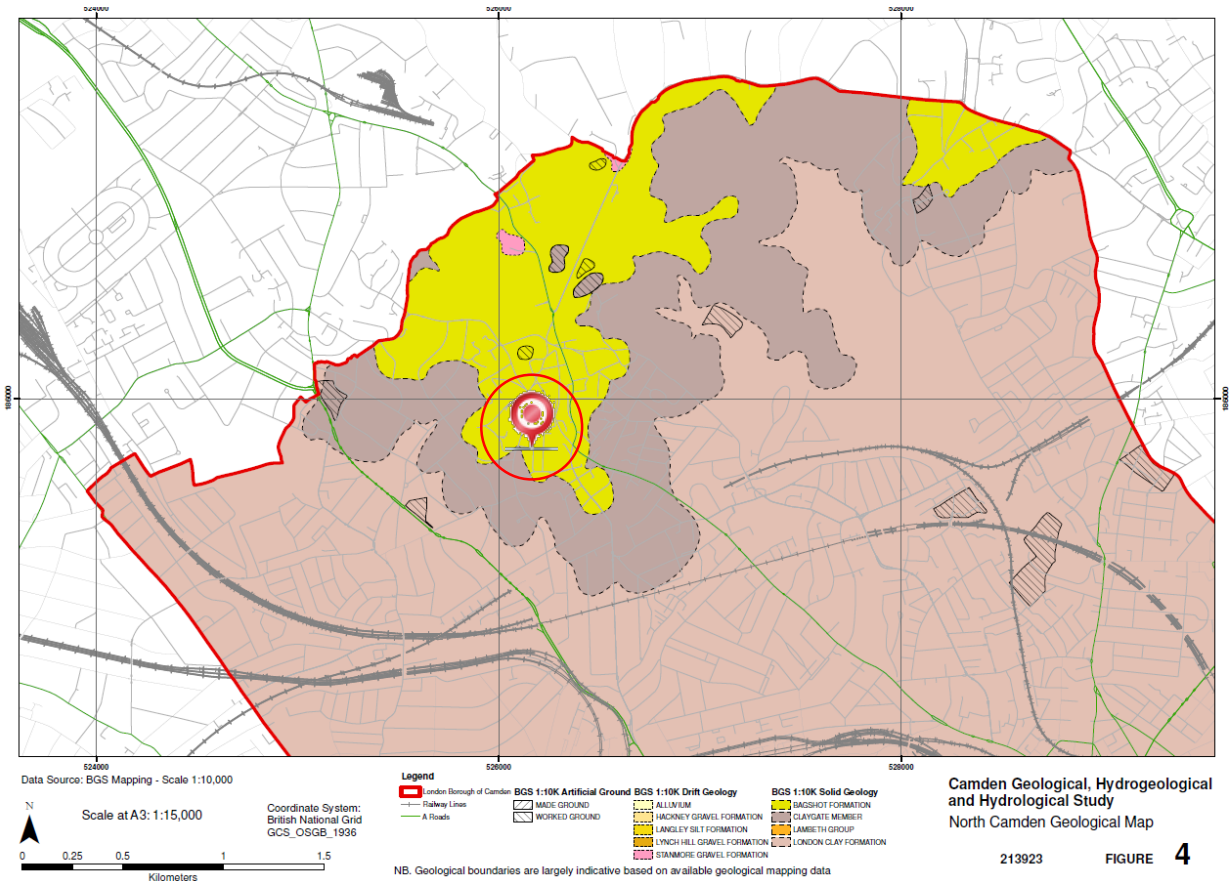
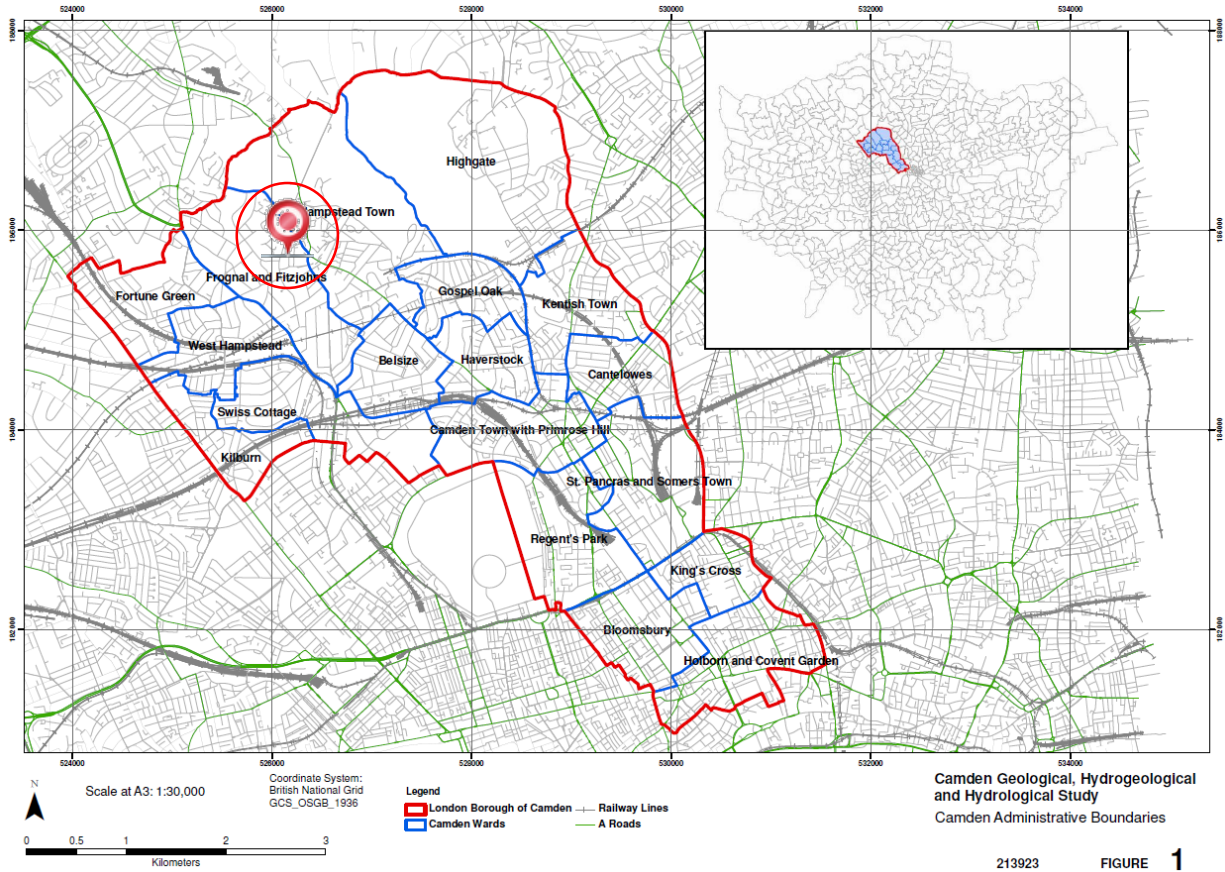
- The site is located within Flood Zone 1.
- This assessment has investigated the possibility of groundwater flooding and flooding from other sources at the site. It is considered that there will be a moderate risk of groundwater flooding which will be mitigated by tanking of the lower ground floor.
- There is a very low surface water flood risk across the site and along Frognal Gardens.
- There is a low sewer flooding risk, however, it is considered that the site should be fitted with a positive pumped device so that it will be protected further from sewer flooding. In addition to the pumped device there should be a non-return valve (e.g. <http://www.forgevalves.co.uk/>) installed so that if the sewers become completely full during a heavy storm, foul water does not backflow into the property.
- There will not be an increase in surface water runoff from the site and there will be no overall net increase in impermeable area. Existing impermeable hardsurfaces at the front of the property will be retrofitted using SUDS permeable paving which will lead to a net reduction in impermeable area and runoff.

