BASEMENT IMPACT ASSESSMENT

FOR

PROPOSED LIGHTWELLS

AT

No 17 Wadham Gardens London NW3

Date: June 2020

Revision: -

Pringuer-James
Consulting Engineers

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1.0 Introduction

Pringuer-James Consulting Engineers (PJCE) were appointed by Spinocchia Freund Ltd. as the structural engineers for the proposed development at No.17 Wadham Gardens, Camden.

As part of the project brief PJCE are required to provide assistance on the structural engineering aspects of the proposed project including the preparation of a Basement Impact Assessment (BIA) to be submitted with the planning submission package.

The BIA has been prepared in accordance with the current format set-out by London Borough of Camden Planning Department (LB Camden) in the document, Camden Planning Guidance - Basements and Lightwells (CPG4). The guidance document is based on the specially commissioned study prepared by Ove Arup & Partners Ltd, Camden Geological, Hydrogeological and Hydrological Study (CGH&H). This document is a detailed study of the geotechnical, hydrogeological and hydrological characteristics of soil strata found in the borough of Camden.

There are three critical criteria identified in the CGH&H study which must be considered and dealt with in each assessment carried out for a proposed basement development. The defining criteria are as follows:-

I) Subterranean Flow
II) Land Stability
III) Surface Flow & Flooding

This BIA document is set out with four stages indicated. Firstly, the initial screening process which leads to stage two, the scoping process, whereby relevant issues are identified for the site and their subsequent potential impacts. The third stage of the process involves gathering of site specific data by various means of a desk study and site investigation. From this the relevant information is obtained to enable an accurate assessment of the potential impacts of any issues identified in the first two stages.

Following the site investigation the fourth stage of the BIA involves an analysis of the information gathered and a site specific assessment is made on the potential impact of the proposed development. If the potential impacts identified are found to have an adverse risk to the existing site, the surrounding properties and/or the extended area, then a series of measures to mitigate against any negative impact are outlined for the project.

The assessment is then submitted as part of the planning package for the project to enable LB Camden make an informed decision on the overall planning submission.

This report presents an outline structural scheme for the construction of the new subterranean structure and proposed alterations to the ground floor plate. Any changes to the superstructure fall outside this report, but a brief summary is included to assist with the understanding of the complete structural scheme.

The report is based on the current design and discussions with the architect (G-PAD Ltd.) and other consultants mentioned in the report. It should be read in conjunction with the information submitted at this stage by all other consultants, for information purposes.

Fig 1 – Existing Site Location Map

2.0 Screening

2.1 Location of the Project

The site is located in Camden at number 17 Wadham Gardens, Primrose Hill and centred at approximate National Grid Reference 527217E 184070N. The site is rectangular in shape and measures approximately 45m x 13m. The proposed lightwells are situated on the left hand side of the existing building toward no. 15 Wadham Gardens.

The surrounding area consists of similar residential dwellings, comprising two and three-storey detached properties and associated gardens. A railway tunnel is located in the rear garden of the site. A Victorian age, brick-built air shaft tower for this tunnel is visible in the rear garden of the next but one property to the west of the site. Public domain information indicates that the tunnel was bored and brick lined through the London Clay [rather than a “cut and cover” construction] at a depth sufficient to ensure that later surface development was not compromised

2.2 Characteristics of the Project

The existing property is two-storey detached house measuring about 11m x 20m in area, with relatively flat, partly grassed and paved front and rear gardens. Historically the building has been used for residential purposes only. In approx. 2015/2016 a new basement level was added below the footprint of the, extending into the rear garden and under the front paved area.

The structure of the building consists of loadbearing brickwork walls with timber floor plates, supported on walls and by a series of steel and timber beams. The entire building is covered by a pitched timber roof, supported on the existing walls. The basement extension had been designed to support the existing structure above in its entirety and was built with RC retaining walls built in sequential underpins, but the area extending under the front paved area, consisted of contiguous piled walls with an RC lining wall towards the interior space. The maximum depth of the basement level is approx.. 6.00 m at its deepest and approx. 3.4m at general areas. The works also involved the re-construction of the existing ground floor slab to suit.

As mentioned previously, any changes to the superstructure fall outside this report, but a brief summary is included to assist with the understanding of the complete structural scheme. An interior load bearing wall is proposed to be removed at ground floor level and new steel beams installed to support the bay window above. It is proposed to remove the existing staircases and replace them with new ones, with the addition of new steel beams supported on the existing walls. Also, a partial dormer extension is proposed at roof level to maximize the space within the roof area.

Preliminary structural details are attached as part of the appendices which outline the proposed construction details to facilitate the installation of the new lightwell structures.

2.3 Physical Form of the Lightwells

The proposed lightwells will be approx. 2.00 m (at its deepest points) below existing ground floor level and each have an approx. plan area of 2.30m^2. It is proposed to form the lightwells by diamond cutting the existing RC retaining wall and contiguous piled walls, after which an RC surround will be cast to form the structure around the lightwells. These also have a double purpose, that of strengthening the existing elements which were diamond cut. In order to create an a good connection between the new and existing members, resin anchored dowels will be used along the entire contact length. The new surrounding structure will be designed for the various loads due to gravity, soil movements and hydrostatic forces.

To the eastern and western sides, the property boundaries with similar sized properties, of similar construction.

2.4 Mitigation Measures Being Considered

As with any development involving the construction of subterranean works, the proposed construction methods and programme of works must be chosen once appropriate levels of consideration are given to the inherent risks associated with excavation, and more specifically in this case, excavation in close proximity to existing buildings and their foundations.

Given the close proximity of the adjacent buildings along the east and west boundaries, the proposed works has been designed to limit the risk of adverse impact to the adjacent properties. This has been achieved by proposing the use of sequentially underpinned walls along the length of the adjacent properties. These walls will also provide support to the excavation in the temporary condition and support the structure on its own as well. These walls will be designed to act as retaining walls in both temporary and permanent conditions.

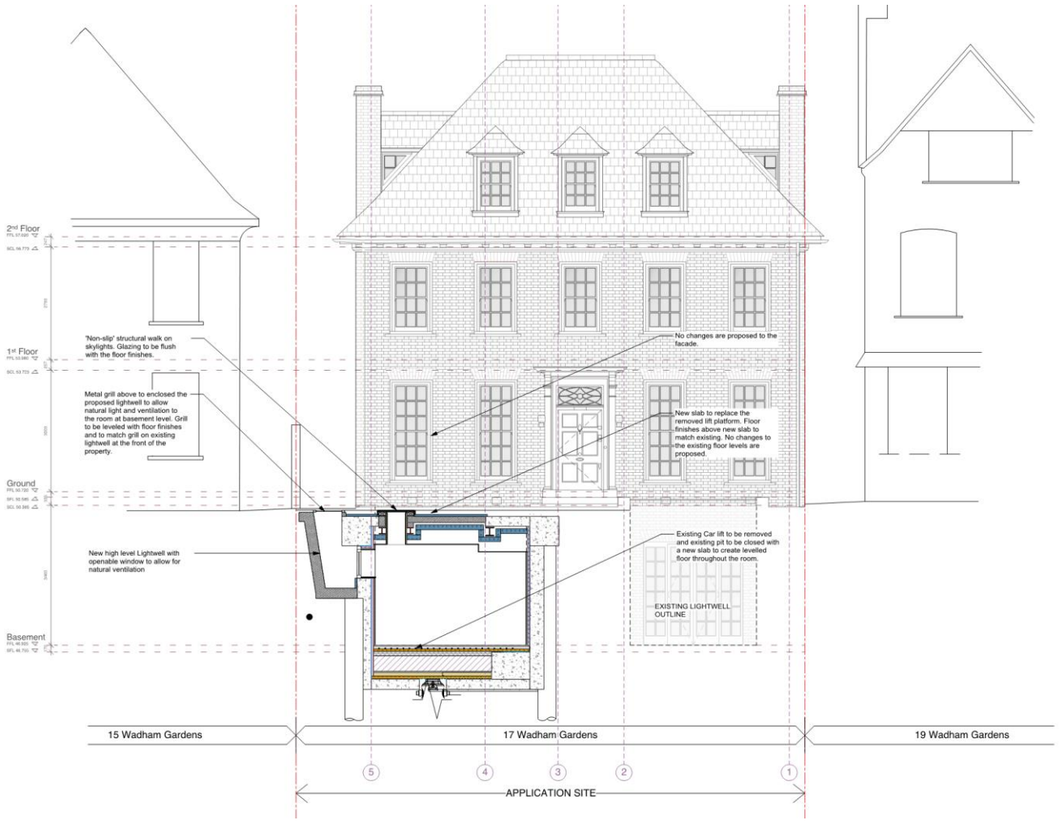

Fig 1 - Proposed Section

2.5 Characteristics of Potential Impacts

2.5.1 Subterranean (Groundwater Flow)

The prevalent geological characteristics of the Camden area consist of a stiff London Clay with a depth varying from 80m to 120m overlying a Chalk bedrock formation.

Over the extended Camden Borough region the upper levels of the clay layer contain relatively small regions of River Terrace Deposits defined by outcrops of Claygate Formation and Bagshot Sands. In these areas of permeable material it is not uncommon to come across a raised groundwater table due to the presence of a perched aquifer or historic river channel. The attributes of the groundwater in these areas varies, sometimes found to be static if not connected to additional groundwater features.

Where a high groundwater table is found the possible effects of excavating for a lightwell include altering the water table levels and/or diverting the existing flow paths. The effect of these changes needs to be taken into consideration in the early planning stages of a development to ensure that adverse effects are accounted for and wherever possible designed out of the proposed development.

These adverse effects may include:-

- Forming alternative flow paths for the groundwater which may conflict with existing basements that have not been adequately protected against moisture.
- Altering existing groundwater levels locally and as a result possibly altering the soil properties of the local area. The altered soil properties may influence among other things, the existing slope stability and the soil bearing capacity.

2.5.2 Slope Stability

Generally:
Slope instability is affected by a number of contributory factors ranging from soil properties, land use, topography, landscape and human activities (e.g.: mining or drainage etc.)The excavation and construction of a lightwell can affect the slope stability of a site and the adjoining land or properties in a number of ways including:-

- Altering the soil properties such as, the moisture content, pore water pressure, consolidation and compaction levels, shear strength and bearing capacity of the soil.
- Requiring an element of pumping or dewatering of the site which can in some instances lead to the removal of “fines” in the existing soil, thus affecting the soil properties and interaction of the particles.
- Requiring the removal of existing vegetation, plants and/or trees from the site which are part of the system of groundwater extraction. This in turn may alter the groundwater levels which can affect the soil properties.
- Altering the natural state of the landscape or possibly involving works to previously disturbed or “worked” soil which could have an historic element of instability.

Beyond the Confines of the Site:
Possible effects of any lightwell construction must take into account the adjoining structures and their existing foundations, and any infrastructure in the area. The scale of proposed works will dictate the potential zone of influence of any works to be undertaken below ground.

During the construction stage of a project the local bearing capacity of the soil in the zone of influence for the works can be temporarily reduced. This is due to the removal of existing overburden pressures. Any project must allow for this reduction in pressure and undertake proper planning, design and execution of the excavation and any temporary works which would be required.

Additional effects which must be considered in the planning and design of a project are the inevitable ground movements which will be experienced. With any excavation there is a degree of ground movement which must be allowed for and this is generally done by specifying agreed design parameters for any soil retaining element of the works and incorporating in the construction sequence a suitable scheme for temporary works.
Once the construction stage of a project is complete possible effects which should be considered include the increased stiffness of the new foundations and also the possible increase in the loads transmitted to the bearing strata.

As part of the project any existing foundations within a site or adjoining the site may require upgrading to support the new building. Upgrading foundations along party wall lines can give rise to a variation in stiffness between old and new foundations which should be considered as part of the planning and design process.

In addition to the variation in stiffness of the foundations, a new or redeveloped building can lead to increased or redirected pressures on soil bearing strata. The effects of this should be catered for in any design with particular attention paid in areas where the primary soil is a clay-based material. This is due to the susceptibility of clay to experience swelling and contraction as moisture content varies. The issue of swelling and contraction can be minimized by excavating below the upper layers of soil which would be more sensitive to weather and moisture conditions.

2.5.3 Surface Flow & Flooding

Potential impacts on the surface flow and flooding characteristics in an area as a result of excavation for a lightwell can vary dependent on a site location and the existing drainage infrastructure which is required to cater for any runoff from a site.

Excavating for a lightwell directly affects the volume of soil below ground and depending on the type of material can affect the natural groundwater storage capacity of the soil. If this is reduced significantly it can cause an increase in the proportion of surface water runoff which needs to be catered for by the local drainage network.

Following on from the point above, with an increase in the volume of surface water runoff, there is an increased risk of overwhelming the local drainage network which may not have sufficient capacity to deal with the increased volumes. This in turn may raise the possibility of flooding properties down-gradient. As part of the planning and design of a project careful consideration should be given to the need to cater for any runoff generated by the development and if possible deal with it within the confines of the development site before finally letting any excess which cannot be catered for flow into the drainage network.

If a project causes an increase in the levels of runoff produced, and the increased volumes are not catered for, the possibility and frequency of flooding is increased. In areas which are already prone to flooding the effects of this must be examined and further analysis may need to be undertaken.

2.6 Screening Process

2.6.1 Subterranean Flow

Q1a: Is the site located directly above an aquifer? ***→ NO***

Referring to Figure 8 of the CGH&HS (see Appendix A.11) indicates that the underlying soil has been classified as “Unproductive Strata” and thus would not be expected to contain any groundwater.

The site investigation carried out shows that the predominant soil condition is found to be a stiff London Clay to a minimum depth of 15m underlying a 1.10m depth of made ground. There are no indications of a high water table or outcrops of permeable material in the immediate area.

Q1b: Will the proposed basement extend beneath the water table surface? ***→ NO***

The proposed lightwell depth is expected to be a maximum of 2.00m. Borehole results and trial pits carried out for the site do not indicate the presence of a high groundwater table and thus it is expected that the proposed lightwell excavation will not extend beneath the water table.

Q2: Is the site within 100m of a watercourse, well (used/disused), or potential spring line? ***→ YES***

The latest available information relating to watercourses in the area would suggest that the site is above an existing natural water feature. Initial inspection of available mapping in the area (see Appendix A.13) shows a watercourse directly below the site.

Historic records from the Lost Rivers of London (see Appendix A.13) suggest that the upper course of the River Fleet may have previously run its course approximately under the site. Preliminary site investigation carried out on the site has not come across any form of dried water channel. On this basis it is assumed that the site will not contain any river channel material.

The site is located over an extensive area of London Clay material (see Appendix A.8) with no evidence of an outcrop of claygate formation or bagshot sands in the nearby area. This would suggest that the potential for a spring is minimal.

Q3: Is the site within the catchment of the pond chains on Hampstead Heath? ***→ NO***

Referring to the Fig 14 of the CHG&HS (see Appendix A.14), the catchment areas for the Hampstead Heath pond chains do not coincide with the site location and are approximately 2km to the Hampstead Chain catchment.

Q4: Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas? ***→ NO***

At present the existing site has a rear garden and a front paved area. It is envisaged that this situation will be maintained once the proposed lightwell is built.

Q5: As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)? ***→ NO***

The existing drainage system for the site is assumed to drain freely into the local authority drainage network. It is not anticipated that the proposed development will not increase the levels discharged to the ground.

Q6: Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not the pond chains on Hampstead Heath) or spring line? ***→ NO***

The lowest point of the proposed excavation will be approximately 2.00metres below ground level. The site is not in close proximity to any local ponds, the nearest pond being 1.5 kilometres to the south in Regents Park.

2.6.2 Slope Stability

Q1: Does the existing site include slopes, natural or manmade, greater than 7 degrees (approximately 1 in 8)? ***→NO***

The existing site has no significant gradient or falls. Topographical data available from existing site surveys suggests the site is relatively flat across the plan area. Over the extended region the site is located in an area which is not noted as vulnerable to landslides or significant soil movements. The elevation of the extended area is found to be approximately 45m AOD

Q2: Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8)? ***→NO***

The site is not anticipated to require any re-profiling to landscaping.

Q3: Does the development neighbour land including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8)? ***→NO***

While the site is located approximately 40m to an existing railway line, initial site inspection and geotechnical investigations do not suggest the presence of any railway cuttings or indeed a slope in excess of 1 in 8.

Q4: Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8)? ***→NO***

The site is set in a region with a relatively flat slope. Approximate site levels are in the region of 45m with variance at a maximum of +/-0.3m.

Q5: Is the London clay the shallowest strata at the site? ***→NO***

The London Clay is the only definable strata at the site and is expected to go as far down as the underlying bedrock. Elements of the surrounding site have previously been used as residential areas and were found to have approximately 1.10m of made ground.

Q6: Will any tree/s be felled as part of the proposed development and/or any works proposed within any tree protection zones where trees are to be retained? ***→NO***

There are a number of semi-mature/mature deciduous trees are present along the rear garden boundaries and along the front paved area. Special attention has been give so that the works will not encroach into the potential root protection zones.

Q7: Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site? ***→UNKNOWN***

With the limited information available (no pre condition survey has been carried out to date on the existing buildings either within or adjacent to the site) the effects of seasonal shrink-swell subsidence cannot be accurately established.

Q8: Is the site within 100m of a watercourse or a potential spring line? ***→YES***

Refer to Q2 of section 2.6.1 Subterranean Flow.

Q9: Is the site within an area of previously worked ground? ***→NO***

The site is not considered to be within an area of previously worked ground. Referring to the historic geological mapping available for the 1920's there is no indication that the area contains any worked ground (see Appendix A.8).

Q10: Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction? ***→NO***

The site is located in an area designated as unproductive strata. Thus it is not expected to be within an aquifer. (See Appendices A.1; A.2; A.11)
Site investigation shows some signs of water ingress into the borehole. This is consistent with the depth of made ground in the area. It is anticipated that there will be no requirement for any dewatering during the construction of the proposed lightwells.

Q11: Is the site within 50m of the Hampstead Heath ponds? ***→NO***

The site is located approximately 1.5kilometres away from the nearest pond in the Hampstead Heath Ponds (See Appendix A.14).

Q12: Is the site within 5m of a highway or pedestrian right of way? ***→YES***

The nearest proposed lightwell is set back approximately 3 metres from the nearest roadway and/or pedestrian right of way which is Wadham Gardens Road. These will remain usable during all works have been carried out.

Q13: Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties? ***→NO***

To the east and west along the boundaries with the adjacent properties it is not anticipated that the differential depth of foundations will increase assuming basement/cellar is found below the neighbouring properties.

Q14: Is the site over (or within) the exclusion zone of any tunnels, e.g. railway lines? ***→NO***

The site is located a minimum of 40m from the surrounding railway lines, and more than 100m from the neighbouring Northern tube line. Thus it is not expected that that the site is over or within any exclusion zones for rail or underground infrastructure. It is also outside the 5.00 m exclusion zone of the Network Rail tunnel running underneath property.

2.6.3 Surface Flow & Flooding

Q1: Is the site within the catchment of the pond chains on Hampstead Heath? → NO

The site is approximately 1.5kilometers from the Hampstead Pond Chain and is not within the catchment of any of the pond chains 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

The site will completely retain its permeable elements and the proposed development will be similar in proportion to the extent of site covered. The use of any existing local authority drainage systems will be maintained and so the proposed development will not materially change the surface water flows.

Q3: Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas? → NO

It is not anticipated that the proposed lightwell will result in a change in surface water generated.

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

The existing site is serviced by a series of drainage sewers and channels which restrict the flow of surface water from the site to adjacent properties. This also ensures that all surface water generated is directed into the gravity fed drainage systems locally. The proposed lightwells are not expected to generate any additional surface water and so is not expected to change the profile of inflows of surface water to adjacent properties or downstream watercourses.

Q5: Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses? → NO

As per Q4, the proposed lightwells will not have any effect on the surface water which will be generated and so will have no subsequent effect on the quality of the surface water received by adjacent properties or downstream watercourses.

Q6: Is the site in an area known to be at risk from surface water flooding, such as South Hampstead, West Hampstead, Gospel Oak and King's Cross, 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 is located along Wadham Gardens. Examination of the available flooding data suggests that the site is not at risk of flooding of any nature. (see Appendix A.16)

2.7 Summary

2.7.1 Subterranean (Groundwater) Flow

The screening process has not identified any issues of concern to be investigated further as part of this BIA.

2.7.2 Slope Stability

The screening process has identified three issues which are of initial concern as part of the planning process and should be examined further as part of the scoping process

1. History of seasonal shrink-swell subsidence in the local area.

2.7.3 Surface Flow & Flooding

The screening process has not identified any issues of concern to be investigated further as part of this BIA.

