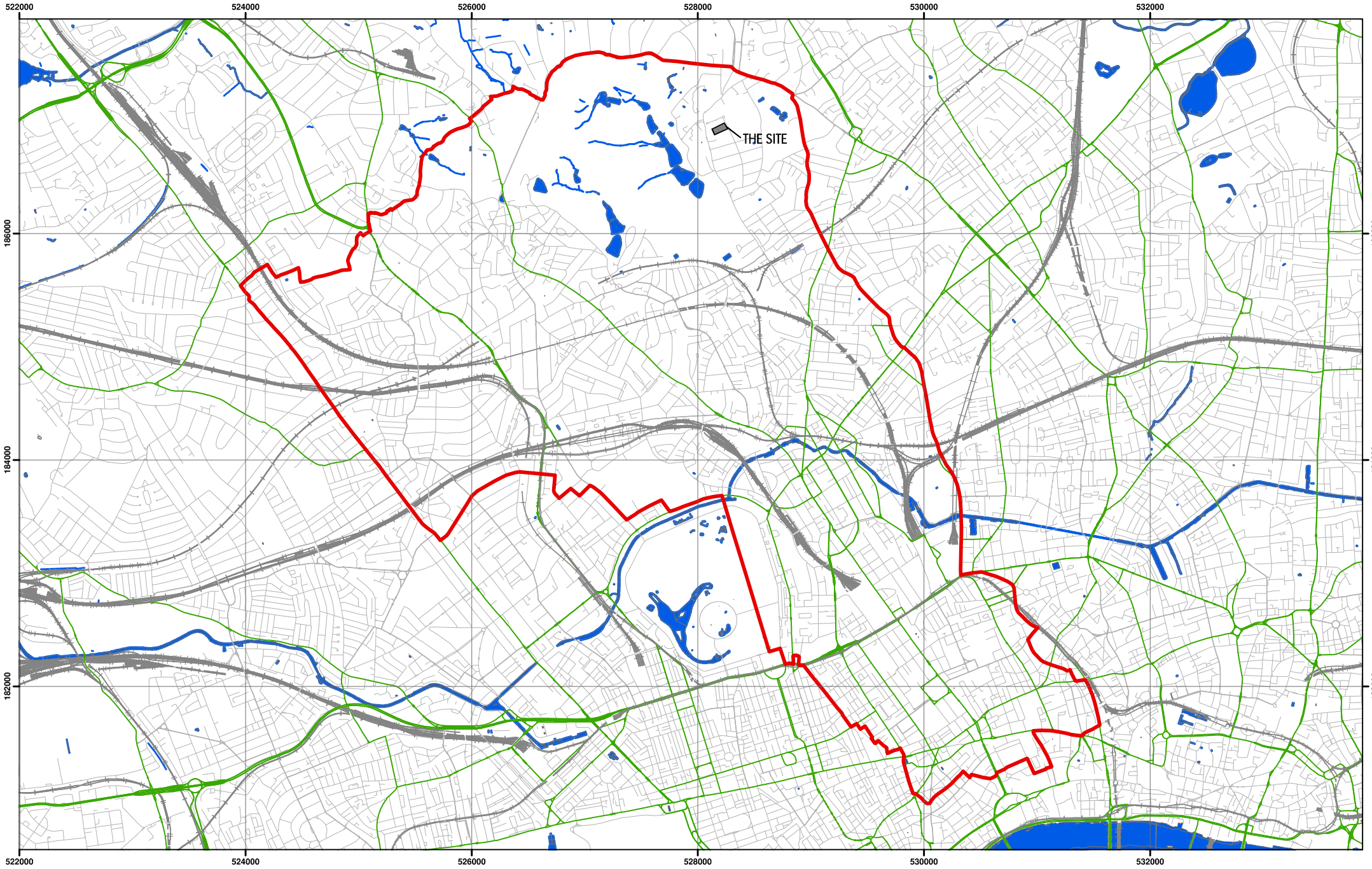


Data Source: London Borough of Camden, 2010

N

Scale at A3: 1:30,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.5 1 2 3
Kilometers