7. BIBLIOGRAPHY

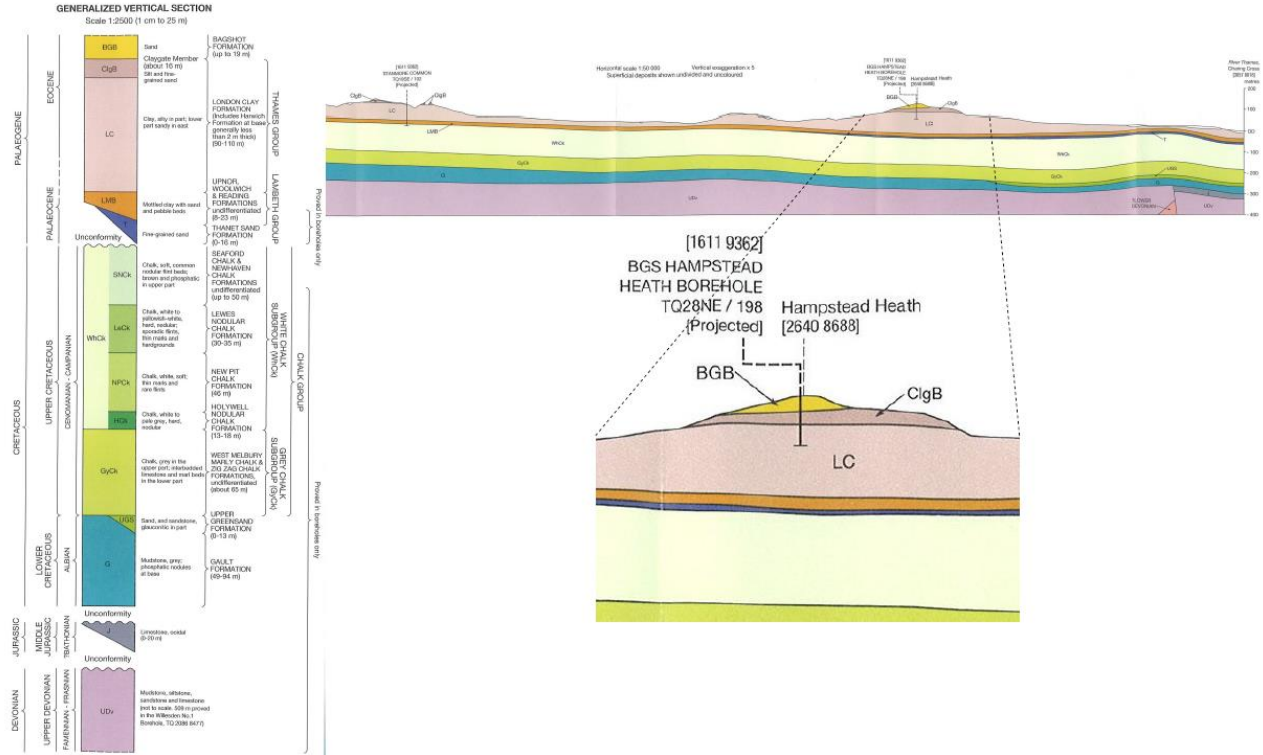
- i. *Camden Planning Guidance – Basements* dated 2018.
- ii. *Camden Planning Guidance – Water and Flooding* dated 2018.
- iii. Communities and Local Government 2018. *National Planning Policy Framework*.
- iv. DEFRA/EA 2005. *Framework and guidance for assessing and managing flood risk for new development, Phase 2, Flood and Coastal Defence R&D Programme, R&D Technical Report FD2320/TR2*. Water Research Council.
- v. DEFRA/Jacobs 2004. *Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS), Final Report, Volumes 1 and 2*.
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- vii. Institute of Geological Sciences 1977. *Hydrogeological Map of England and Wales, 1:625,000*. NERC.
- viii. London Borough of Camden Preliminary Flood Risk Assessment (PFRA) Version 0.2 dated 2011.
- ix. London Borough of Camden Strategic Flood Risk Assessment (SFRA) dated 2014.
- x. London Borough of Camden Surface Water Management Plan (SWMP) Version 1 dated 2011.
- xi. London Borough of Camden flood risk management strategy (FRMS) dated 2013.
- xii. Water UK 2012. *Sewers for Adoption 7th Edition, A design and construction guide for developers*. Water Research Council.