3.0 Scoping

3.1 Potential Impacts of the Proposed Scheme

3.1.1 Subterranean Flow

Not applicable

3.1.2 Slope Stability

3.1.2.1 Seasonal Shrink-Swell Subsidence

The history of the seasonal shrink-swell ground movements in the local area is not readily known, although the clay-based nature of the underlying soil does point to the need to consider the cause and effects of shrink-swell movement in the proposed structural design.

There are a number of methods for dealing with possible ground movements which occur in clay soils. For areas of deep underground excavation, these can include the use of tension piles to counteract the anticipated hydrostatic pressures and/or the use of compressible material (e.g. Cordek) to reduce the build-up of hydrostatic pressure acting on the slab. In situations where a raft slab is used it is necessary to design the slab to resist the anticipated hydrostatic pressures.

In ground bearing RC strip foundation systems it is generally accepted that increasing the depth of a foundation below ground minimizes its susceptibility to the problems associated with the more frequent shrink-swell movement of clay soils due to freezing. A minimum depth of 1000mm is typically used for ground bearing foundations and is normally assumed to be below the level at which soil is susceptible to freezing and thawing.

The form of the foundations underlying the existing buildings adjacent to the excavation perimeter (typically stepped brickwork corbels to a depth of approximately 1.45m below existing ground level) allows us to presume that the problems that are inherent with shrink/swell of clay soils in shallow foundations are not applicable to the existing buildings on the site and would lead to the assumption that shrink-swell movements in the local area are currently not causing any undue deterioration in the buildings or boundaries.

For the proposed development, the building foundations are expected to comprise a suitably designed RC slab, with an underlying layer of compressible material. A suitably designed scheme of sequentially underpinned wall is proposed to the perimeter of the new lightwell excavation.

3.1.3 Surface Flow & Flooding

Not applicable

3.2 Summary

The proposed development is located in a region underlain by London Clay throughout. The potential impacts of the lightwell excavation have been assessed in relation to the three screening flowcharts provided by LB Camden.

The scoping process has examined the particular areas which pose the highest risk for potential impact on the adjacent properties. Given the relatively shallow depth of the excavation and the proposed structure it is not expected that the works will present significant risk to any of the boundaries affected provided the works are carried out in the appropriate manner.

4.0 Site Investigation & Study

A geotechnical site investigation has been carried out by Soil Consultants Ltd. This has been used to interpret the soil conditions found in the proposed development site. The borehole log and trial pit details are attached in Appendix C of this document.

The findings of the borehole investigation confirm the assumptions made in relation to clay-based subsoil in the vicinity and serve to back up the points made as part of this BIA.

A brief summary of the findings from the site investigation reveals that the proposed excavation will be carried out in an area of soil containing predominantly stiff London Clay below. The subsoil has also been defined as unproductive in terms of groundwater and no evidence of water ingress was found during the site investigation.

5.0 Impact Assessment & Conclusion

5.1 Existing vs Proposed

The existing site is currently developed below ground level. The new lightwells form only a small addition to the already constructed basement level.

5.2 Site Attributes & Features Affected

5.2.1 Subterranean Flow

An analysis of preliminary site investigation results and an initial interpretation of the information obtained from various additional sources (British Geological Service, Environment Agency, Camden Geological Hydrogeological and Hydrological Study) would indicate that the presence of groundwater in the area is minimal and thus the potential impacts to the groundwater as a result of the development would safely be considered negligible.

5.2.2 Slope Stability

The scope of the proposed works and the extent of existing foundations in the area facilitate the construction for the proposed lightwells with a relatively low level of risk to the slope stability of the adjacent properties.

5.2.3 Surface Flow & Flooding

The existing site has large areas of permeable surfaces and thus the construction of the lightwells is anticipated to have negligible effects on the volume and quality of surface water generated by the redeveloped site.

Analysis of the available material in relation to flooding has indicated that the site is not historically prone to flooding and is not in an area which is required to consider flooding as part of the lightwell construction.

5.3 Conclusion

The basement impact assessment for No.17 Wadham Gardens has been carried out in accordance with current guidelines provided by London Borough of Camden Planning Department.

The three principle criteria identified by the department and which must be dealt with in each assessment include, subterranean (groundwater) flow, slope stability, and surface runoff and flooding.

At each stage of this assessment these three criteria have been considered and any requirements for each category have been incorporated into the projects proposed development scheme.

As a result of this assessment it is reasonable to conclude that the proposed lightwells will not be detrimental to the region in terms of groundwater, slope stability and surface flow and flooding.

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Report checked by:		Sean Pringuer-James *MSc Eng, C Eng, Pr Eng, MICE, SAICE*
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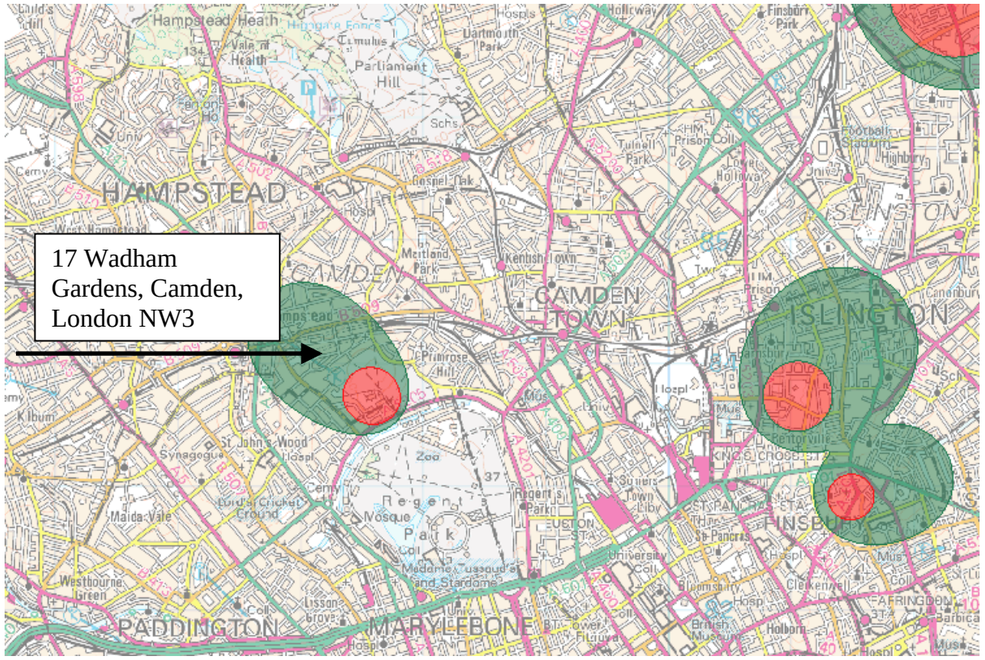
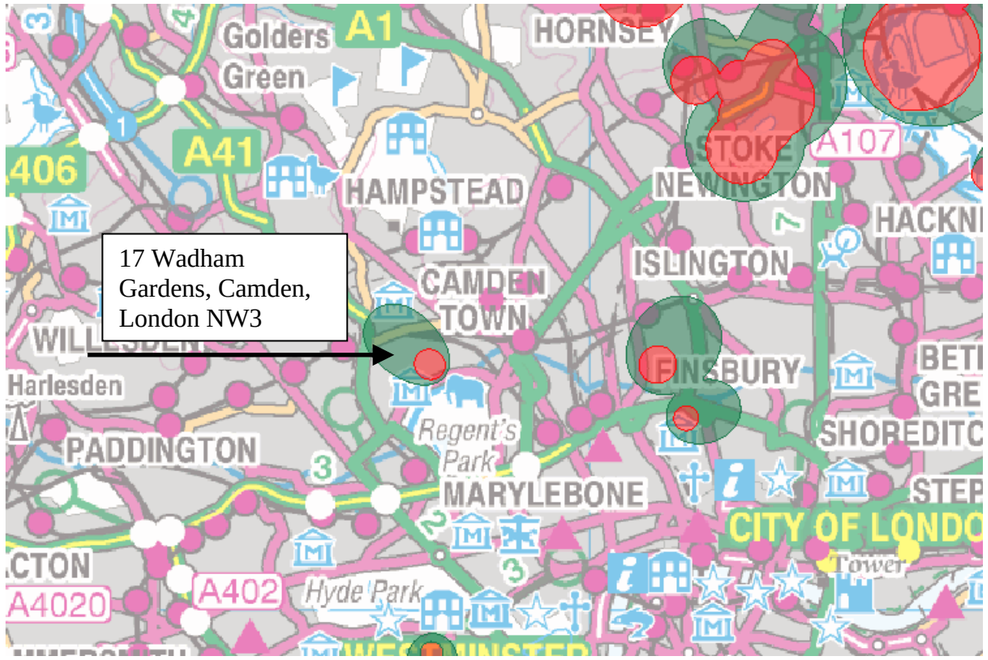
Appendix A

Pringuer-James Consulting Engineers
Basement Impact Assessment

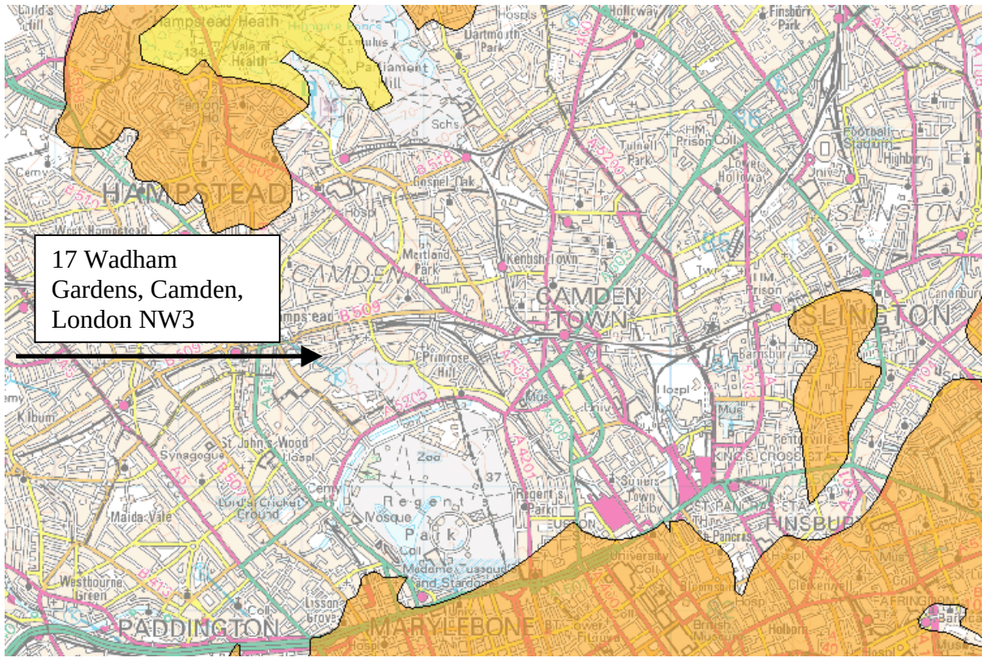
Mapping Data



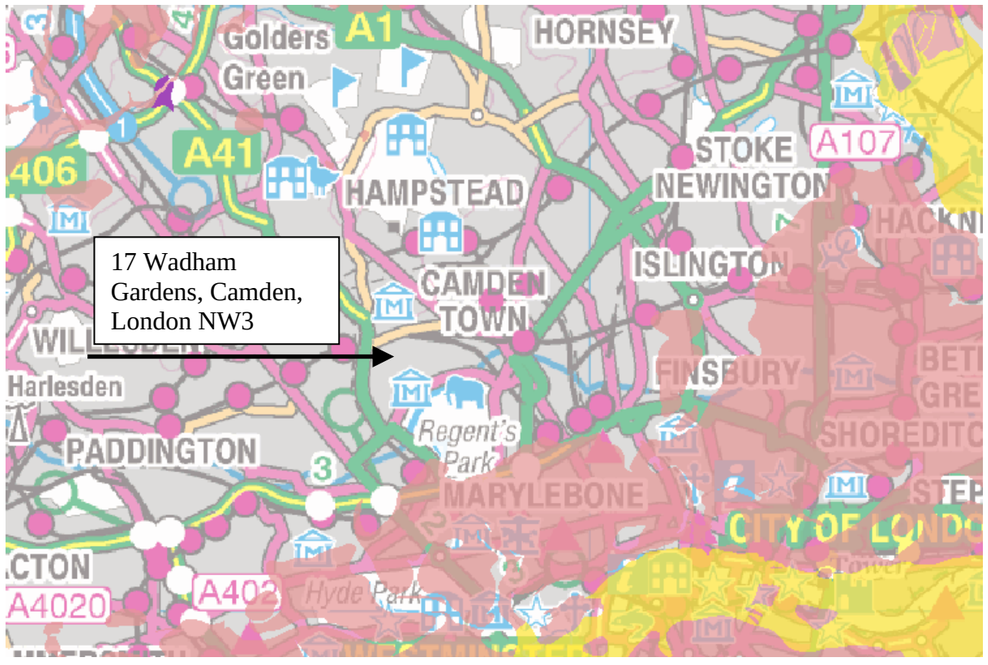
A.1 AQUIFER – SOURCE PROTECTION ZONES (1:40,000)



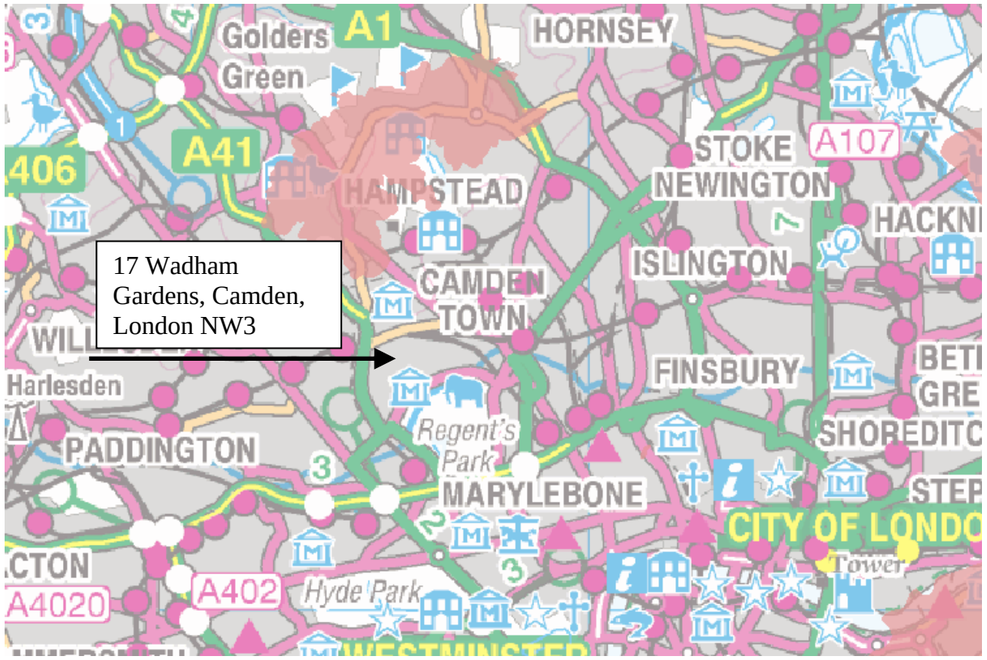
A.3 AQUIFER – SOURCE PROTECTION ZONES (1:75,000)



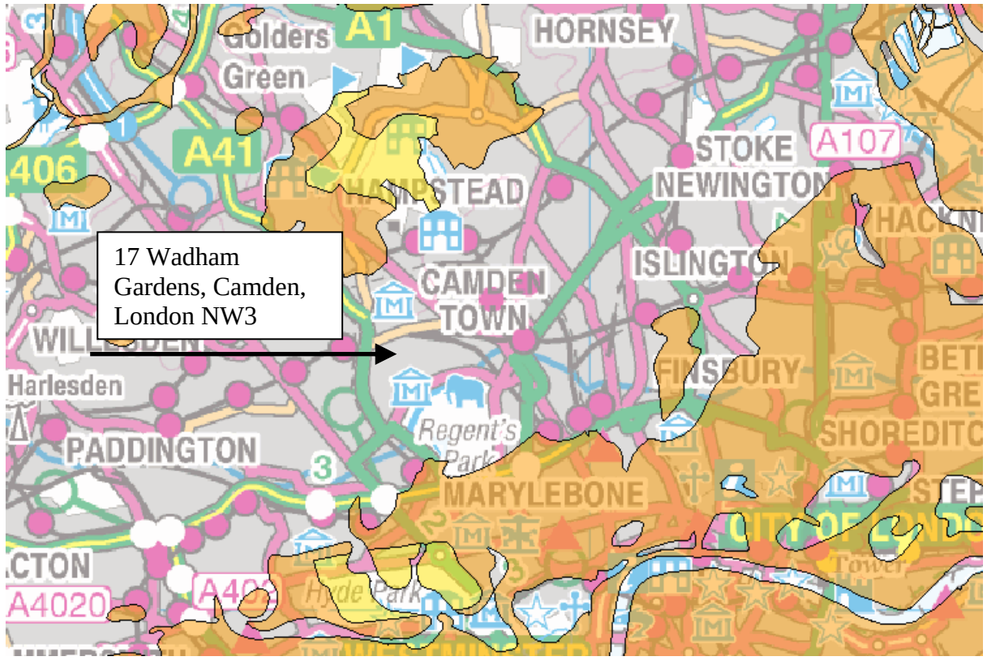
A.2 AQUIFER – GROUNDWATER VULNERABILITY ZONES (1:40,000)



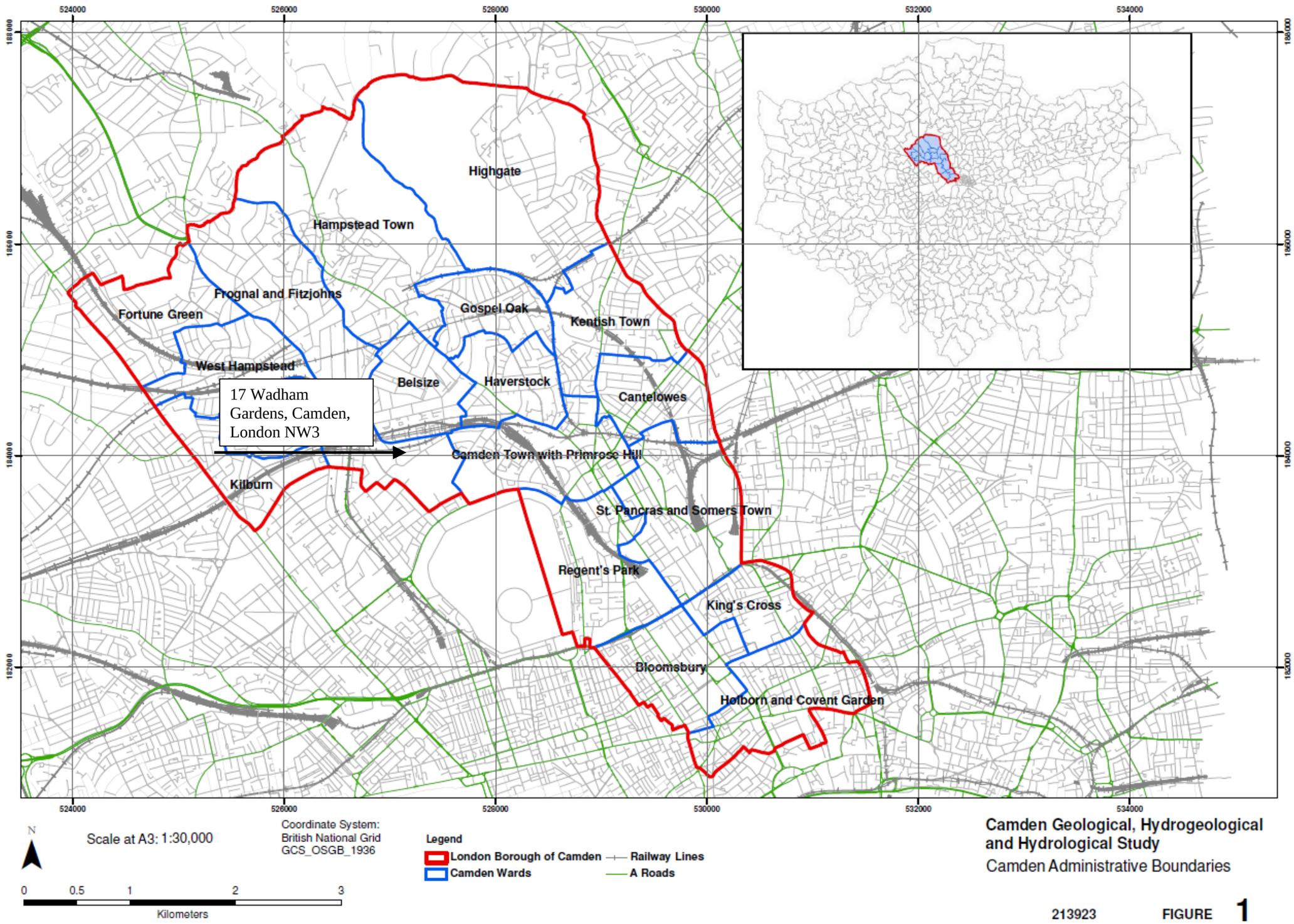
A.4 AQUIFER – SUPERFICIAL DEPOSITS DESIGNATION (1:75,000)



