Basement Impact Assessment

and

Construction Method Statement

for

Proposed Development

at

2 Templewood Avenue, Hampstead, London NW3 7XA

Date: January 2022

Revision: 01

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1.0 Introduction

Pringuer-James Consulting Engineers (PJCE) were appointed by Mr G. Fazio and Mrs K. Fazio as the structural engineers for the proposed development at No.2 Templewood Avenue, Hampstead, London NW3 7XA.

As part of the project brief, PJCE are required to provide assistance on the structural engineering aspects of the proposed development, including the preparation of a Basement Impact Assessment (BIA) and outline Construction Method Statement (CMS) to submitted as part of a planning application package.

The BIA has been prepared in accordance with the current format set out by the London Borough of Camden Planning Department 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 London borough of Camden.

There are three critical criteria identified in this study which must be considered and dealt with 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 in four stages accordingly. Stage One, the initial screening process which leads to Stage Two, the scoping process, whereby relevant impacts are identified for the site. Stage Three of the process involves gathering site specific data by means of a desk study and geotechnical site investigation. From this, the relevant information is obtained to enable an accurate assessment of the potential impacts of issues identified in the first two stages.

Following this, Stage Four of the BIA involves an analysis of the information gathered and a site specific assessment of 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.

This report presents an outline structural scheme for the construction of the new subterranean structure and proposed alterations to the ground floor plate. Above ground floor superstructure falls outside this report, but a 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 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.

The report has been compiled for Mr G. Fazio and Mrs K. Fazio and shall be for the private and confidential use of the client and should not be reproduced in whole or in part or relied upon by third parties for any use without express written authority from PJCE.

Figure 1 – Existing Site Location Map

2.0 Screening

2.1 Location of the Project

The site is located in LB Camden at No.2 Templewood Avenue, Hampstead, approximately 0.3 miles South of Golders Hill Park and 1.0 mile West of Hampstead Heath Ponds. The site is rectangular in shape, measures approximately 23m x 59m and slopes approximately 3 metres from front to back.

The existing property is a large three storey detached house, measuring approximately 17.5m x 19.0m and built of traditional loadbearing masonry walls, timber joisted floor plates and a traditional cut timber roof.

The property is bounded to the East, South and West by private residential properties and to the North by Templewood Avenue.

The surrounding area consists of similar residential properties, comprising two, three and four-storey detached houses also built of traditional loadbearing masonry construction, with associated gardens and public highways.

2.2 Characteristics of the Project

The existing property is a four-storey detached house located on relatively flat land with partly grassed and paved front and rear gardens and several semi-mature and mature tree species and shrubs present. Historically the building has been used for residential purposes only.

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 existing walls.

It is proposed to part demolish the existing lower ground floor and form a new full-height basement structure below the footprint of the existing house including a below ground side extension and two front lightwells. The basement will be formed as a reinforced concrete raft structure, RC underpin walls and embedded pile retaining walls to new below ground side and front extensions.

The basement will be designed to support the existing primary structure above with RC walls built in sequential underpins. The basement also features localised deepening for a swimming pool formed of reinforced concrete. The installation and associated design of which will be undertaken by a swimming pool specialist.

The existing ground floor structure will be demolished and re-formed as a steel framed structure with a composite profiled metal deck concrete slab forming a prop to the underpin walls. Steel beams will support the retained structure over, not supported by underpins, and frame out new openings in the slab.

Alterations to the superstructure fall outside the scope of this report, but a summary is included to assist with the understanding of the complete structural scheme. The superstructure will be altered to allow a new steel framed lift structure, above ground floor. This will enable new room configurations at each level.

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

2.3 Mitigation Measures Being Considered

As with any development involving construction of subterranean works, the proposed construction methods and sequencing of the works must give consideration to the inherent risks associated with excavation adjacent to existing buildings and their foundations.

Given the close proximity of neighbouring properties along the east and west boundaries, the proposed works have been designed to limit the risk of adverse impact to the buildings. This has been achieved by proposing the use of sequentially underpinned walls along the length of the adjacent properties. These walls will be designed to act as retaining walls in both temporary and permanent conditions.

Figure 2 - Proposed Section

2.4 Characteristics of Potential Impacts

2.4.1 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.

Over the extended Camden Borough region, the upper levels of clay 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 common to come across a raised groundwater table due to the presence of a perched aquifer or historic river channel. The attributes of 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 basement structure include altering the water table level and/or diverting the existing groundwater flow paths. The effect of these changes needs to be taken into consideration in the early planning stages of a development and 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, altering the soil properties of the local area. The altered soil properties may influence existing slope stability, soil bearing capacity etc.

2.4.2 Slope Stability

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

- Altering soil properties such as, 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 lead to removal of "fines" in the existing soil, thus affecting soil properties through interaction of the soil particles.
- Requiring the removal of existing vegetation, plants and/or trees from site which are part of groundwater extraction systems. This in turn may alter groundwater levels, affecting soil properties.
- Altering the natural state of the landscape or possibly involving works to previously disturbed or "worked" soil which could have a historic element of instability.

Beyond the confines of the site, possible effects of any subterranean construction works must consider 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 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 ground movements. With any excavation there is a degree of ground movement which must be allowed for. 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 increased stiffness of new foundations and a possible increase in the loads transmitted to the bearing strata.

As part of the project, any existing foundations within a site or adjoining 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 variation in stiffness of foundations, a new or redeveloped building can lead to increased or redirected pressures on soil bearing strata. The effects of this should be accommodated for in any design, with particular attention to areas where the primary soil is clay. 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 upper layers of soil which would be more sensitive to weather and moisture conditions.

2.4.3 Surface Flow & Flooding

Potential impacts on surface flow and flooding characteristics in an area because of excavation for a basement can vary dependent on site location and existing drainage infrastructure which is required for any site runoff.

Excavating for a basement 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 carried 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 could raise the risk of flooding properties downhill of site. As part of the planning and design process, careful consideration should be given to any runoff generated by the development and how it is managed within the confines of site, with any excess flow making its way into the drainage network in a controlled manner.

If a project causes an increase in runoff produced, and the increased volumes are not accommodated, 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.