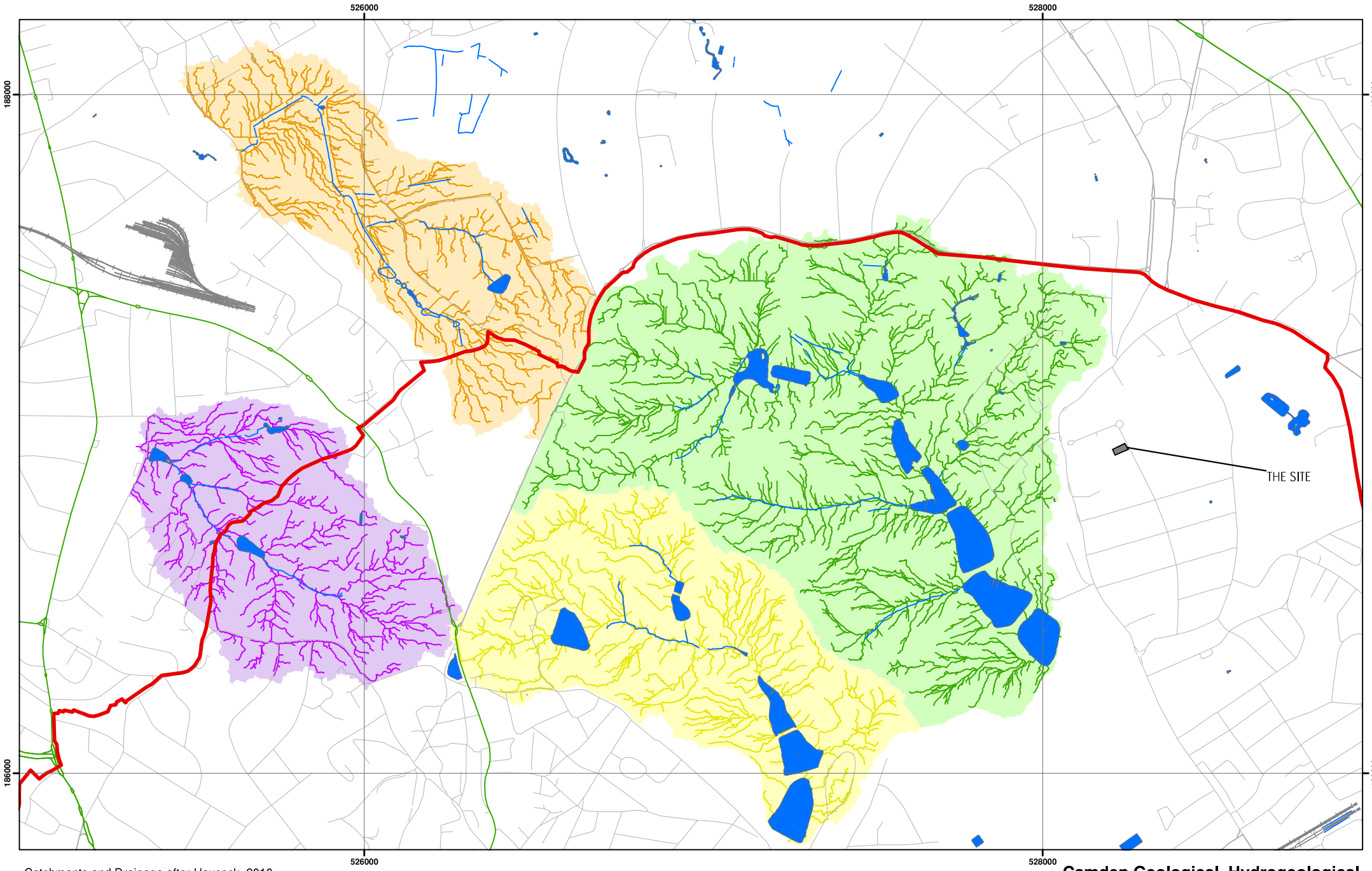
Legend

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

Camden Geological, Hydrogeological and Hydrological Study

Camden Surface Water Features

Report: J11891 Site: 93 Hillway, London N6 Figure: 4



Catchments and Drainage after Haycock, 2010

N

Scale at A3: 1:10,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.125 0.25 0.5 0.75 1
Kilometers