Arup Figs for BIA



Arup Figs for BIA

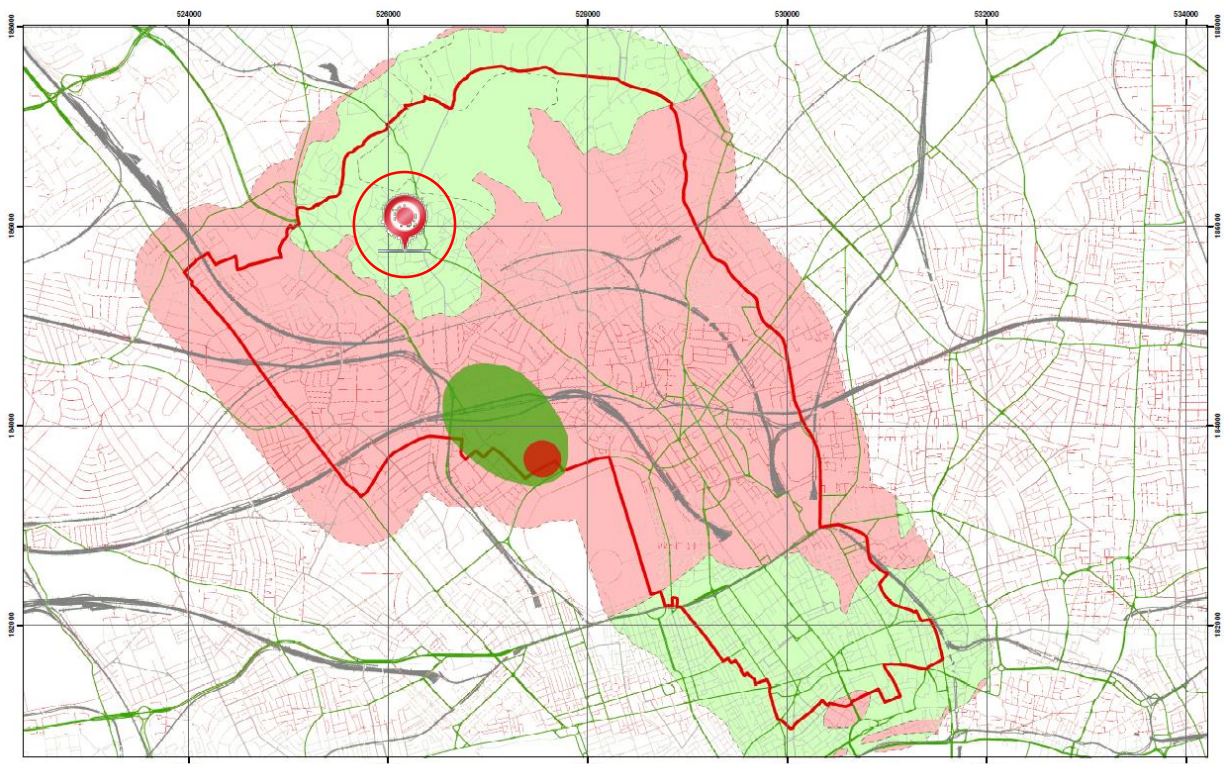


Source - British Geological Society, 1:50,000 Series England and Wales Sheet 256 - North London

Camden Geological, Hydrogeological and Hydrological Study Geological Long Section (NW - SE)

213923

FIGURE 7



Environment Agency Aquifer Designation based on BGS Mapping
 Scale at A3: 1:30,000
 Coordinate System: British National Grid GCS_OSGB_1936

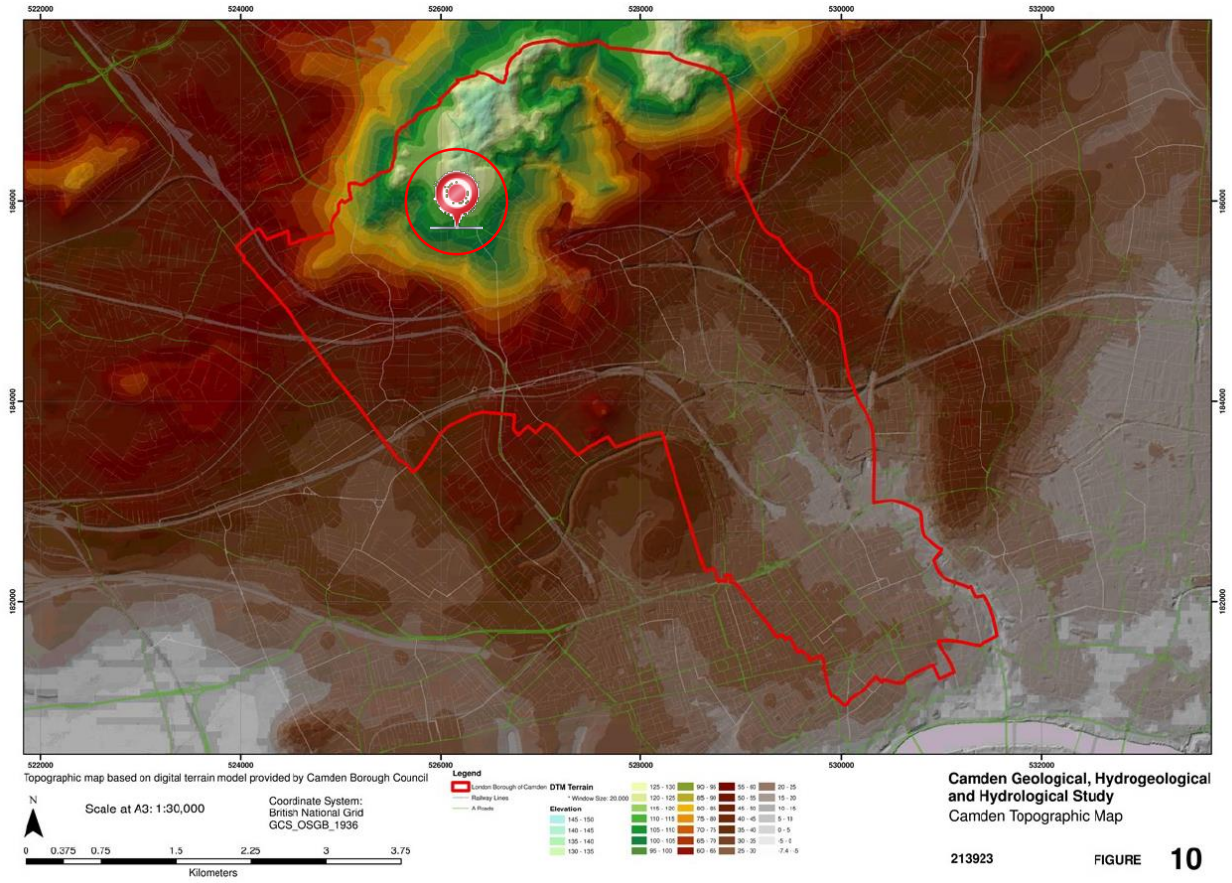
Legend
 Borough of Camden
 Railway Lines
 A Roads
 Aquifer Designation
 Secondary A Aquifer
 Unproductive Strata
 Source Protection Zone
 Outer Source Protection Zone
 Inner Source Protection Zone
 NB. Aquifer boundaries are indicative based on available geological mapping data