2.5 Screening Process

2.5.1 Subterranean Flow

Q1a: Is the site located directly above an aquifer? ***→ <u>NO</u>***

Figure 8 of the CGH&H study (see Appendix A.11) indicates that the site is located over an aquifer with EA designation Secondary A. This means permeable layers capable of supporting water supplies at local scale are found in the area.

The site specific geotechnical investigation carried out shows that the predominant soil condition is found to be a firm to stiff London Clay to a minimum depth of 6m underlying approximately 0.5m depth of made ground. There were no indications of a high groundwater table or outcrops of permeable material in the immediate area, thus indicating the site is not located above an aquifer.

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

The proposed basement depth is expected to be a maximum of 4.0m below ground level, locally increasing to 4.5m for the swimming pool. 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 basement excavations will not extend beneath the water table.

Q2: Is the site within 100m of a watercourse, well (used/disused), or potential spring line? ***→ NO***

The latest available information relating to watercourses in the area would suggest that the site is within 100m of an existing natural water feature. Initial inspection of available historic mapping in the area (see Appendix A.13) shows a watercourse nearby.

According to geological mapping data (see Appendix A.8), the site is located over an area of permeable Claygate Beds. This suggests a potential for a natural spring.

However, geotechnical investigation carried out on site did not come across any form of dried water channel or spring. On this basis it is assumed that the site will not contain any river channel material, well or potential spring line.

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

Referring to Fig 15 of the CHG&H study (see Appendix A.15), the catchment areas for the Hampstead Heath pond chains do not coincide with the site location.

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 paved areas in the front and rear garden. It is envisaged that this situation will be maintained once the proposed basement 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 site is assumed to drain freely into the local authority drainage network. It is not anticipated that the proposed development will 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 site is not in close proximity to any local ponds.

2.5.2 Slope Stability

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

Topographical data available from existing site surveys suggest that the site is relatively flat across the plan area with no significant gradient or falls. 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 98m 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 of current landscaping to steeper than 7 degrees.

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

Initial site inspection and geotechnical investigations do not suggest the presence of any railway cuttings or a slope in excess of 7 degrees.

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 gentle slope however this does not exceed 7 degrees.

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

The underlying London clay was found to be overlain by 0.4-0.5m of topsoil and made ground across the site.

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? →YES

There are a number of semi-mature and mature trees present along the rear garden boundaries, and along the front paved area, including a large mature tree in the centre of the rear garden.

Several trees are proposed to be removed as part of the development.

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 precondition survey has been carried out to date on the existing buildings either within or adjacent to 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? → NO

Refer to Q2 of section 2.5.1 Subterranean Flow.

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

Referring to the historic geological mapping available for the 1920's and current data, there is no indication that the site is within an area of previously worked ground (see Appendix A.8 and A.10).

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

Refer to Q1 of section 2.5.1 Subterranean Flow.

Additionally, site specific geotechnical investigation carried out found no indications of a high water table or outcrops of permeable material to a depth of 6.0m.

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

The site is located approximately 1.5 kilometres 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? → NO

The nearest proposed lightwell at the front of the property is approximately 8 metres from the nearest highway and pedestrian right of way, which is Templewood Avenue. These will remain usable during all works.

Q13: Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties? → YES

To the east and west along the boundaries with adjacent properties, it is anticipated that the differential depth of foundations will be approximately 2.5–3.0m, assuming no basement/cellar is found below the neighbouring properties, as a worst case scenario.

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

The site is located more than 400m from the nearest section of the Northern Underground Line. It is not expected that the site is over or within any exclusion zones for rail or underground infrastructure.

2.5.3 Surface Flow & Flooding

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

Refer to Q3 of section 2.5.1 Subterranean Flow.

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 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 basement 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 site to adjacent properties. This also ensures that all surface water generated is directed into gravity fed drainage systems locally. The proposed basement is 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 basement will not have any effect on surface water generated and so will not affect the quality of surface water received by adjacent properties or downstream watercourses.

Q6: Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water feature? ***→ YES***

The site is located along Templewood Avenue. Examination of the available flooding data suggests that the street flooded in 2002 (see Appendix A.16).

2.6 Summary

2.6.1 Subterranean (Groundwater) Flow

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

2.6.2 Slope Stability

The screening process has identified one issue which is of initial concern as part of the planning process and should be examined further as part of the scoping process.

1. Trees to be felled as part of the proposed development.
2. History of seasonal shrink-swell subsidence in the local area.
3. Possible differential depth between foundations of adjacent structures.

2.6.3 Surface Flow & Flooding

The screening process has identified one issue which is of initial concern as part of the planning process and should be examined further as part of the scoping process.

1. History of local flooding in 2002.

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 Trees to be felled as part of the proposed development

Several trees are proposed to be removed as part of the works. These have been identified in the arboriculturist report and are either recommended to be removed as they are poor specimens, diseased/defective, or required to be removed to facilitate the development. In the latter case, tree removal can be easily compensated for by new planting and management of existing retained trees.

Tree removal is unlikely to present any risk to the new or existing structure as new foundations (namely contiguous embedded pile retaining wall) will extend deeper than the likely desiccation level present on site.

3.1.2.2 Seasonal Shrink-Swell Subsidence

The history of seasonal shrink-swell ground movements in the local area is not readily known, although the clay-based nature of underlying soil suggests the need to consider the cause and effects of shrink-swell movement on 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 include the use of tension piles to counteract anticipated hydrostatic pressures and/or the use of compressible material (e.g. Cordek) to reduce 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 anticipated hydrostatic uplift 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 ground level) allows us to presume that the problems inherent with shrink/swell of clay soils in shallow foundations are not applicable to existing buildings on site. Leading to the assumption that shrink-swell movements in the local area are not currently causing any undue deterioration in the buildings or boundaries.

3.1.2.3 Differential Depth Between Foundations

The neighbouring properties are assumed to have traditional corbel footings or mass concrete trench fill foundations down to a level of approximately 1.0m below ground floor level. On this basis, the expected differential depth between the existing foundations and the excavated depth of the proposed basement will be in the order of 3.0m. The actual foundation depth may be deeper than 1.0m due to tree influence, however it is conservative to assume shallower foundations.