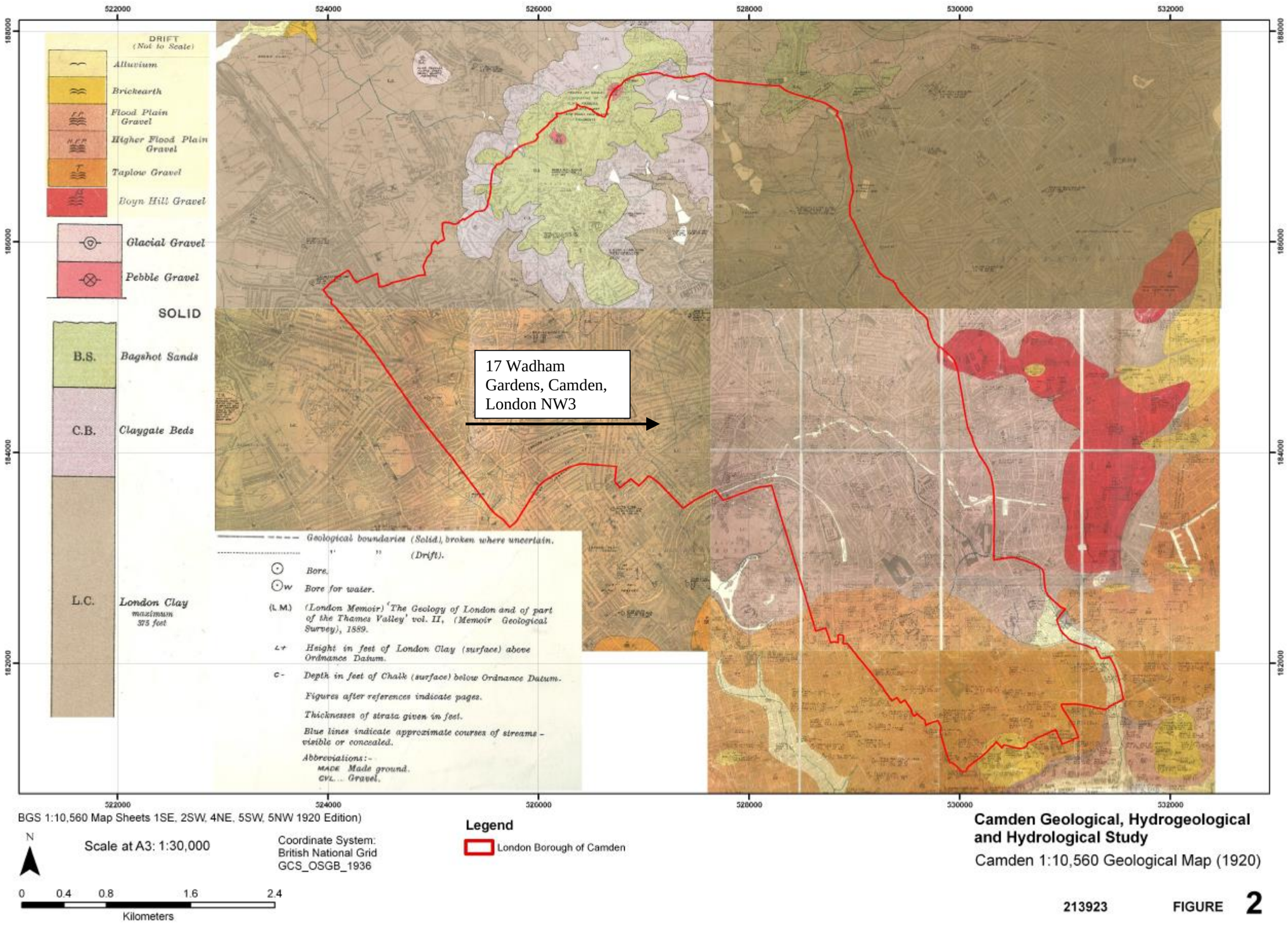
A.5 AQUIFER – BEDROCK DESIGNATION (1:75,000)



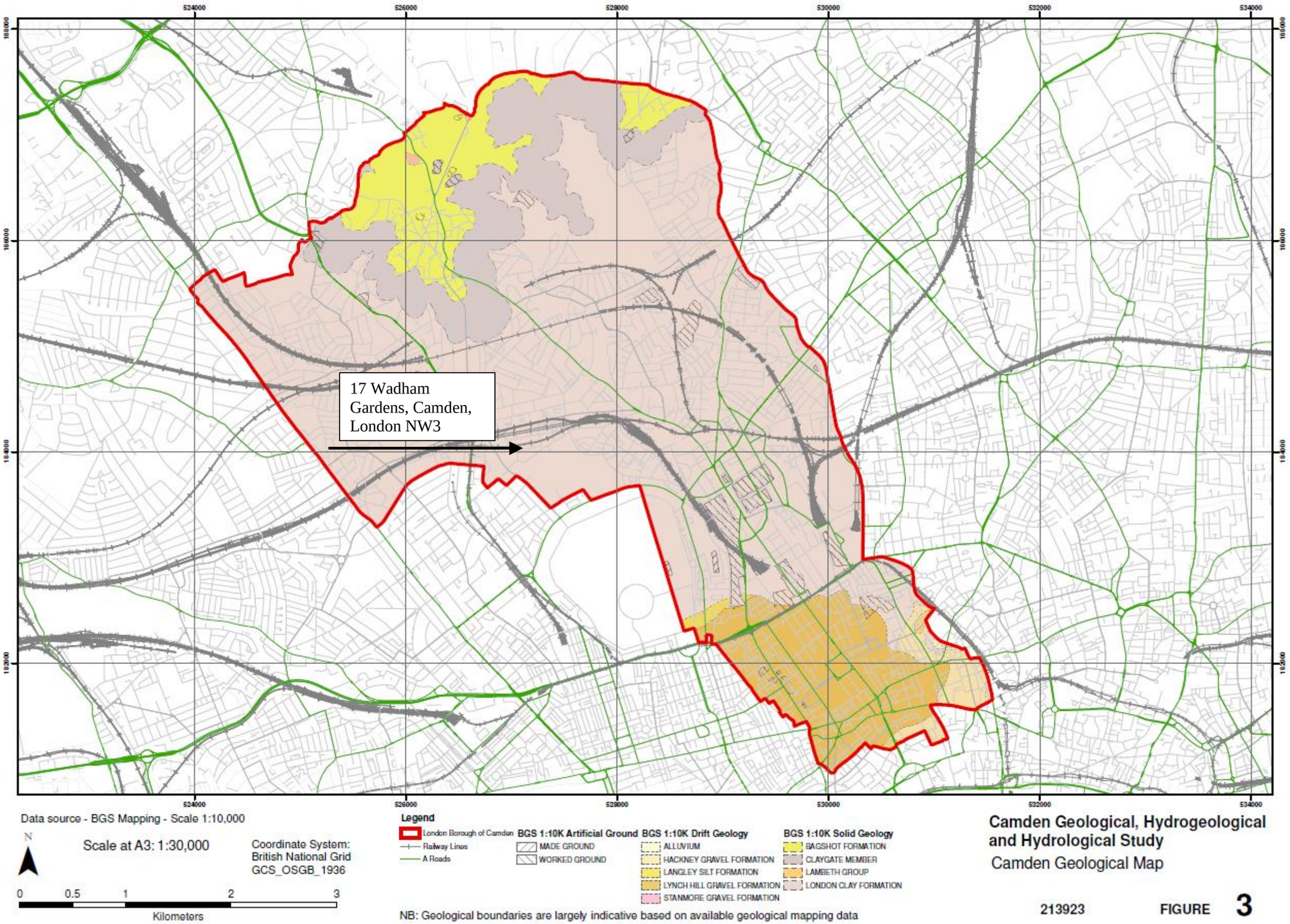
A.6 AQUIFER – GROUNDWATER VULNERABILITY ZONES (1:75,000)



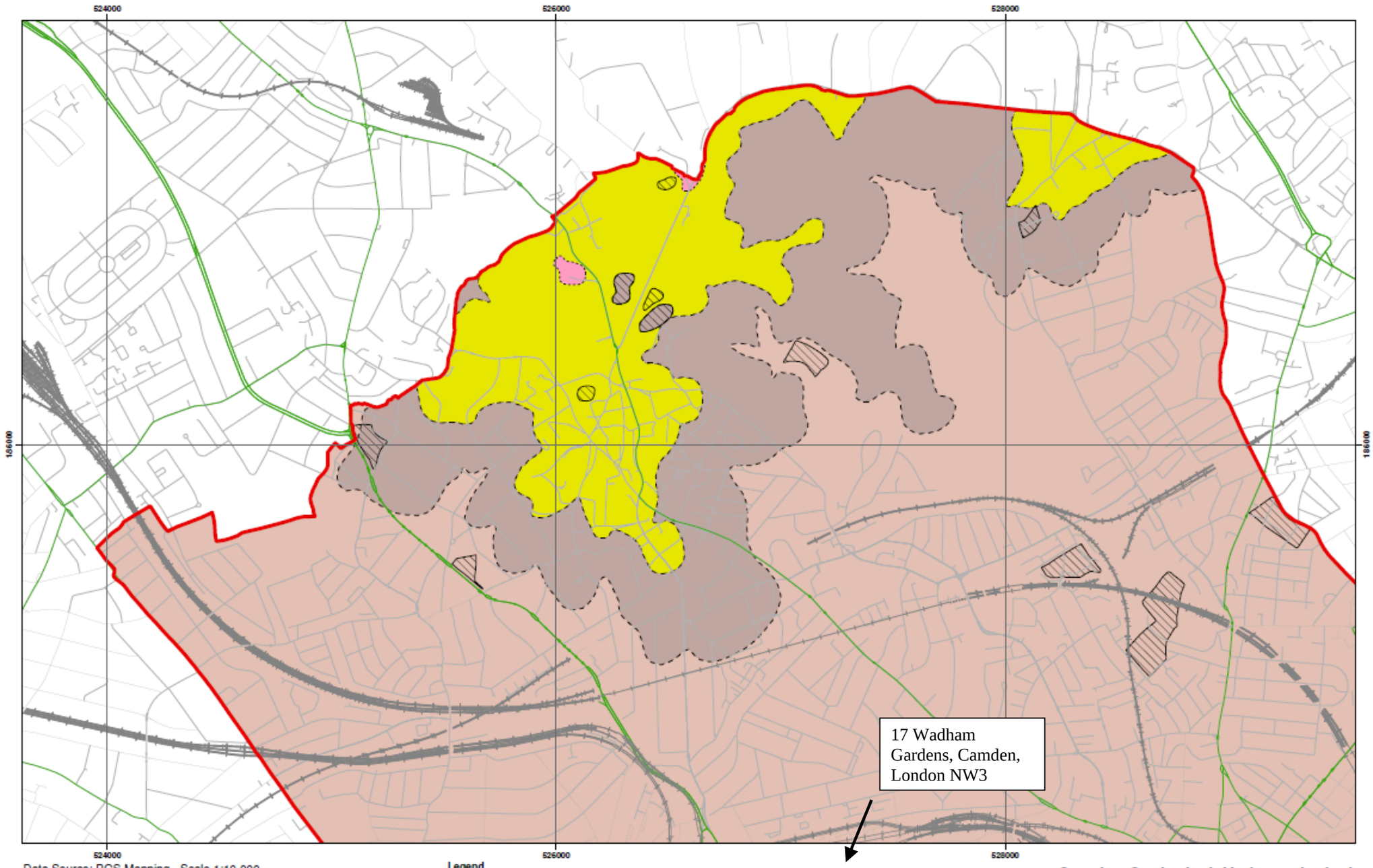
A.7 CGH&HS Study – Fig 1 Administrative Boundaries



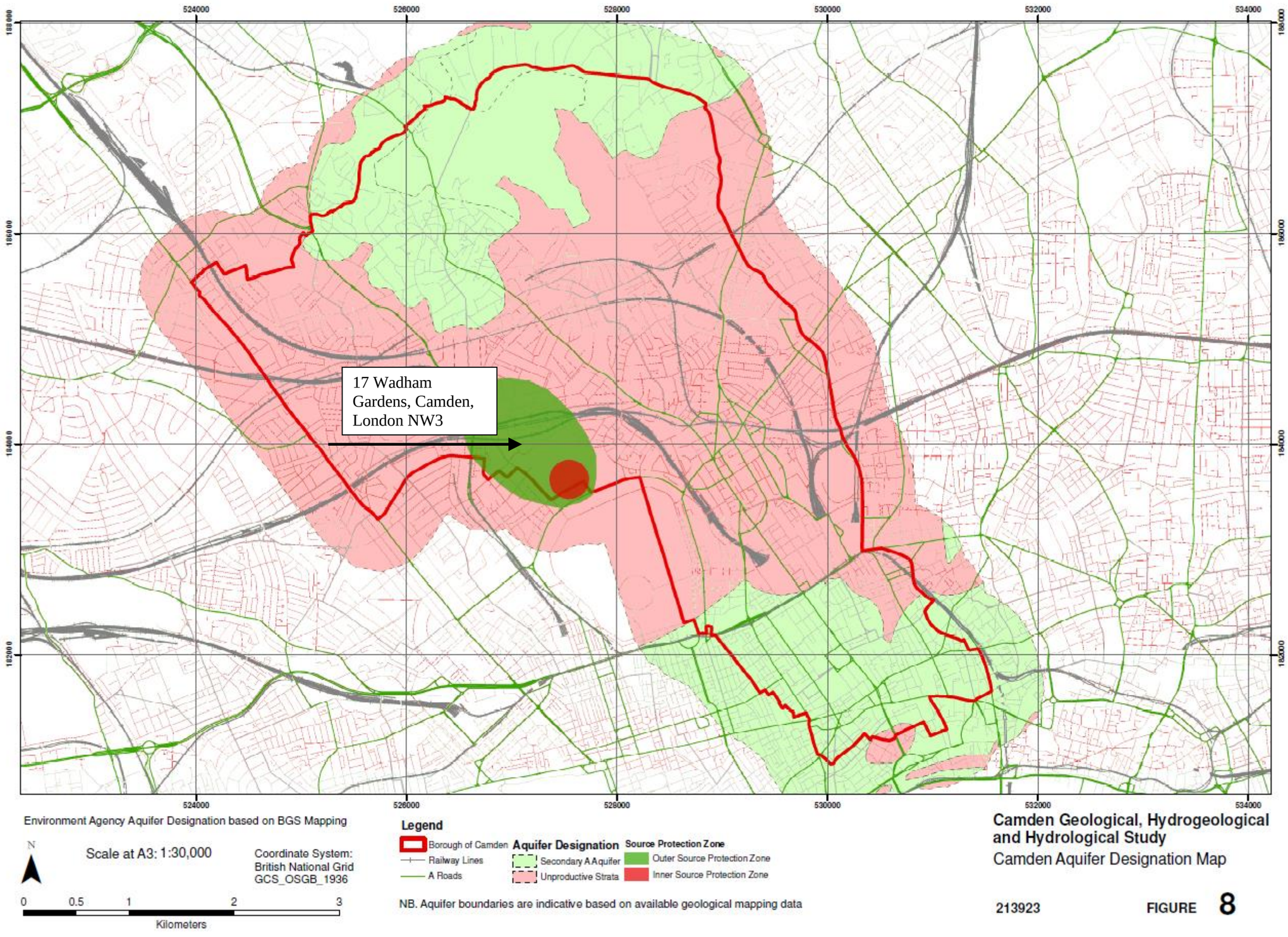
A.8 CGH&H Study – Fig 2 Geological Mapping Data (1920)



