Lyons | O'Neill
Structural Engineers

18 Grove Terrace,

Job No. 15168

Basement Impact Assessment

10th September 2015

Lyons | O'Neill
Structural Engineers

Contents

Appendices

1. Introduction

The site address is 18 Grove Terrace, NW5 1PH. The approximate National Grid Reference of the site is TQ 28521 58992

Lyons O'Neill were appointed in August 2015 by the client, Mr Jatin Vara to produce a Basement Impact Asssessment (BIA) which would accompany the report produced by Southern Testing Report titled "Basement Impact Assessment and Site Investigation Report" (Ref:JD11987).

The BIA has been produced in accordance with the guidance given within the Camden planning documents defined below:

- Camden Planning Guidance Document CPG4 : Basements and Lightwells,
- Camden Geological, Hydrogeological and Hydrological Study - Guidance for subterranean development, November 2010 (Arup)
- Camden Development Policy DP27: Basements and Lightwells

The report has been written by Lyons O'Neill, Structural Engineers and is to be read in conjunction with Southern Testing's report (Ref:JD11987) which focuses on the geotechnical issues.

Written by: Maeve Ní Bhuachalla BE

Signed: 

Checked by: Ian Jewison BEng CEng MIStrucE

Signed: 

2. Existing Building and Site Constraints

2.1. Site

The site is referred to as No. 18 Grove Terrace, London, NW5 1PH. The site is roughly rectangular in shape and measures approximately 60m long x 4.9m wide.

The topographic map shown on Figure 10 within Appendix D shows the site area as being at approximately 45 - 50m elevation above sea level.

The approximate National Grid Reference of the site is TQ 28521 58992.

The site is located on Terrace Grove, which has a gradual slope (approximately 1-2 degrees) in the south easterly direction from Parliament Hill/Hampstead Heath to the North/Northwest of the site. Gospel Oak station is located approximately 0.4km to the South West of the site.

The existing building is 4 storey's high with a lower ground floor and is a mid-terrace residential property. The property is classified as a listed building and is not thought to have been significantly altered since it was originally built.

2.1.1. Historical Maps

The site history map contained within Appendix C shows that in 1866, a road had been constructed called 'Grove Road' on the site of the current road 'Grove Terrace'. It is highly likely that the road has since been renamed to Grove Terrace. If so this map shows the current property no 18. Grove Terrace was constructed prior to 1866.

2.1.2. Bomb Blast Map

The Bomb Blast Map contained within Appendix C shows that the site was not directly hit by a bomb. However, a bomb did fall, approximately 50m away from the site. It is deemed that the any construction works at 18 Terrace Grove will be unaffected by this. Prior to the main works commencing further searches should be made as this information is not exhaustive.

2.1.3. London Underground Map

The map within Appendix C shows the proximity of both the Northern Underground Line and the London Overground to the site. The London Overground lines are located approximately 300m to the South West of the site, and serve Gospel Oak Station which is approximately 400m from the site.

The Northern Line is located approximately 700m from the eastern side of the site

They will not be affected by the works.

2.2. Existing Structure

The existing structure is a 4 storey residential building with a lower ground floor. It is situated mid terrace and is classified as a listed building. The structure is thought to comprise of solid load bearing masonry walls around the perimeter of the main building. Internal walls at ground level are thought to be a mixture of masonry and studwork, with timber joist floors at each level spanning between these walls.

It is proposed to carry out localised minor repairs within the interior of the existing building and to construct a one story basement extension at the rear of the property, within the garden.

The below ground drainage to the building is thought to run out to Grove Terrace. This is to be verified using information from both Thames Water and a CCTV below ground drainage survey. The intention is to, where possible, re-use the existing connection to the main sewer.

3. Screening (Stage 1)

3.1. Introduction

As part of the pre planning application process for basements within Camden, there are 4 stages that are defined within the Camden documentation that must be worked through in order to be able to:

- demonstrate how the proposed construction will impact on the existing situation
- identification of items that need to be investigated further, further investigation of these items
- describe proposed mitigation measures.

Information required within the screening stage is contained within Sections 3.2 – 3.4 below.

3.2. Groundwater flow

(Please refer to Section 13 of the ST Report titled "Basement Impact Assessment and Site Investigation Report" (Ref:JD11987).

3.3. Slope Stability

(Please refer to Section 14 of the ST Report titled "Basement Impact Assessment and Site Investigation Report" (Ref:JD11987)

3.4. Surface Flow and Flooding

Q1 Is the site within the catchment of the pond chains on Hampstead Heath?

No. Refer to Figure 14 Hampstead Heath Surface Water Catchments and Drainage Camden within Appendix D that shows the site located approximately 0.6 km from the catchment of the ponds on Hampstead Heath.

Q2. As part of the proposed site drainage, will surface water flows (e/g volume of rainfall and peak run-off) be materially changed from the existing route.

No. Existing surface water on the site either flows into drainage gulley's which are then linked to the existing below ground drainage system, or soaks into the existing soft landscaping.

In the proposed condition, the drainage serving the drained cavity to the perimeter of the basement will be pumped up to the ground level and then link in with the existing drainage at this level. It is proposed that the existing connection of the combined foul and surface water to the sewer within the roadway will be maintained, where possible, based on the condition of this.

The extent and condition of the existing drainage will be investigated within the detailed design phase using a CCTV survey.

Q3. Will the proposed basement development result in a change in the proportion of hard surfaced/paved external areas?

Yes. The proposed works involve some hard landscaping. The increase from the existing surface is within the rear garden and confined to the new pathways. The terrace roof will be a green roof and the upper level and paving will be designed to drain to the new planting beds.

Q4. Will the proposed basement result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?

No. There is no run off in the existing condition affecting these properties. Under the new proposals this will not change - there will be no surface water being received by the adjacent properties either upstream or downstream of the development.

Q5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream properties?

No, as no changes are occurring to the surface water on the property, the neighbouring properties will experience no change to the surface water that they receive.

Q6.Is the site in an area known to be at risk from surface water flooding, or is it at risk from flooding, for example, because the proposed basement is below the static water level of a nearby surface water feature?

No. The site address has been checked against the "New Basement Development and Extensions to Existing Basement Accommodation-Guidance Note" issued by London Borough of Camden-Dec '08 and the address is not within a location of surface water flood risk.

4. Scoping (Stage 2)

From the screening charts, the following questions produced a "yes" or "unknown" response. Q1b. of the Groundwater section and Q13 of the Slope Stability contained within the Southern Testing Report titled "Basement Impact Assessment and Site Investigation Report" (Ref:JD11987).

These items will be carried forward into the scoping stage of the process.

Specific items are:

- That the proposed basement may extend beneath the water table surface (see response to Q1b, within the ST Report titled "Basement Impact Assessment and Site Investigation Report" (Ref:JD11987).
- The proposed basement will significantly affect the depth of foundations relative to the neighbouring properties.(see response to Q13, within the ST Report titled "Basement Impact Assessment and Site Investigation Report" (Ref:JD11987).

These are addressed in the text below.

4.1. Basement constructed below the water table.

During the site investigation groundwater was not encountered within the shallow hand excavated pits, or in the deeper boreholes, during the intrusive phase of this site investigation.

Monitoring wells were installed in two boreholes and the site was revisited on two occasions to measure the standing water levels. A summary of the readings taken from the borehole piezometers is outlined in Table 1.

Date of Reading	7/10/2014	22/10/2014
Location	Standing Water Level (mBGL)	
WS1	3.00	2.01
WS2	1.80	1.34

Table 1 Summary of Borehole Piezometers

From the above table it's clear the highest recorded ground water levels were 1.34m BGL

and 2.01m BGL. The presence of standing water at these levels indicates that a perched water table exists, this is due to the fact that site consists of London Clay overlain by made ground and the perched water sits within the more permeable made ground.

Any perched water encountered during the formation of the basement will be dealt with using localised sump pumps.

The hydraulic gradient of the existing water table is believed to be almost flat, meaning there will be negligible risk of any up-stream rise in water levels as a result of the basement formation.

The basement will slab be will designed for a water level 1m above the slab level.

The basement formed by the underpinned walls will be a grade 3 habitable space, formed by placing an internal cavity drainage system around the perimeter of the basement.

4.2. Stability of neighbouring properties

The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground, particularly the garden. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures.

The proposed development will also result in differential foundation depths between the site and adjacent property and as such the Party Wall Act will be used and considered during the design phase. For basement developments in densely built urban areas, the Party Wall Act (1996) will usually apply because neighbouring houses would typically lie within a defined space around the proposed building works. Specifically, the Party Wall Act applies to any excavation that is within 3m of a neighbouring structure; or that would extend deeper than that structure's foundation; or which is within 6m of the neighbouring structure and which also lies within a zone defined by a 45° line from the foundation of that structure. The Party Wall process will be followed and adhered to during this development. Refer to Section 8 for more information on this.

5. Site Investigation and Study (Stage 3)

Stage 3 of the process covers the site specific site investigation to determine the site specific ground conditions and groundwater level. This is described within the Southern Testing report titled "Basement Impact Assessment and Site Investigation Report" (Ref:JD11987).

5.1. Desk Top Study

The North Camden Geological Map shown in Figure 4 in Appendix D shows the site geology as London Clay. This ties up with copy of the British Geological Map for the North London area, in Appendix C, that shows the site as being well within the London Clay strata.

5.1.1. London Clay

London Clay is a well-known stiff (high strength) blue-grey, fissured clay, which weathers to a brown colour near the surface. It contains thin layers of nodular calcareous mudstone - "claystone" - from place to place, and crystals of water clear calcium sulphate (selenite) are common. Although slopes will stand in the clay at steep angles in the short term, the long-term stable slope angle is about 7^{o} for grassed, or cleared slopes, and a few degrees more for wooded slopes.

5.1.2. Radon Risk

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

5.2. Groundwater

Data from the Environment Agency and other information relating to controlled waters is summarised in Table 2. The groundwater vulnerability assessment is based on the most current data on the EA website.

The site is shown as being approximately 0.6km from Highgate ponds, along the western edge of Hampstead Heath. Figure 14 within Appendix D shows that the site sits well outside the catchment area of any of the Hampstead ponds.

The Highgate Ponds are located approximately 2.5km away. Local watercourses drain into and through these ponds, which turns into the River Fleet.

5.2.1. Lost Rivers

The Lost Rivers of London map shown within Appendix C shows an old tributary running very close to the site, but it is thought that this, if still active, has previously been placed in a culvert as there is no evidence of this at street level.

5.3. Site Investigation

A ground investigation was carried out by Southern Testing Limited (ST) on the site 28^{th} of September 2014, and is summarised below, reference should be made to Southern Testing Report titled "Site Investigation Report" (Ref:JD11987) for a detailed description of the works.

The investigation comprised of the following works:

- 2 No. window samples carried out to a depth of 6m (WS1, WS2).
- Groundwater monitoring wells were installed in both window sample boreholes for groundwater monitoring purposes

- 4 No. Hand excavated pits to establish the nature of the existing foundations to the existing building, and those to the perimeter garden boundary walls with the neighbouring properties. These also provided information on the ground conditions in these areas.

The location of these trial holes is given within the copy of the site investigation report contained in Appendix F.

Whilst detailed descriptions of the soils encountered within the borehole, together with trial pit logs are given in ST's Investigation report, a condensed summary of the soil conditions encountered is given within Table 2 below, with depth below ground level (BGL) noted.

The locations of the trial pits and windows sample are shown within Southern Testing Report titled "Site Investigation Report" (Ref:JD11987).

Trial Pit 1 was formed against the face of the brickwork boundary wall with the neighbouring property on the northern side of the site (No. 17 Terrace Grove) and against the rear porch of the subject property (No.18 Terrace Grove). TP1 showed that the footings for both the rear porch wall and the boundary wall were shallow brickwork footings, founded approximately 1m – 1.38m below ground level within the made ground

Trail Pits 2 and 3 were formed against the brickwork boundary wall along the property on the southern side of the site (No. 19 Terrace Grove). Trial Pit's 2 and 3 showed the footing to the wall is a shallow brickwork footing, founded approximately 1m – 1.38m below ground level within the made ground.

Trial Pit 4 was formed against the face of the brickwork boundary wall with the neighbouring property on the northern side of the site (No. 17 Terrace Grove) and showed the footing to the wall is a shallow brickwork footing, founded approximately 1m below ground level within the made ground.

The 2 window samples showed a consistent site geology comprising of a layer of made ground, between 1.24m and 2m thick, underlain by a layer of London Clay, becoming stiffer with depth. No groundwater was encountered during the digging of these samples. Detailed descriptions are provided in the borehole logs.

5.4. Bearing Capacity

Where it is necessary to construct spread foundations or bases to retaining walls/underpinned sections as part of the proposed works, all foundations will penetrate any made ground and be formed within the underlying natural High Strength Clay materials. For foundations formed on these materials, the geotechnical engineers recommend that an allowable bearing capacity of 125kPa should be adopted.

5.5. Heave

Due to stress relief following the removal of the existing soils to form the basement structure(s), both immediate (undrained) and long term (drained) heave displacements can be expected to occur in the underlying London Clay. The immediate (undrained) heave displacements will occur as excavation of the basement takes place and before the construction of basement elements e.g. slabs etc. Accordingly, only the long term (drained) heave displacements will need to be catered for in design, to overcome the problem of uplift pressures forming.