The slope stability and soil condition within neighbouring sites and adjacent areas may be subject to various potential impacts as a result. The impacts associated with the proposed works and a differential foundation depth of 3.0m may include:

1. A nominal degree of horizontal deflection in the temporary works scheme proposed would possibly result in a reduction in the passive pressure exerted by the temporary works on the retained material, facilitating a reduction in shear pressure between the soil particles. This in turn would possibly lead to settlement of the soil material immediately beyond the line of excavation and some settlement of the more heavily loaded foundations.

Neighbouring Property Damage Assessment

Eastern Boundary with No. 4 Templewood Avenue

Building Data:

Length (L):	17.8m
Height (H):	8.4m
Length/Height ratio (L/H):	2.12 (say 2.0)
RC wall height:	3.0m
Stiffness:	High (i.e. permanent prop at high level)

➔ From CIRIA C580 table 2.4:

Horizontal surface movement: 0.15%
Vertical surface movement: 0.10%

➔ Total horizontal movement (δ_h): 3000x0.0015 = 4.5mm
Total vertical movement (δ_v): 3000x0.0010 = 3.0mm

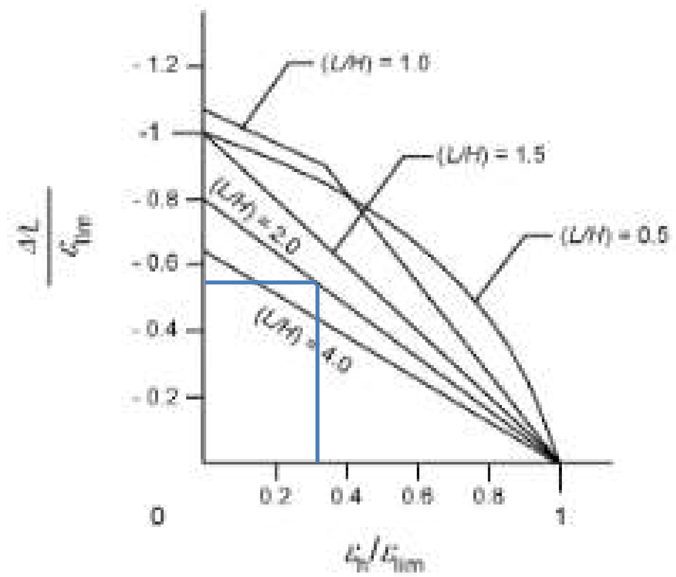
➔ Horizontal strain: $\varepsilon_h = \delta_h/L = 0.025\%$
Vertical strain: $\varepsilon_v = \delta_v/H = 0.036\%$

For damage category 1 (very slight), from CIRIA C580 table 2.5:

Limiting tensile strain: $\varepsilon_{lim} = 0.075\%$

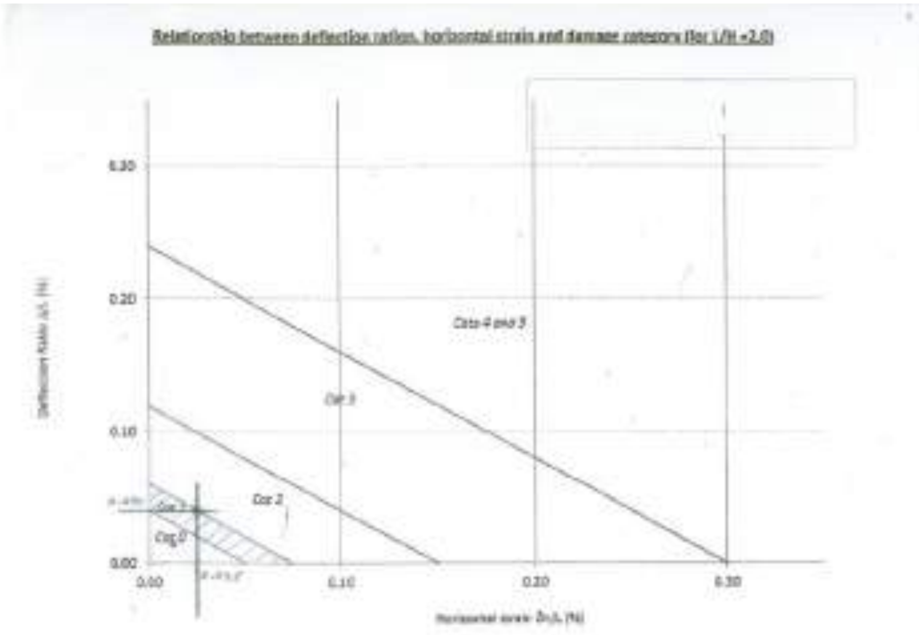
For No. 4 Templewood Avenue building, 6m from excavation:

➔ $\varepsilon_h/\varepsilon_{lim} = 0.025 / 0.075 = 0.33\%$



From above graph: $(\Delta/L)/\varepsilon_{lim} = -0.55$

➔ $\Delta/L = -0.55 \times 0.075 = -0.041$



From the graph, the estimated movements fall within **Category 1** based on the Boscardin and Cording / Burland Classification of visible damage to walls published in CIRIA C580, i.e. fine cracks (approximate width <1mm) that can easily be treated during normal decoration.

Western Boundary with No. 2A Templewood Avenue

Building Data:

Length (L):	18.0m
Height (H):	3.0m
Length/Height ratio (L/H):	6.0 (say 4.0)
RC wall height:	3.0m
Stiffness:	High (i.e. permanent prop at high level)

➔ From CIRIA C580 table 2.4:

Horizontal surface movement: 0.15%
Vertical surface movement: 0.10%

➔ Total horizontal movement (δ_h): 3000x0.0015 = 4.5mm
Total vertical movement (δ_v): 3000x0.0010 = 3.0mm