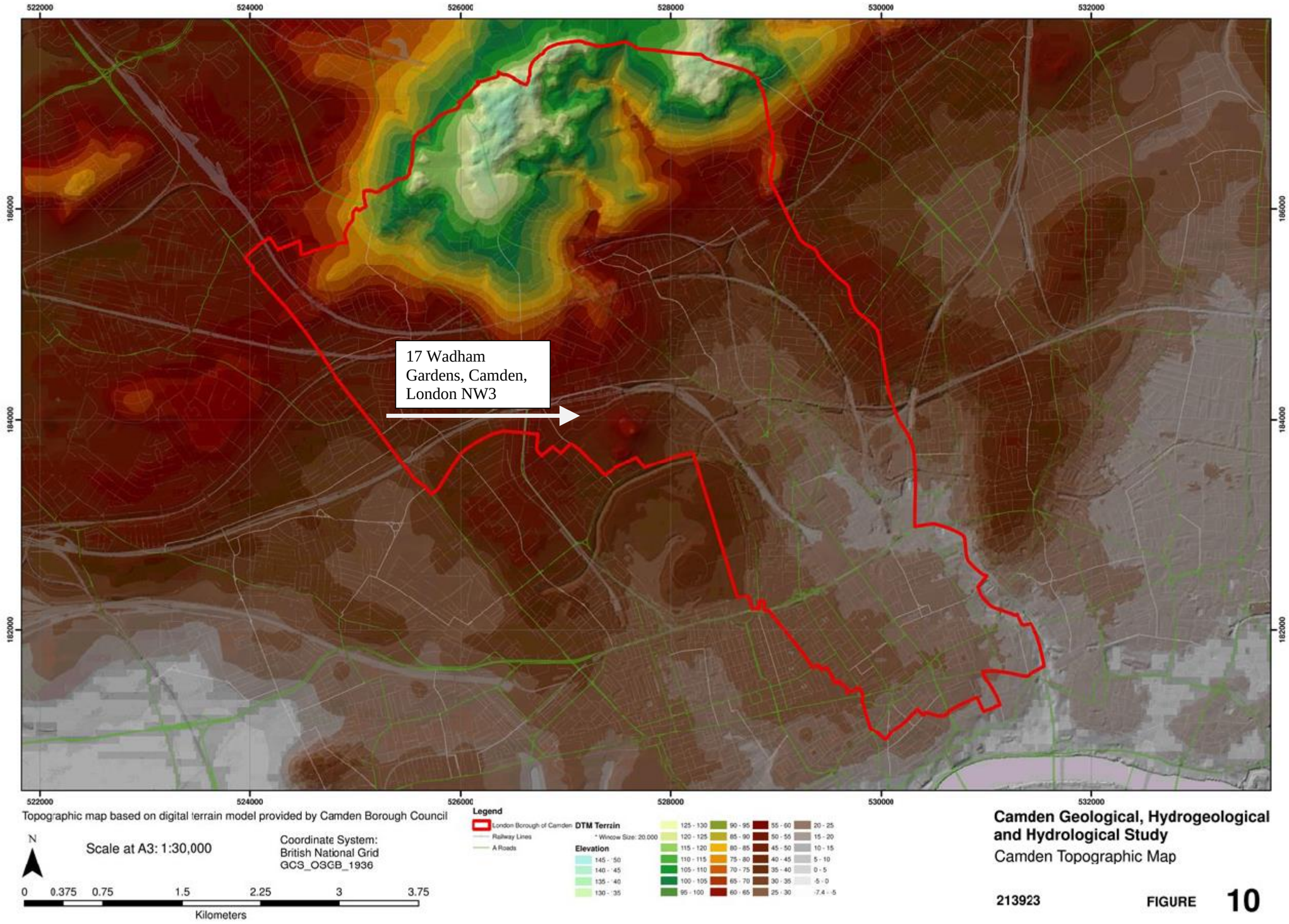
A.9 CGH&H Study – Fig 3 Geological Map



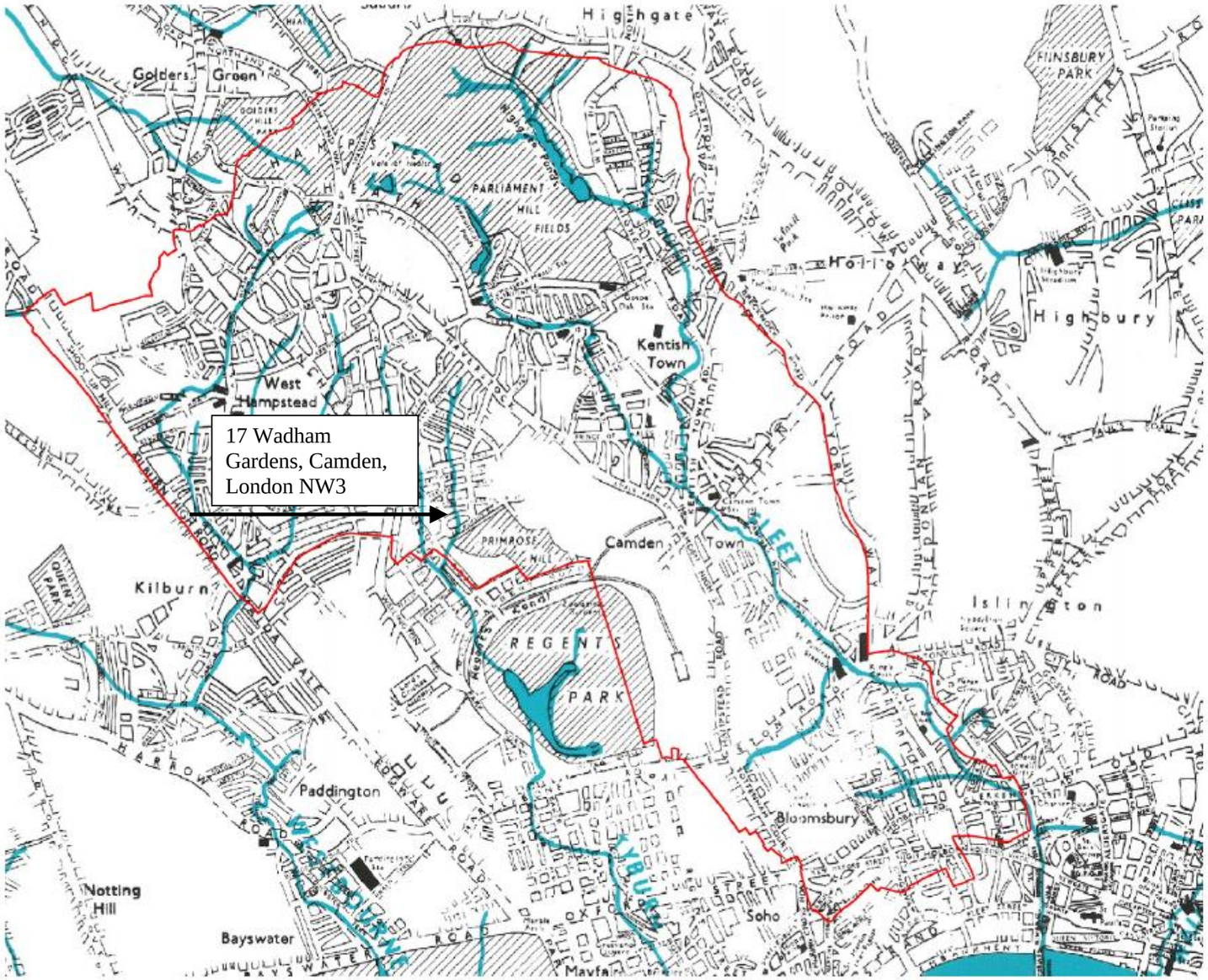
A.10 CGH&H Study – Fig 4 South Camden Geological Map



A.11 CGH&H Study – Fig 8 Camden Aquifer Designation Map



A.12 CGH&H Study – Fig 10 Camden Topographic Map

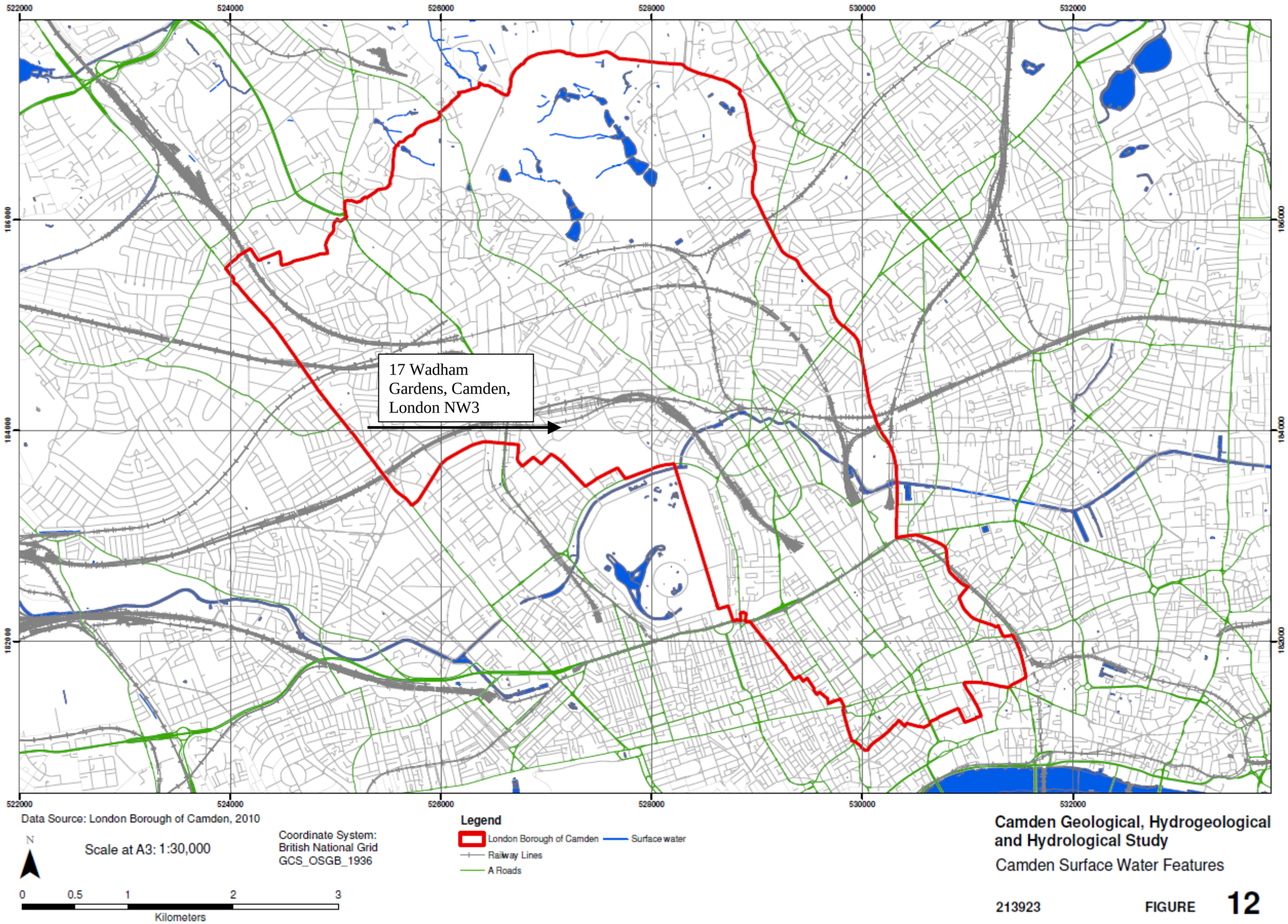


Source – Barton, Lost Rivers of London

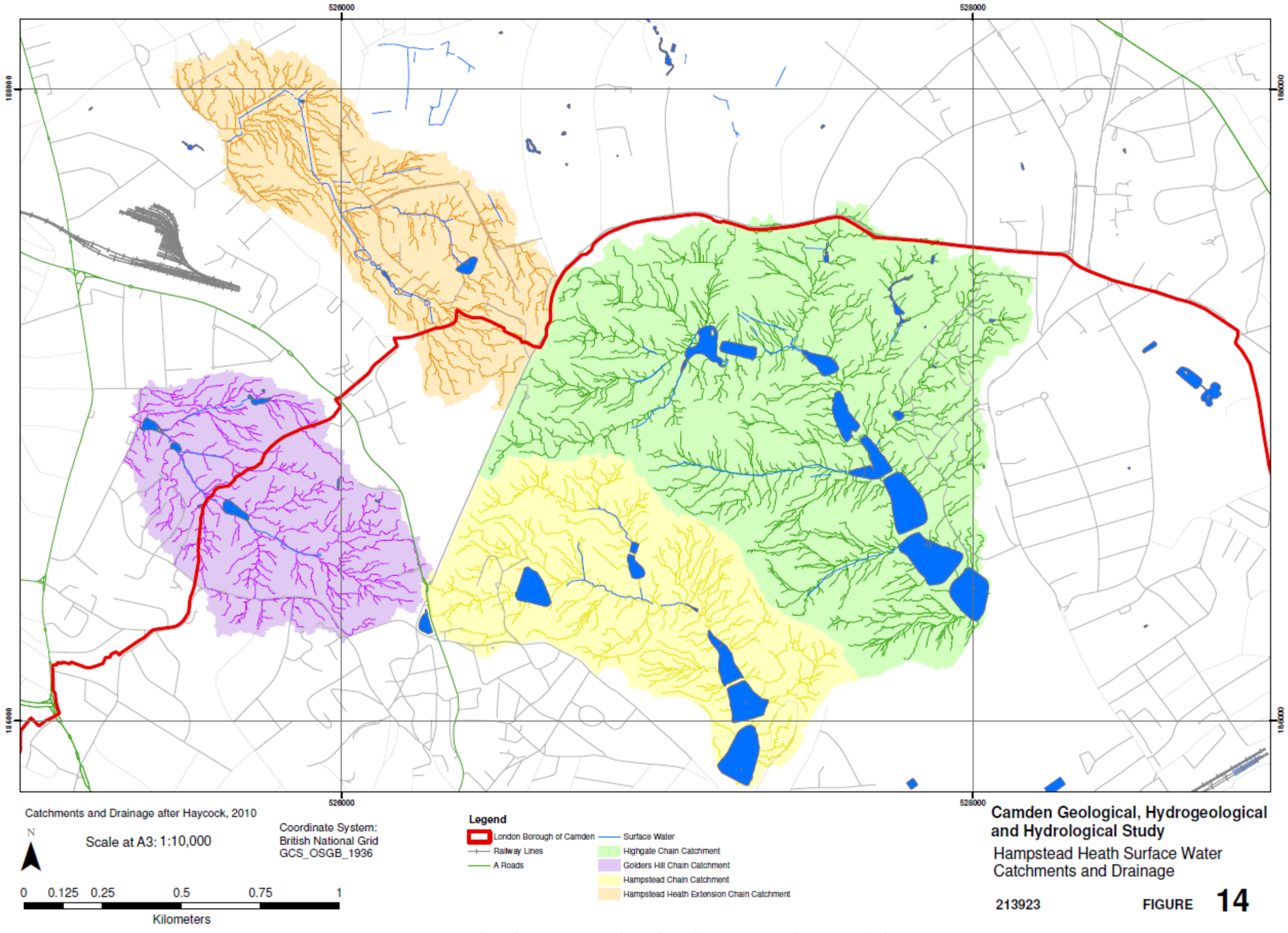
Camden Geological, Hydrogeological and Hydrological Study
Watercourses

213923 FIGURE **11**

A.13 CGH&H Study – Fig 11 Camden Watercourses



A.14 CGH&H Study – Fig 12 Camden Surface Water Features



A.15 CGH&H Study – Fig 14 Hampstead Heath Surface Water Catchments & Drainage

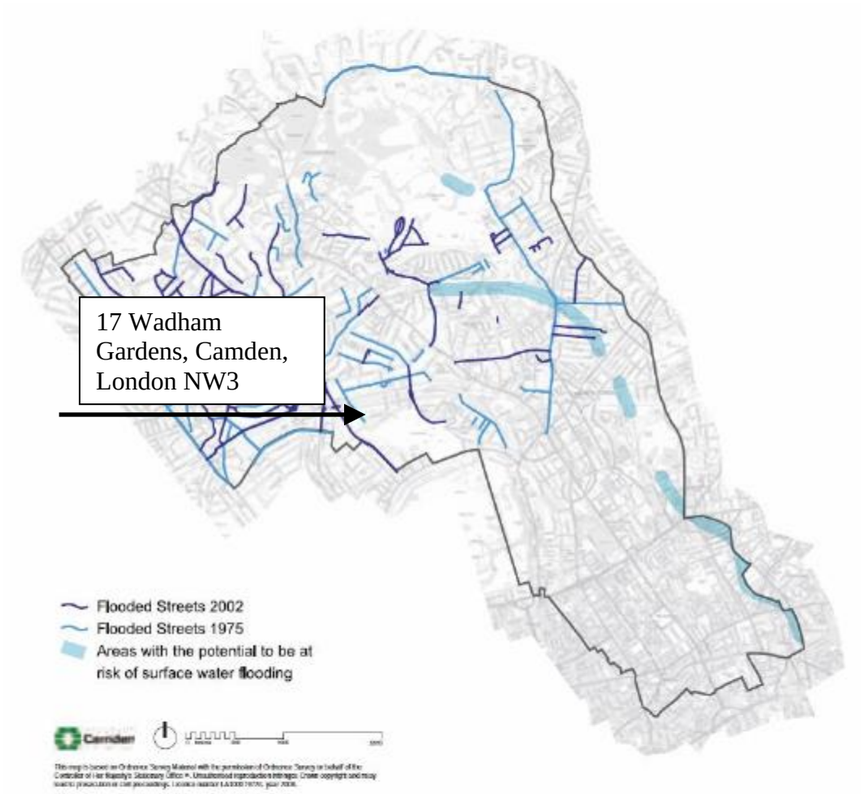
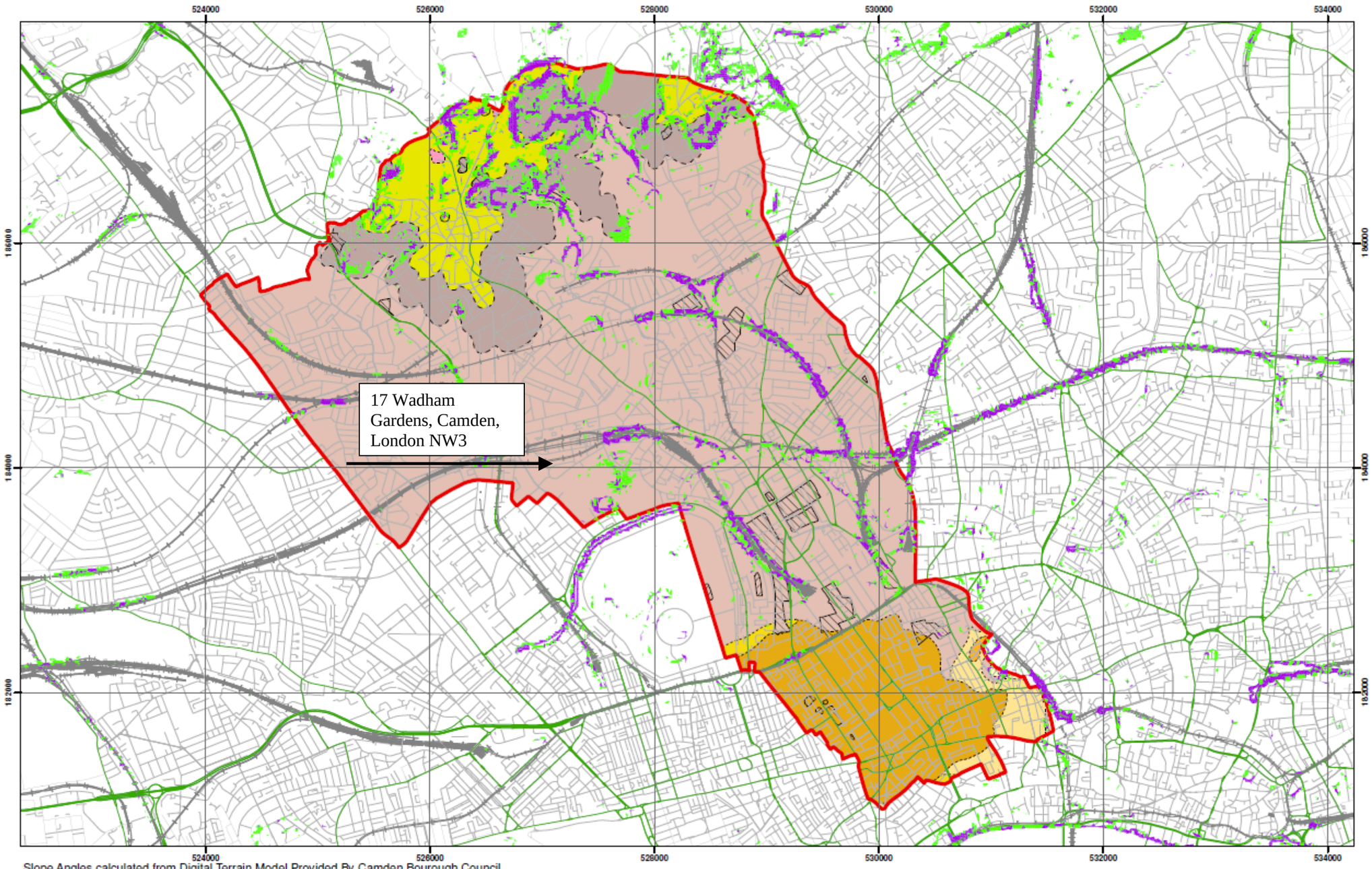


Figure 5 from Core Strategy, London Borough of Camden

Camden Geological, Hydrogeological and Hydrological Study
Flood Map

213923 FIGURE **15**

A.16 CGH&H Study – Fig 15 Camden Flood Map

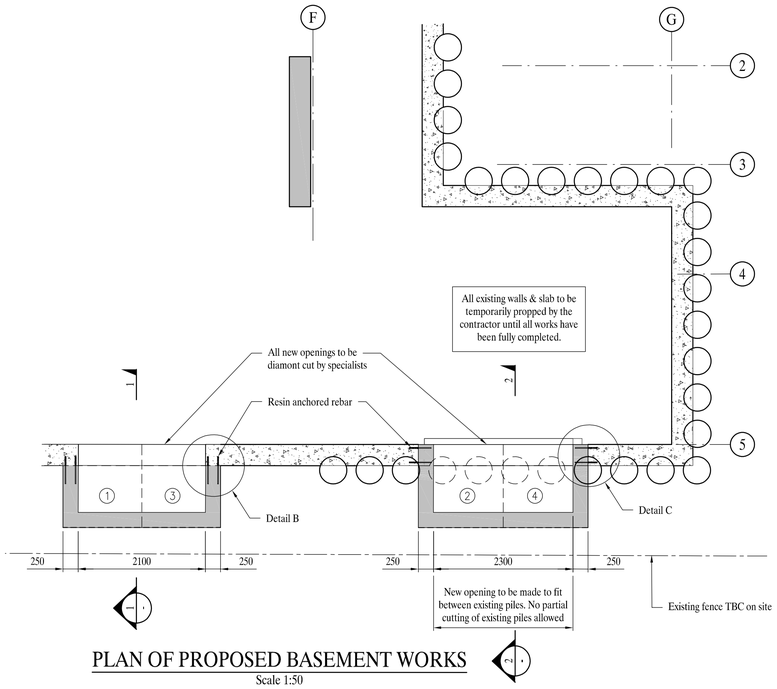


A.17 CGH&H Study – Fig 16 Camden Slope Angle Map

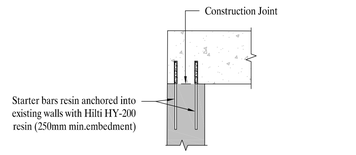
Appendix B

Pringuer-James Consulting Engineers
Basement Impact Assessment

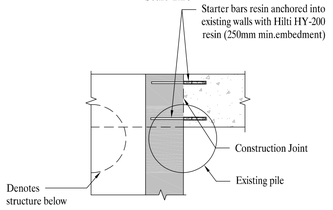
Preliminary Drawings



PLAN OF PROPOSED BASEMENT WORKS
Scale 1:50



DETAIL B
Scale 1:20



DETAIL C
Scale 1:20

CONSTRUCTION SEQUENCE NOTES :-

1. The bearing strata shall be approved by the Engineer and the Local Authority's Building Inspector before casting foundations. Any additional excavation shall be replaced with a grade C16/20 concrete. In the event of extensive additional excavation being required, the Engineer must be informed immediately and fresh instructions obtained.