To cater for the heave, a compressible material will be placed to the underside of the suspended basement slab. This will compress in the event of any upwards movement from the soil. Checks will also be made to ensure that the dead load applied to foundations will be sufficient to resist uplift forces (with concrete thickness being locally increased where additional dead load is required).

Depth to Base (m BGL)	Soil Type	Description
GL-1.24m/2m	Made Ground	Variable Made Ground comprising sandy gravelly clay, coarse to fine angular gravel comprised of brick and concrete.
2m-6m	London Clay	Very stiff dark grey sandy fissured CLAY with scattered gypsum crystals.

Table 2 Summary of Borehole Logs

6. Site Hydrology

6.1. Site Specific Groundwater Conditions

No groundwater was encountered during the formation of the trial pits or the boreholes. As part of the investigate works, groundwater level monitors were also installed within the 2 boreholes constructed.

The monitoring wells measured standing water levels of 1.34m BGL and 2.01m BGL. The presence of standing water reflects a perched groundwater table within the made ground.

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. However, an allowance for a sump and temporary pump will be provided on an as required basis to remove any water that collects in the excavation during the construction of the basement (due to rain water / ground water ingress into the excavation).

Seepage entries from fissure flow within the clays and any perched groundwater will be dealt with in the permanent condition using a drained cavity placed internally around the

perimeter of the piled walls forming the basement. Any perched groundwater will be collected in a channel at the base of the internal drained cavity, which will then be routed to an internal manhole and pumped up to ground floor level to the existing below ground drainage system, in accordance with BS8102.

Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1 x 10-9 m/s and 1x 10-14 m/s, with an even lower vertical permeability. Accordingly, the groundwater flow rate is anticipated to be extremely low to negligible.

Any groundwater flows that will take place will likely follow the local/regional topography which in this instance comprises of local falls to the south of around 1-2º. Given the very slights fall in the local/regional topography, hence almost negligible hydraulic gradient, and the very low/impermeable nature of the underlying clay materials, there is negligible risk of the proposed basement walls causing a 'damming effect' or mounding of water on the upstream faces. On the basis of the observations/comments, it is concluded that the proposed development will not result in any specific issues relating to the hydrogeology of the site.

The proposed basement will therefore not cause any issues relating to the hydrogeology and hydrology of the site.

Data		
Aquifer Designation	Superficial Deposits	There are no superficial deposits mapped
	Bedrock	London Clay-Unproductive Strata. Deposits with low permeability that have negligible significance for water supply or river base flow.
Source Protection Zones		The site is not located with a Source Protection Zone
Abstractions		On the basis of the information on the EA website (October 2014) There is no licences for water abstraction in this area.
Surface Water Features		The "Risk of Flooding from Surface Water" mapping on the Environment Agency website Ocrober 2014) shows the site to be within an area of Very Low Risk. Very Low Risk means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%).
Watercourses, well (used/disused) or potential spring lines		The nearest water course shown on the Camden Plan of Watercourses (Source Lost Rivers of London) shows the River Fleet approximately 100m to East. According to the BGS Geology of Britain Viewer the nearest well (now abandoned) is shown 220m to the North West in the grounds of William Ellis School. We are not aware of any other active wells. Given the geology of the area (London Clay) the potential presence of spring lines are negligible.
Fluvial & Reservoir Flood Risk		On the basis of the information given on the EA website (September 2015) the site is not located within an area of potential risk of flooding from reservoirs or fluvial sources.

Table 3: Summary of Geology and Hydrology

The proposed basement will not result in any specific issues relating to land or slope stability. Whilst a proposed sequence of construction is outlined in Section 9, the contractor will be expected to work up his own sequence, outlining the temporary works involved and when in the construction process these will be installed.

7. Proposed Works

7.1. Introduction

Drawings **15168/P/001** and **15168/P/002** within Appendix A show the proposed structural arrangement of the building. Whilst there are other methods of construction for the upper levels, the form of construction for the basement is not expected to change.

7.1.1. Basement

A new single storey basement is proposed to be formed as part of the new development. This will be formed at the lower level, approximately 3.0m below ground level. The perimeter walls to this will be formed using RC underpins, which will act as RC retaining walls. The RC retaining wall will sit directly underneath the party fence as shown in the drawing 15168/P/002. The flank walls of the existing basement and the garden boundary walls will be underpinned in reinforced concrete using a hit and miss sequence with a maximum pin width of 1m to allow existing masonry to arch over. The head of this RC retaining wall will be restrained by the new ground floor slab.

The basement is categorised as Type 3, in line with the requirements of BS 8102. This defines the space as a dry environment, with no water penetration. In order to comply with

this, a drained cavity will be placed in front of the retaining walls. This will pick up any perched water within the made ground that may have ingressed through the wall.

The retaining walls will be designed to carry earth and water pressures. The walls which run underneath the perimeter wall will also be designed for surcharge from adjacent structures.

Although the water table has been shown to be located well below the level of the new basement, the design of the new perimeter basement walls will be designed for both soil and water pressures, taking a height of water equivalent to 1m below the top of the basement.

The new basement is will be formed within the clay strata. This will heave as a result of the unloading from the excavation of the soil, required to form the basement. A layer of heave protection will therefore be placed to the underside of the basement slab to accommodate this movement.

The ground floor above the lowered basement is proposed to be formed using a folded RC slab which steps at the edge of the green roof.

7.2. Proposed Method of Analysis

The overall construction sequence and temporary/permanent propping regime will require detailed design to ensure that potential lateral and vertical movements are kept within acceptable levels.

For the purpose of analysing the basement walls and foundations, appropriate parameters will be used for the design associated with changes in loadings on the London Clay.

A heave/settlement analysis will be carried out using commercial software packages such as RSA or VDisp to assess any possible movements.

Condition surveys of the subject building will also be undertaken prior to the commencement and at the end of the site works.

The party wall process may also require that targets are installed on this building and monitored on a regular basis throughout the duration of the works to ensure that any movements are kept within acceptable and pre-agreed levels, as described within Section 8.

8. Protection of Adjacent Structures

8.1. Party Wall Matters

The proposed development falls within the scope of the Party Wall Act 1996. Procedures under the Act will be dealt with by the Employer's Party Wall Surveyor. The Party Wall Surveyor will prepare necessary notices under the provisions of the Act and agree Party Wall Awards in the event of any disputes.

The Contractor will be required to provide the Party Wall Surveyor with appropriate drawings, method statements and all other relevant information covering the works that are notifiable under the Act, which will necessitate confirmation of existing footing profiles for each condition. The resolution of matters under the Act and provision of the Party Wall Awards will protect the interests of all owners.

The proposed works to form the basement will be designed and detailed so that any movement of the existing structure is no worse than "Category 1", defined as Very Slight within the BRE Digest 251 Table 1 and CIRIA 580 (Burland et Al).

The example calculation within Appendix E shows how this category is achieved using the anticipated movements of the RC underpins. This exact levels will be agreed as part of the party wall process, and the movement of the existing building will be monitored twice weekly during the formation of the basement using targets placed to the face of the walls. Monitoring is discussed in more detail in Section 8.3

Condition surveys of the adjoining properties will be undertaken prior to commencement of the site works. Data from monitoring stations will be regularly analysed during construction to ensure that there is no unexpected movement that may affect the adjoining properties on either side.

8.2. Temporary Works

The design of the temporary works and the temporary stability of any existing structure to be retained as part of the permanent works is entirely the responsibility of the contractor.

The temporary works discussed below and shown indicatively on the drawings within Appendix B outline the expected temporary works required. All of this information will be firmed up by the contractor following their appointment. The contractor is to submit an overall Method Statement a minimum of 4 weeks prior to a site start and detailed drawings and calculations a minimum of 4 weeks, which are to include an assessment of the anticipated ground movement due to the RC underpinned, this is also to cover each stage of construction, initial excavation, propping, full excavation etc.

The contractor will also be required to appoint a Temporary Works Co-ordinator for the duration of the contract in accordance with the specification.

8.3. Monitoring Strategy

All items of temporary works and surrounding structures are to be monitored in a manner and frequency commensurate with the construction activity taking place. As a minimum the monitoring should include a daily full visual survey of all temporary works and surrounding structures, and a twice weekly measured survey of the existing structure using fixed survey points to be agreed with the Party Wall Surveyors.

The limits of any movement may be set against the colours green, amber and red:

Green: - Settlement recorded within predicted movements.
Amber: - Settlement recorded is approaching the predicted movements.
Red: - Settlement recorded is above the predicted movements.

8.4. Remediation Measures should levels be exceeded

If the amber levels are exceeded, the contractor is to notify the Engineer and review the construction sequence.

If the red levels are exceeded at any point during the works, the contractor is to immediately cease the construction works and install temporary props/reinstall excavated material such as required to the face of the wall in order to prevent any further movement. These measures are to be kept in place until such time as the engineer deems them suitable to be removed.

The contractor is to ensure he has either have adequate provision in terms of props on site during the works, or be able to obtain temporary props required at short notice in order to install these in the event of the amber levels being exceeded.

8.5. Outline Monitoring Specification

Target locations for monitoring are to be agreed with the adjoining owners Party Wall Surveyors for inclusion on the Party Wall Award. The frequency of monitoring is to be agreed prior to execution of the works. A recommended frequency for monitoring is outlined below:

Prior to the commencement of the works: - Baseline readings are to be taken
During the installation of the underpins - Weekly readings
At the completion of each phase of the work: - Single readings taken
End of the construction stage: - Final readings taken

A stable datum must be maintained and the observed monitoring points must be an integral part of the structure. Targets are to be surveyed to an accuracy of ±1mm and read in three dimensions, i.e. the X, Y and Z axes.

Recordings should demonstrate the vertical and horizontal movements that have occurred since the previous measurements were taken.

Lateral and vertical movement limits are to be set against Green, Amber and Red limits. These limits are to be agreed by the Party Wall Engineer and the Pile Designer during the party wall process.

9. Impact Assessment (Stage 4)

9.1. Conclusion

It has been shown within this document that the proposed basement will not impact on the existing geological or hydrogeological conditions, and as the ground is flat, slope stability will not be an issue.

Whilst perched groundwater within the made ground has been identified, the proposed basement design has included measures to accommodate this.

Provided the works are undertaken in a logical and safe manner the works will not have a detrimental effect on either the existing building. An assumed construction sequence is included within the report, which it is expected that the appointed contractor will use to inform his sequencing for undertaking the works.

10. Proposed Sequence of Construction

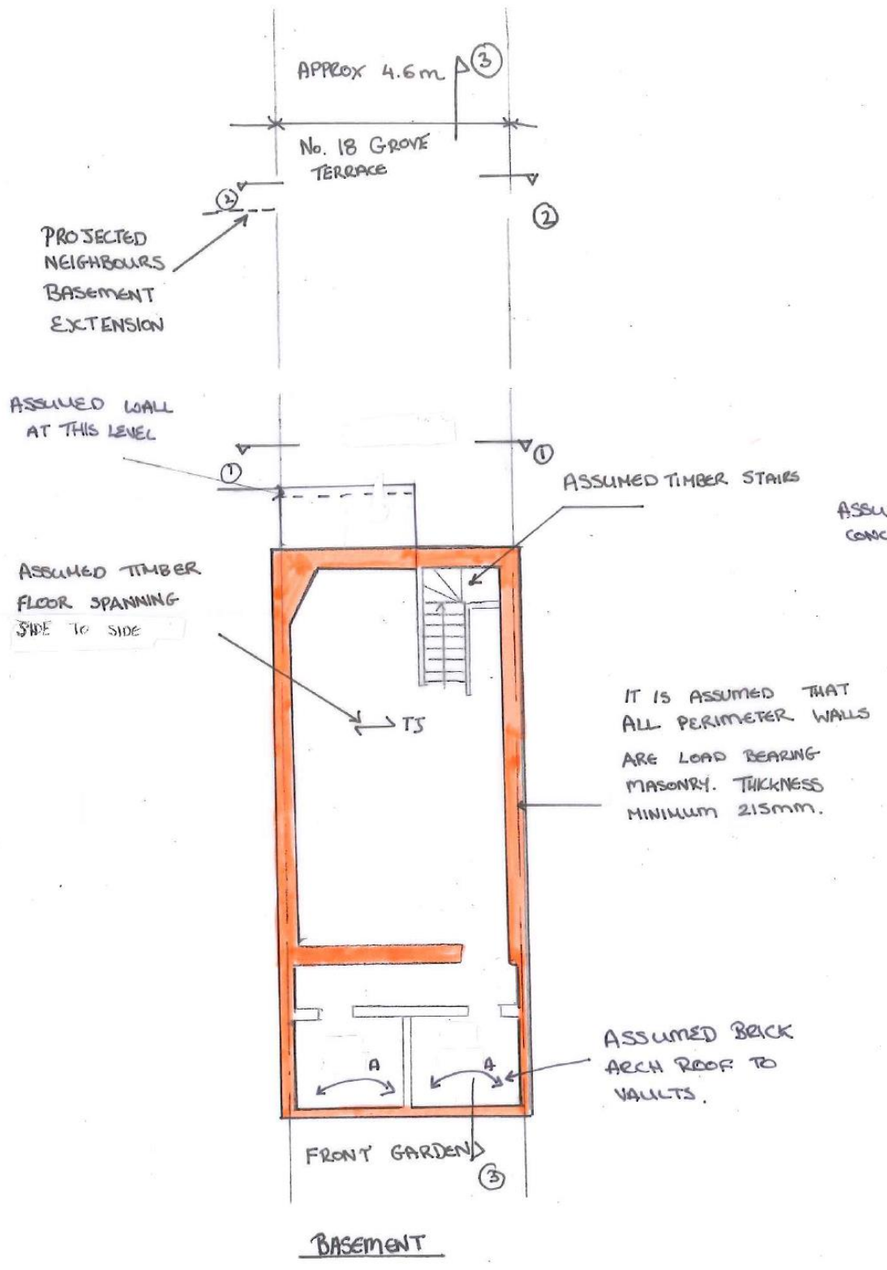
An assumed sequence of construction is described below. This summarises our initial thinking as to how the proposed works will be undertaken. but does not relieve the contractor from undertaking his own construction sequence in order to demonstrate that he has understood all of the challenges involved.