Camden Geological, Hydrogeological and Hydrological Study Camden Aquifer Designation Map

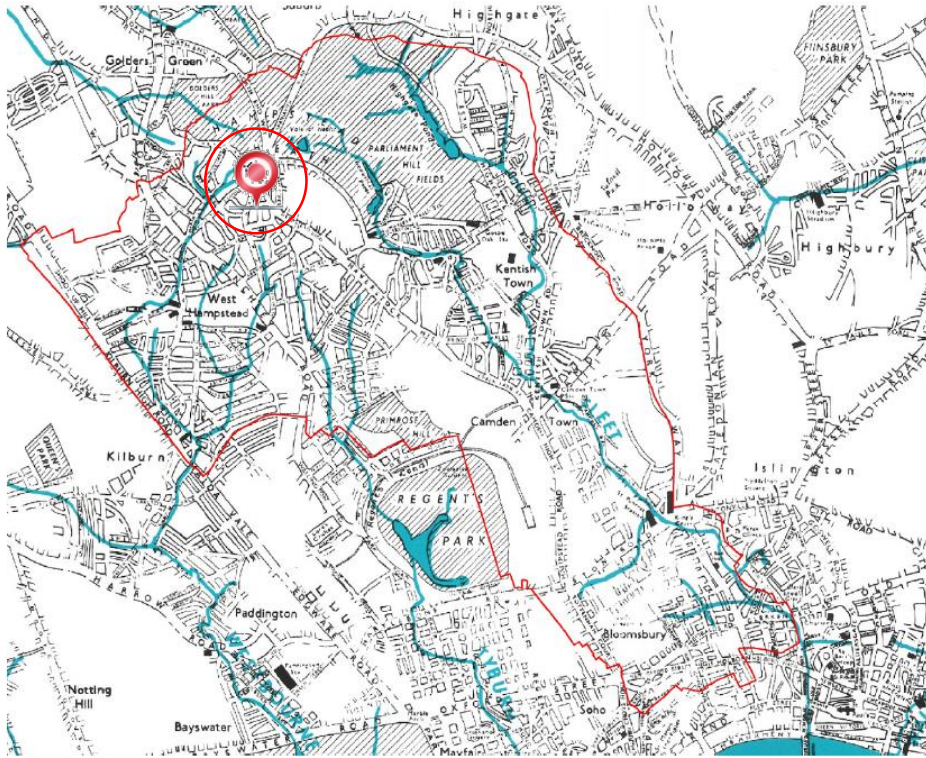
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FIGURE 8