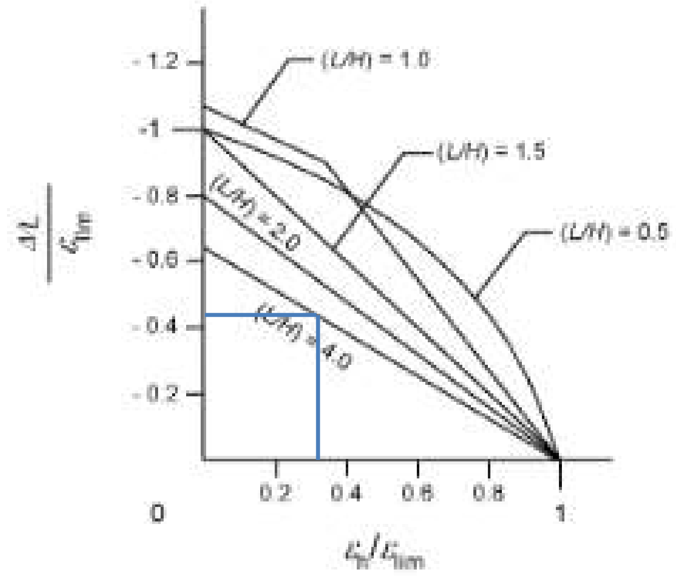
➔ Horizontal strain: $\varepsilon_h = \delta_h/L = 0.025\%$
Vertical strain: $\varepsilon_v = \delta_v/H = 0.10\%$

For damage category 1 (very slight), from CIRIA C580 table 2.5:

Limiting tensile strain: $\varepsilon_{lim} = 0.075\%$

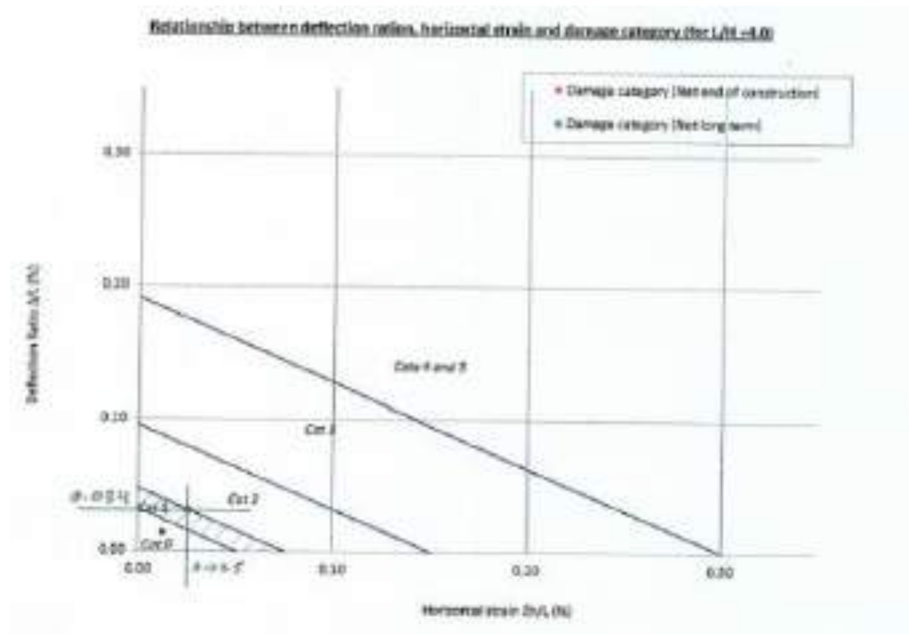
For No. 2A Templewood Avenue building, 3m from excavation:

➔ $\varepsilon_h/\varepsilon_{lim} = 0.025 / 0.075 = 0.33\%$



From above graph: $(\Delta/L)/\varepsilon_{lim} = -0.45$

➔ $\Delta/L = -0.45 \times 0.075 = -0.034$



From the graph, the estimated movements fall within **Category 1** based on the Boscardin and Cording / Burland Classification of visible damage to walls published in CIRIA C580, i.e. fine cracks (approximate width <1mm) that can easily be treated during normal decoration. The full classification is shown below in Figure 3.

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

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

Notes

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

Figure 3 – Classification of visible damage to walls

PJCE have proposed movement monitoring of the adjoining properties to be undertaken during the construction stage where trigger levels have been set to protect the adjoining properties. A scheme for movement monitoring will be incorporated into the final construction scheme for the proposed development to monitor the adjacent properties and establish the extent of any future potential movement to the buildings. The temporary and permanent works have been designed to limit eventual movement.

3.1.3 Surface Flow & Flooding

3.1.3.1 History of local flooding in 2002

It was recorded that Templewood Avenue and some of the surrounding roads flooded in 2002 during an extreme rainfall event. However, no properties on the road were flooded during this time.

As a result of the flooding event, the local council improved its gully cleaning performance by devising a more rigorous and effective maintenance regime, paying particular attention to those areas of known flooding issues.

Refer to Flood Risk Assessment in Appendix E for further details.

3.2 Summary

The potential impacts of the basement excavation and construction 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 to the existing property or adjacent properties in detail. These have subsequently been designed out/mitigated against in the final construction scheme.

4.0 Site Investigation & Study

A geotechnical site investigation has been carried out by Paddock Geo Engineering 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 firm to stiff London Clay. 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 Outline Construction Method Statement

5.1 Proposed Substructure and Basement

The proposals for the basement structure are described on the structural drawings included in Appendix A of this report. They have been developed by PJCE in conjunction with the Architectural drawings to address the specific site requirements and constraints including:

- Ground conditions
- Permanent support of the new structure above
- Stability of the neighbouring structures
- Health and safety

5.1.1 Under existing masonry walls to be retained

The reinforced concrete walls will be constructed in a typical underpin sequence. Their respective thickness will be determined by the existing wall thickness above, with a minimum criterion of circa 350mm.

5.1.2 Basement and lightwell extensions

A contiguous piled wall will be constructed around the perimeter of the extended area to provide the lateral resistance to the soil, surcharges, predicted live loads and anticipated line loads from neighboring properties. Internally, a 200-250 mm thick RC lining wall will be constructed to resist the hydrostatic component of the lateral forces formed against the piled walls. The construction of the RC lining walls will be cast in one, the piled wall and new RC basement slab providing the temporary support.

5.1.3 Basement Slab

The basement slab will be ground bearing and tied into the wall reinforcement to create a continuous structure, and an effective RC box. The complete RC structure will be designed to a crack width of 0.2mm during detailed design to ensure adequate water tightness.

A conservative water table of 1.0m below ground level has been assumed, leading to a total hydrostatic head of circa 4.0m applied to the deepest section of basement slab. The maximum uplift after consideration of the load condition above and after deduction of the slab dead load is found to be approximately 35 KN/m^2.

A minimum ground bearing slab depth of 350 mm will be constructed to the deepest section of basement slab.