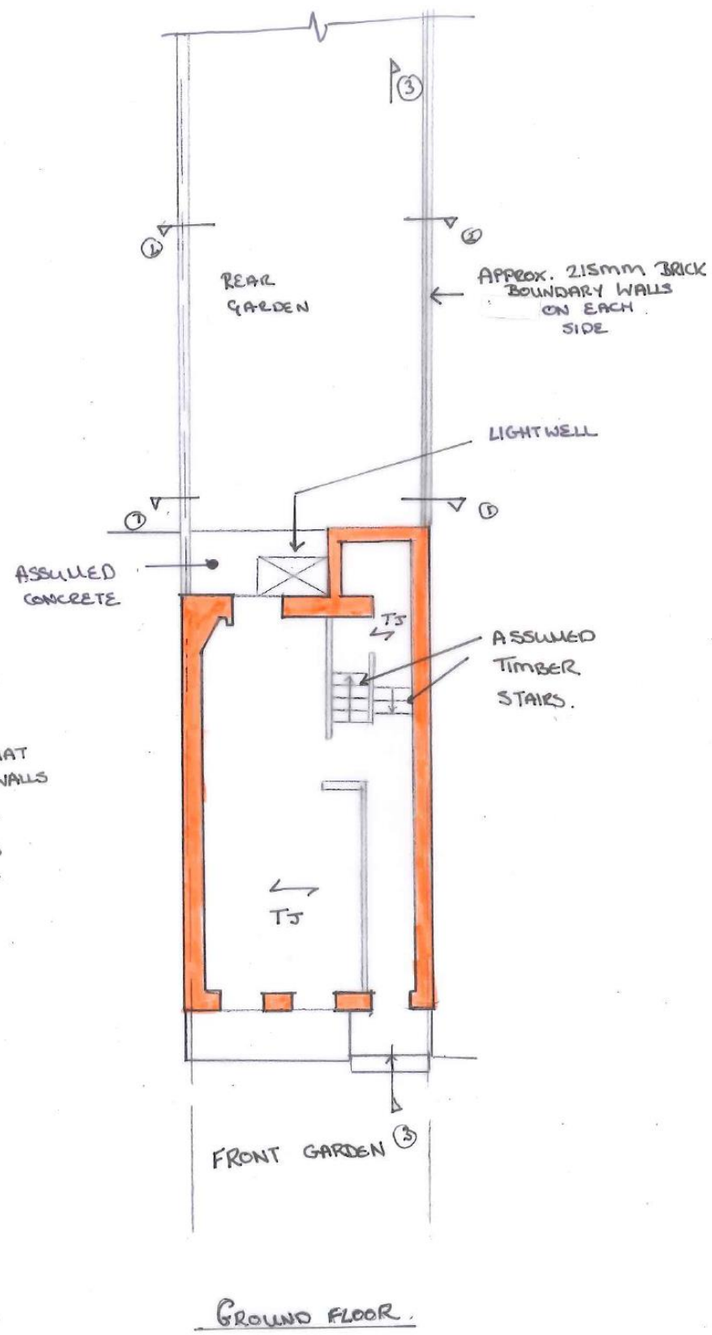
The proposed construction sequence for the new basement works and superstructure works are outlined below:

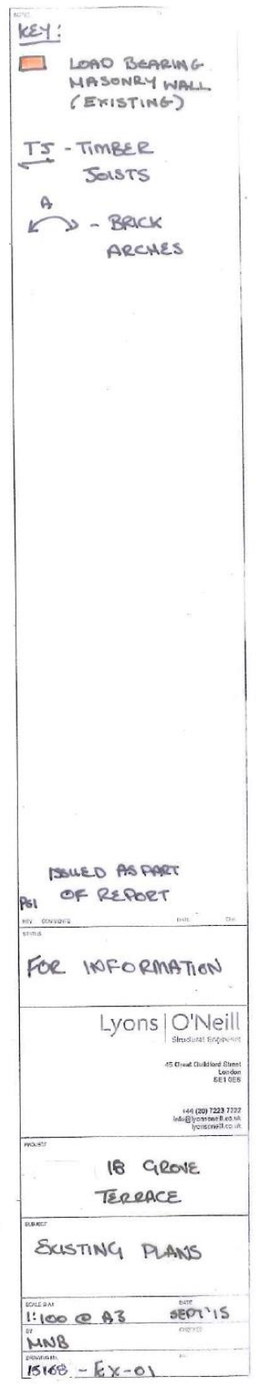
- Mobilise and set up site welfare
- Determine route of all services and cap these off as required.
- Commence underpinning of existing masonry boundary walls, in a hit and miss sequence to a depth great enough to achieve minimum 150mm depth into the clay layer.
- Finish hit and miss underpinning
- Install heave protection to the underside of the basement slab.
- Place basement slab reinforcement and cast basement slab.
- Remove temporary props.
- Commence superstructure works.

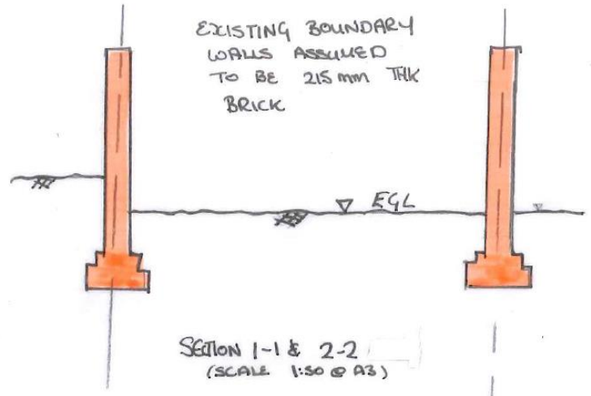
Appendix A

Proposed Drawings









SECTION 1-1 & 2-2
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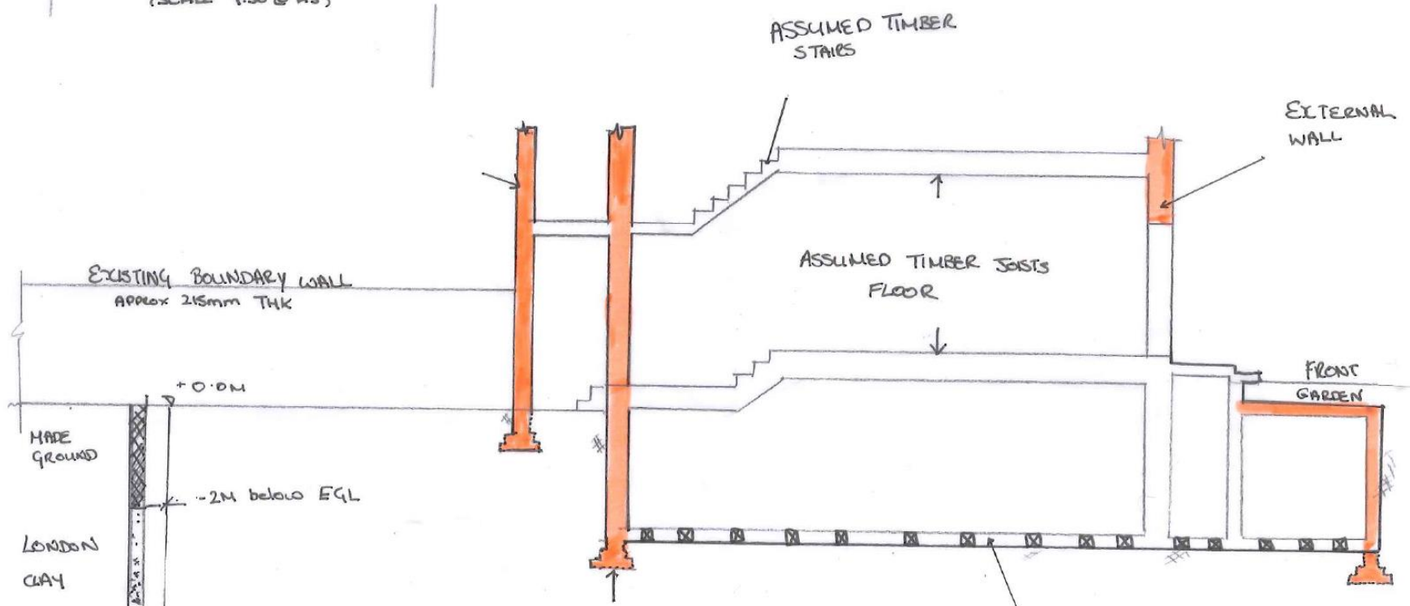


SECTION 3-3 (1:100@A3)

NOTE: GEOLOGY TAKEN FROM SITE INVESTIGATION REPORT BY SOUTHERN TESTING REF JD 11987

KEY:

- ASSUMED LOAD BEARING MASONRY
- TIMBER JOISTS

ISSUED AS P01 PART OF REPORT

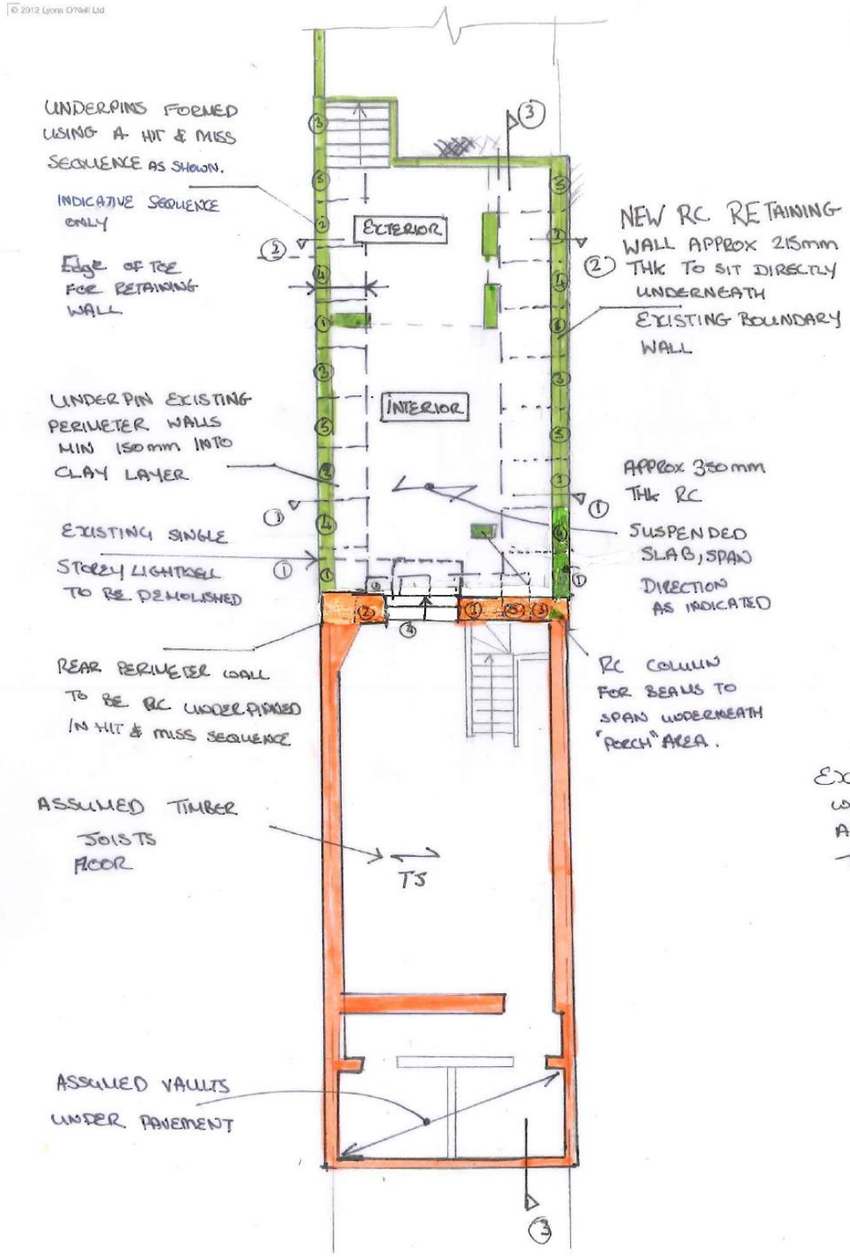
STATUS: INFORMATION

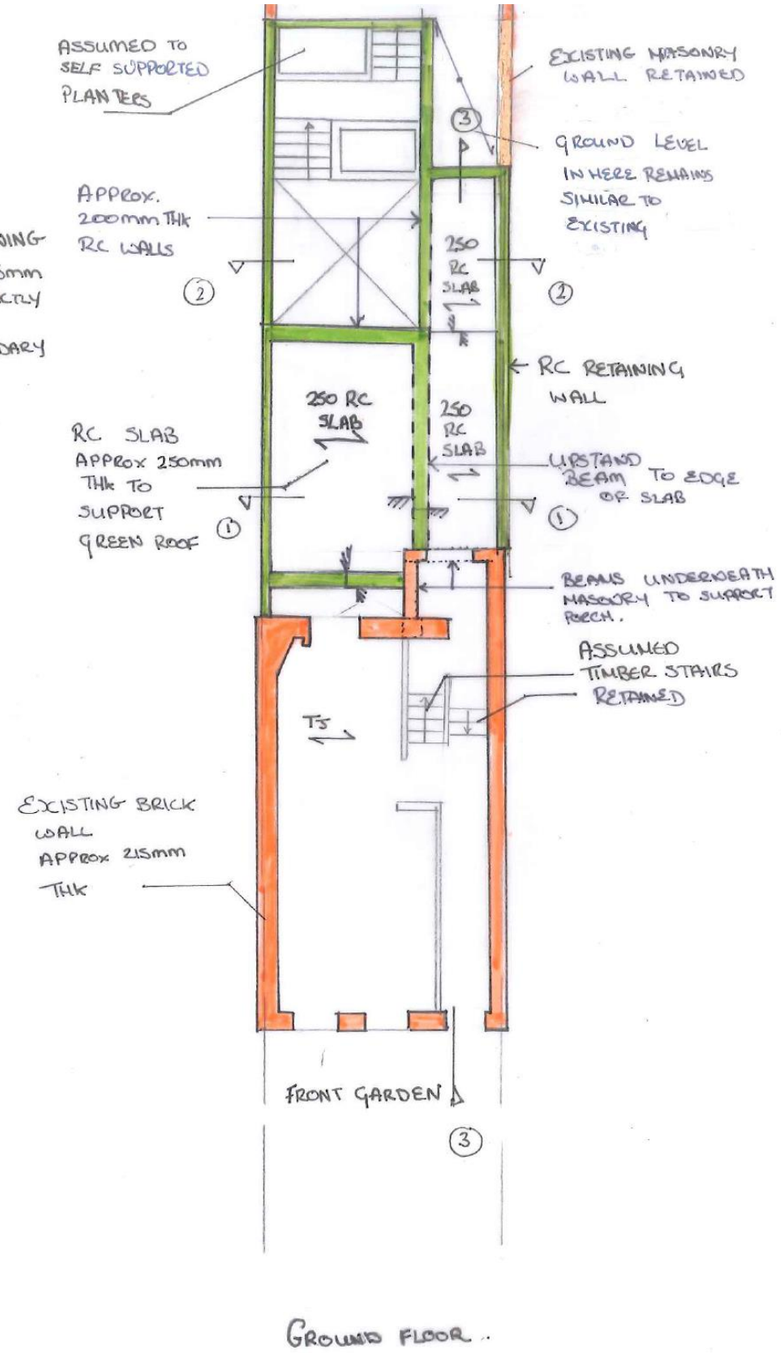
Lyons | O'Neill
Structural Engineers
49 Great Guildford Street
London
SE1 0ES
+44 (20) 7023 7222
info@lyonsoneill.co.uk
lyonsoneill.co.uk

PROJECT: 18 GROVE TERRACE

SUBJECT: EXISTING SECTIONS

SCALE @ A3: AS SHOWN
DATE: SEPT 15
BY: NWB
CHECKED:
DRAWING No: 15168-EX-02
REV: P01





KEY:

- ASSUMED LOAD BEARING MASONRY
- TIMBER JOISTS

ISSUED AS P01 PART OF REPORT

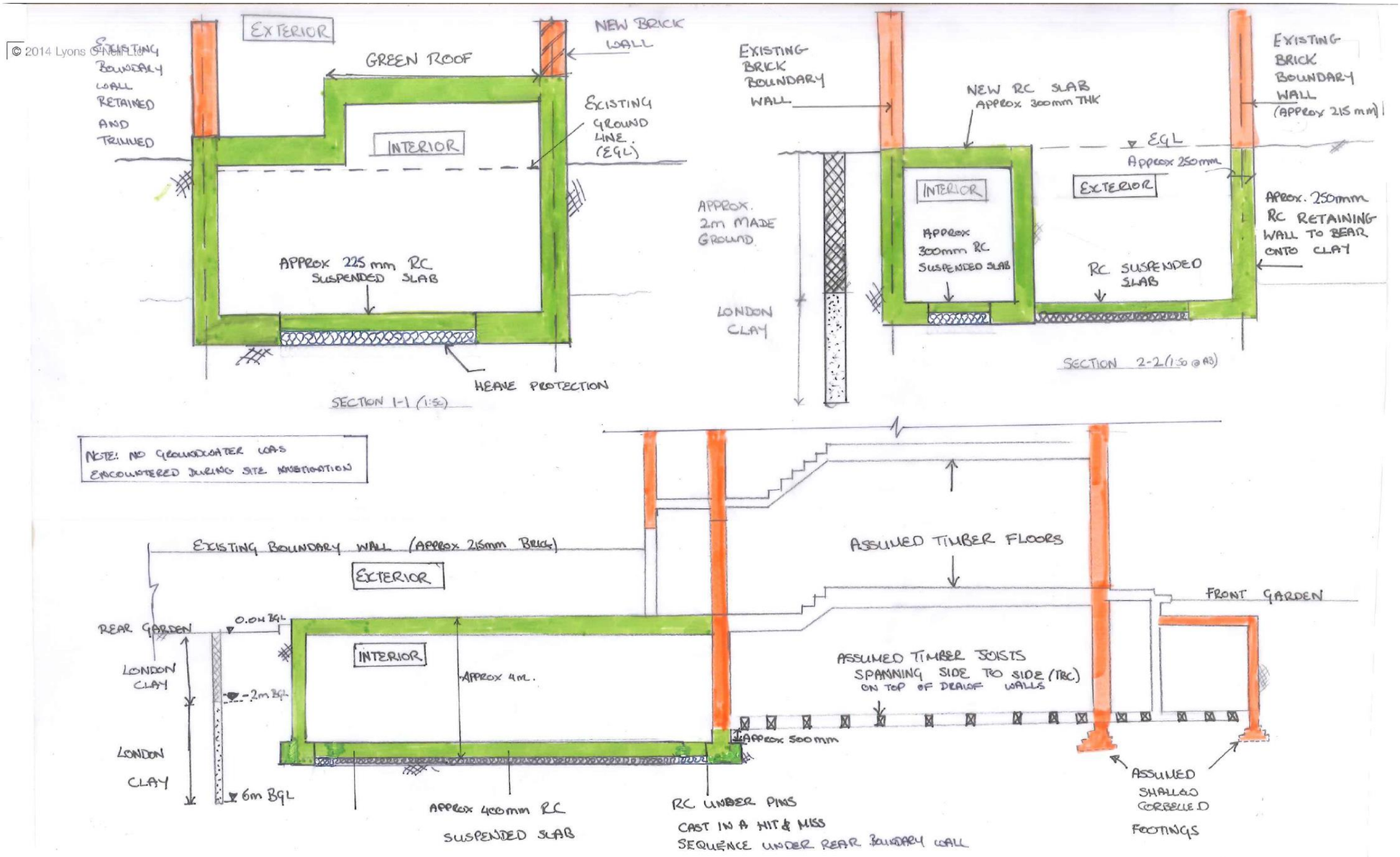
INFORMATION

Lyons | O'Neill
Structural Engineers
49 Great Guildford Street
London
SE1 0ES
+44 (20) 7223 7222
info@lyonsoneill.co.uk
lyonsoneill.co.uk

PROJECT: 18 GROVE TERRACE

SUBJECT: EXISTING SECTIONS

SCALE @ A1: AS SHOWN	DATE: SEPT 15
BY: MMB	CHECKED:
DRAWING No.: 1516B-EX-02	REV: P01



NOTES

KEY:

- EXISTING LOAD BEARING MASONRY
- NEW RC STRUCTURE
- TIMBER JOISTS

STATUS

FOR INFORMATION

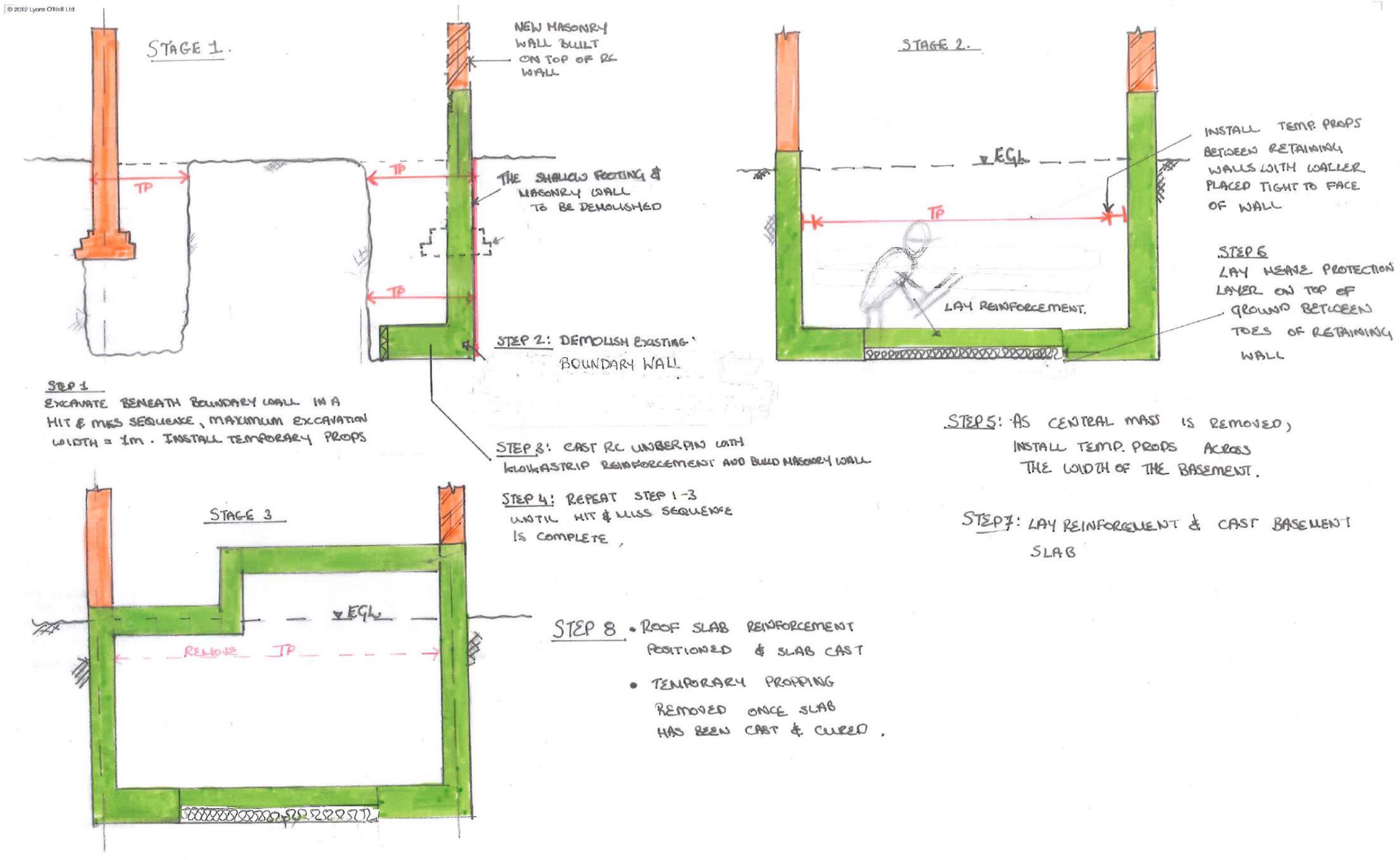
REV	COMMENTS	DATE	CHK
P01	ISSUED AS PART OF REPORT		

Lyons | O'Neill
Structural Engineers
45 Great Guildford Street
London
SE1 0ES
+44 (20) 7223 7222
info@lyonsoneill.co.uk
lyonsoneill.co.uk

PROJECT				
18 GROVE TERRACE				
SUBJECT				
PROPOSED SECTIONS				
SCALE @ A3	BY	DATE	CHECKED	
AS SHOWN	MNB	SEPT'15		
DRAWING No.				REV
15168 - P - 02				P01