Arup Figs for BIA



Arup Figs for BIA

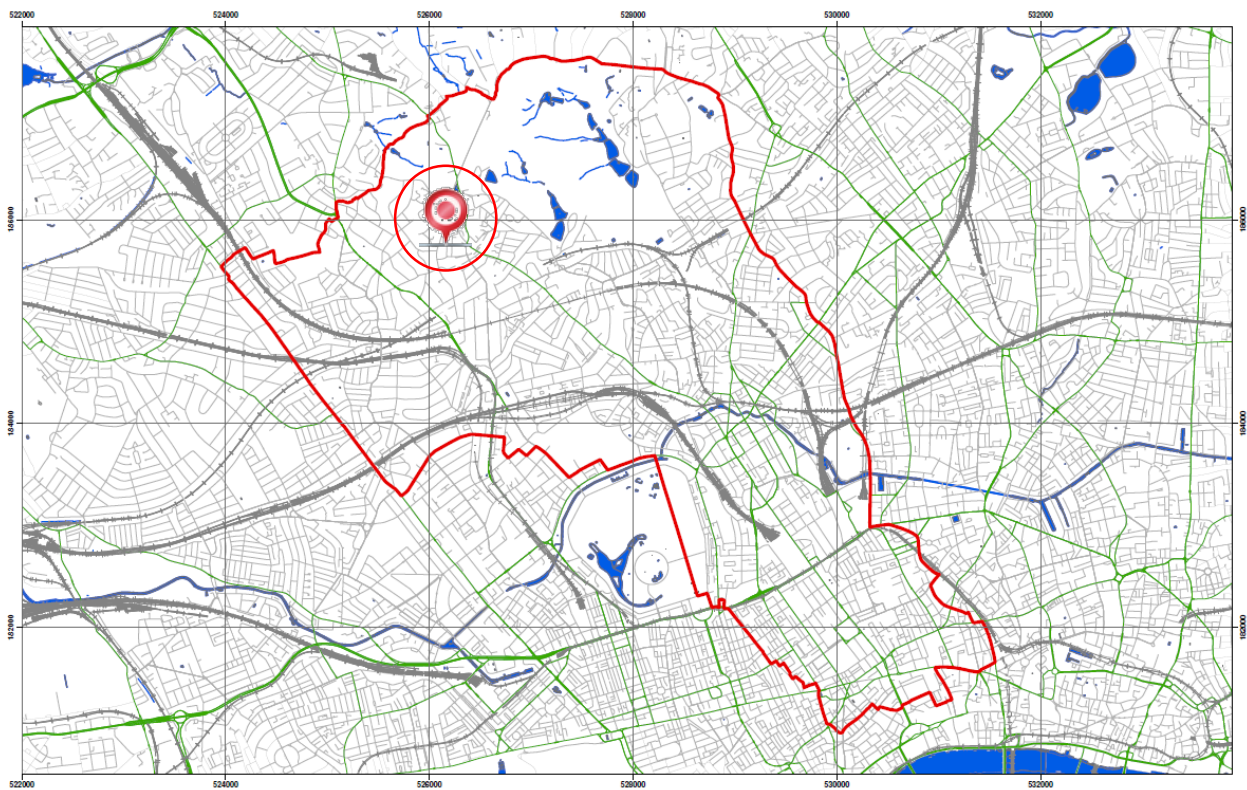


Camden Geological, Hydrogeological and Hydrological Study
Watercourses

Source – Barton, Lost Rivers of London

213923

FIGURE 11



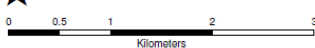
Data Source: London Borough of Camden, 2010

Scale at A3: 1:30,000

Coordinate System:
British National Grid
GCS_OSGB_1996

Legend

- ▭ London Borough of Camden
- Surface water
- Railway Lines
- A Roads



Camden Geological, Hydrogeological and Hydrological Study
Camden Surface Water Features