5.1.4 Ground floor

Above the proposed basement level, the superstructure will be constructed to a similar level as the original building. The new ground floor will primarily be constructed of 150 mm RC composite slab spanning between steel beams supported on load bearing walls.

The floor structure will also act as a prop to the basement RC walls. Around stair voids and lightwells, the basement RC walls are modelled as 2 way spanning mechanisms; transferring the lateral loads across the voids.

5.2 Temporary Works Proposals

The following section provides details on the preferred methods for construction of the new basement by PJCE. The Contractor may propose solutions to suit an alternative method of working and the project's programme. No structural works shall commence until a detailed temporary works design, drawings and calculation package have been reviewed and commented upon by PJCE, this includes all necessary construction method statements.

5.2.1 Reinforced Concrete Walls Constructed in Underpinning Sequence

It is proposed to construct part of the new basement using traditional underpinning methods, as adopted widely in the construction industry. The PJCE scheme suggests forming underpins as RC walls which will act as the retaining structure forming the new basement. The maximum width of underpin used for the project has been defined as 1.2m wide. This is to ensure that, as the works are carried out, any adverse effects due to excavation below existing footings will be minimized, with the brickwork walls above the excavation expected to arch over. In areas where the brickwork will potentially not be suitable to generate the necessary arch thrust to stabilize the wall, a scheme of propping will be advised.

Due to the depth of the proposed basement the sequence of works has indicated the need to carry out the underpinning in two levels with maximum depth of circa 2.0 m per hit. As the wall should act as a continuous structure in the permanent condition, a "birdsmouth" detail is proposed between the two levels of underpins to allow for adequate vibrating of concrete to achieve suitable levels of compaction to the poured concrete and ensure satisfactory concrete strength.

5.2.2 Waling Beams and Temporary Propping

To ensure the stability of the excavation and safe construction of the basement, PJCE have proposed temporary waling beams and propping between them at high level. The proposed waling beams and props are designed to transfer the active earth pressure and surcharge loads applied to the RC underpins back to the soil.

Preliminary design for the temporary propping system is attached in the appendices of this submission. In some areas the levels of the waling beams may be varied due to site specific conditions, but the principles set on the PJCE drawings will remain. After forming the basement slab and installing the new lower ground floor plate (steel beams and metal deck concrete slab), all temporary works relating to basement excavation support can be removed.

Figure 4 – Typical underpinning bay

Figure 5 – Typical temporary propping

5.3 Construction Sequence

The construction sequence for the proposed temporary works has been detailed in the PJCE temporary works drawings in the appendices of this submission. Below is summary of the proposed steps for the contractor to follow:

Contiguous piled wall

- Contiguous piled wall installed.
- RC slab cast and tied into the pile capping beams to act as a working platform and simultaneously acting as the temporary support to the contiguous piled wall.
- Excavation under the driveway/side extension and existing building footprint to be simultaneous with the underpinning excavations.

First stage underpins

- First stage underpins down to a max depth of circa 2.0m. Temporary footing installed to match existing width above, and each underpin backfilled and compacted to ensure lateral stability is restored.
- The existing brickwork footing removed using non-percussive tools.
- High-level propping scheme installed.

Second stage underpins

- Excavate down to top level of temporary footing of upper level underpins.
- Intermediate level propping system immediately installed
- Excavation and installation of second stage underpins.
- Contractor to remove protruding toe of upper-level temporary footing.

Basement slab

- Excavation down to top of footing of the stage two underpins.
- Installation of low-level propping system.
- Formation of complete basement RC slab.
- RC lining walls under drive constructed.

Ground floor

- Installation of new composite floor.
- Once ground floor is in place, propping systems can be removed.

6.0 Impact Assessment & Conclusion

6.1 Site Attributes & Features Affected

6.1.1 Subterranean Flow

An analysis of site specific geotechnical data obtained from site investigation indicates that the presence of groundwater on site is minimal and thus the potential impacts to the groundwater as a result of the development would safely be considered negligible.

6.1.2 Slope Stability

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

6.1.3 Surface Flow & Flooding

Construction of the basement is not anticipated to materially change the amount of permeable surface area currently on site and therefore is not anticipated to have a negligible effect on the volume and quality of surface water generated by the redeveloped site.

Analysis of the available material has indicated that the street flooded in 2002 without affecting any of the properties. The council has since upgraded its gully maintenance regime to mitigate against any future risk of flooding brought about by similar extreme rainfall events.

6.2 Conclusion

The basement impact assessment for No. 2 Templewood Avenue 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 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 proposed development scheme.

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

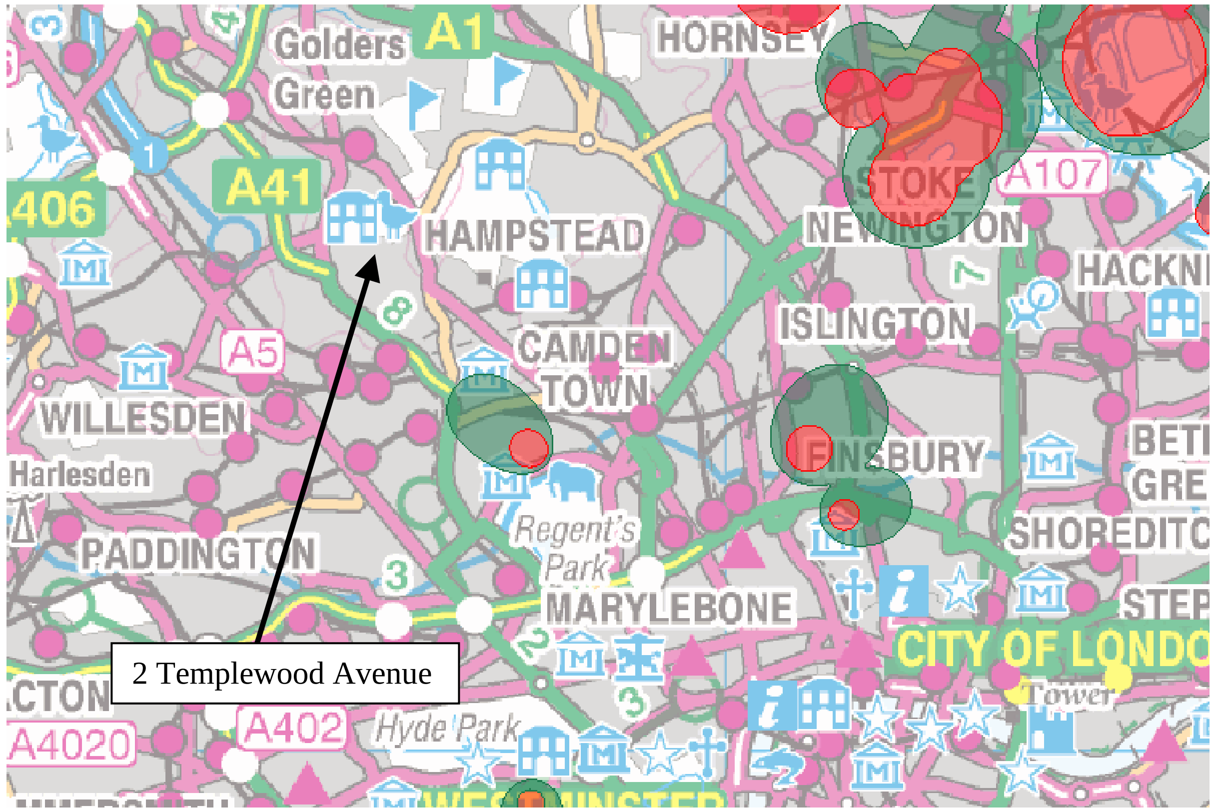
Report prepared by:	Michael Smith *MEng(Hons)*
Report checked by:	James Green *BEng(Hons) MIEAust CPEng*
Date:	February 2022
Revision:	02