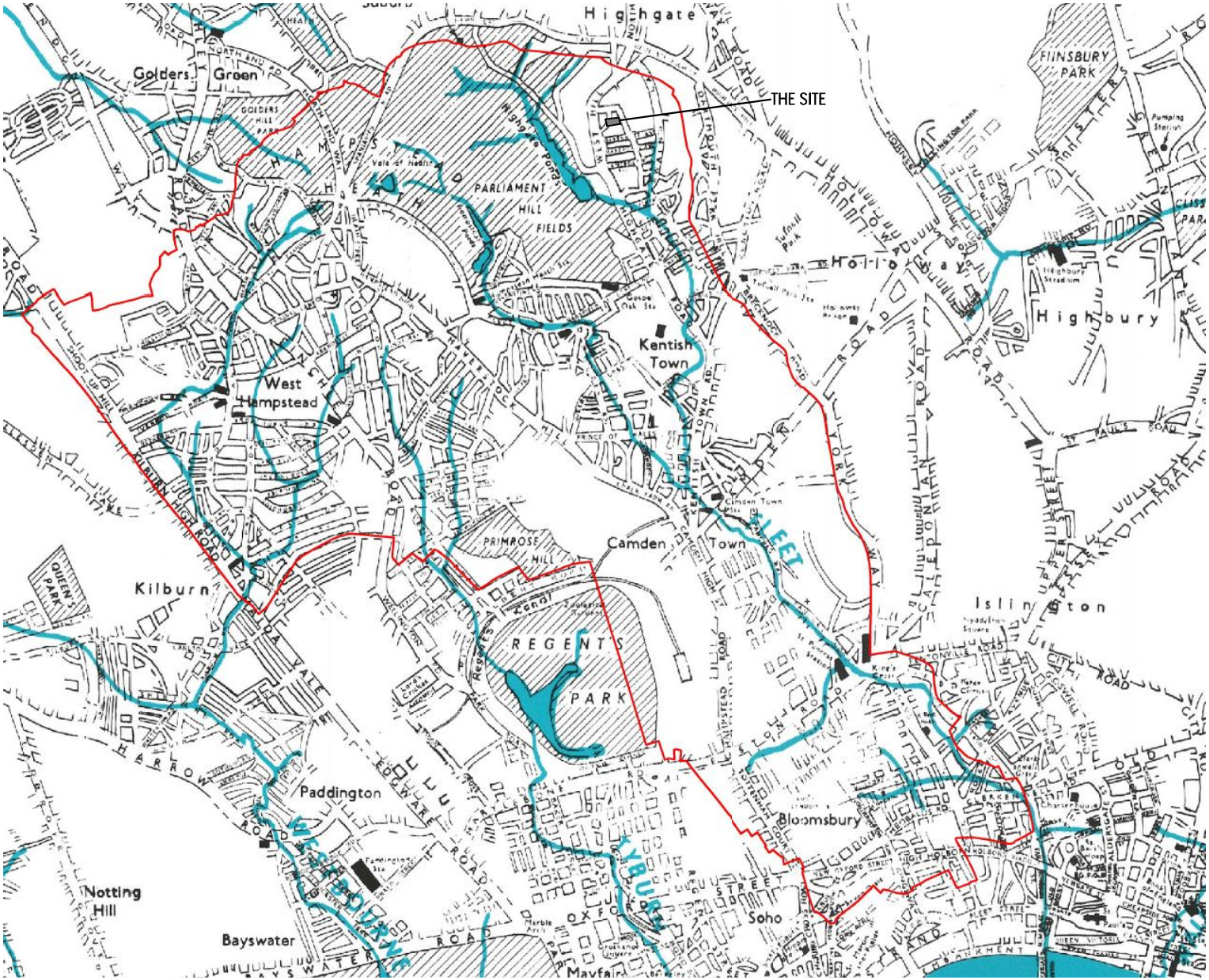
Legend

- London Borough of Camden
- Railway Lines
- A Roads
- Surface Water
- Highgate Chain Catchment
- Golders Hill Chain Catchment
- Hampstead Chain Catchment
- Hampstead Heath Extension Chain Catchment