2. Concrete mix for foundations shall be grade C32/40 with a minimum of 300kg of ordinary portland cement per cubic metre and a maximum water/cement ratio of 0.60.

3. The underside of the construction is to be dug to a strata capable of sustaining a permissible ground bearing pressure of 180 kN/m².

4. The central area of excavation shall not be carried out until the perimeter underpinning has been completed.

5. Backfilling behind retaining walls shall be a grade C16/20 concrete using ordinary Portland cement.

6. The Contractor is to keep a record of the sequence and dimensions of the construction actually carried out including relevant details of excavation, casting concrete and pinning up for each section.

7. Excavated material intended for backfilling is to be kept protected from drying out or wetting and is to be placed in maximum 150mm layers, carefully compacted with a pneumatic or electric percussion tool with compacting plate.

8. Foundations have been designed to impose a bearing pressure of 180 kN/m². The bearing strata shall be approved by the Local Authority's Building Inspector before laying blinding or casting foundations. Any additional excavation shall be replaced with a nominal 1:8 mix concrete. But in the event of extensive additional excavation being required, the Engineer must be informed immediately and fresh instructions obtained.

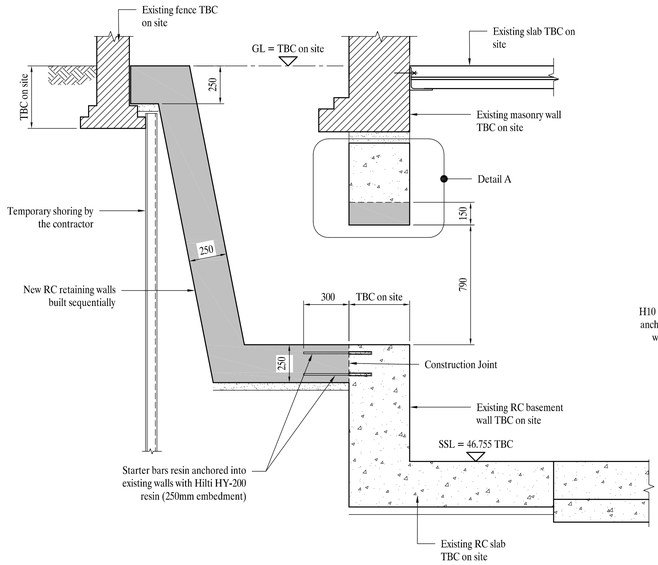
9. The sequence numbering is for identification purposes only. The sequence of basement wall bays is to be agreed on site with the district surveyor, but at all times the minimum requirement for the time lapse between the construction of adjacent bays must be adhered to. See basement wall notes for minimum sequence requirements.

Note:

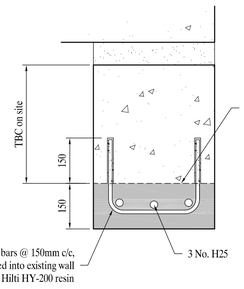
Contractor to submit detailed method statement including temporary works and sequence of construction, for approval prior to commencement.

	6	1	4	7	2	5	8	3	6	1	4	

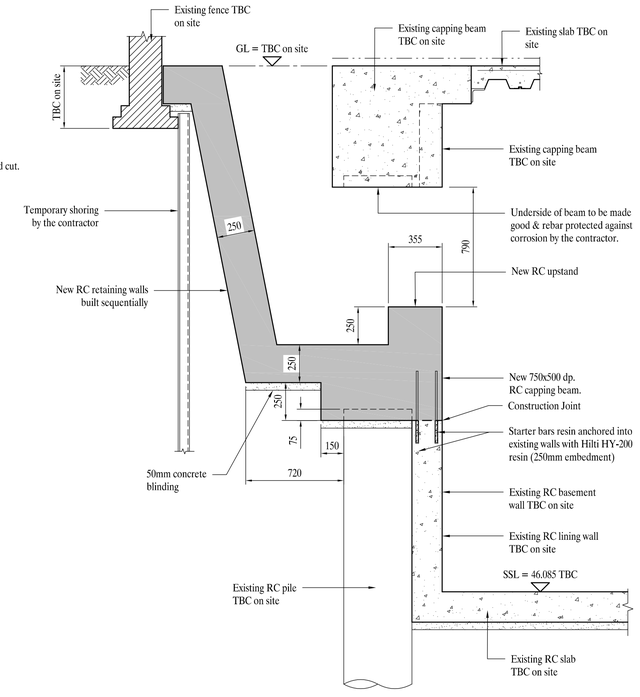
TYPICAL BASEMENT WALL CASTING SEQUENCE



SECTION 1-1
Scale 1:20



Detail A
Scale 1:10



SECTION 2-2
Scale 1:20

1 General
All Structural Engineering drawings are to be read with the specification and with all relevant Architects drawings and specifications.

Do not scale from any Structural Engineers drawing. All dimensions are in millimetres and levels in metres.

All waterproofing (DPM & DPC) works to Architects details.

All fire protection works to Architects details unless specifically noted otherwise.

Abbreviations:-

SSL - Structural slab level	FFL - Finished floor level
C\S - Column Stops	C\C - Column Capped
UNO - Unless Noted Otherwise	OSA - Or Similar Approved

The Contractor is responsible for the design, installation and maintenance of all necessary temporary works to ensure the strength and stability of the building throughout the course of the works. Drawings and calculations detailing all temporary works shall be submitted to the Engineer for comment prior to commencement of the works.

The existing structural information shown on these drawings is based on visual inspection of the building and upon limited opening up works. All details of the existing construction are subject to confirmation by the Contractor during the works on site.

2. Concrete
Concrete to be in accordance with BS EN 206-1 and as follows :
Blinding - C16/20
Mass concrete - C25/30
Reinforced concrete - C32/40

Rev.	Date	Drawn	Amendment
-	19.06.20	PE	Issued for Information

PRINGUER-JAMES
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WHITEHALL PARK

17 WADHAM GARDENS
LONDON NW3 3DN

GA OF PROPOSED
BASEMENT WORKS

Status :	INFORMATION		
Scales :	As noted @ A1	Date :	JUNE 20
Drawn : PE	Engineer : TF	Checked :	SPJ
Drawing No.	L1802-S-20-30		-

Appendix C

Pringuer-James Consulting Engineers
Basement Impact Assessment

Site Investigation Report
Soil Consultants Ltd.
Report Ref: 9722/KOG/JRCB

Soil Consultants
Ground Investigation
Geotechnical Analysis
Contamination Assessment

SITE INVESTIGATION REPORT

PROPOSED REDEVELOPMENT:

17 WADHAM GARDENS, LONDON, NW3 3DN

Client	**WHITEHALL PARK LTD** **106 Hampstead Road, London, NW1 2LS**
Project manager	**G-PAD LTD** **Unit 1, 9a Dallington Street, Clerkenwell, London EC1V 0BQ**
Engineer:	**PRINGUER JAMES CONSULTING ENGINEERS LTD** **10 Beulah Road, Wimbledon, London ,SW19**
Report ref:	**9722/KOG/JRCB**
Date:	**10th February 2015 [Rev 0]**

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Registered in England No 1814762 – 36 Harefield Road, Uxbridge, Middlesex UB8 1PH
VAT No 491 8249 15

SITE INVESTIGATION REPORT

PROPOSED REDEVELOPMENT:

17 WADHAM GARDENS, LONDON, NW3 3DN

DOCUMENT ISSUE STATUS:

Issue	Date	Description	Author	Checked/approved
Rev 0	**10/02/15**	**First issue**	**Keith Gibbs** BSc, MSc, FGS	**John Bartley** BSc, MSc, FGS, CGeol

9722/KOG/3RCB
Client: Whitehall Park Ltd
Site Investigation Report – 17 Wadham Gardens, London, NW3 3DN
Consulting Engineers: Pringuer James

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10th February 2015 [Rev 0]

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Fieldwork, in-situ testing and monitoring

- Borehole records
- SPT results
- SPT hammer calibration certificate

Laboratory testing

- Unconsolidated undrained triaxial test results [QUT]
- Index property testing
- Plasticity charts

Ground profiles

- Cohesion versus depth graph

Contamination testing [QTS Environmental]

- General soil suite and soluble sulphate/pH results

Plans & drawings

- Photographs of the site
- Proposed development drawings
- Site Plan
- Location Plan

APPENDIX B

- GroundSure historical maps [Ref SCL-1840707]
- GroundSure EnviroInsight Report [Ref SCL-1840705]
- GroundSure GeoInsight Report [Ref SCL-1840706]

1.0 INTRODUCTION

A new basement is to be constructed at this existing residential property, together with refurbishment and internal restructuring. In connection with the proposed works, Soil Consultants Ltd [SCL] were commissioned to carry out a ground investigation to include the following elements:

- Desk Study to identify site history and potential contaminative uses
- Identification of ground sequence
- Provision of recommendations for geotechnical design
- Contamination appraisal, risk assessment and conceptual model
- Basement impact assessment [BIA] : Land stability and Hydrological sections [issued separately]

This report describes the investigation undertaken, gives a summary of the ground conditions encountered and then provides geotechnical related design recommendations. In addition an outline contamination appraisal is provided. The Basement Impact Assessment will be provided in a separate report.

2.0 SITE DESCRIPTION

The site is located at 17 Wadham Gardens, Primrose Hill and centred at approximate National Grid Reference 527217E 184070N. The site is rectangular in shape and measures approximately 45m [N-S] x 13m [E-W].

At the time of our investigation the site comprised an existing two-storey detached house [with additional roof level accommodation] measuring about 11m x 20m in area, with relatively flat, partly grassed and paved front and rear gardens. A number of semi-mature/mature deciduous trees are present along the rear garden boundaries and along the road pavement. There is an existing basement [approximately 2m depth bgl] to the house and this is located in the central part of the western side of the building.

OS benchmark [corner adjacent house at No.15] and spot height data [middle of Wadham Gardens at the front of No.17] indicate a ground surface OD level of about +47.5m for the site.

The surrounding area consists of similar residential dwellings, comprising two and three-storey detached properties and associated gardens.

A railway tunnel is located in the rear garden of the site. A Victorian age, brick-built air shaft tower for this tunnel is visible in the rear garden of the next but one property to the west of the site. Public domain information indicates that the tunnel was was bored and brick lined through the London Clay [rather than a "cut and cover" construction] at a depth sufficient to ensure that later surface development was not compromised.

The current site features are shown on the Site Plan which is included in Appendix A, together with selected photographs taken at the time of our fieldwork. An aerial view of the site is shown on the front cover of this report

3.0 SITE HISTORY AND GEOLOGICAL/ENVIRONMENTAL INFORMATION

3.1 GroundSure historical map pack and reports

A historical map and environmental database search was commissioned from GroundSure to ascertain the site history/usage and surrounding land usage. An indication of the gradual development of the site over the years can be gained by a study of the historical maps [shown in Appendix B]. The following table contains a summary of the site development obtained from the source maps provided in the GroundSure report.

Historical development of site and surrounding area		
Map date	**The site**	**Significant development / features in surrounding area [generally within 250m]**
1866- 1871	The site consists of open land on the margin of Primrose Hill with no development visible A footpath or track is shown to traverse the site in an approximate north-west to south-east direction	Detached residential properties are shown along King Henry's Road along the northern side of the site Tunnel entrances are shown below Primrose Hill Road about 380m to the east-north-east and below Adelaide Road North shown about 700m to the west The Eton and Middlesex Cricket Ground is shown about 90m to the east The West Middlesex Waterworks Reservoir is shown about 380m to the south Two small ponds are shown about 200m to the south Residential development is shown along Avenue Road to the south-west
1894-1896	No significant changes apparent	An Air Shaft [presumed related to the underground railway tunnel] is shown about 40m to the west Increased residential development of the surrounding areas

Historical development of site and surrounding area		
Map date	**The site**	**Significant development / features in surrounding area [generally within 250m]**
1915-1948	The existing house is now shown together with the adjacent properties along Wadham Gardens	The Air shaft is shown in the rear garden of one of the adjacent residential properties Residential development of the area between Wadham Gardens and Primrose Hill to the south-east has occurred along Elsworthy Road
1952-Present	The route of the underground railway tunnel below the rear garden of the site is shown for the first time on the 1952 edition	No significant changes apparent

The relevant historical maps are included in Appendix B of this report.

The GroundSure Report includes information from a database of local activities encompassing a range of subjects related to land use, pollution, and geological/hydrological conditions. A summary of contaminative uses and other environmental issues covered by the desk study within the site and its immediate surroundings is as follows:

Environmental Permits, Incidents and Registers

- No recorded data within 500m buffer

Landfill and other Waste Sites

- Records of Environment Agency historic landfill sites within 1500m:
  1no, 1,324m NW, Canfield Place – no detail on type-Surrendered
- Records of Environment Agency licensed waste sites within 1500m
  2no [for same location] for a Household Amenity site, 1442m E, at Jamestown Road, Camden - Surrendered

Current Land Use

- Potentially contaminative uses: 8no records within 250m, mainly electricity substations with the nearest being 62m SW. Others include Sports and Leisure Equipment repair; Special Purpose Machinery and Equipment; and Hobby, Sports and Pastime Products
- Petrol and Fuel station sites - None

Geology

- Artificial/Made Ground: none

- No superficial deposits or landslips recorded
- Bedrock/Solid Geology: London Clay Formation [very low to moderate permeability]
- Bedrock Faults [500m buffer]: No record
- Radon: The property is not in a Radon Affected Area [<1% of properties are above action level] - no protective measures required
- Historical Surface Ground Workings: one entry for 192m S - ponds
- Historical Underground Workings [1000m buffer]: Numerous entries for railway tunnels and associated air shafts, the nearest records refer to the tunnel previously identified in the rear garden of the site
- Current Ground Workings: None recorded within 1000m of the site
- Mining, Extraction & Natural Cavities [1000m buffer]: Numerous Air shaft entries with the nearest being 40m W [previously identified Air Shaft on old maps]
- Natural Ground Subsidence: Very low to negligible risk for all categories where identified, with the exception of shrink-swell clays, moderate risk due to the presence of London Clay on the site
- Borehole Records Map: A cluster of 6no boreholes approximately 200m to the east
- Railways and Tunnels: Numerous entries within 250m of site with the nearest recorded on-site [see previous references above]
- Active railways: Tunnel identified on site relates to an active Fast line railway service [WCML]
- High Speed 2 rail project: The site is located within 500m of the High Speed 2 rail project

Hydrogeology and Hydrology

- Aquifer within Superficial deposits: None
- Aquifer within bedrock deposits: 'Unproductive' [London Clay Formation]
- Groundwater Abstraction [2000m buffer]: 7no [some duplication of entries], nearest being 442m NW, Swiss Cottage Borehole – irrigation water, Thames Groundwater
- Surface Water Abstraction: 3no entries, nearest Grand Union Canal at 1265m E Oval Road, Camden and used for evaporative cooling
- Potable Water Abstraction [2000m buffer]: 4no entries [some duplication], the nearest being 545m SE, Barrow Hill Borehole
- Source Protection Zones [500m buffer]: Type 2 on site – Outer catchment; 248m SE, Type 1 Inner catchment
- Source Protection Zones within confined aquifer [500m buffer]: None
- Ground water vulnerability/soil leaching: None
- River Quality: No data

- Detailed River Network [500m buffer]: 1no entry , 32m W -culvert
- Surface Water Features: None recorded within 250m of the site

Flooding

- None recorded for Zone 2 or Zone 3 floodplains within 250m of site
- Flood defences: No records
- Groundwater Flooding Susceptibility Areas: Not prone to flooding

Designated Environmentally Sensitive Areas

- Records of Local nature reserves [2000m buffer]: 2no, nearest 1004m S for St John's Wood Church Grounds

3.2 Walk-over survey

Our walkover survey was undertaken in conjunction with the fieldwork on 13 January 2015. The site was found to be in a clean and tidy state with no waste, rubbish, tanks etc. present. The surrounding areas were also noted to be in a well-maintained and tidy state.

Overall we have not identified any particular features [such as fuel tanks], materials [such as chemical containers] or land use within the site or in its immediate vicinity which are likely to give rise to significant contamination risks and we thus have no particular concerns in this regard.

4.0 EXPLORATORY WORK

The ground investigation was carried out on 13 January 2015 and comprised the following elements.

Boreholes

A single 150mm diameter cable percussive borehole [BH1] to 15m bgl and a single smaller diameter borehole [BH2] using hand held window sampler equipment to 7m bgl were constructed. In situ Standard Penetration testing [SPT] was undertaken in BH1 together with hand shear vane testing where appropriate. Representative samples [both disturbed and undisturbed] were taken for geotechnical testing and contamination analyses.

Water level observation pipes were installed in both of the boreholes upon their completion to a depth of 7m to enable later ground water monitoring.

The current calibration certificate for the cable percussive drilling rig SPT equipment indicates that an Energy Ratio, Er, of 76% should be used to provide corrected N_{60} values in line with the recommendations given in BS EN ISO 22476-3, 2005, National Annex A.

To facilitate later assessment and correlation of the borehole records we have used the external ground level as shown on the Architect's section drawings for an approximate ground level of +50.2m SD for the exploratory locations.

Geotechnical laboratory testing

The following geotechnical laboratory testing was completed:

- Unconsolidated undrained triaxial test results [QUT]
- Moisture content and index property tests [Atterberg Limits]
- Soluble sulphate/pH analyses [tested externally by QTS Environmental Ltd]

Contamination testing

Selected soil samples were delivered to a specialist laboratory [QTS Environmental Ltd] and the following testing was carried out:

- General soil suite 5 no samples
- WAC tests 1 no samples

The borehole logs and the laboratory test results are included in Appendix A.

5.0 GROUND CONDITIONS

The geological survey map of the area indicates that the site is underlain by the London Clay Formation. Below a surface layer of made ground this stratum was confirmed by our boreholes. The sequence met may be summarised as follows:

Stratum	Depth to base	Thickness
Made ground	Up to 1.10m	0.70-1.10m
London Clay		
Naturally reworked zone	Up to 3.50m	2.50m [approx.]
Undisturbed zone	>15.00m [not proven]	>11.70m [not proven]

5.1 Made Ground

Below the surface layer of topsoil in BH1 [front garden] and below the paved surface in BH2 [rear garden] the made ground comprised a mottled brown and grey silty sandy clay containing scattered stone and brick debris.

5.2 London Clay Formation

The London Clay was met directly below the made ground in both boreholes and proved to the maximum depth of boring at 15m. A natural re-worked upper layer was present overlying the 'undisturbed London Clay.

Naturally re-worked clay

Initially this deposit comprised an orange brown mottled silty clay, containing rare or isolated medium to coarse rounded flint gravel (indicative of some geological reworking). The results of our in-situ vane and laboratory strength tests indicated this clay to correspond to a low to medium strength classification with shear strength values mainly ranging between 40 kN/m^2 and 50 kN/m^2 and with an SPT N_{60} value of 11 at 1.50m [BH1]. Lower moisture contents near the base of this layer and a slightly lower shear vane value of 35 kN/m^2 in BH2 at 3.3m depth reflect a slightly more silty composition.

Results of laboratory tests in this top part of the London Clay indicate Plasticity Index [PI] values to range from 22% to 40%, corresponding to an Intermediate to High plasticity according to the British Standard 5930 classification and a Medium to High volume change potential according to NHBC Standards, Chapter 4.2 'Building near trees'. Live rootlets/root hairs were noted in BH1 and BH2 to depths of 1.5m and 2.3m respectively, but no obvious signs of desiccation were noted.

'Undisturbed' clay

Below about 3.3m [BH1] and 3.5m [BH2] there was an obvious visual change into a fissured brown slightly stained blue grey clay containing occasional selenite crystals. Below about 6m a more uniform brown colour was evident, which became a fissured grey clay with occasional fine sand partings below about 9.45m [BH1].

From about 3.5m depth there was a general increase in strength of the clay with increasing depth with laboratory undrained strength values ranging from 88 kN/m^2 to 127 kN/m^2 and SPT N_{60} values increasing from 16 to 28. Below about 14m, an SPT N_{60} test indicates the clay to correspond to a very high strength classification.

Results of laboratory tests below 3.5m depth indicate an increased plasticity with PI values in the range 46% to 54%. This corresponds to a Very High plasticity [BS:5930] and a High volume change potential [NHBC].

5.3 Groundwater

Groundwater was met during our fieldwork in BH2 only as an inflow at the interface of the made ground and the underlying relatively impermeable London Clay at about 1.10m depth. Standpipes have been installed both boreholes to enable future monitoring.

5.4 Environmental observations

No obvious olfactory or visual signs of soil or groundwater contamination were encountered in the boreholes.