213923

FIGURE 12

Arup Figs for BIA

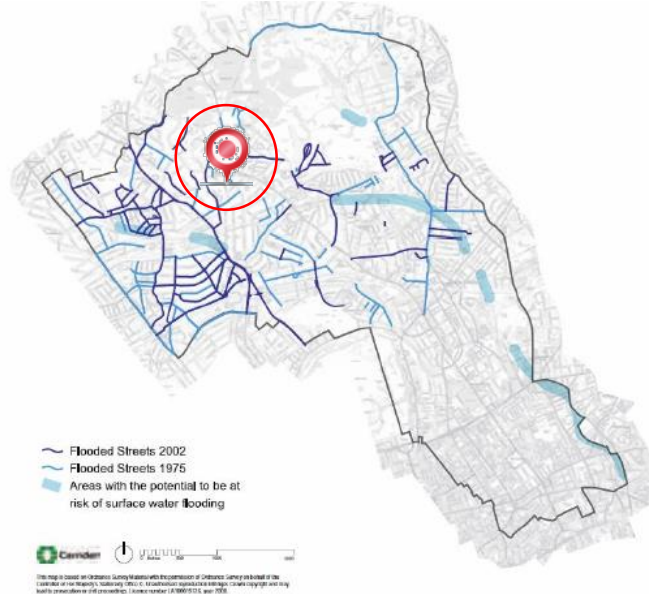
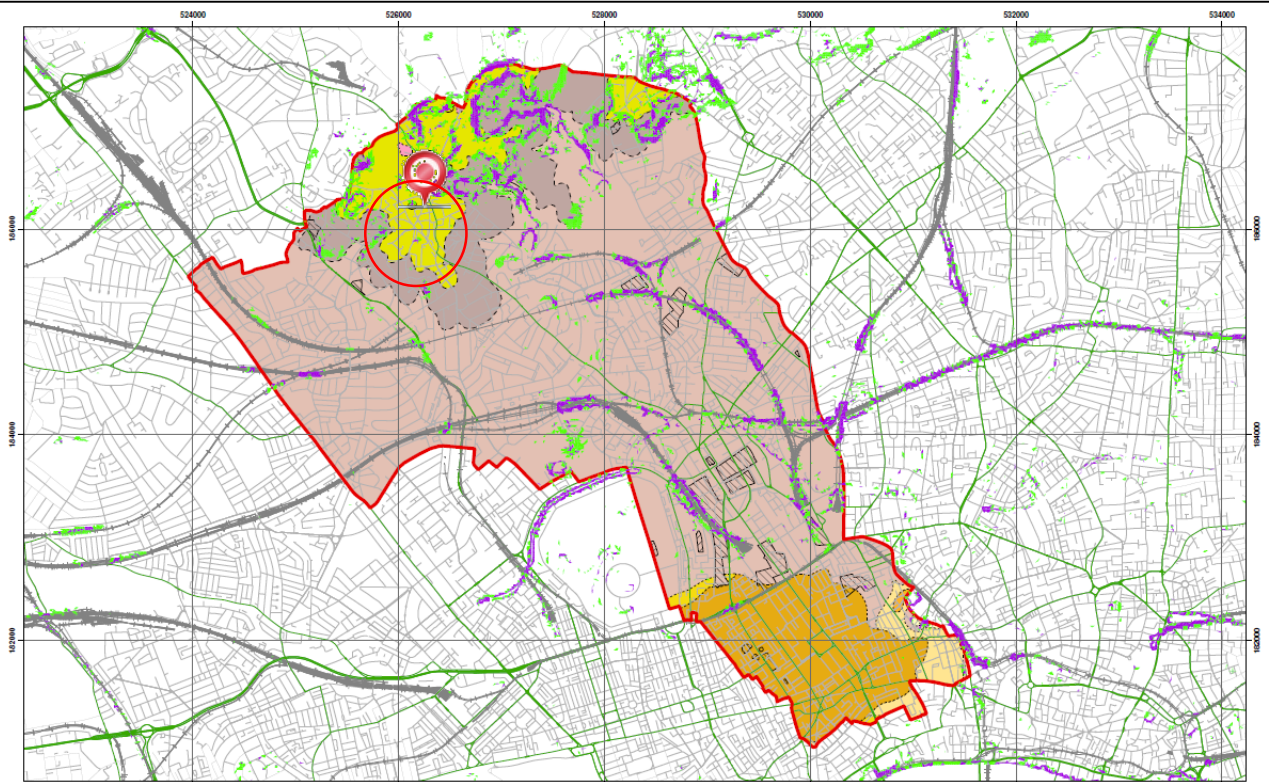


Figure 5 from Core Strategy, London Borough of Camden

**Camden Geological, Hydrogeological and Hydrological Study
Flood Map**

213923

FIGURE 15



Slope Angles calculated from Digital Terrain Model Provided By Camden Borough Council

Scale at A3: 1:30,000
 1:10,000 BGS Mapping
 Coordinate System:
 British National Grid
 GCS_OSGS_1936

Legend
 Slope: 0°-2° (Green), 2°-10° (Yellow), >10° (Red)
 London Borough of Camden (Red outline)
 Railway Lines (Black dashed)
 A Roads (Green dashed)
 BGS 1:10K Artificial Ground (Grey)
 MADE GROUND (Black outline)
 WORKED GROUND (Black outline)
 BGS 1:10K Drift Geology: ALLUVIUM (Light Green), HACKNEY GRAVEL FORMATION (Light Blue), LANSLEY HILL FORMATION (Light Purple), STANMORE GRAVEL FORMATION (Light Orange)
 BGS 1:10K Solid Geology: BAGSHOTT FORMATION (Light Green), CLAYGATE MEMBER (Light Blue), AMBETH GROUP (Light Purple), LONDON CLAY FORMATION (Light Orange)