Camden Geological, Hydrogeological and Hydrological Study

Hampstead Heath Surface Water Catchments and Drainage

Report: J11891 Site: 93 Hillway, London N6 Figure: 5



Camden Geological, Hydrogeological and Hydrological Study
Watercourses

Source – Barton, Lost Rivers of London

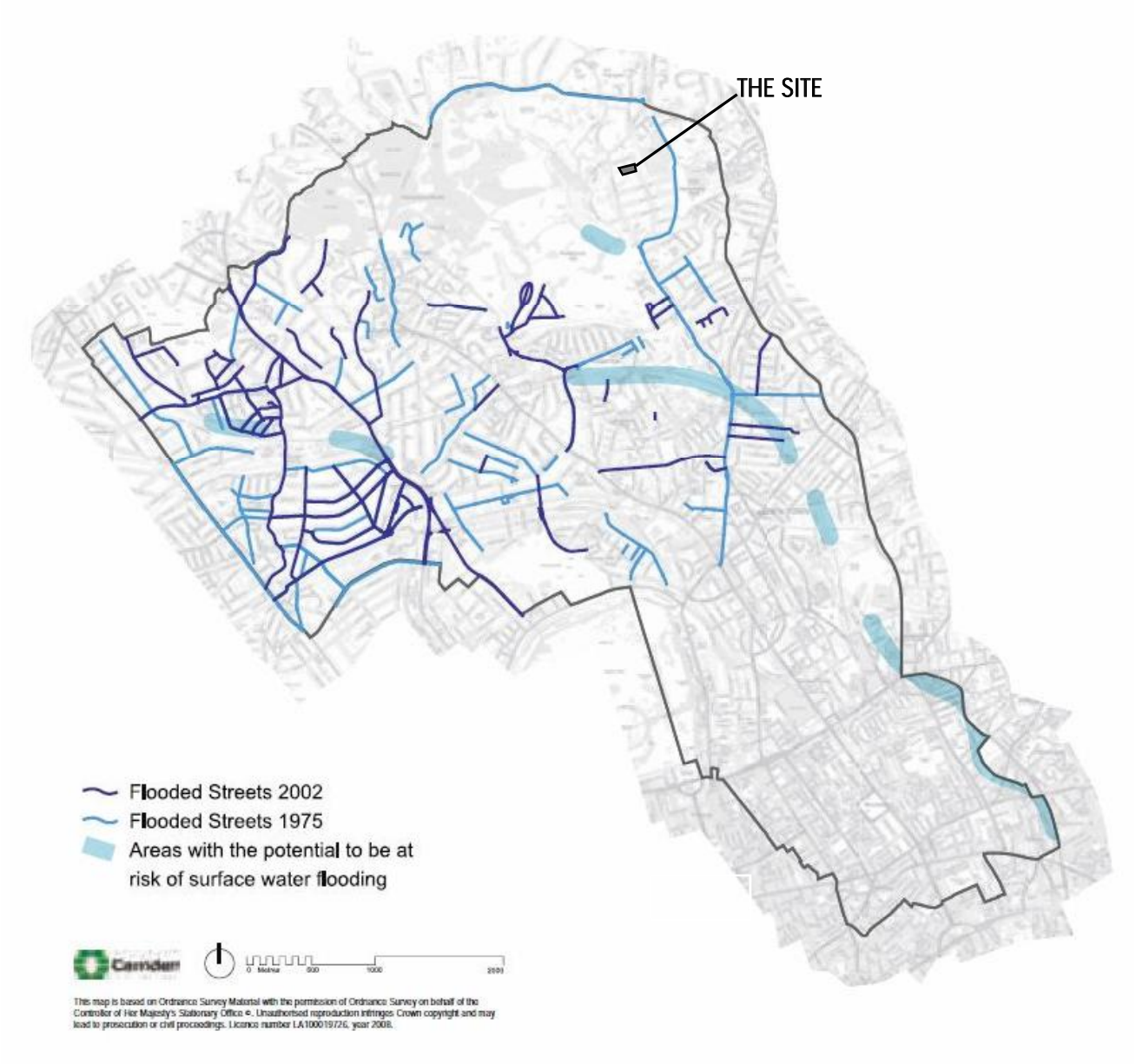
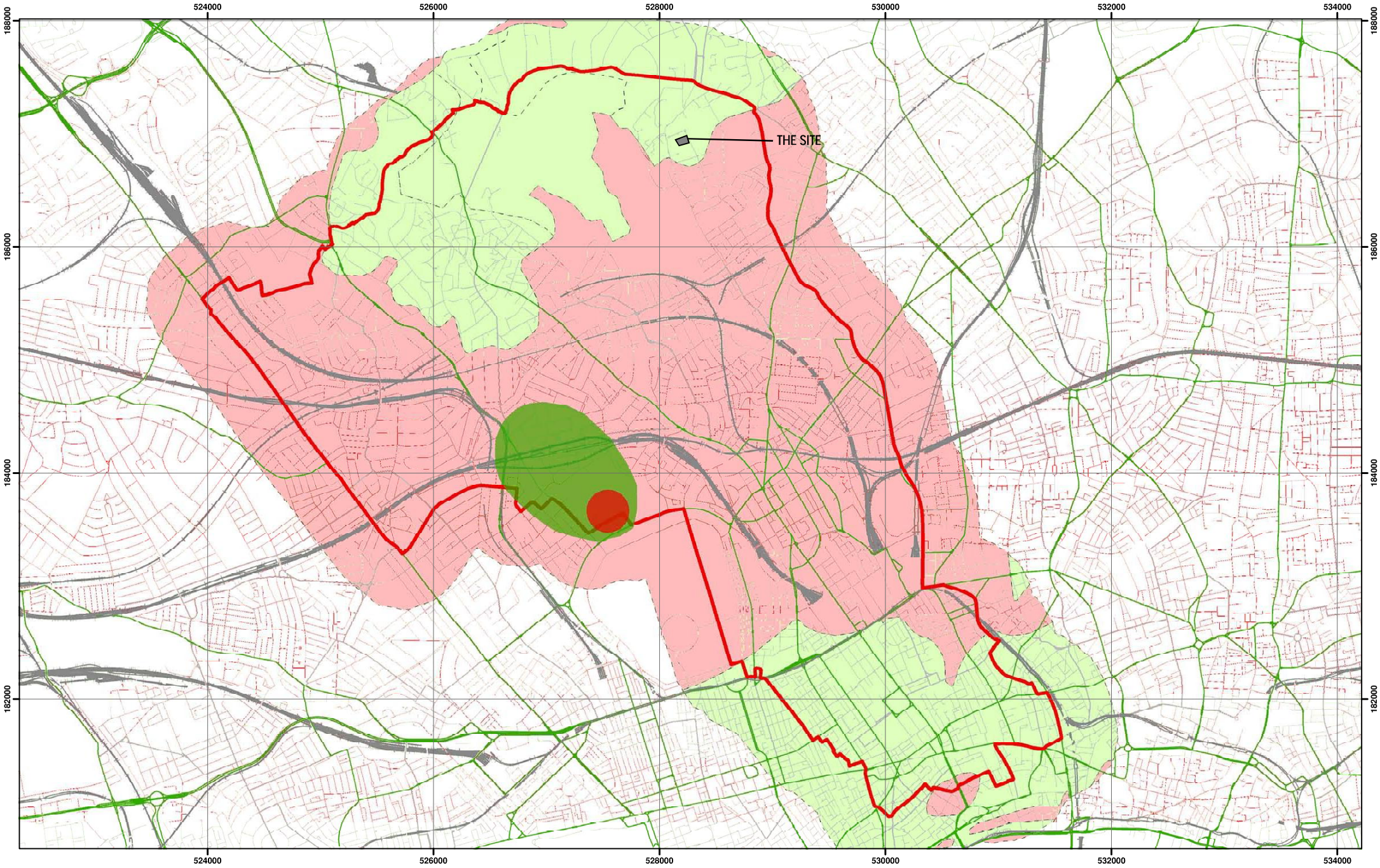