6.0 GEOTECHNICAL APPRAISAL

Current redevelopment proposals include retaining the existing house superstructure and the construction of a full footprint basement. This basement will extend about 1m into the rear garden from the northernmost end wall of the house. In addition a new lightwell basement [approx.2.2m x 4.2m] is to be excavated below the front garden at the south-eastern corner. Some local deepening of the basement will be required to accommodate a swimming pool and a potential plant room.

The architect's proposed development plans are included in Appendix A. These drawings indicate an external ground level of about +50.2m SD and show the main part of the proposed basement to extend to about 3.6m depth. The swimming pool and plant areas are shown to extend to about 4.6m depth and 6m depth respectively, measured below current external ground level.

Of prime significance is the location of the railway tunnel in the rear garden of the house. A precise on-site location of this tunnel has not been provided, however the desk study mapping indicates that the southern wall of the tunnel may be about 6m from the nearest northern end wall of the house. The existence of the tunnel is known by the client and we understand that some representations have previously been made to determine whether any permissions/authorisations are required to allow the proposed scheme. Confirmation should be sought from the tunnel owners as to the precise location and depth of the tunnel crown and walls in order to determine the effects [if any] on the proposed scheme and whether or not it will be necessary to demonstrate any effects upon the tunnel.

The existing house is assumed to be supported on shallow spread foundations and clearly the building loads will need to be transferred to competent soils at basement level. The investigation has indicated that beneath a nominal thickness of made ground, the London Clay Formation is present and this will extend to the full depth of the proposed basement excavation. The London Clay is a relatively competent stratum which should be capable of supporting the likely underpinning loads and should allow relatively straightforward basement construction using either traditional underpinning techniques or if preferred [in areas close to adjacent buildings] an embedded retaining wall. From our observations localised groundwater will probably be encountered at the interface between the made ground and London Clay and control measures will be necessary, depending on the techniques adopted.

Some trees and hedges are present along the garden boundaries and close to the area of the proposed basement construction and other trees are present along the road pavement. Obvious effects of desiccation were not noted in the boreholes but tree roots were observed to extend to a depth of 2.3m in BH2. Given the depth of excavation proposed however, this aspect should not be a major issue at this site and no special precautions are considered necessary with respect currently desiccated clay soils. Notwithstanding this, all foundation design should be carried out in full accordance with the NHBC Standards.

6.1 Basement excavation and construction

The generally cohesive made ground and the London Clay are expected to be self-supporting in the short term and any ground-water should be limited to the interface of the made ground and the London Clay as previously discussed. Although claystones or significant silt/sand layers were not noted in the London Clay to the depth envisaged by the basement excavation, their occurrence should be allowed for together with any associated seepages of trapped water.

Conventional underpinning of the wall foundations should be appropriate if properly designed, with correctly specified 'pin' widths and construction sequencing. The underpinning to the foundations would act as the basement retaining structure during construction and particular consideration will clearly need to be given to the excavation for the basement along the western and eastern sides of the basement footprint which are close to the neighbouring houses. Excavation depths of between 3m and approximately 6m are envisaged and the adjacent houses at No.15 and No.19 are about 3m and 1.5m distant respectively from the edge of the proposed basement. The foundations of these neighbouring houses are likely to be similar to No 17, ie presumed shallow spread foundations, and if this is the case they are likely to impose some surcharge on the back of the new retaining wall. Any significant lateral movement of the basement wall would be translated into settlement beneath the adjacent foundations and provision of a well-designed lateral and vertical support system will obviously be essential; a robust system of waling beams and propping across the site is likely to be required. We recommend that a well-established underpinning specialist who has extensive experience with this type of construction undertakes this work and provides the temporary works design.

The alternative of a contiguous piled basement retaining wall may also be considered. Such methods may allow the construction of a more integrated support structure with more predictable overall stability. It should be noted however that access will be extremely tight and marginal even for a micro piling rig; a specialist contractor should be consulted to advise on the practicalities of installing such a system.

In the permanent case the lateral earth pressures will be retained directly by the underpinning/piles or by an internal RC lining wall. In either case horizontal support will be provided by the new ground and basement floor slabs.

The following table of coefficients may be used for the design of the basement retaining wall:

Stratum	Bulk density [Mg/m³]	Effective cohesion, c' [kN/m²]	Effective friction angle, φ' [degrees]
Made ground	1.80	0	22
London Clay:			
<5m below basement level	2.00	0	22
>5m below basement level	2.00	5	22

The wall designer should use these parameters to derive the active and passive earth pressure coefficients, Ka and Kp. The determination of appropriate earth pressure coefficients, together with

factors such as the pattern of earth pressure distribution, will depend upon the final type/geometry of the wall and the overall design approach.

6.2 Underpinning/spread foundations at basement level

At the main basement excavation depth of 3.6m, high strength natural London Clay should be present at the formation and this stratum should be capable of supporting the likely structural loads using spread foundations. Any internal columns or load-bearing walls would be supported either by separate pad/strip foundations or more probably by properly specified pad/strip thickenings within the slab. Within the undisturbed high strength London Clay we recommend that an allowable bearing pressure of 180kN/m^2 is adopted for foundations at 3.6m and below. At this pressure the Factor of Safety against bearing capacity failure should be >3 and settlements should remain within tolerable limits.

All foundation excavations should be carefully inspected to ensure that a competent stratum is present and if any obviously desiccated or root-infested clays are encountered local deepening should be carried out.

6.3 Piled foundations

If an embedded piled basement retaining structure is to be considered these piles may also be used to carry the existing/proposed structural loads. Advice on the practicalities of deploying this equipment at this site should be sought at the earliest opportunity from specialist contractors. For the ground conditions and the restricted access available we presume that mini piled rotary augered piles [with temporary casing though any made ground] would be considered. Alternative pile types such as screw piles could also be considered subject to specialist advice/design.

The following table of coefficients may be used for the design of rotary piles, based upon the measured strength versus depth profile, included in Appendix A.

Shaft adhesion

Stratum	Depth	Undrained cohesion [from strength profile]	Ultimate unit shaft adhesion 'q_s'
All soils to say 6m [allow for max. basement excavation]	Above say 6.0m depth	N/A	Ignore
London Clay	6.0m to 15.0m depth	Increases linearly from 100kN/m^2 at a rate of 6.67kN/m^2/m	Increases linearly from 50kN/m^2 at a rate of 3.33kN/m^2/m [incorporates α = 0.50]

Notes:
a] Unit shaft adhesion 'q_s' = $\alpha \times c_u$ [where α = 0.50 and c_u is the undrained cohesion from the design line]
b] The α value of 0.5 is based upon 102mm diameter triaxial tests and this should not be varied
c] The average shaft adhesion over the pile length should be limited to 110kN/m^2
d] The maximum value for unit shaft adhesion should be limited to 140kN/m^2

End bearing

Stratum	Depth	Undrained cohesion [from strength profile]	Ultimate unit base resistance 'q_b'
London Clay [see Note b]	Below 12m depth	Increases linearly from 140kN/m^2 at a rate of 6.67kN/m^2/m	Increases linearly from 1260kN/m^2 at a rate of 60kN/m^2/m [incorporates Nc = 9]

Notes:
a] Unit base resistance 'q_b' = Nc x c_u [where Nc = 9 and c_u is the equivalent undrained cohesion from the design line]
b] For small diameter mini-piles, the end bearing component is often generally ignored

An overall Factor of Safety of 2.6 should be appropriate when applied to these ultimate parameters, in line with the current guidelines by the London District Surveyors Association [LDSA]. As a guide to the use of the above coefficients, we have calculated the following pile capacity examples:

Pile diameter [mm]	Depth of pile toe- see Note d [m]	Ultimate load [kN]	Working load [kN]
300	12	425	160
	15	650	250
450	12	700	265
	15	1050	400

Notes:
a] Working load is calculated using F_{shaft} and F_{base} = 2.6
b] Concrete stress should be considered in the final design
c] These capacities incorporate an end-bearing contribution
d] The depth of the base of the pile is measured below existing external ground level

Some water was met at shallow level within the surface made ground [BH2] which would need to be sealed. Although seepages within the London Clay were not noted in our boreholes such seepages/inflows are not uncommon, and therefore some modification of the pile parameters or downgrading of the pile capacities may be warranted to mitigate the possible risk of clay softening.

The working load settlement of the piles will vary depending on the pile diameter and loads. This should be checked by analysis for final design by the piling contractor. Tension forces generated by any heave of the London Clay should be checked by the designer.

6.4 Basement slab

The proposed works will comprise new basement excavations to depths of between about 3.5m and 6m which will result in soil unloading of between approximately 70kN/m^2 and 120kN/m^2. The new structure will probably not re-apply the same level of stress and the soils beneath the new basement slab will theoretically be in a state of net unloading. The magnitude of the heave pressure/movement will be determined not only by the variation in net unloading by a number of factors such as slab stiffness, the foundation type and the construction programme.

For illustration purposes we have carried out preliminary assessments of heave effects in relation to the design of the basement slab for the main basement excavation. We estimate that total unconstrained heave at the centre of the excavation could be of the order of 40mm. About 50% of this total movement would be expected to occur prior to construction of the slabs, leaving therefore about 20mm of theoretical post construction heave [unrestrained].

If it is assumed that the relationship between heave movement and heave pressure is linear, the maximum heave pressure for a very stiff rigid slab [for the fully constrained condition] could be about 50% of the unload value which would correspond to between 35kN/m^2 for the main basement area. For a typical slab, which can undergo some deflection, the pressures are likely to be approximately 15kN/m^2, with maximum movements of about 10mm.

It will be necessary to consider uplift of the slab due to potential hydrostatic pressures and in this respect the guidelines incorporated in BS8102:2009 should be followed. The London Clay will be present at basement level and the development of a full maintained hydrostatic head in this low permeability soil is considered to be unlikely. Notwithstanding this, the slab design should take account of accidental conditions [leaking drains, burst water mains etc] and we would recommend that a water level at say 1m depth below the external ground level should be adopted. It is important to note that the water pressures will not be additional to any soil heave pressures, but will be the minimum uplift pressure for design purposes.

6.5 Foundation concrete

Low to moderately high concentrations [max 1760 mg/kg] of soluble sulphates were measured in selected soil samples with slightly alkaline pH values. Overall, a Design Sulphate Class DS-3 [Table C2 given in BRE Special Digest 1:2005, 3rd Edition, 'Concrete in aggressive ground'] is considered to be applicable for the site. We assess the site to have mobile groundwater conditions [to allow for potential seepages within the London Clay] and our recommendation is that buried concrete should be designed in accordance with ACEC Site Class AC-3.

The London Clay typically contains up to 4% pyrite which can increase sulphate levels in the soil once oxidised when the soil is exposed [for example during shallow foundation construction]. However, from our boreholes it is apparent that the sections of the clay to the proposed basement depth are already in an oxidised state [weathered/brown colouration] thus significant additional oxidation is not anticipated and the Site Class indicated above is considered realistic.

7.0 ENVIRONMENTAL APPRAISAL

This appraisal adopts the current UK practice which uses the Source-Pathway-Receptor methodology to assess contamination risks. For a site to be designated as contaminated a plausible linkage between any identified sources and receptors must be identified, i.e. whether significant pollution linkages [SPLs] are present. In considering the potential for contamination to cause a significant effect, the extent and

nature of the potential source are assessed and pathways/receptors identified; without an SPL there is theoretically no risk to the receptors from contamination. The assessed risks to the various potential receptors are summarised in the tabulated Conceptual Site Model which forms Section 7.5 of this report.

7.1 Environmental setting and context

The Site is underlain by the London Clay which is classified as an **unproductive aquifer**. Environment Agency records indicate the nearest groundwater abstraction point as being 442m distant with the nearest surface water abstraction point over 1 km distant and no surface water features nearby. The site is however within a source protection zone [Outer Catchment].

The site is assessed as being of **Low to Moderate Environmental Sensitivity.**

7.2 Potential contamination sources [on-site and off-site]

The desk study map historical map review has indicated that that prior to the construction of the house in the early 1900's the site formed part either open parkland or agricultural land.

The history of predominantly residential usage [both within the site and its vicinity] indicate a **Low** risk Potential of contaminative sources which could affect the site include the underground railway tunnel and the nearby electricity sub stations.

7.3 Contamination testing

In order to identify whether known or unknown sources within [and outside] the site have caused contamination, we have carried out testing including a general suite of analysis on a number of samples from the boreholes recovered during our investigation. The results were assessed where relevant against the DEFRA Soil Guideline Values [SGV] and the LQM/CIEH Generic Assessment Criteria [GAC] for Human Health Risk Assessment in which LQM/CIEH have derived additional SGVs from the current CLEA Model [2nd Edition, 2009]. There are currently no published SGV's or GAC's for Extractable/Total Petroleum Hydrocarbons and the results were compared with the frequently used EA remedial target of 1,000mg/kg. The SGV for Lead contamination was withdrawn as of 2008 but new Category 4 Screening Levels [C4SLs] have been introduced by DEFRA recently, which can be useful values for comparison with recorded results. C4SLs have also been useful for comparison with several other results.

The contamination testing was carried out specifically for the purpose of providing a general guidance evaluation for the proposed development. Reference should be made to the foreword to the appended contamination test results in order to fully understand the context in which this discussion should be viewed.

For the soil tests we have used, where relevant, the trigger levels for **residential development with home grown produce** to assess the results of the contamination testing. Using these criteria the all of the soil contaminant concentrations were found to be below guidance values or test detection levels, with no exceptions.

Notwithstanding these test results the proposed scheme does not involve any change in usage to that present though there may be some reduction in landscaped areas at the front of the house where the proposed lightwell basement is to be formed.

It should be noted that the investigation provided limited coverage of the site and there may of course be areas of undetected contamination.

The implications of these results are addressed in the site specific Risk Assessment and Conceptual model below.

7.4 Soil Disposal

Our investigation has indicated that there is relatively thin cover of made ground underlain by natural [and assumed uncontaminated] soils. A rigorous hazard assessment of this aspect was not within the scope of our investigation, but our preliminary conclusion is that any made ground will probably classify as either 'inert' or 'non-hazardous' industrial waste', with an 'inert' classification for natural soils. The results WAC test and our other testing detailed in the Appendix will aid in this preliminary classification. We recommend that early consultations are made with the appropriate waste facilities or regulators to confirm the classification for off-site disposal.

7.5 Risk Assessment and Conceptual Model

Taking into account the above discussion, the assessed risks to potential receptors are summarised as follows:

Source/ hazard	Pathway	Receptor	Mitigation measures/explanation	Assessed Risk level
Contaminated soil: on-site and off-site sources	Ingestion/ contact	Site end users and construction workers	• Railway tunnel has been identified on-site and there is an electricity substation about 60m from the site. There are no recorded instances of associated contamination with these features recorded in the desk study. • No soil contamination was detected in samples from the boreholes • Risks to construction workers will be controlled by the use of appropriate PPE • A careful watching brief should be kept during construction and if obvious or suspected contamination is encountered this should be dealt with prescriptively	LOW

Source/ hazard	Pathway	Receptor	Mitigation measures/explanation	Assessed Risk level
Contaminated soil: on-site sources	Migration of contaminated ground water and/or surface run-off through contaminated fill into aquifer	Aquifer and surface water	• The site is underlain by very low permeability London Clay which classifies as unproductive strata • No significant groundwater was present • No contamination was measured and no potential contaminative uses identified • Whilst the site lies within a Source Protection Zone 2 [outer catchment], the nearest abstraction point is > 400m from the site	LOW
Ground gas: on-site and off-site sources	Migration	Construction workers	• No gas monitoring has been undertaken, to date, however, we consider the site to be in a low risk of being affected by ground gas • The desk study states that no Radon protection measures are required	LOW

In conclusion, based upon the information reviewed and the results of the investigation, our assessment is that the with appropriate mitigation measures the risks to potential receptors should be **LOW.** It is self-evident that there may be zones of contamination within the site which were not encountered in our boreholes. A careful watching brief should be kept during construction and if soil contamination is suspected then specialist advice should be sought.

GENERAL INFORMATION, LIMITATIONS AND EXCEPTIONS

Unless otherwise stated, our Report should be construed as being a Ground Investigation Report [GIR] as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report [GDR] as defined in EN1997-2. Any 'design' recommendations which are provided are for guidance only and are intended to allow the designer to assess the results and implications of our investigation/testing and to permit preliminary design of relevant elements of the proposed scheme.

The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access and space limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique we have adopted a practical technique to obtain indicative soil parameters and any interpretation is based upon our engineering experience and relevant published information.

The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during our investigation. In addition Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata both between the exploratory points and/or below the maximum depth of the investigation; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

Comments made relating to ground-water or ground-gas are based upon observations made during our investigation unless otherwise stated. Ground-water and ground-gas conditions may vary with time from those reported due to factors such as seasonal effects, atmospheric effects and and/or tidal conditions. We recommend that if monitoring installations have been included as part of our investigation, continued monitoring should be carried out to maximise the information gained.

Specific geotechnical features/hazards such as [but not limited to] areas of root-related desiccation and dissolution features in chalk/soluble rock can exist in discrete localised areas - there can be no certainty that any or all of such features/hazards have been located, sampled or identified. Where a risk is identified the designer should provide appropriate contingencies to mitigate the risk through additional exploratory work and/or an engineered solution.

Where a specific risk of ground dissolution features has been identified in our Report [anything above a 'low' risk rating], reference should be made to the local building control to establish whether there are any specific local requirements for foundation design and appropriate allowances should be incorporated into the design. If such a risk assessment was not within the scope of our investigation and where it is deemed that the ground sequence may give rise to such a risk [for example near-surface chalk strata] it is recommended that an appropriate assessment should be undertaken prior to design of foundations.

Where spread foundations are used, we recommend that all excavations are inspected and approved by suitably experienced personnel; appropriate inspection records should be kept. This should also apply to any structures which are in direct contact with the soil where the soil could have a detrimental effect on performance or integrity of the structure.

Ground contamination often exists in small discrete areas - there can be no certainty that any or all such areas have been located, sampled or identified.

The findings and opinions conveyed in this Report may be based on information from a variety of sources such as previous desk studies, investigations or chemical analyses. Soil Consultants Limited cannot and does not provide any guarantee as to the authenticity, accuracy or reliability of such information from third parties; such information has not been independently verified unless stated in our Report.

Our Report is written in the context of an agreed scope of work between Soil Consultants Ltd and the Client and should not be used in any different context. In light of additional information becoming available, improved practices and changes in legislation, amendment or re-interpretation of the assessment or the Report in part or in whole may be necessary after its original publication.

Unless otherwise stated our investigation does not include an arboricultural survey, asbestos survey, ecological survey or flood risk assessment and these should be deemed to be outside the scope of our investigation.

[Rev_1_08_03_2013]

9722/KOG/JRCB
Client: Whitehall Parrk Ltd
Site Investigation Report – 17 Wadham Gardens, London, NW3 3DN
Engineers: Pringuer James

APPENDIX A

Fieldwork, in-situ testing and monitoring

- Borehole records
- SPT results
- SPT hammer calibration certificate

Laboratory testing

- Unconsolidated undrained triaxial test results [QUT]
- Index property testing
- Plasticity charts

Ground profiles

- Cohesion versus depth graph

Contamination testing [QTS Environmental]

- General soil suite and soluble sulphate/pH results

Plans & drawings

- Photographs of the site
- Proposed development drawings
- Site Plan
- Location Plan

10th February 2015 [Rev 0]
Soil Consultants

FOREWORD - GUIDANCE NOTES

GENERAL
The Borehole Records are compiled from the driller's description of the strata encountered, an examination of the samples by our Geotechnical Engineer and the results of in-situ and laboratory tests. Based on this data, the report presents an opinion on the configuration of strata within the site. However, such reasonable assumptions are given for guidance only and no liability can be accepted for changes in conditions not revealed by the boreholes.

BORING METHODS
The Cable Percussion technique of boring is normally employed and allows the ground conditions to be reasonably well established. However, some disturbance of the ground is inevitable, particularly some "softening" of the upper zone of clay immediately beneath a granular soil. The presence of thin layers of different soils within a stratum may not always be detected.

GROUND WATER
The depth at which ground water was struck is entered on the Borehole Records. However, this observation may not indicate the true water level at that period. Due to the speed of boring and the relatively small diameter of the borehole, natural ground water may be present at a depth slightly higher than the water strike. Moreover, ground water levels are subject to variations caused by changes in the local drainage conditions and by seasonal effects. When a moderate inflow of water does take place, boring is suspended for at least 10 minutes to enable a more accurate short term water level to be achieved. An estimate of the rate of inflow is also given. This is a relative term and serves only as a guide to the probable flow of water into an excavation.