Appendix A

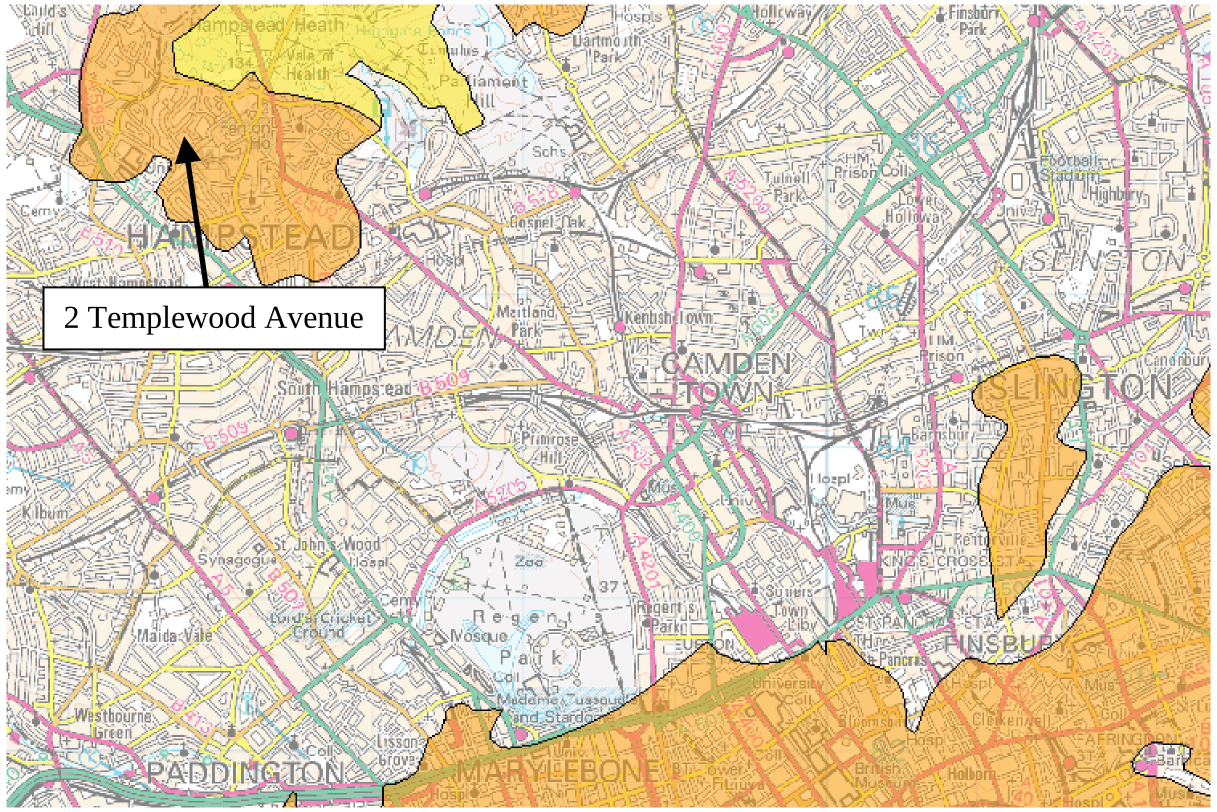
Pringuer-James Consulting Engineers
Basement Impact Assessment