Figure 5 from Core Strategy, London Borough of Camden

Camden Geological, Hydrogeological and Hydrological Study
Flood Map



Environment Agency Aquifer Designation based on BGS Mapping

N

Scale at A3: 1:30,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.5 1 2 3
Kilometers

Legend

- Borough of Camden
- Railway Lines
- A Roads

Aquifer Designation

- Secondary A Aquifer
- Unproductive Strata

Source Protection Zone

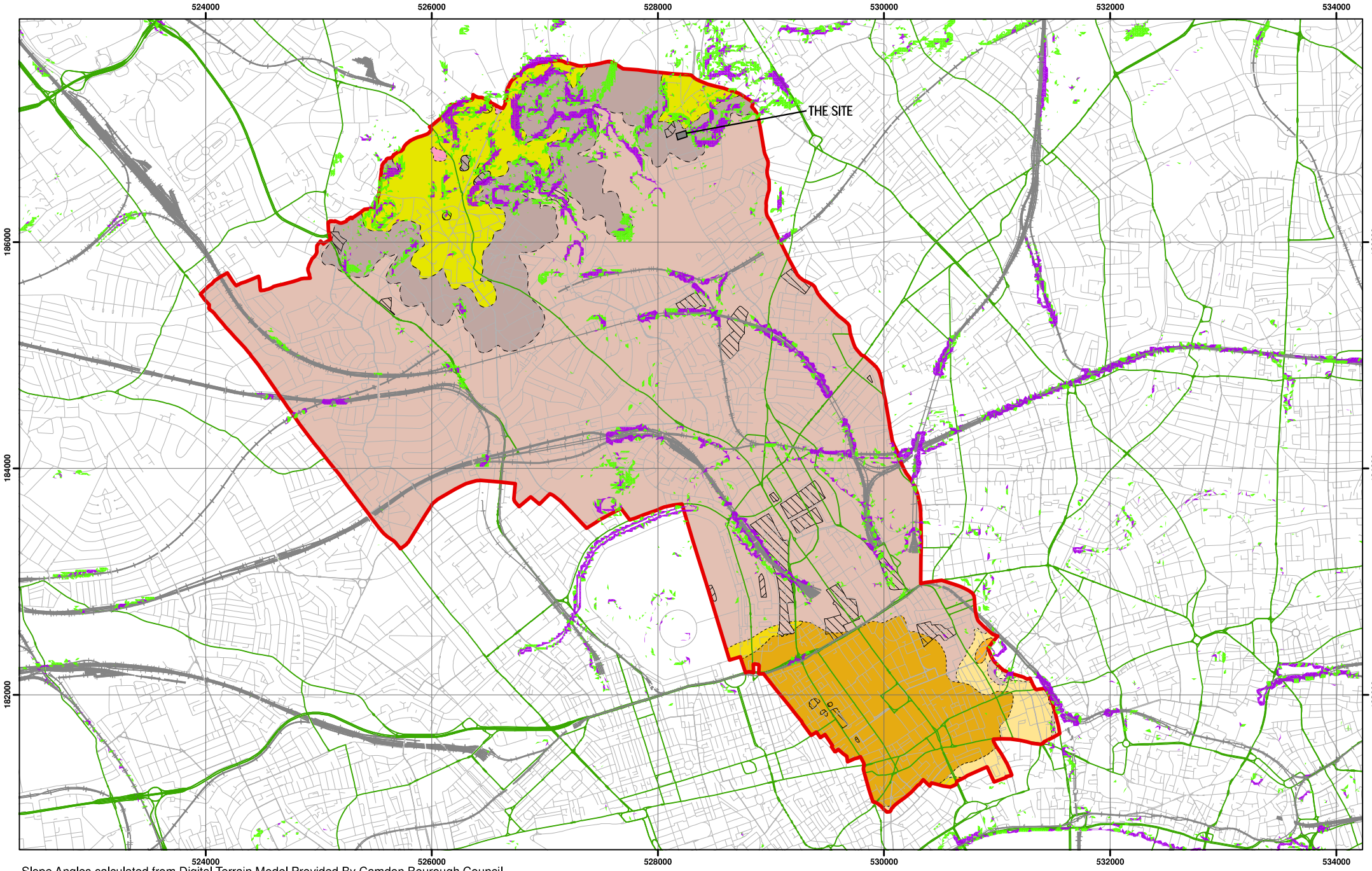
- Outer Source Protection Zone
- Inner Source Protection Zone