Appendix B

Assumed Sequence of Construction Sketches



NOTES
Key:
- EXISTING MASONRY
- NEW MASONRY
- NEW RC STRUCTURE

FOR INFORMATION

STATUS

P01 ISSUED AS PART OF REPORT

REV COMMENTS DATE CHK

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45 Great Guildford Street
London
SE1 0ES
+44 (20) 7223 7222
info@lyonsoneill.co.uk
lyonsoneill.co.uk

PROJECT: 18 GROVE TERRACE
SUBJECT: CONSTRUCTION SEQ
SCALE @ A1:
BY: MNB
DATE: 09/15
CHECKED:
DRAWING No: 1516B - C- 01
REV:

Appendix C

Historical and Geological Maps

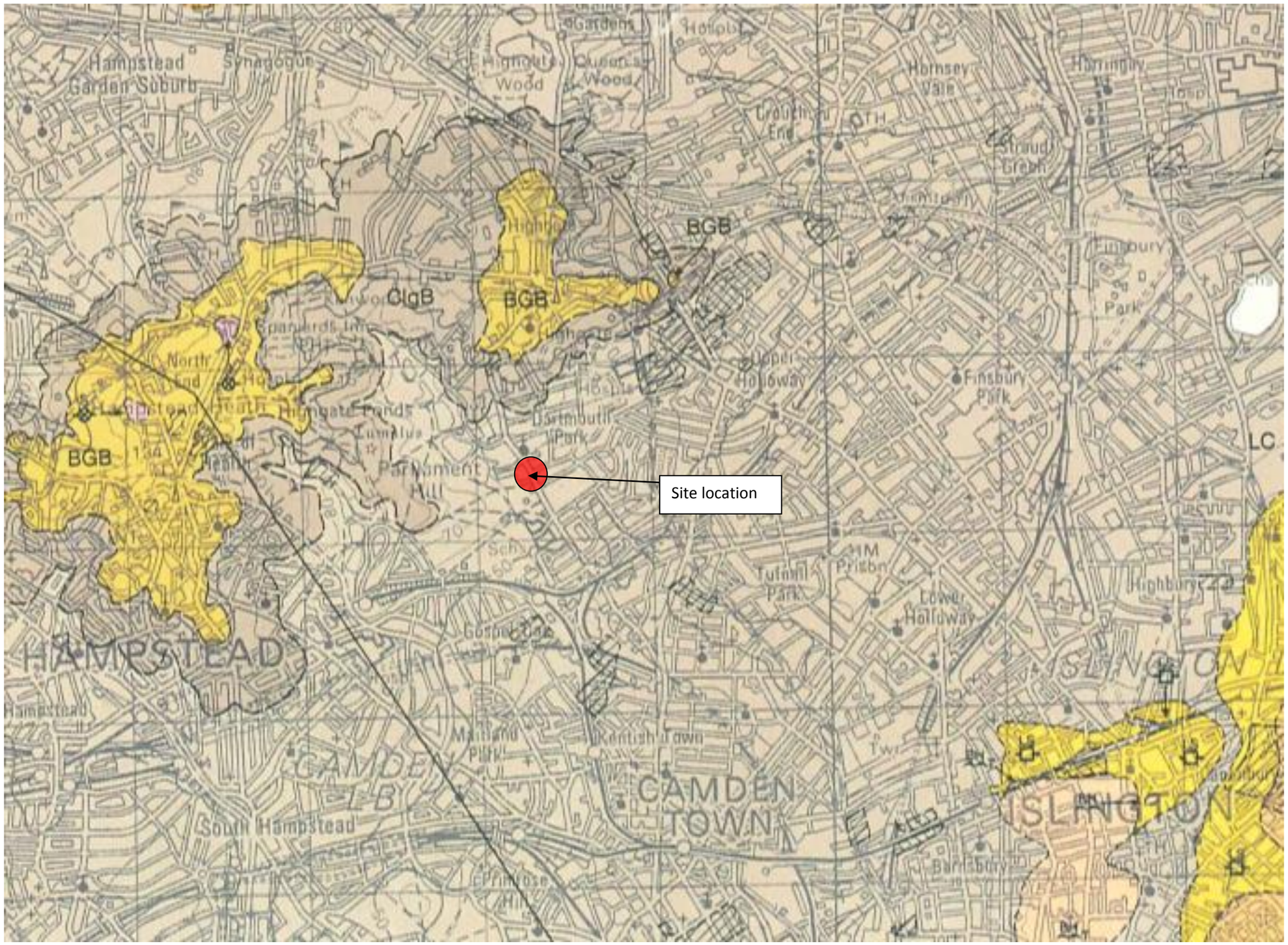

Figure 1 Topographical Map of London

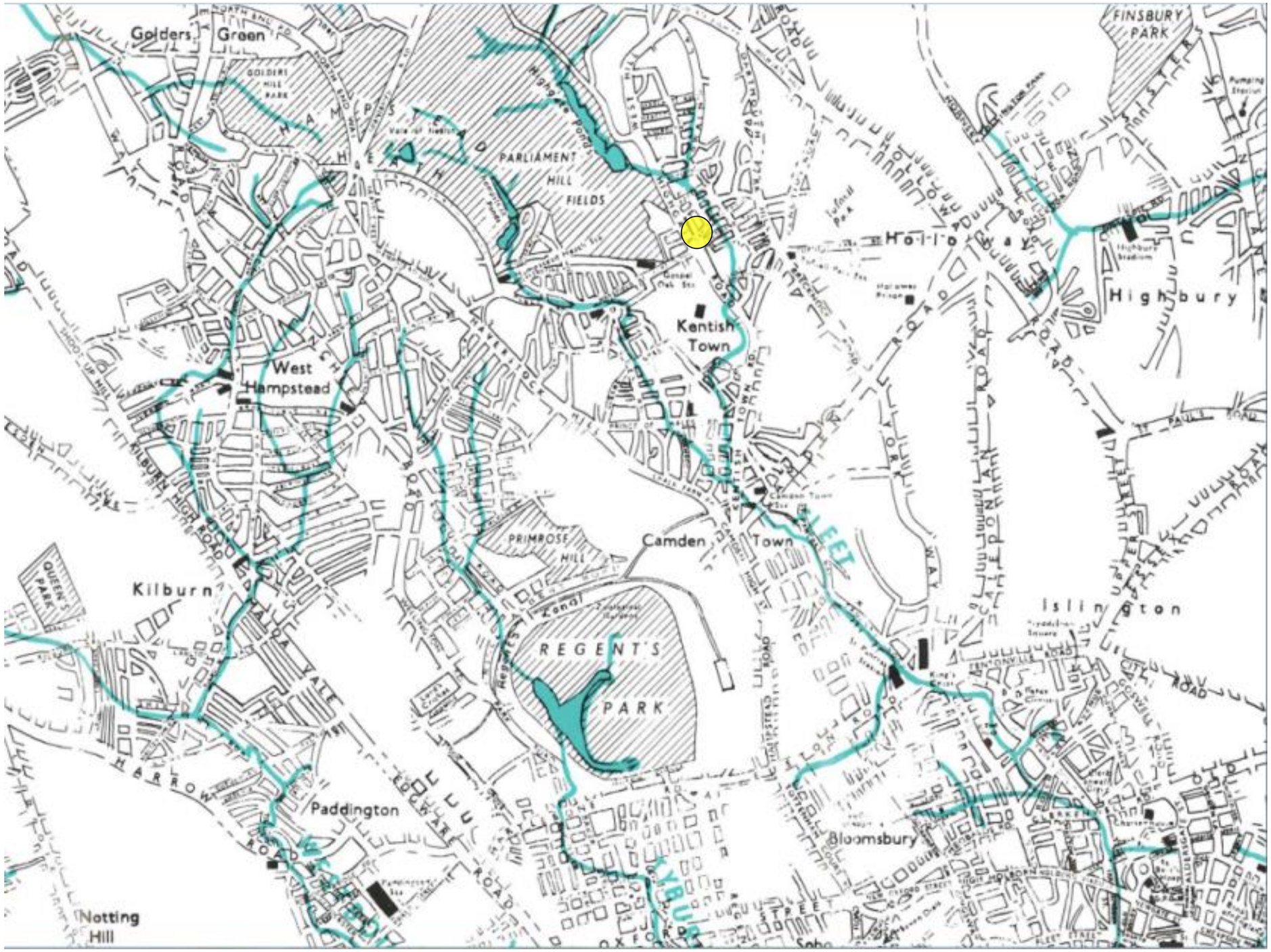

Figure 2 Map of the Lost Rivers of London

Figure 3 Bomb Blast Map

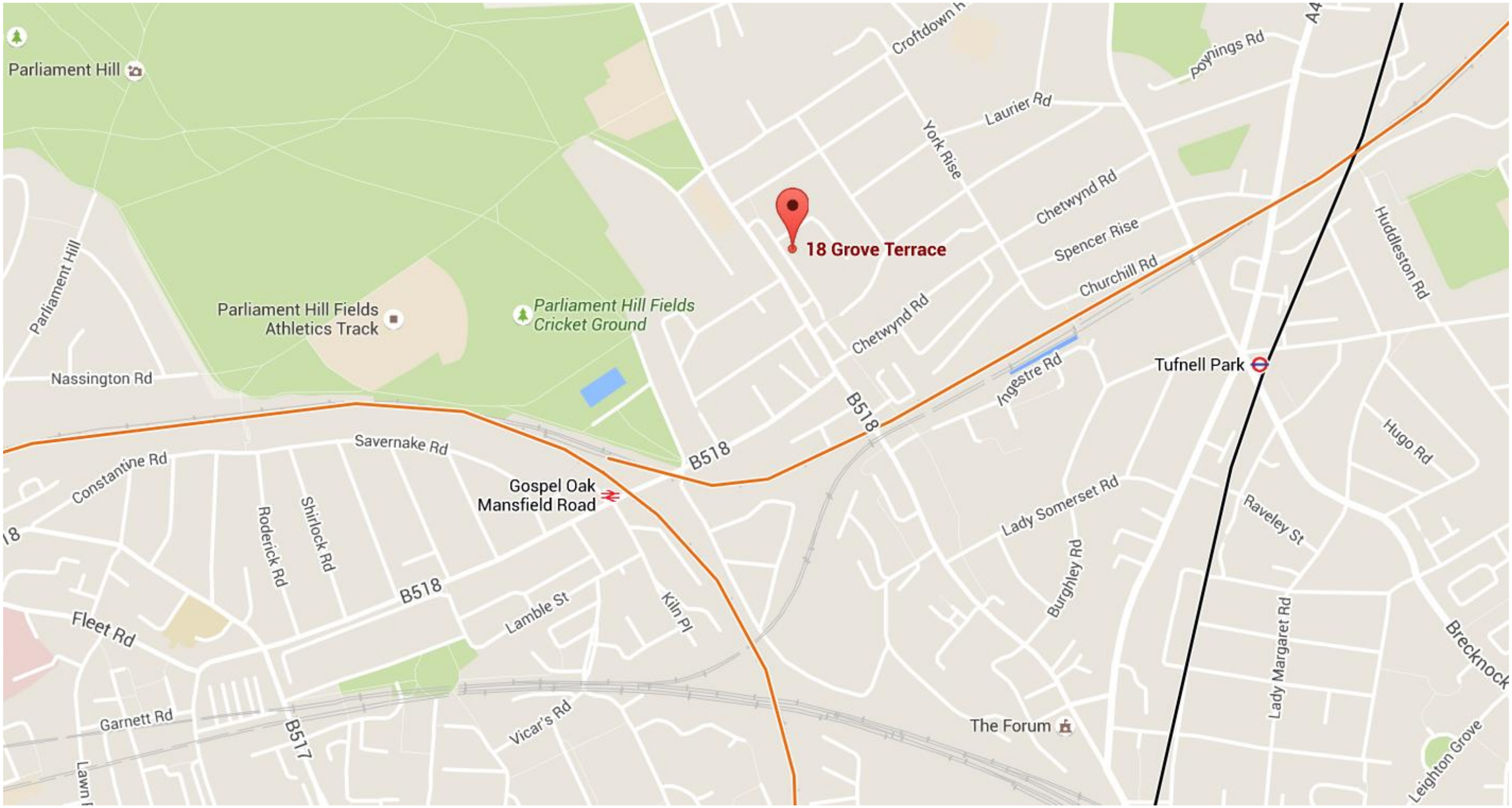

Figure 4 Map of London Transit links near the site

History Maps - 1866

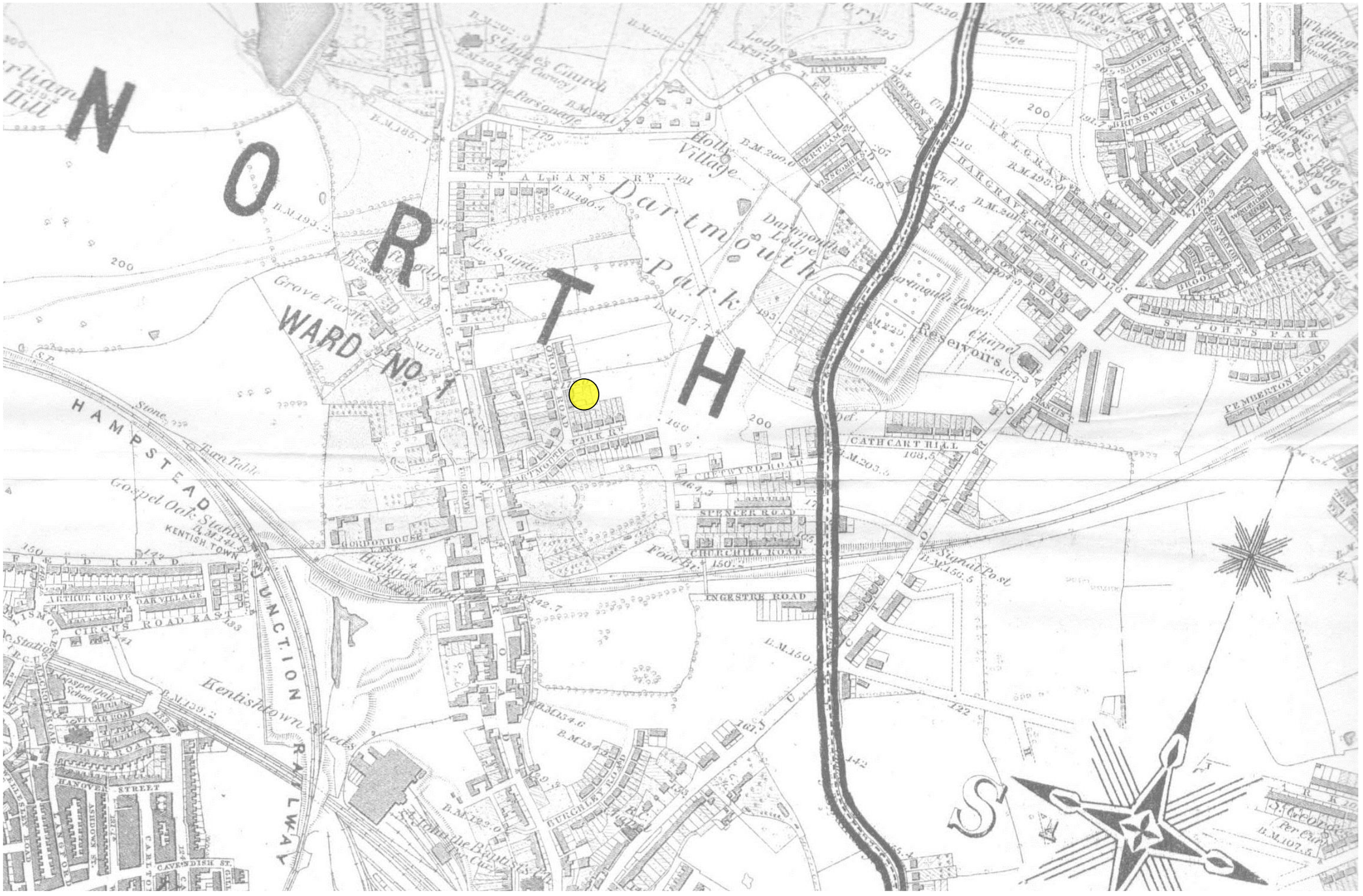

Figure 5 Historical Map of St. Pancras North from 1866

Appendix D

Camden Geological, Hydrogeological + Hydrological Maps

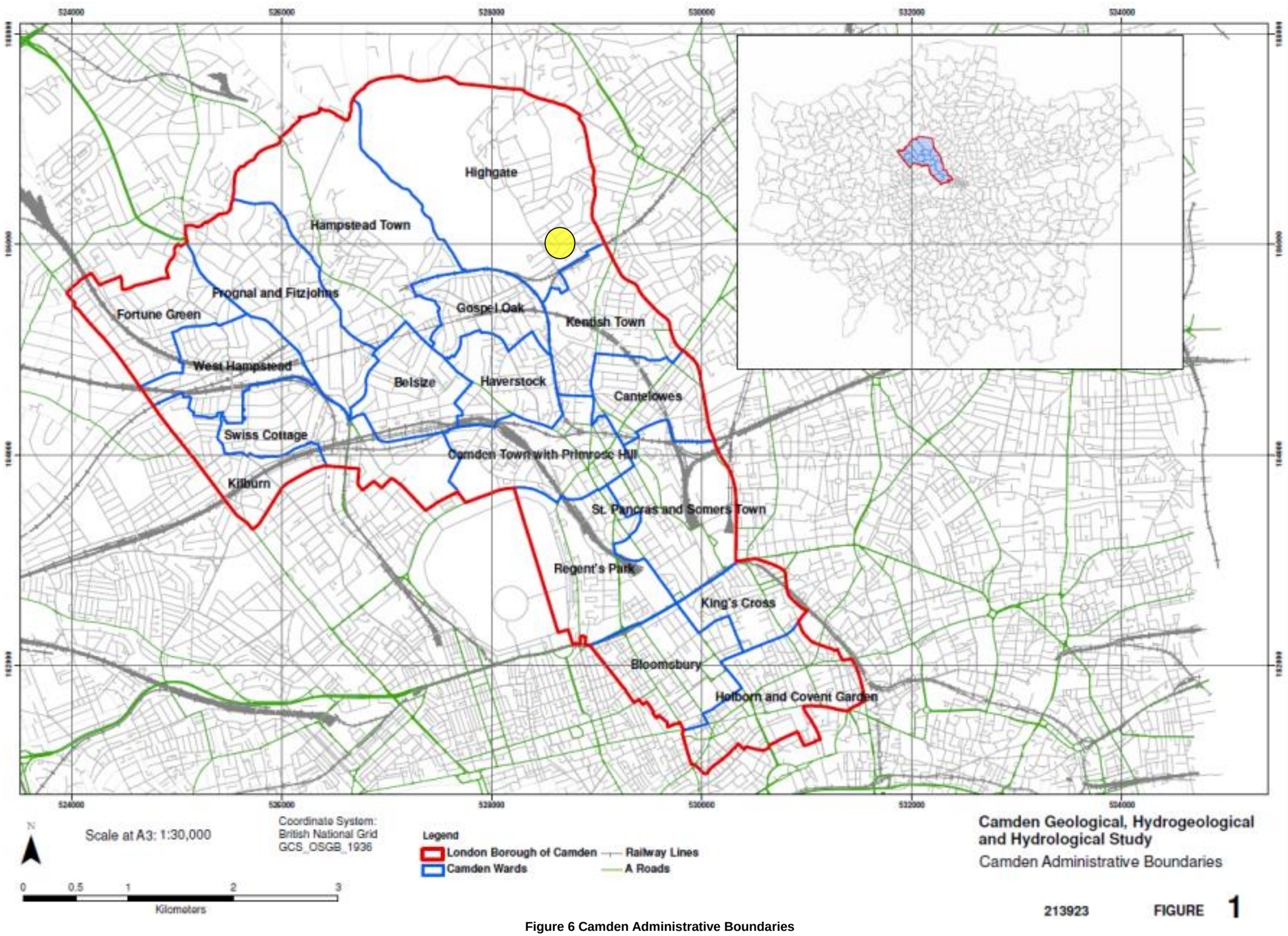

Figure 6 Camden Administrative Boundaries

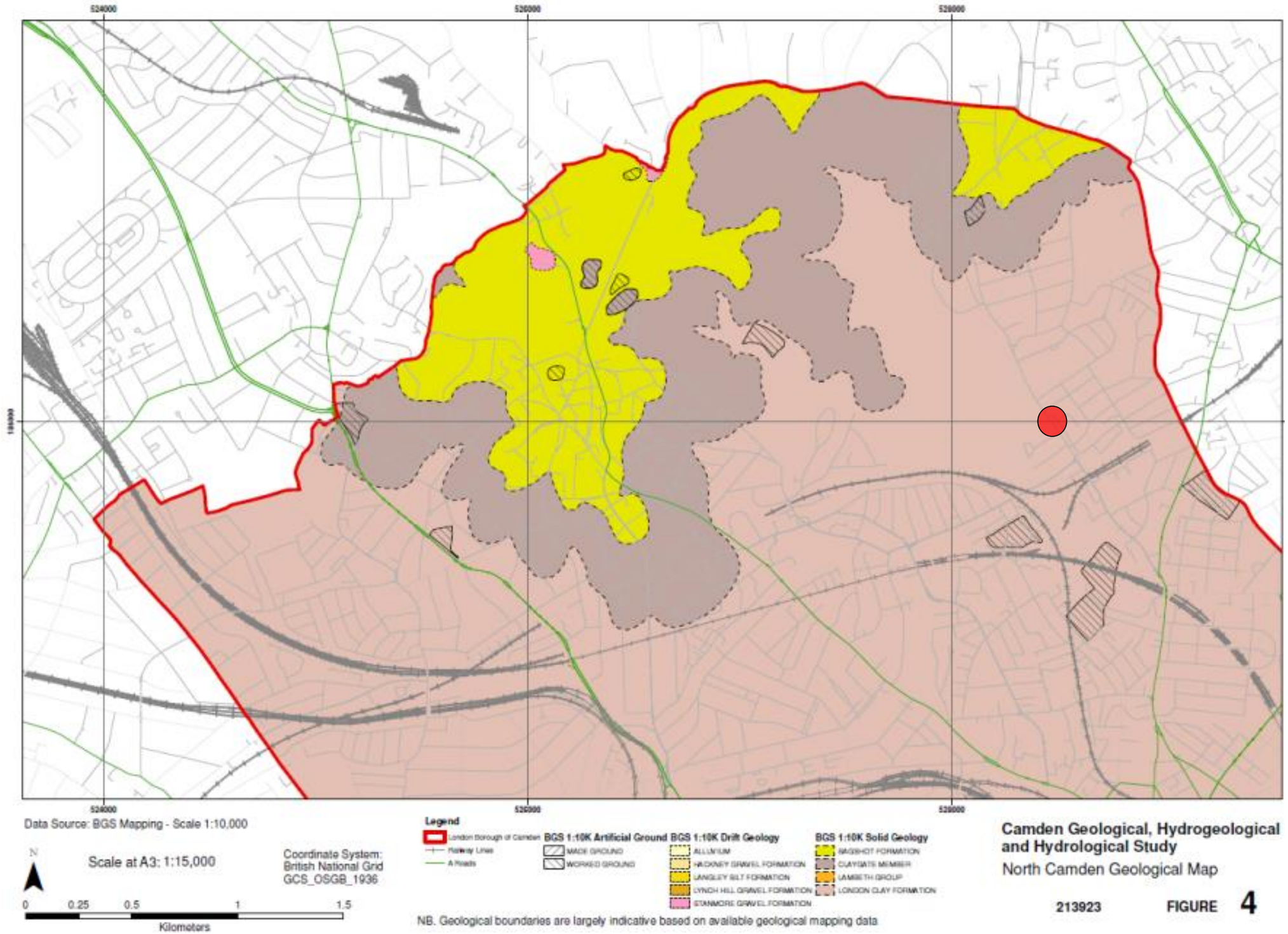

Figure 7 North Camden Geological Map

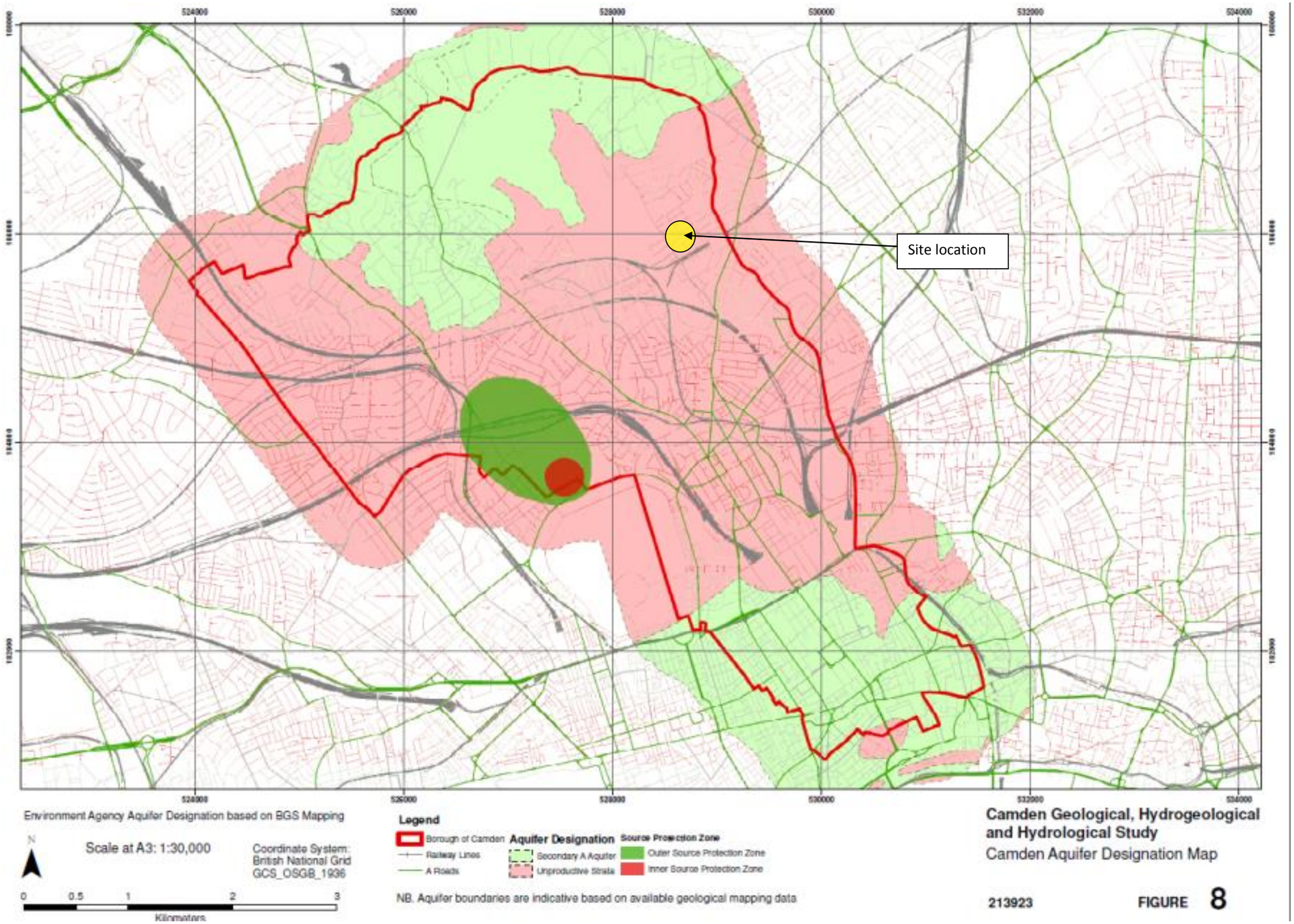

Figure 8 Camden Aquifer Designation Map

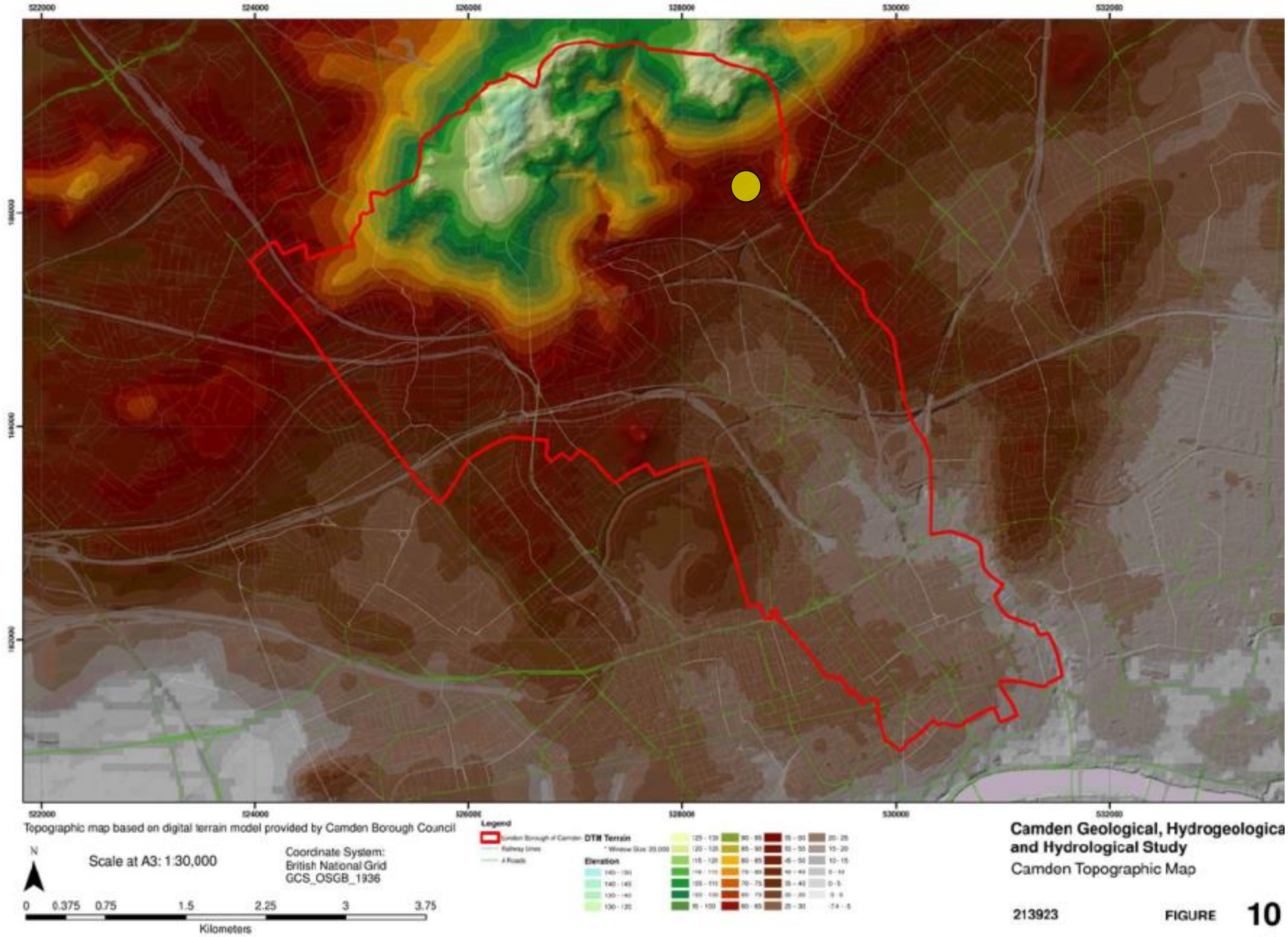

Figure 9 Camden Topographic Map

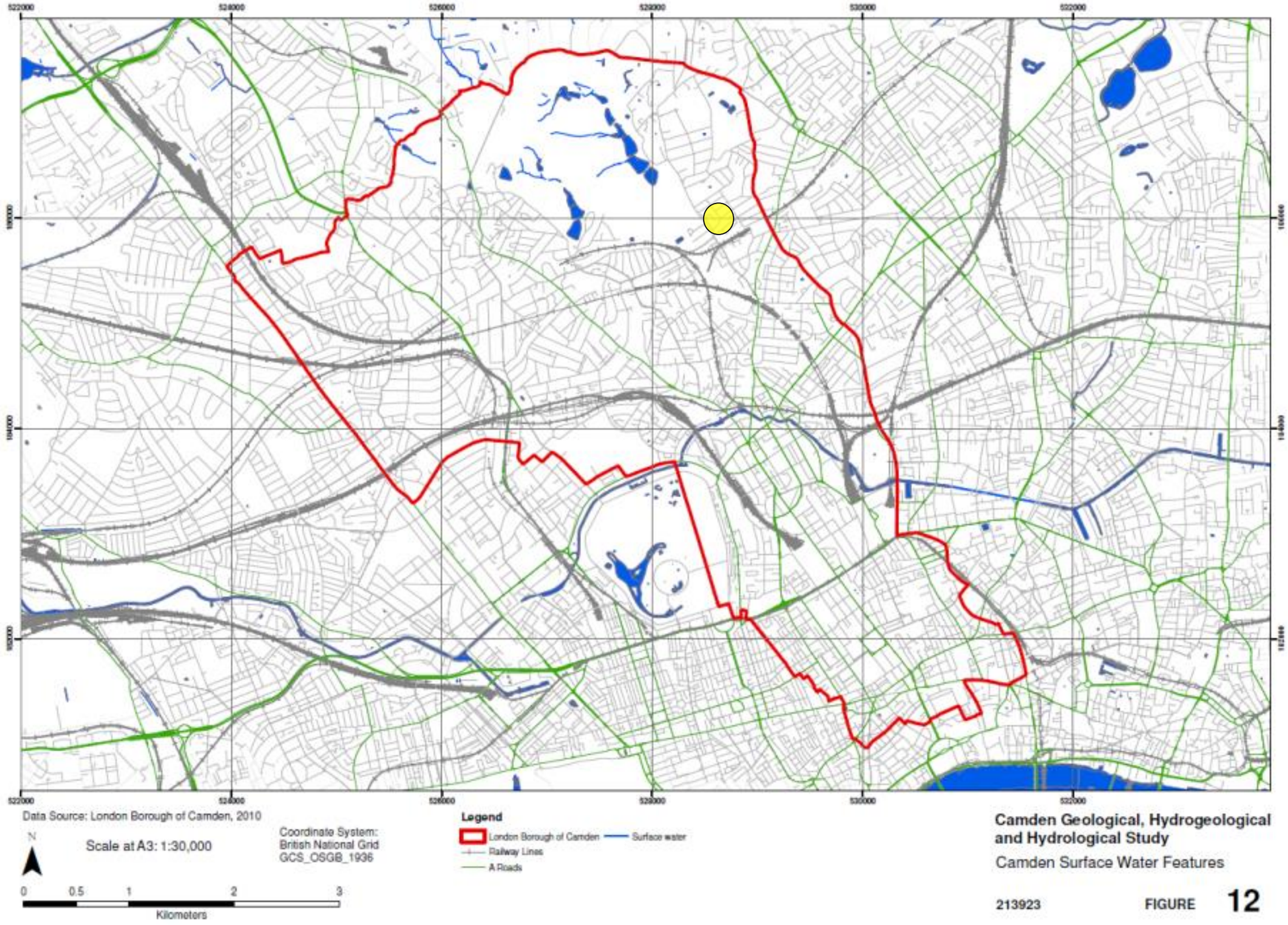

Figure 10 Map of the Camden Surface Water Features

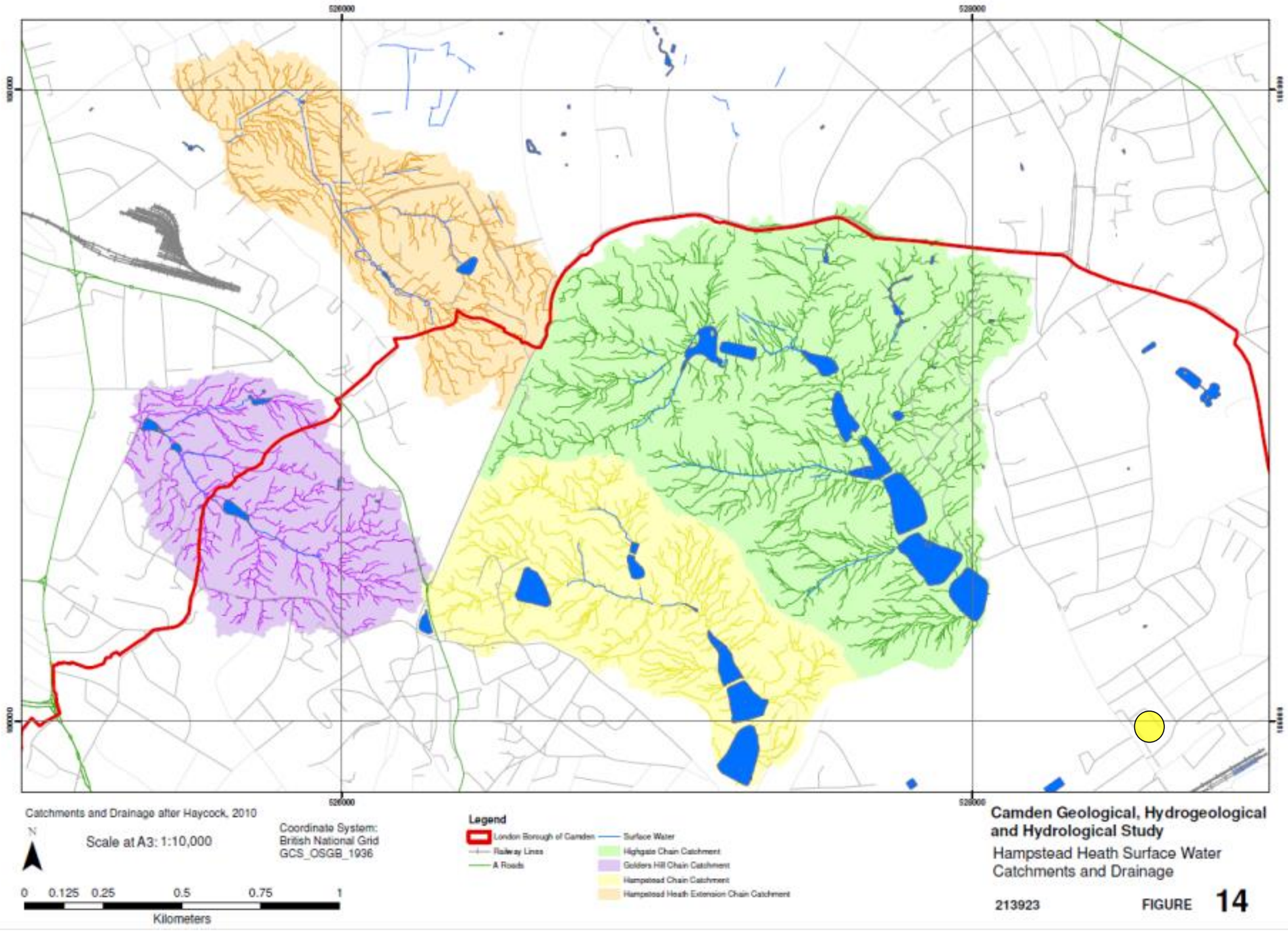