Further observations of the water level made during the progress of the borehole are shown including end of shift and overnight readings and the depth at which water was sealed off by the borehole casing, if applicable.

Whilst drilling through granular soils, it is usually necessary to introduce water into the borehole to permit their extraction. When additional water has been used a remark is made on the Borehole Record and the implications are discussed in the text.

SAMPLES
Undisturbed samples of the predominantly cohesive soils are obtained using a 100mm diameter open-drive sampler. In granular soils, disturbed bulk samples are taken and placed in polythene bags. Small jar samples are taken at frequent intervals in all soils for subsequent visual examination. Where ground water is encountered in sufficient quantity, a sample of the ground water is also taken.

IN-SITU STANDARD PENETRATION TESTS
This test is performed in accordance with the procedure given in B.S.1377: 1990. The individual blow count record for each test is given on a separate table. The 'N' value is normally the number of blows to achieve a penetration of 0.3m following a seating distance of 0.15m and is quoted at the mid-depth of the test zone. However, if a change of stratum occurs within the test zone then a revised 'N' value is calculated to assess one layer in particular. In hard strata full penetration may not be obtained. In such cases the suffix '+' indicates that the result has been extrapolated from the limited penetration achieved. Where ground water has affected the measured values, the resultant 'N' value has been placed in brackets since it is unlikely to represent the true in-situ density of the soil.

Soil Consultants

Rev: August 2009

Site & Location: **17 Wadham Gardens, London, NW3 3DN**

Borehole No: **BH1**

Client: **Whitehall Park Ltd**

Coords (E/N): 527219.00 - 184060.00

Sheet 1 of 2

Engineer: **Pringuer James Consulting Engineers**

Ground Level (m): 50.20

Report No: 9722/KOG

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Description	Backfill / Installation
BH commenced: 13/01/15	D	0.25					TOPSOIL over MADE GROUND: brown/grey silty sandy clay with scattered brick and stone debris and roots	
BH/casing dia: 150mm	D	0.50						
Inspection pit to 1.2m				0.70	49.50		Firm orange brown mottled grey silty CLAY with rare medium to coarse rounded flint gravel	
	D	1.00						
	D	1.50					..frequent roots to 0.6m, with occasional rootlets noted to 1.6m	
	SPT/S	1.50	N=9 N60=11					
	D	2.00						
	U	2.50						
BH cased 150mm to 3.0m	D	3.00					..slightly more silty towards base	
				3.30	46.90		Stiff fissured brown stained blue grey CLAY containing occasional selenite	
	D	3.50						
	SPT/S	3.50	N=13 N60=16					
	D	4.00						
	U	4.50						
	D	5.00						
	SPT/S	6.00	N=16 N60=20	6.00	44.20		Stiff fissured brown CLAY	
Standpipe installed to 7.00m depth	D	7.00						
	U	7.50						
	D	8.00						
	D	9.00						
	SPT/S	9.00	N=20 N60=25					
				9.45	40.75		Stiff fissured grey CLAY with occasional fine grey sand partings	
	D	10.00		10.00	40.20		Continued on next sheet	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water E = glass jar & plastic tub SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa]

PP = Pocket Penetrometer [kg/cm2] PID = Photo Ionisation Detector [ppmv]

Borehole type: Cable Percussion

Remarks :- Approximate coordinates interpolated from desk study OS mapping and ground level interpolated from Architects external ground level site datum

Borehole No: **BH1**

[* = full SPT penetration not achieved - see summary sheet]

Soil Consultants

Site & Location:	**17 Wadham Gardens** **London, NW3 3DN**	Borehole No:	**BH1**
Client:	**Whitehall Park Ltd**	Coords (E/N): 527219.00 - 184060.00	Sheet 2 of 2
Engineer:	**Pringuer James Consulting Engineers**	Ground Level (m): 50.20	Report No: 9722/KOG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Description	Backfill / Installation
							Stiff fissured grey CLAY with occasional fine grey sand partings	
	U	10.50						
	D	11.00						
	SPT/S	12.00	N=22 N60=28					
	D	13.00						
	U	13.50						
	D	14.00					..becoming very stiff below 14.00m	
	SPT/S	14.50	N=25 N60=32					
BH depth 15.00m, dry				15.00	35.20		End of borehole at 15.00 m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water E = glass jar & plastic tub SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa]

PP = Pocket Penetrometer [kg/cm2] PID = Photo Ionisation Detector [ppmv] | Borehole type: Cable Percussion

Remarks :- Approximate coordinates interpolated from desk study OS mapping and ground level interpolated from Architects external ground level site datum | Borehole No: **BH1**

[* = full SPT penetration not achieved - see summary sheet]

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Foreword to: Window Sampler Boreholes

Window Sample Boreholes are constructed by driving in steel sample tubes in which long slots have been cut to enable the soil to be examined, tested or sampled. The tubes are either 1m or 2m in length. The borehole commences using a large diameter tube, 70mm or 80mm, with each succeeding tube reducing usually by 10mm in diameter to assist the extraction of the tube from the ground. Thus, it is theoretically possible to obtain a total continuous sample of the soil for examination or testing.

Window Sample boreholes are a means of rapid and economic sampling where access is not necessarily good or where impact of the investigation must be kept to a minimum.

The method is primarily suited to clay soils and can also achieve reasonable penetration into many granular soils. Soil recovery beneath the water table in granular soils can however be reduced.

The open slot in the sample tube allows hand shear vane and pocket penetrometer tests to be carried out. Samples can also be taken where necessary for laboratory testing, including moisture content, index property tests and contamination analyses.

Hand Shear Vane : The shear strength of cohesive soils are reported in kPa.
Pocket Penetrometer : The unconfined compression strengths values are reported in kg/cm^2.

Rev: August 2009

Soil Consultants

Site & Location:	**17 Wadham Gardens** **London, NW3 3DN**		Borehole No: **BH2**
Client:	**Whitehall Park Ltd**	Coords (E/N): 527218.00 - 184080.00	Sheet 1 of 2
Engineer:	**Pringuer James Consulting Engineers**	Ground Level (m): 50.20	Report No: 9722/KOG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Description	Backfill / Installation
BH commenced: 13/01/15							PAVING SLAB and sand blinding layer [50mm] over MADE GROUND: brown/grey silty sandy clay with scattered brick and stone debris and roots	
BH diameter 90mm, diameter reducing with increasing epth	D	0.50						
	D	0.80						
Medium ground water inflow at 1.10m				1.10	49.10		Firm orange brown mottled grey silty CLAY with rare medium to coarse rounded flint gravel	
	D HV	1.30 1.30	40					
	D HV	1.60 1.60	45					
	D HV	1.90 1.90	60				..occcasional fine root hairs noted to 2.30m	
	D HV	2.30 2.30	40					
	D HV	2.60 2.60	50				..slightly more silty towards base	
	D HV	2.90 2.90	45					
	D HV	3.30 3.30	35					
				3.50	46.70		Stiff fissured brown stained blue grey CLAY containing occasional selenite	
	D HV	3.60 3.60	90					
	D HV	3.90 3.90	110					
	D HV	4.30 4.30	90					
	D HV	4.60 4.60	85					
	D HV	4.90 4.90	95					
				5.00	45.20		Continued on next sheet	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water E = glass jar & plastic tub SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa]

PP = Pocket Penetrometer [kg/cm2] PID = Photo Ionisation Detector [ppmv] | Borehole type: Window Sampler

Remarks :- Approximate coordinates interpolated from desk study OS mapping and ground level interpolated from Architects external ground level site datum | Borehole No: **BH2**

[* = full SPT penetration not achieved - see summary sheet]

Soil Consultants

Site & Location:	**17 Wadham Gardens** **London, NW3 3DN**		Borehole No: **BH2**
Client:	**Whitehall Park Ltd**	Coords (E/N): 527218.00 - 184080.00	Sheet 2 of 2
Engineer:	**Pringuer James Consulting Engineers**	Ground Level (m): 50.20	Report No: 9722/KOG

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Description	Backfill / Installation
	D HV	5.30 5.30	100				Stiff fissured brown stained blue grey CLAY containing occasional selenite	
	D HV	5.60 5.60	110					
	D HV	5.90 5.90	100	6.00	44.20		Stiff fissured brown CLAY	
	D HV	6.30 6.30	80					
	D HV	6.60 6.60	90					
Standpipe installed to 7.00m depth								
BH 7.00m , water level 1.3m	D HV	6.90 6.90	110	7.00	43.20		End of borehole at 7.00 m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water E = glass jar & plastic tub SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa]

PP = Pocket Penetrometer [kg/cm2] PID = Photo Ionisation Detector [ppmv] | Borehole type: Window Sampler

Remarks :- Approximate coordinates interpolated from desk study OS mapping and ground level interpolated from Architects external ground level site datum | Borehole No: **BH2**

[* = full SPT penetration not achieved - see summary sheet]

Soil Consultants

Site & Location: **17 Wadham Gardens, London, NW3 3DN** | Report No: **9722/KOG**

STANDARD PENETRATION TEST SUMMARY

BH ID	Depth [m]	Test type	'N' value and blow-counts [Seating blows/Test blows]	N_{60}	N_{60} - ext	Casing depth [m]	Water depth [m]	Remarks
BH1	1.50	S	N = 9 :1 1/ 2 2 2 3	11		0.00	DRY	
BH1	3.50	S	N = 13 :2 2/ 3 3 3 4	16		2.70	DRY	
BH1	6.00	S	N = 16 :2 3/ 3 4 4 5	20		2.70	DRY	
BH1	9.00	S	N = 20 :3 4/ 4 5 5 6	25		2.70	DRY	
BH1	12.00	S	N = 22 :4 4/ 5 5 6 6	28		2.70	DRY	
BH1	14.50	S	N = 25 :5 6/ 5 7 6 7	32		2.70	DRY	

Standard Penetration Test : BS EN ISO 22476:2005 Part 3 Hammer Energy Ratio, Er = 76%

* where full penetration not achieved, the reported N_{60} is based on maximum uncorrected blow-counts of 50

** extrapolated N_{60} value where full penetration not achieved - this is indicative only and should be used with caution [SPT Sheet 1 of 1]

Soil Consultants

Site Location: **17 Wadham Gardens, London, NW3 3DN** | Report No: **9722/KOG**

SPT Hammer Calibration Certificate

Southern Testing
Keeble House
Stuart Way
East Grinstead
West Sussex
RH19 4QA

SPT Hammer Ref: DW1
Test Date: 25/09/2014
Report Date: 25/09/2014
File Name: DW1.spt
Test Operator: NPB

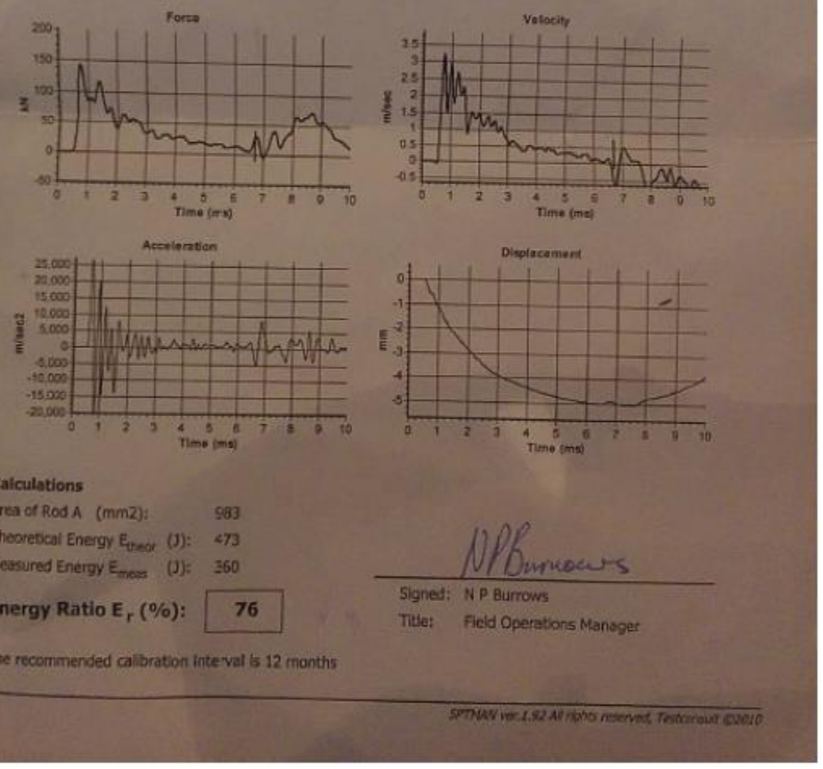
Instrumented Rod Data

Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.5
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 6458
Accelerometer No.2: 6459

SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 14.5

Comments / Location
Charlwoods Road



Calculations

Area of Rod A (mm2): 983
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 360

Energy Ratio E_r (%): 76

The recommended calibration interval is 12 months

Signed: N P Burrows
Title: Field Operations Manager

Head Office: Chiltern House, Earl Howe Road, Holmer Green, High Wycombe, Bucks HP15 6QT, t: 01494 712494, e: mail@soilconsultants.co.uk
Cardiff office: 23 Romilly Road, Cardiff CF5 1FH, t: 02920 403575, e: cardiff@soilconsultants.co.uk
Harwich Office: Haven House, Albemarle Street, Harwich, Essex CO12 3HL, t: 01255 241639, e: harwich@soilconsultants.co.uk

Soil Consultants

Site: **17 Wadham Gardens**
Location: **London, NW3 3DN**
Report No: **9722/K0G**

SUMMARY OF UNDRAINED SHEAR STRENGTH TEST RESULTS

BH ID	Depth [m]	Moisture content [%]	Bulk density [Mg/m³]	Dry density [Mg/m³]	Cell pressure [kPa]	$(\sigma_1-\sigma_3)_f$ [kPa]	Failure strain [%]	Failure mode	Undrained cohesion [kPa]	Remarks
BH1	2.50	24	2.00	1.61	90	94	8.00	P	47	
BH1	4.50	32	1.93	1.46	100	176	3.50	I	88	
BH1	7.50	31	1.92	1.47	150	219	5.50	B	110	
BH1	10.50	29	1.95	1.51	210	254	4.00	B	127	
BH1	13.50	29	1.97	1.53	270	201	2.00	B	101	

Testing in accordance with BS EN ISO 17892 UU = unconsolidated, undrained; MUU = multistage, unconsolidated, ur Date: 23 January 15
Unless stated otherwise: Rate of strain = 2mm/min, Standard latex membrame used with thickness = 0.5mm
Failure modes: B = brittle, I = intermediate, P = plastic [Triaxial Sheet 1 of 1]

Soil Consultants

Site & Location: **17 Wadham Gardens, London, NW3 3DN**
Report No: **9722/K0G**

SUMMARY OF CLASSIFICATION TEST RESULTS

BH ID	Depth (m)	Type	w (%)	wL (%)	wP (%)	Pass 425 (%)	IP (%)	Mod IP (%)	IL (%)	LOI (%)	Description
BH1	1.50	D	34								Orange brown mottled grey silty CLAY with rare gravel
BH1	2.00	D	36								Orange brown mottled grey silty CLAY with rare gravel
BH1	2.50	U	24								Orange brown mottled grey silty CLAY with rare gravel
BH1	3.00	D	19								Orange brown mottled grey silty CLAY with rare gravel
BH1	3.50	D	30	79	29	>95	50		0.02		Fissured brown stained blue grey CLAY
BH1	4.00	D	31								Fissured brown stained blue grey CLAY
BH1	4.50	U	32								Fissured brown stained blue grey CLAY
BH1	5.00	D	32								Fissured brown stained blue grey CLAY
BH1	7.50	U	31								Fissured brown CLAY
BH1	9.00	D	30	82	30	>95	52		0.00		Fissured brown CLAY
BH1	10.00	D	30								Fissured grey CLAY
BH1	10.50	U	29								Fissured grey CLAY
BH1	13.50	U	29								Fissured grey CLAY
BH1	14.00	D	29	83	29	>95	54		0.00		Fissured grey CLAY
BH2	1.30	D	26								Orange brown mottled grey silty CLAY with rare gravel
BH2	1.60	D	43	66	26	>95	40		0.43		Orange brown mottled grey silty CLAY with rare gravel
BH2	1.90	D	28								Orange brown mottled grey silty CLAY with rare gravel
BH2	2.30	D	31								Orange brown mottled grey silty CLAY with rare gravel
BH2	2.60	D	25								Orange brown mottled grey silty CLAY with rare gravel

Testing in accordance with BS EN ISO 17892 unless specified otherwise Date: 23 Jan 15
Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)
Percent passing 425µm: by estimation, by hand* or by sieving** (Classification Sheet 1 of 2)

Soil Consultants

Site & Location: **17 Wadham Gardens, London, NW3 3DN** | Report No: **9722/KOG**

SUMMARY OF CLASSIFICATION TEST RESULTS

BH ID	Depth (m)	Type	w (%)	wL (%)	wP (%)	Pass 425 (%)	IP (%)	Mod IP (%)	IL (%)	LOI (%)	Description
BH2	2.90	D	23								Orange brown mottled grey silty CLAY with rare gravel
BH2	3.30	D	24	40	18	>95	22		0.28		Orange brown mottled grey silty CLAY with rare gravel
BH2	3.60	D	28								Fissured brown stained blue grey CLAY
BH2	3.90	D	27	71	24	>95	47		0.07		Fissured brown stained blue grey CLAY
BH2	4.30	D	31								Fissured brown stained blue grey CLAY
BH2	4.60	D	32	78	28	>95	50		0.08		Fissured brown stained blue grey CLAY
BH2	4.90	D	31								Fissured brown stained blue grey CLAY
BH2	5.30	D	32								Fissured brown stained blue grey CLAY
BH2	5.60	D	31	72	26	>95	46		0.11		Fissured brown stained blue grey CLAY
BH2	5.90	D	32								Fissured brown stained blue grey CLAY
BH2	6.30	D	31								Fissured brown CLAY
BH2	6.60	D	32	76	29	>95	47		0.07		Fissured brown CLAY
BH2	6.90	D	32								Fissured brown CLAY

Testing in accordance with BS EN ISO 17892 unless specified otherwise — Date: 23 Jan 15

Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)

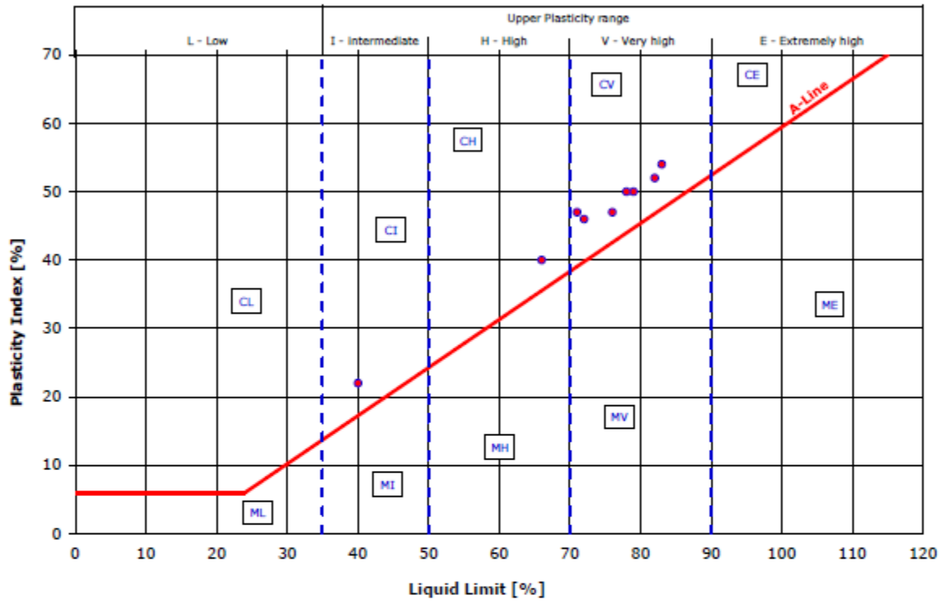
Percent passing 425µm: by estimation, by hand* or by sieving**

(Classification Sheet 2 of 2)

Soil Consultants

Site & Location: **17 Wadham Gardens, London, NW3 3DN** | Report No: **9722/KOG**