Mapping Data

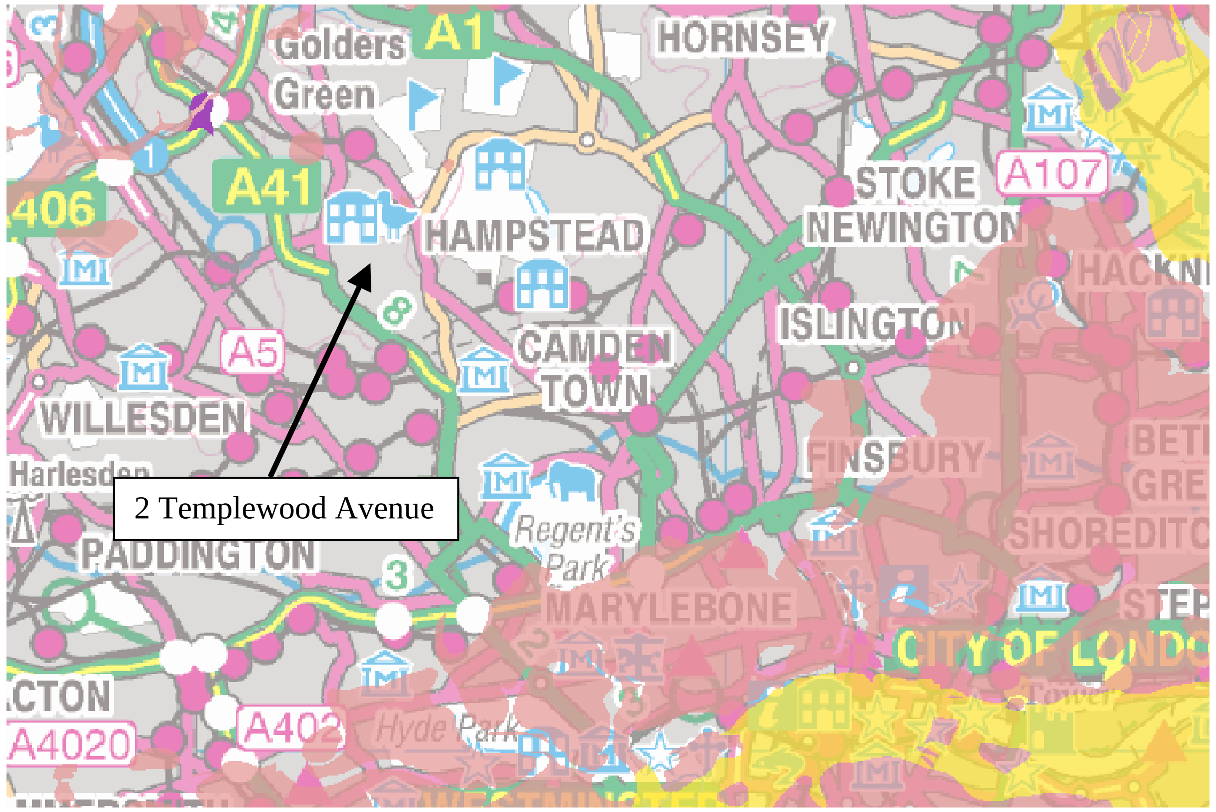
A.1 AQUIFER – SOURCE PROTECTION ZONES (1:40,000)



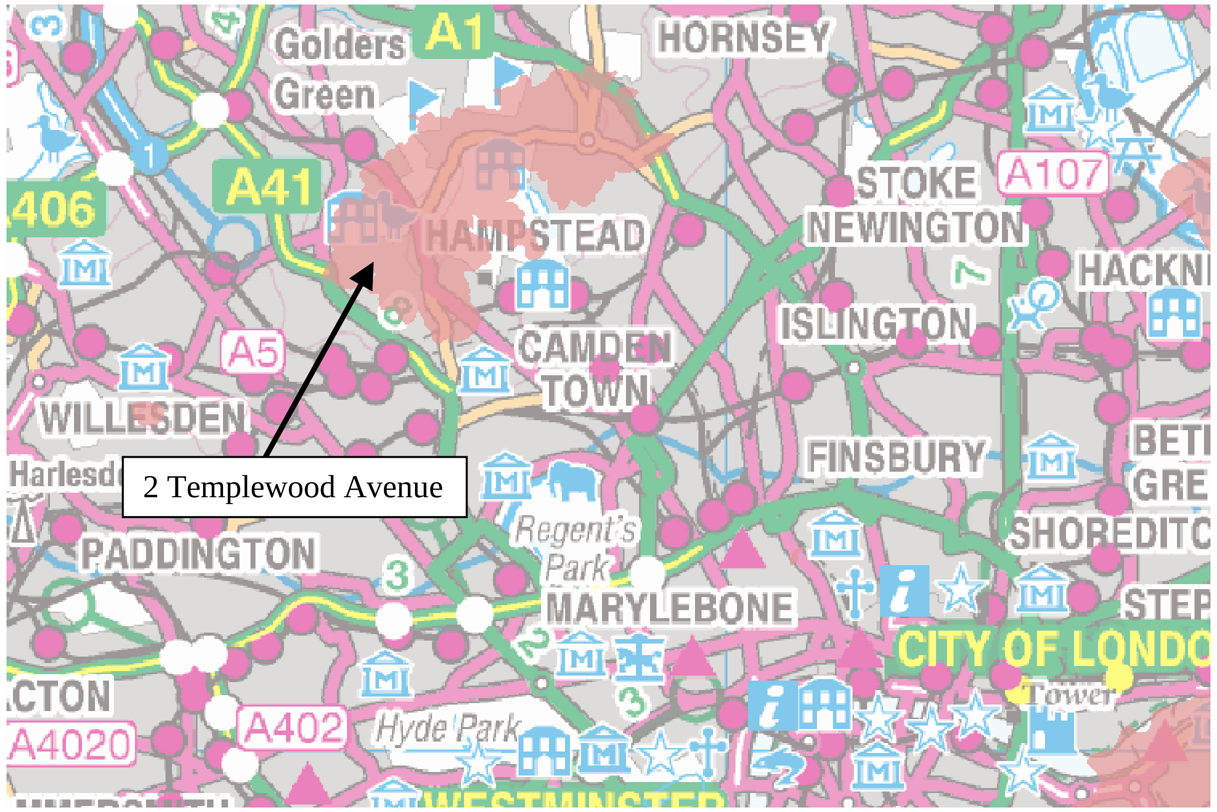
A.3 AQUIFER – SOURCE PROTECTION ZONES (1:75,000)