Figure 11 Map of the Hampstead Heath Surface Water Catchments and Drainage

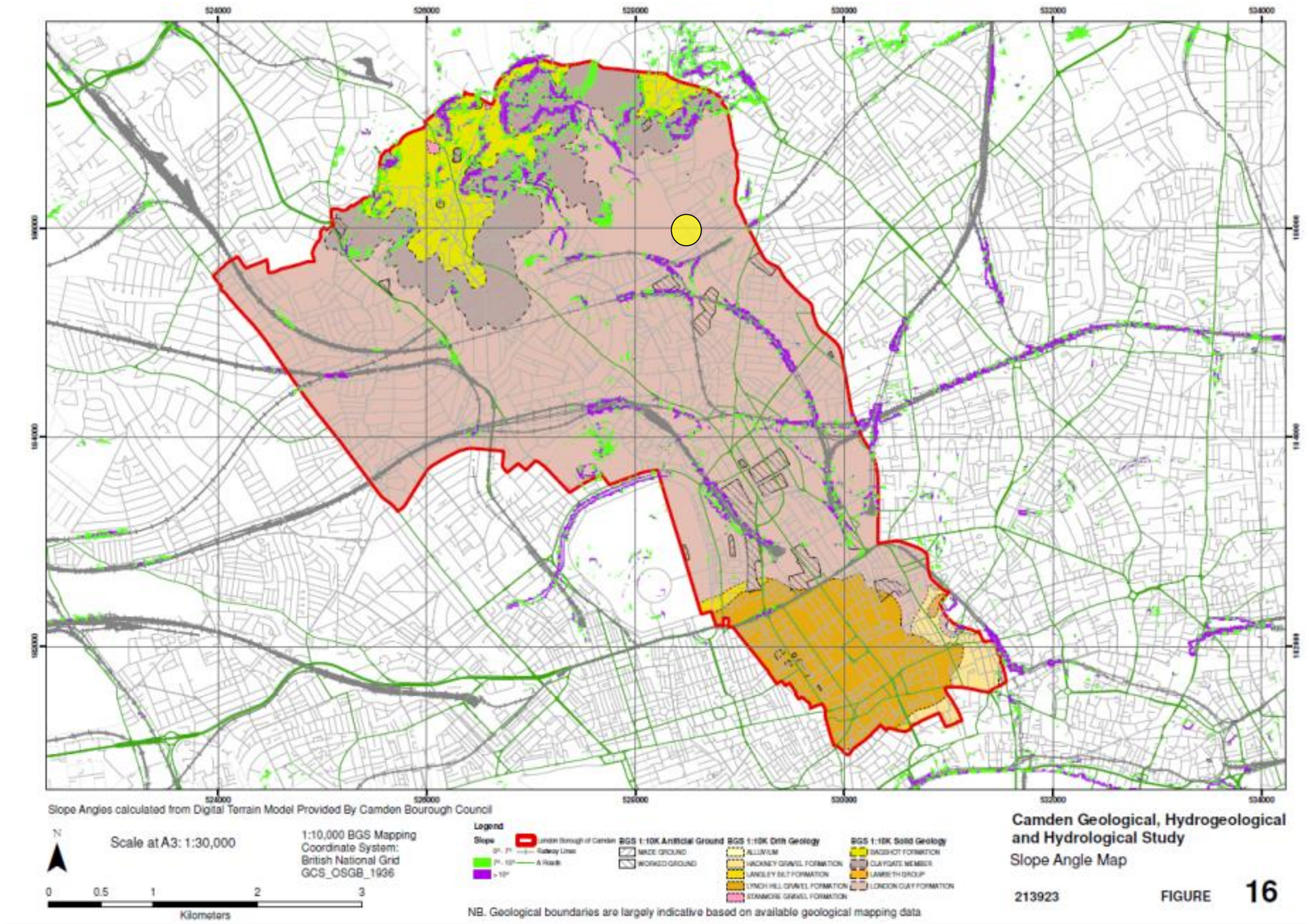

Figure 12 Camden Slope Angle Map

Appendix E

Example Damage Category Calculation

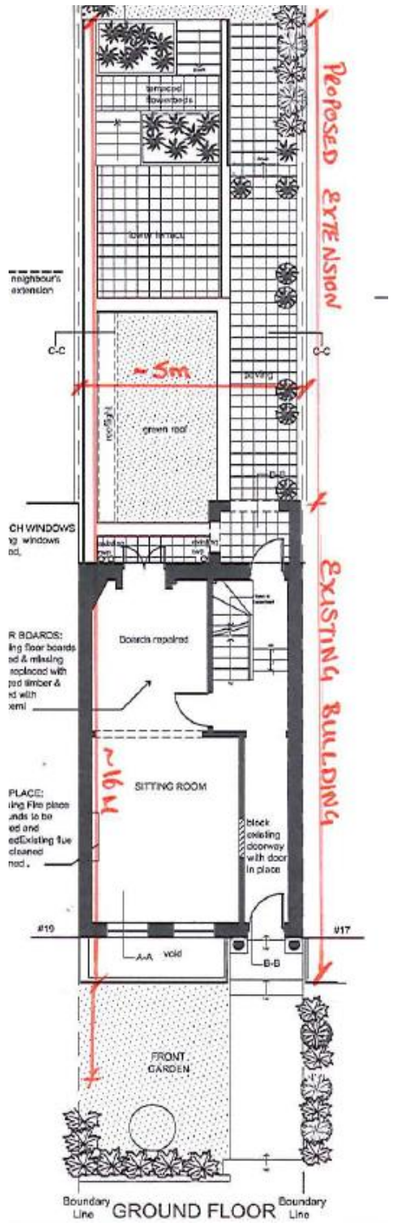

Figure 14 Dimensions of Proposed Works

Stage 1

Ground movements behind the retaining wall should be estimated as described in Section 2.5.2 assuming greenfield conditions, ie ignoring the presence of the building or utility and the ground above foundation level. Contours of ground surface movements should be drawn and a zone of influence established based on specified settlement and distortion criteria. All structures and utilities within the zone of influence should be identified.

Stage 2

A condition survey should be carried out on all structures and utilities within the zone of influence before starting work on site. The structure or utility should be assumed to follow the ground (ie it has negligible stiffness), so the distortions and consequently the strains in the structure or utility can be calculated. The method of damage assessment should adopt the limiting tensile strain approach as described by Burland *et al* (1977), Boscardin and Cording (1989) and Burland (2001); see Table 2.5 and Figure 2.18.

Table 2.5 *Classification of visible damage to walls (after Burland* et al, *1977, Boscardin and Cording, 1989; and Burland, 2001)*