NB. Aquifer boundaries are indicative based on available geological mapping data

Camden Geological, Hydrogeological and Hydrological Study

Camden Aquifer Designation Map

Report: J11891 Site: 93 Hillway, London N6 Figure: 8



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

N

Scale at A3: 1:30,000

1:10,000 BGS Mapping
Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.5 1 2 3
Kilometers

Legend

Slope
- 0° - 7°
- 7° - 10°
- > 10°

- London Borough of Camden
- Railway Lines
- A Roads

BGS 1:10K Artificial Ground
- MADE GROUND
- WORKED GROUND

BGS 1:10K Drift Geology
- ALLUVIUM
- HACKNEY GRAVEL FORMATION
- LANGLEY SILT FORMATION
- LYNCH HILL GRAVEL FORMATION
- STANMORE GRAVEL FORMATION

BGS 1:10K Solid Geology
- BAGSHOT FORMATION
- CLAYGATE MEMBER
- LAMBETH GROUP
- LONDON CLAY FORMATION

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

Camden Geological, Hydrogeological and Hydrological Study

Slope Angle Map

Report: J11891

Site: 93 Hillway, London N6

Figure: 9

Southern Testing
Environmental & Geotechnical

Site Investigation Report

Desk Studies | Risk Assessments | Site Investigations | Geotechnical | Contamination Investigations | Remediation Design and Validation

Site: 93 Hillway, Highgate, London N6 6AB

Client: Lisa Lang

Report Date: August 2014

Project Reference: J11891

Southern Testing
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SUMMARY

The site comprises an existing terraced property No 93 Hillway, London, N6 6AB. It is proposed to construct a new replacement below ground swimming pool with simple pool pavilion over.

Geological records indicate the site to be underlain by Claygate Beds, with Bagshot formation outcropping nearby.

A single phase of ground investigation has been undertaken by others.

The soils encountered comprised sandy topsoil over sands and silty sands with thin clay bands at depth. These soils are consistent with either Claygate Beds or the overlying Bagshot Formation.

To date, standing water levels of between 4.36 to 4.90m BGL have been measured within the monitoring wells.

The pool development which is to be constructed using conventional underpinning methods. Parameters for retaining wall design are given.

The design of any subterranean structure system should take account the nature of the existing/adjacent foundations and their condition.

D. Vooght MSc
(Countersigned)

Jon Race MSc CGeol
(Signed)

For and on behalf of Southern Testing Laboratories Limited

STL: J11891
3 September 2014

TABLE OF CONTENTS

A INTRODUCTION

1 Authority

Our authority for carrying out this work was given in an email dated 19th June 2014 from Mr Peter Zussman of Zussman bear, the structural engineers, on behalf of the client Lisa Lang.

2 Location

The subject site comprises an existing terraced property, 93 Hillway, London, N6 6AB. The approximate National Grid Reference of the site is TQ 294 831.

3 Proposed Construction

It is proposed to construct a new swimming pool and enclosing building at the rear of the property. The proposed pool will replace an existing above-ground pool on more or less the same footprint. It is understood that the works will be undertaken using conventional reinforced concrete construction methods.

4 Object

Intrusive works and groundwater monitoring have been undertaken by others (refer Appendix A), and our report comments on ground conditions and other soil parameters relevant to the proposed scheme. An initial Basement Impact Assessment (screening & scoping) was undertaken and this report addresses some of the issues that came out of that exercise.

5 Scope

This report presents our Basement Impact Assessment, ground investigation information supplied by others and our interpretation of these data.

As with any site there may be differences in soil conditions between exploratory hole positions.

Issues relating to contamination are outside of the scope of this investigation.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

The findings and opinions conveyed via this Site Investigation Report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Limited believes are reliable. Nevertheless, Southern Testing Laboratories Limited cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Lisa Lang and her appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing

Laboratories Limited. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes.

B THE SITE

5.1 Geology

The British Geological Survey Map at 1:50,000 indicates that the site geology consists of Claygate Member, but the site is recorded as being very close to the boundary with the overlying Bagshot Formation.