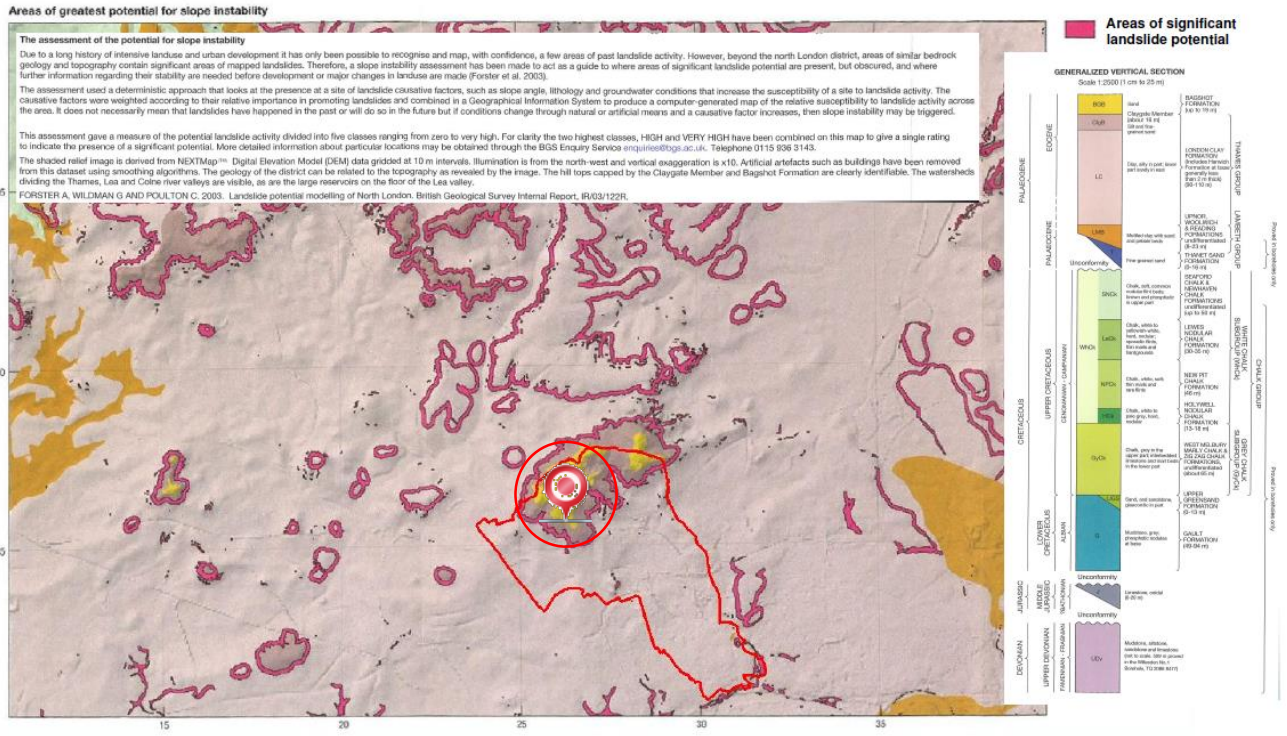
**Camden Geological, Hydrogeological and Hydrological Study
Slope Angle Map**

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FIGURE 16

NB. Geological boundaries are largely indicative based on available geological mapping data

Arup Figs for BIA

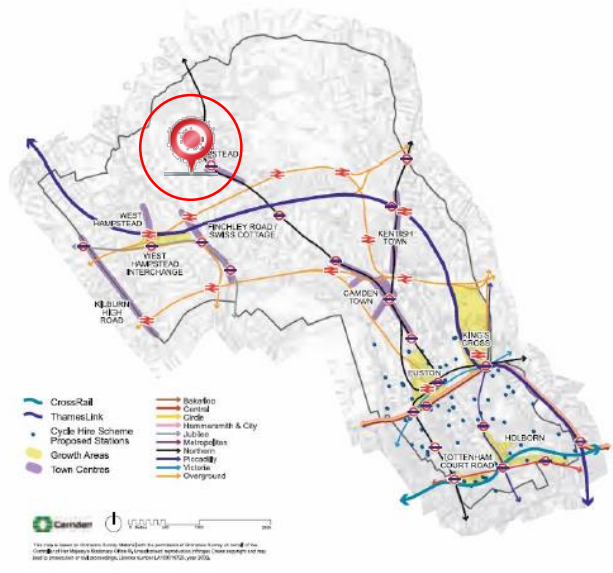


Source - British Geological Society, 1:50,000 Series England and Wales Sheet 256 - North London

Camden Geological, Hydrogeological and Hydrological Study
Areas of landslide potential

213923

FIGURE 17



Source - London Borough of Camden, January 2010. Camden Core Strategy Proposed Submission.

Camden Geological, Hydrogeological and Hydrological Study
Transport Infrastructure

213923

FIGURE 18