Category of damage	Description of typical damage (case of repair is underlined)	Approximate crack width (mm)	Limiting tensile strain ε_{lim} (per cent)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible.	< 0.1	0.0–0.05
1 Very slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection.	< 1	0.05–0.075
2 Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly.	< 5	0.075–0.15
3 Moderate	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5–15 or a number of cracks > 3	0.15–0.3
4 Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 but also depends on number of cracks	> 0.3
5 Very severe	This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	usually > 25 but depends on number of cracks.	

Notes

1. In assessing the degree of damage, account must be taken of its location in the building or structure.
2. Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.

IA C580

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Figure 13 Damage Categories

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Title MOVEMENT ASSESSMENT By MNB Chkd

INTRO: THE FOLLOWING CALCS WILL DEMONSTRATE THE ANTICIPATED DAMAGE CATEGORY FOR THE PROPOSED BUILDING WORKS, IN ACCORDANCE WITH CIRIA C580.

Proposed building DIMS H=13m Lw=16m Lb=5m (Note: all dims are approx.)

Estimation of visible damage to walls.
REF CIRIA C580 TAB 2.5 & Fig 2.18

a) L/H = 5/13 = 0.38 ← worst case.
b) L/H 16/13 = 1.23

option a is closest to the L/H=0.5 curve, where as option b is closest to the L/H = 1 curve.

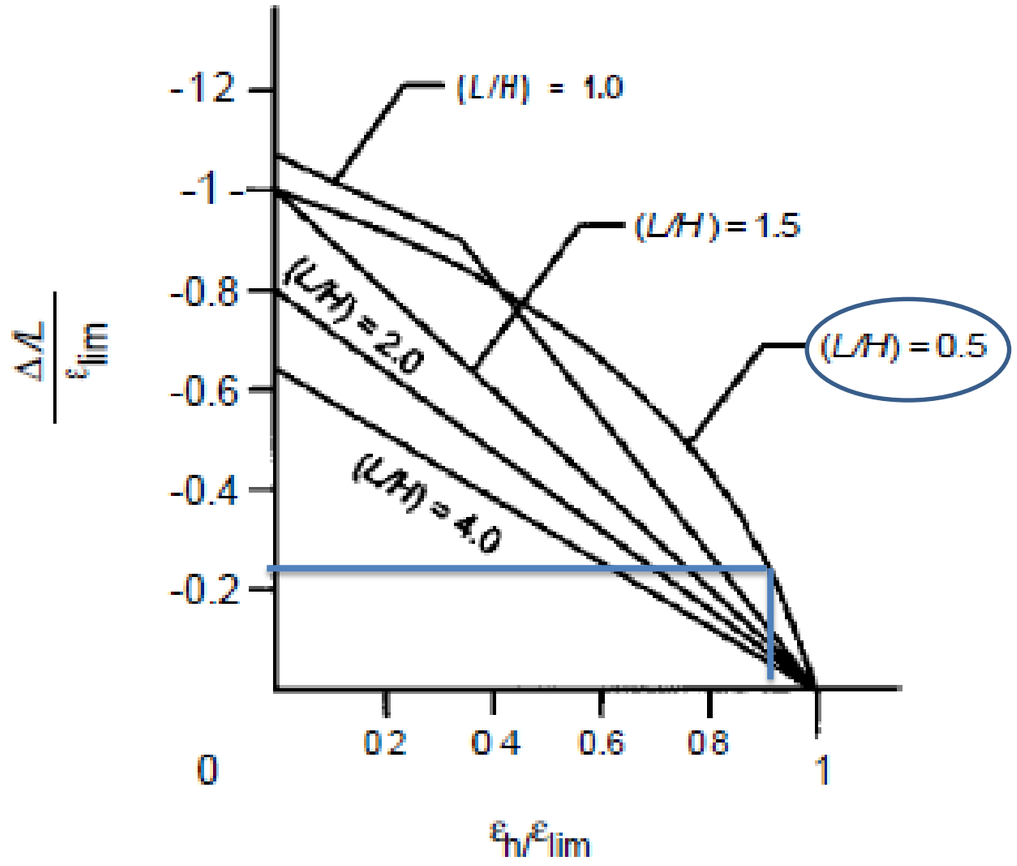