Bagshot Formation

This formation consists of fine white, buff and crimson sands with occasional seams of pipe clay, silt, and local beds of flint gravel. The Beds are usually 30-45m in thickness and often have a band of flint pebbles at the base. There is a basal layer of mottled loams and clay, with subordinate amounts of reddish sand that resembles the Reading Beds. The clays are succeeded by more sandy, locally pebbly, yellow or gold coloured strata. These beds produce a marked feature above the loam, and sometimes have been taken as the junction with the underlying London Clay. The uppermost part of the formation is a grey clay and mottled loam, about 6m thick in the type area.

Claygate Member

The Claygate Member of the London Clay formation comprises sandy transition beds, about 15 m thick, at the top of the London Clay and consists of alternations of sand and clay. Sand predominates above, and clay below. They were commonly worked for brick making.

5.2 Hydrology and Hydrogeology

Data from the Environment Agency and other information relating to controlled waters is summarised below. The groundwater vulnerability assessment is based on the current data on the EA website.

Data		
Groundwater Vulnerability	Superficial Deposits	There are no superficial deposits mapped.
	Bedrock	Secondary A aquifer, relating to the Bagshot Formation and Claygate Member. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
Source Protection Zones		The site is not located within a Source Protection Zone.

Data	
Surface Water Features	There are no surface water features within the immediate vicinity of the site. The nearest surface water features are Highgate Ponds some 400m to the southwest of the site.
Flood Risk from Surface Water	On the basis of the information given on the EA website the site is not located within an area at risk of flooding from surface water.
Flood Risk from Fluvial Sources	On the basis of the information given on the EA website the site is not located within an area at risk of flooding from fluvial sources.

5.3 Radon Risk

With reference to BRE guidance, no radon protection is required on this site.

5.4 Bomb Map

The published bomb map for the area taken from the London County Council Bomb Damage Maps (1939-1945), shows that the site did not suffer any bomb damage during WWII.

5.5 Site Location

The subject site comprises an existing terraced property, 93 Hillway, London, N6 6AB. This site is located in a private gated road on the eastern side of Hampstead Heath. It is approximately 800m west of Archway Underground Station.

5.6 General Description

The subject property 93 Hillway comprises a two-storey terraced residential dwelling with gardens to the front and rear. The property is believed to have been developed as part of the Holly Tree Lodge Estate in the 1920's on what was previously private parkland. The existing building appears to be of masonry brick construction.

On the more northern and southern sides the site is bounded by adjacent terraced properties and their respective rear garden areas. The site is bounded on its rear (western) side by a fairly steeply sloping wooded slope.

The rear area comprises a small terrace with steps leading to a lawned area and shrub lined borders. Also to the rear is a raised above ground pool with decking around and underpool storage. In terms of vegetation, the site itself has a number of mature shrubs within the rear garden area. There are mature trees to the southwest beyond the site boundary and some semi-mature trees within the garden of 95 Hillway. To the front Hillway is lined with mature trees mainly London Plane.

The adjacent terraced properties are residential, of similar age and construction to that of the subject building and are understood not to have basements.

Regionally ground levels slope towards the south and southwest, with a steeply wooded slope beyond the end of the garden to 93 Hillway.

C SITE INVESTIGATION

11 Method

A factual site investigation was undertaken by others (Herts & Essex Site Investigation). The fieldwork was carried out on the 9th July 2014 at which time the weather was hot and dry.

The intrusive investigation comprised the following:

- 2 No window sample holes (BH1 & BH2) were carried out to depths of 6m with insitu testing and sampling;
- Groundwater monitoring wells were installed in both exploratory holes and monitored on two occasions;
- Particle size distribution determinations were undertaken on some of the recovered soil samples.

The exploratory hole logs, plan and test results are included in Appendix A.

12 Soils as Found

The soils encountered during the investigation (BH1 & BH2) are described in detail in the attached exploratory hole logs (Appendix A). It is not clear whether the soils beneath this site are part of Claygate Beds or the base of the Bagshot Formation. A brief summary of the soils encountered is also given below.

Depth to Base (m BGL)	Soil Type	Description
0.2/0.3	TOPSOIL	Sandy TOPSOIL.
2.7/3.7	CLAYGATE BEDS/BAGSHOT FORMATION?	Medium dense yellow brown fine SAND.
6.0+	CLAYGATE BEDS/BAGSHOT FORMATION?	Medium dense orange brown silty fine SAND with thin bands of silty CLAY.

The variation in strata depths seen within the two boreholes probably reflects that these materials are very gradational in their stratigraphical changes and the difference in ground levels between the boreholes rather than significant dips to the beds themselves.

13 Groundwater Observations

A summary of the various water level observations during siteworks is given below.

Test Location	Water Strikes/Observations
BH1	Very slight seepage at 5.00m
BH2	Moderate seepage at 3.90m

13.1 Groundwater Monitoring

Following the initial fieldworks the site was re-visited on two separate occasions, to monitor the standpipes. The results of these measurements are given below.