Plasticity Chart



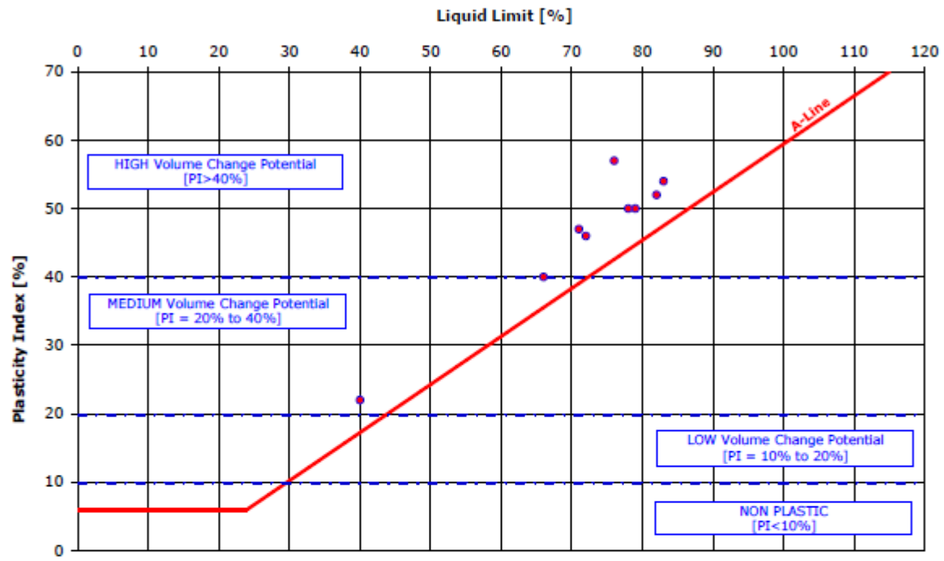
M - SILT [plots below the A-Line}
C - CLAY [plots above the A-Line]

Classification in accordance with BS5930:1999+A2:2010 "Code of practice for site investigations"

Soil Consultants

Site & Location	17 Wadham Gardens London, NW3 3DN	Report No:	9722/KOG

Plasticity Chart



Modified Plasticity Index, I'p:

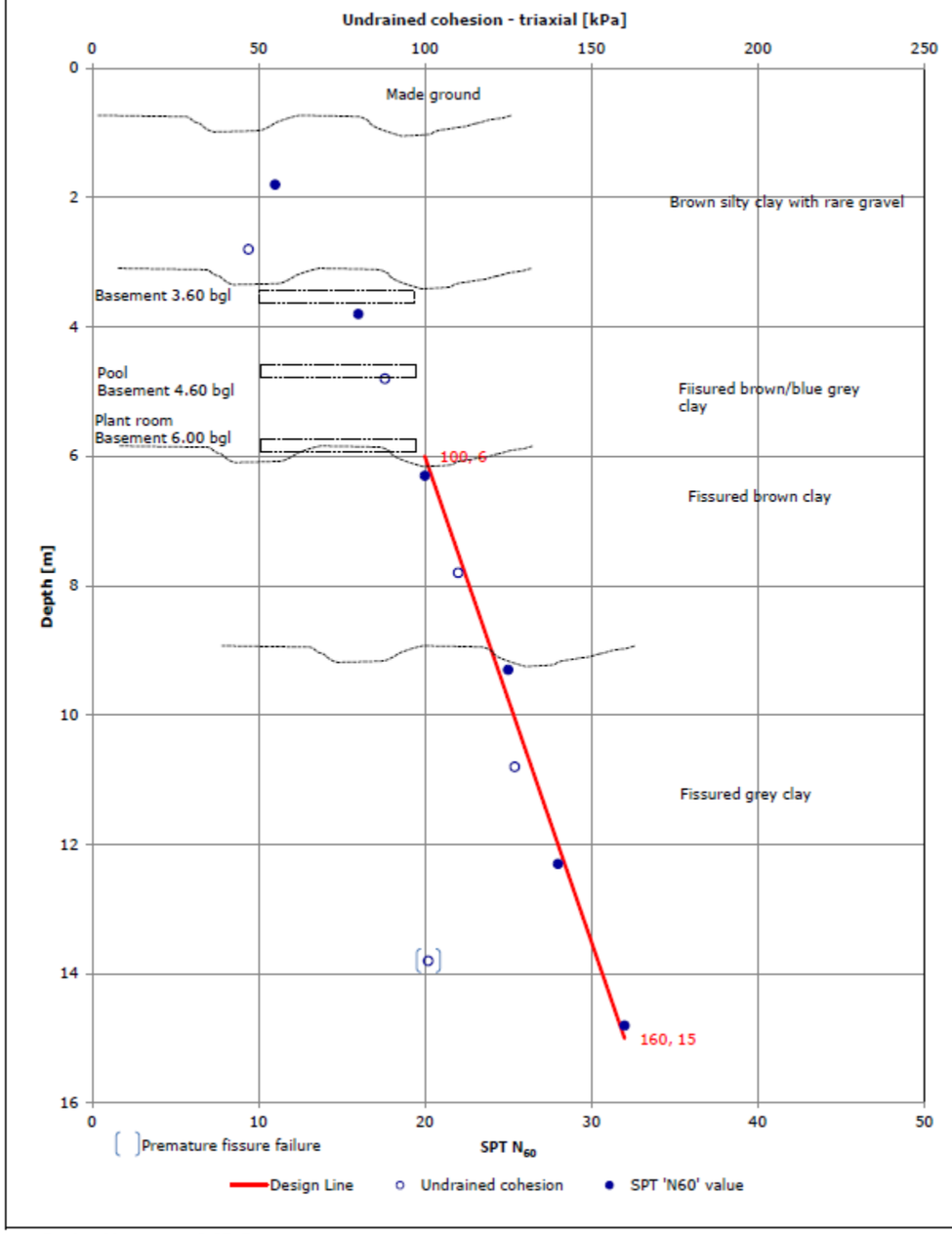
$$I'p = \frac{Ip \times (\%\ passing\ 425mm)}{100\%} \qquad [where\ Ip = Plasticity\ Index]$$

Classification in accordance with NHBC Standards, Part 4 'Foundations', Chapter 4.2 'Building near trees'

Soil Consultants

Site & Location	17 Wadham Gardens London, NW3 3DN	Report No:	9722/KOG

Undrained cohesion and SPT [N60] vs depth



Design Line Δcu = 6.67kPa/m

Note: this plot may incorporate extrapolated results, generally where 'N' >50 - these are indicative only and should be used with caution

Soil Consultants

Foreword to: CONTAMINATION TESTING AND ASSESSMENT

The following statements are designed to inform and guide the Client and other potential parties intending to rely upon this report, with the express intent of protecting them from misunderstanding as to the extent and thus the potential associated risks that may result from proceeding without further evaluations or guidance.

1) Unless otherwise stated in this report, the testing of soils and waters is based on a range of commonly occurring potential contaminants for the specific purpose of providing a general guidance evaluation for the proposed form of development. Thus, the range of potential contaminants is neither exhaustive nor specifically targeted to any previous known uses or influences upon the site.

2) The amount and scope of the testing should not be assumed to be exhaustive but has been selected, at this stage, to provide a reasonable, general view of the site ground conditions. In many cases this situation is quite sufficient for the site to be characterised for the purposes of development and related Health and Safety matters for persons involved in or directly affected by the site development works. It must be understood, however, that in certain circumstances aspects or areas of the site may require further investigation and testing in order to fully clarify and characterise contamination issues, both for regulatory compliance and for commercial reasons.

3) The scope of the contamination testing must not automatically be regarded as being sufficient to fully formulate a remediation scheme. For such a scheme it may be necessary to consider further testing to verify the effectiveness of the remedial work after the site has been treated. It must be understood that a remediation scheme which brings a site into a sufficient state for the proposed development ("fit for purpose") under current legislation and published guidance, may result in some contamination being left in-situ. It is possible that forthcoming legislation may result in a site being classified by the Local Authority and assigned a "Degree of Risk" related to previous use or known contamination.

4) The scope of the environmental investigation and contamination testing must not be automatically regarded as sufficient to satisfy the requirements in the wider environmental setting. The risks to adjacent properties and to the water environment are assessed by the regulatory authorities and there may be a requirement to carry out further exploration, testing and, possibly monitoring in the short or long term. It is not possible to sensibly predict the nature and extent of such additional requirements as these are the direct result of submissions to and liaison with the regulatory authorities. It is imperative, therefore, that such submissions and contacts are made as soon as possible, especially if there are perceived to be critical features of the site and proposed scheme, in this context.

5) New testing criteria have been implemented by the Environment Agency to enable a waste disposal classification to be made. The date of implementation of this Waste Acceptance Criteria (WAC) testing was July 2005. It is this testing that will be used by the waste regulatory authorities, including waste disposal sites, to designate soils for disposal in landfill sites. In certain circumstances, to satisfy the waste regulations, there may be the necessity to carry out additional testing to clarify and confirm the nature of any contamination that may be present. If commercial requirements are significant then this process may also necessitate further field operations to clarify the extent of certain features. Thus, the waste classification must be obtained from the waste regulation authorities or a licensed waste disposal site and we strongly recommend that this classification is obtained as soon as possible and certainly prior to establishing any costings or procedures for this or related aspects of the scheme.

Rev: August 2009

Soil Consultants

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mCERTS 4480 UKAS TESTING

QTS Environmental Report No: 15-28084

Site Reference:	17 Wadham Gardens, London
Project / Job Ref:	9722/KOG
Order No:	9722/KOG
Sample Receipt Date:	22/01/2015
Sample Scheduled Date:	22/01/2015
Report Issue Number:	1
Reporting Date:	28/01/2015

Authorised by:
Russell Jarvis
Director
On behalf of QTS Environmental Ltd

Authorised by:
Kevin Old
Director
On behalf of QTS Environmental Ltd

QTS Environmental Ltd
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Lenham Heath
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4480

Soil Analysis Certificate

QTS Environmental Report No: 15-28084	Date Sampled	13/01/15	13/01/15	13/01/15	13/01/15	13/01/15
Soil Consultants Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: 17 Wadham Gardens, London	TP / BH No	BH2	BH2	BH2	BH2	BH2
Project / Job Ref: 9722/KOG	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 9722/KOG	Depth (m)	0.50	0.80	1.20	2.60	3.90
Reporting Date: 28/01/2015	QTSE Sample No	132799	132800	132801	132802	132803

Determinand	Unit	RL	Accreditation					
Asbestos Screen	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	9.1	7.9	9.0	7.9	7.7
Electrical Conductivity	uS/cm	< 5	NONE	145	75	156		
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2		
Total Sulphate as SO_4	mg/kg	< 200	NONE	3332	910	1181		
W/S Sulphate as SO4 (2:1)	g/l	< 0.01	MCERTS	0.09	0.13	0.09	0.10	0.14
Total Sulphur	mg/kg	< 200	NONE	1113	336	430		
Organic Matter	%	< 0.1	MCERTS	5.2	2	0.8		
Arsenic (As)	mg/kg	< 2	MCERTS	6	16	6		
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	0.3	< 0.2		
Chromium (Cr)	mg/kg	< 2	MCERTS	18	51	25		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	19	37	13		
Lead (Pb)	mg/kg	< 3	MCERTS	139	100	25		
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	14	54	15		
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3		
Zinc (Zn)	mg/kg	< 3	MCERTS	40	150	35		
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2		
EPH (C10 - C40)	mg/kg	< 6	MCERTS	< 6	< 6	< 6		

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C
Analysis carried out on the dried sample is corrected for the stone content
The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)
This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.
The material description shall be regarded as tentative and is not included in our scope of UKAS Accreditation.
Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.
Asbestos Analyst: Javeed Malik
RL: Reporting Limit
Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).
Subcontracted analysis (S)

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate

QTS Environmental Report No: 15-28084	Date Sampled	13/01/15	13/01/15	13/01/15	13/01/15	13/01/15
Soil Consultants Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: 17 Wadham Gardens, London	TP / BH No	BH2	BH1	BH1	BH1	BH1
Project / Job Ref: 9722/KOG	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 9722/KOG	Depth (m)	5.90	0.40	0.90	9.00	14.00
Reporting Date: 28/01/2015	QTSE Sample No	132804	132805	132806	132808	132809

Determinand	Unit	RL	Accreditation					
Asbestos Screen	N/a	N/a	ISO17025		Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	7.5	8.2	7.8	7.5	7.6
Electrical Conductivity	uS/cm	< 5	NONE		158	133		
Total Cyanide	mg/kg	< 2	NONE		< 2	< 2		
Total Sulphate as SO_4	mg/kg	< 200	NONE		2296	759		
W/S Sulphate as SO4 (2:1)	g/l	< 0.01	MCERTS	1.76	1.06	0.25	0.48	0.42
Total Sulphur	mg/kg	< 200	NONE		773	540		
Organic Matter	%	< 0.1	MCERTS		0.9	1.1		
Arsenic (As)	mg/kg	< 2	MCERTS		8	9		
W/S Boron	mg/kg	< 1	NONE		< 1	< 1		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS		< 0.2	< 0.2		
Chromium (Cr)	mg/kg	< 2	MCERTS		29	30		
Chromium (hexavalent)	mg/kg	< 2	NONE		< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS		28	63		
Lead (Pb)	mg/kg	< 3	MCERTS		126	47		
Mercury (Hg)	mg/kg	< 1	NONE		< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS		23	26		
Selenium (Se)	mg/kg	< 3	NONE		< 3	< 3		
Zinc (Zn)	mg/kg	< 3	MCERTS		58	68		
Total Phenols (monohydric)	mg/kg	< 2	NONE		< 2	< 2		
EPH (C10 - C40)	mg/kg	< 6	MCERTS		< 6	< 6		

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C
Analysis carried out on the dried sample is corrected for the stone content
The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)
This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.
The material description shall be regarded as tentative and is not included in our scope of UKAS Accreditation.
Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.
Asbestos Analyst: Javeed Malik
RL: Reporting Limit
Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).
Subcontracted analysis (S)

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate			
QTS Environmental Report No: 15-28084	Date Sampled	13/01/15	
Soil Consultants Ltd	Time Sampled	None Supplied	
Site Reference: 17 Wadham Gardens, London	TP / BH No	BH2	
Project / Job Ref: 9722/KOG	Additional Refs	None Supplied	
Order No: 9722/KOG	Depth (m)	1.30	
Reporting Date: 28/01/2015	QTSE Sample No	132810	

Determinand	Unit	RL	Accreditation	
Asbestos Screen	N/a	N/a	ISO17025	
pH	pH Units	N/a	MCERTS	7.7
Electrical Conductivity	uS/cm	< 5	NONE	
Total Cyanide	mg/kg	< 2	NONE	
Total Sulphate as SO_4	mg/kg	< 200	NONE	
W/S Sulphate as SO4 (2:1)	g/l	< 0.01	MCERTS	0.19
Total Sulphur	mg/kg	< 200	NONE	
Organic Matter	%	< 0.1	MCERTS	
Arsenic (As)	mg/kg	< 2	MCERTS	
W/S Boron	mg/kg	< 1	NONE	
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	
Chromium (Cr)	mg/kg	< 2	MCERTS	
Chromium (hexavalent)	mg/kg	< 2	NONE	
Copper (Cu)	mg/kg	< 4	MCERTS	
Lead (Pb)	mg/kg	< 3	MCERTS	
Mercury (Hg)	mg/kg	< 1	NONE	
Nickel (Ni)	mg/kg	< 3	MCERTS	
Selenium (Se)	mg/kg	< 3	NONE	
Zinc (Zn)	mg/kg	< 3	MCERTS	
Total Phenols (monohydric)	mg/kg	< 2	NONE	
EPH (C10 - C40)	mg/kg	< 6	MCERTS	

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C
Analysis carried out on the dried sample is corrected for the stone content
The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)
This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.
The material description shall be regarded as tentative and is not included in our scope of UKAS Accreditation.
Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.
Asbestos Analyst: Javeed Malik
RL: Reporting Limit
Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).
Subcontracted analysis [S]

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 15-28084	Date Sampled	13/01/15	13/01/15	13/01/15	13/01/15	13/01/15
Soil Consultants Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: 17 Wadham Gardens,	TP / BH No	BH2	BH2	BH2	BH1	BH1
Project / Job Ref: 9722/KOG	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 9722/KOG	Depth (m)	0.50	0.80	1.20	0.40	0.90
Reporting Date: 28/01/2015	QTSE Sample No	132799	132800	132801	132805	132806

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	0.13	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.14	< 0.1	< 0.1	0.20	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	0.17	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C

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Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

					Landfill Waste Acceptance Criteria Limits		
QTS Environmental Report No: 15-28084	Date Sampled	13/01/15			Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Soil Consultants Ltd	Time Sampled	None Supplied					
Site Reference: 17 Wadham Gardens, London	TP / BH No	BH1					
Project / Job Ref: 9722/KOG	Additional Refs	None Supplied					
Order No: 9722/KOG	Depth (m)	1.20					
Reporting Date: 28/01/2015	QTSE Sample No	132807					

Determinand	Unit	MDL					
TOC[M,U]	%	< 0.1	0.5		3%	5%	6%
Loss on Ignition	%	< 0.01	3.70		--	--	10%
BTEX[M,U]	mg/kg	< 0.05	< 0.05		6	--	--
Sum of PCBs	mg/kg	< 0.7	< 0.7		1	--	--
Mineral Oil[M,U]	mg/kg	< 10	< 10		500	--	--
Total PAH[M,U]	mg/kg	< 1.7	< 1.7		100	--	--
pH[M,U]	pH Units	N/a	7.7		--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	1.4		--	To be evaluated	To be evaluated

Eluate Analysis	2:1 mg/l	8:1 mg/l		Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic[U]	< 0.01	< 0.01		< 0.2	0.5	2	25
Barium[U]	0.04	< 0.02		0.2	20	100	300
Cadmium[U]	< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium[U]	< 0.005	< 0.005		< 0.20	0.5	10	70
Copper[U]	< 0.01	< 0.01		< 0.5	2	50	100
Mercury[U]	< 0.005	< 0.005		< 0.01	0.01	0.2	2
Molybdenum[U]	< 0.001	0.001		< 0.1	0.5	10	30
Nickel[U]	< 0.007	< 0.007		< 0.2	0.4	10	40
Lead[U]	< 0.005	< 0.005		< 0.2	0.5	10	50
Antimony[U]	< 0.005	< 0.005		< 0.06	0.06	0.7	5
Selenium[U]	< 0.005	< 0.005		< 0.1	0.1	0.5	7
Zinc[U]	< 0.005	< 0.005		< 0.2	4	50	200
Chloride[U]	35	6		77	800	15000	25000
Fluoride[U]	0.7	0.6		6	10	150	500
Sulphate[U]	47	9		112	1000	20000	50000
TDS	204	93		989	4000	60000	100000
Phenol Index	< 0.01	< 0.01		< 0.5	1	-	-
DOC	20.7	12.4		129	500	800	1000
Leach Test Information							
Sample Mass (kg)	0.22						
Dry Matter (%)	80.9						
Moisture (%)	23.8						
Stage 1							
Volume Eluate L2 (litres)	0.31						
Filtered Eluate VE1 (litres)	0.09						

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

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Soil Analysis Certificate - Sample Descriptions

QTS Environmental Report No: 15-28084	
Soil Consultants Ltd	
Site Reference: 17 Wadham Gardens, London	
Project / Job Ref: 9722/KOG	
Order No: 9722/KOG	
Reporting Date: 28/01/2015	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
132799	BH2	None Supplied	0.50	14.3	Light brown clayey gravel with rubble
132800	BH2	None Supplied	0.80	20.4	Light brown clayey gravel
132801	BH2	None Supplied	1.20	17.9	Light brown clayey gravel with rubble
132802	BH2	None Supplied	2.60	17.2	Light brown clay
132803	BH2	None Supplied	3.90	18	Light brown clay
132804	BH2	None Supplied	5.90	20.1	Light brown clay
132805	BH1	None Supplied	0.40	19.3	Light brown clayey gravel with vegetation
132806	BH1	None Supplied	0.90	19.2	Light brown clay
132807	BH1	None Supplied	1.20	19.1	Light brown clay
132808	BH1	None Supplied	9.00	17.7	Light brown clay
132809	BH1	None Supplied	14.00	18.9	Light brown clay
132810	BH2	None Supplied	1.30	17.7	Light brown clay

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample [1/9]
Unsuitable Sample [1/9]

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Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 15-28084
Soil Consultants Ltd
Site Reference: 17 Wadham Gardens, London
Project / Job Ref: 9722/KOG
Order No: 9722/KOG
Reporting Date: 28/01/2015

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	D	Fluoride - Water Soluble	Determination of fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	TPH LQM	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6 - C10)	Determination of hydrocarbons C6-C10 by headspace GC-MS	E001

D Dried
AR As Received

Site Location	17 Wadham Gardens, London, NW3 3DN	Report No: 9722/KOG

Photographs of the site [January 2015]

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