It is more conservative to take the L/H = 0.5 curve AS SHOWN OVER →

Expected Movement Ratios
Δ_V = 3mm (approximately)

$\varepsilon_V = \Delta_V / L$ = 3/5000 x 100 = 0.06 %

$\varepsilon_h = \Delta_H / L$ = 4/5000 x 100 = 0.06 %

∴ THEREFORE THIS SHOWS THE WORKS FALL WITH CATEGORY 1



(b) Influence of horizontal strain on Δ/L / ε_{lim} (after Burland. 2001)

Title to Identify Wall

Longitudinal Length, L_1 = 16.0 m → L/H = 0.38
Transverse Length, L_2 = 5.0 m
Height, H = 13.0 m

Damage Category 0 ε_{lim} = 0.050 %

$\varepsilon_h/\varepsilon_{lim}$	ε_h (%)	δ_h (mm)	$(\Delta/L)/\varepsilon_{lim}$	Δ/L	Δ (mm)
0	0	0	1	5.0E-04	8.0
0.2	0.01	2	0.91	4.6E-04	7.3
0.4	0.02	3	0.8	4.0E-04	6.4
0.6	0.03	5	0.64	3.2E-04	5.1
0.8	0.04	6	0.42	2.1E-04	3.4
1	0.05	8	0	0.0E+00	0.0

Damage Category 1 ε_{lim} = 0.075 %

$\varepsilon_h/\varepsilon_{lim}$	ε_h (%)	δ_h (mm)	$(\Delta/L)/\varepsilon_{lim}$	Δ/L	Δ (mm)
0	0	0	1	7.5E-04	12.0
0.2	0.015	2	0.91	6.8E-04	10.9
0.4	0.03	5	0.8	6.0E-04	9.6
0.6	0.045	7	0.64	4.8E-04	7.7
0.8	0.06	10	0.42	3.2E-04	5.0
1	0.075	12	0	0.0E+00	0.0

Damage Category 2 ε_{lim} = 0.150 %

$\varepsilon_h/\varepsilon_{lim}$	ε_h (%)	δ_h (mm)	$(\Delta/L)/\varepsilon_{lim}$	Δ/L	Δ (mm)
0	0	0	1	1.5E-03	24.0
0.2	0.03	5	0.91	1.4E-03	21.8
0.4	0.06	10	0.8	1.2E-03	19.2
0.6	0.09	14	0.64	9.6E-04	15.4
0.8	0.12	19	0.42	6.3E-04	10.1
1	0.15	24	0	0.0E+00	0.0

Conclusion: Therefore this shows the proposed works fall within category 1.

Plot Showing Upper Bound Limit of Acceptable Movement