Date of Reading	BH1 Standing Water Level mBGL (mASD)*	BH2 Standing Water Level mBGL (mASD)*
29/07/2014	4.88 (100.28)	4.36 (101.03)
29/08/2014	4.90 (100.26)	4.39 (101.00)

*m Above Site Datum – taken from topographic survey.

D DISCUSSION OF GEOTECHNICAL TEST RESULTS AND RECOMMENDATIONS

14 Soil Classification and Properties

Soil Type	Depth	Compressibility	VCP	Permeability	Frost Susceptible	Remarks
Topsoil	GL to 0.2/0.3m	N/A	N/A	N/A	Yes	
Sand	0.2/0.3 to 2.7/3.7m	Low to Medium	Negligible	Fair	Yes	
Silty Sand with thin clay bands	2.7/3.7 to 6.0m+	Low to Medium	Negligible	Fair but vertical permeability will be affected by the clay bands	Yes	

15 Swelling and Shrinkage

The results of the particle size distribution tests indicate that the percentage of clay and silt particles are too low to regard these soils are being potentially shrinkable as defined by the NHBC guidelines. Therefore no special precautions for the construction of the proposed pool and its pavilion will need to be applied in regard to shrinkage and swelling.

16 Groundwater Levels

It should be noted that ground water levels vary considerably from season to season and year to year, often rising close to the ground surface in wet or winter weather, and falling in periods of drought. Long term monitoring is required to assess the ground water regime and this was not possible during the course of this site investigation.

While the siteworks were in progress, groundwater entries were noted within both the exploratory holes.

The two subsequent groundwater monitoring visits to date have measured standing water levels within the monitoring wells of between 4.36 and 4.90m BGL. The monitoring wells have been levelled relative to each other and a site datum. Whilst there are only two monitoring wells and so triangulation of the groundwater surface is not possible, the measurements from the wells indicate that the groundwater gradient appears to be falling towards the west or southwest, away from the buildings. This may be a reflection of the topography which falls gently in this direction within the garden area and then much more steeply beyond that immediately west of the boundary fence.

On the basis of the measurements to date, groundwater ingress is not expected to be a significant problem in terms of dewatering issues etc during construction, as standing water levels are much lower than the structure's formation level. However, as with all excavations, allowances for some dewatering should be made in the form of intermittent pumping from strategically placed collector sumps.

Estimated permeability values for the silty sands and sands on this site give values in the general range of 1×10^{-7} m/s and $1x\ 10^{-5}$ m/s using Hazen approximation methods. These values would be more applicable for horizontal permeability, vertical permeability is likely to be lower given the recorded presence of 'thin bands of silty clay'.

Given the depth of the proposed pool structure, the depth to the underlying standing water levels and the estimated soil permeability values, it would not be anticipated that groundwater levels would rise sufficiently, even during wet weather, for the proposed walls to cause a "damming effect" or mounding of water on the upstream faces.

In terms of the potential cumulative effects of other future subsurface structures such as pools or basements being granted/constructed in the immediate area, again the topography and likely permeabilities/hydraulic gradients should have little influence on groundwater levels both locally or regionally.

On the basis of the observations/comments, it is concluded that the proposed pool development will not result in any specific issues relating to the hydrogeology and hydrology of the site.

17 Sulphates and Acidity

No soluble sulphate or pH value determinations have been undertaken as part of this investigation. It is likely that the sands and silty sands contain low concentrations of soluble sulphate and that DS-1 conditions are present, however, this would need to be confirmed by laboratory testing.

18 Bearing Capacity

We understand that it is proposed to construct the structure of the swimming pool using conventional underpinning methods.

Where it is necessary to construct spread foundations or bases to retaining walls/underpinned sections as part of the proposed works, all foundations should be formed on the underlying natural medium dense sands. For foundations formed on these materials, an allowable bearing capacity of 150kPa may be adopted.

19 Heave

Due to stress relief following the removal of the existing soils to form the pool structure, heave displacements can be expected to occur in the underlying Claygate Beds/Bagshot Formation.

Due to the drained nature of the shallow soils only immediate heave displacements will be relevant and this is likely to occur as excavation of the pool takes place and before the construction of main basal slab.

20 Basement Construction

The following soil parameters are suggested for design of retaining walls:

Soil Type	Bulk density γ_b (kN/m^3)	Undrained Shear Strength (Temporary Condition)	Long Term Drained Condition	
			c' (kN/m^2)	φ^o
Medium dense sands	19	N/A	0	30

21 Excavations and Trenching

Statutory lateral earth support will be required in all excavations where men must work. Given the presence of dry sands and silty sands any unsupported excavation would not be anticipated to be stable even in the short-term. Accordingly, measures should be taken at all times to ensure that excavations are adequately supported or battered back.

Given the location of the proposed excavation, being so close to the property boundary, it will not be practical to batter the excavation on that side and temporary support systems are likely to be required. Close attention in design of temporary and permanent propping is required at all times to prevent settlement or excessive lateral yielding of the excavation.