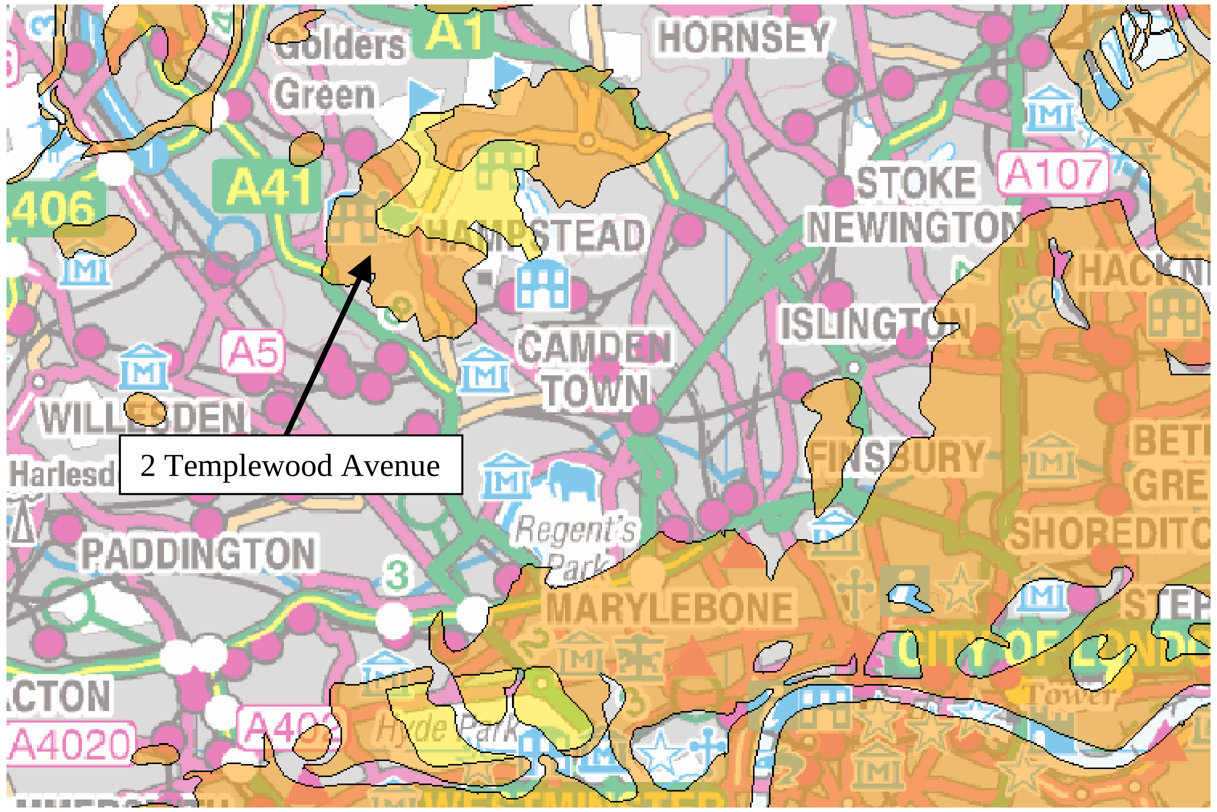
A.2 AQUIFER – GROUNDWATER VULNERABILITY ZONES (1:40,000)



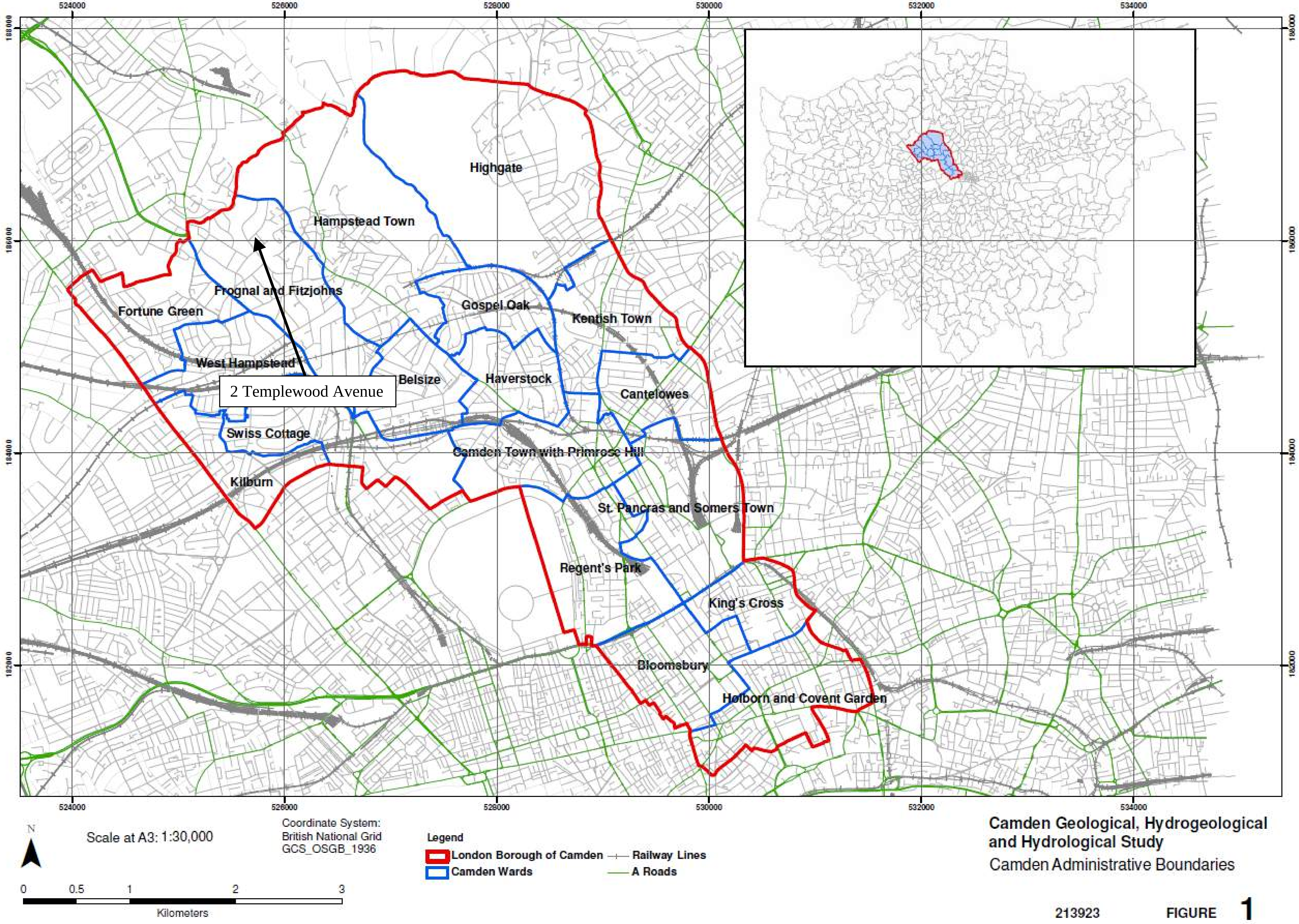
A.4 AQUIFER – SUPERFICIAL DEPOSITS DESIGNATION (1:75,000)



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

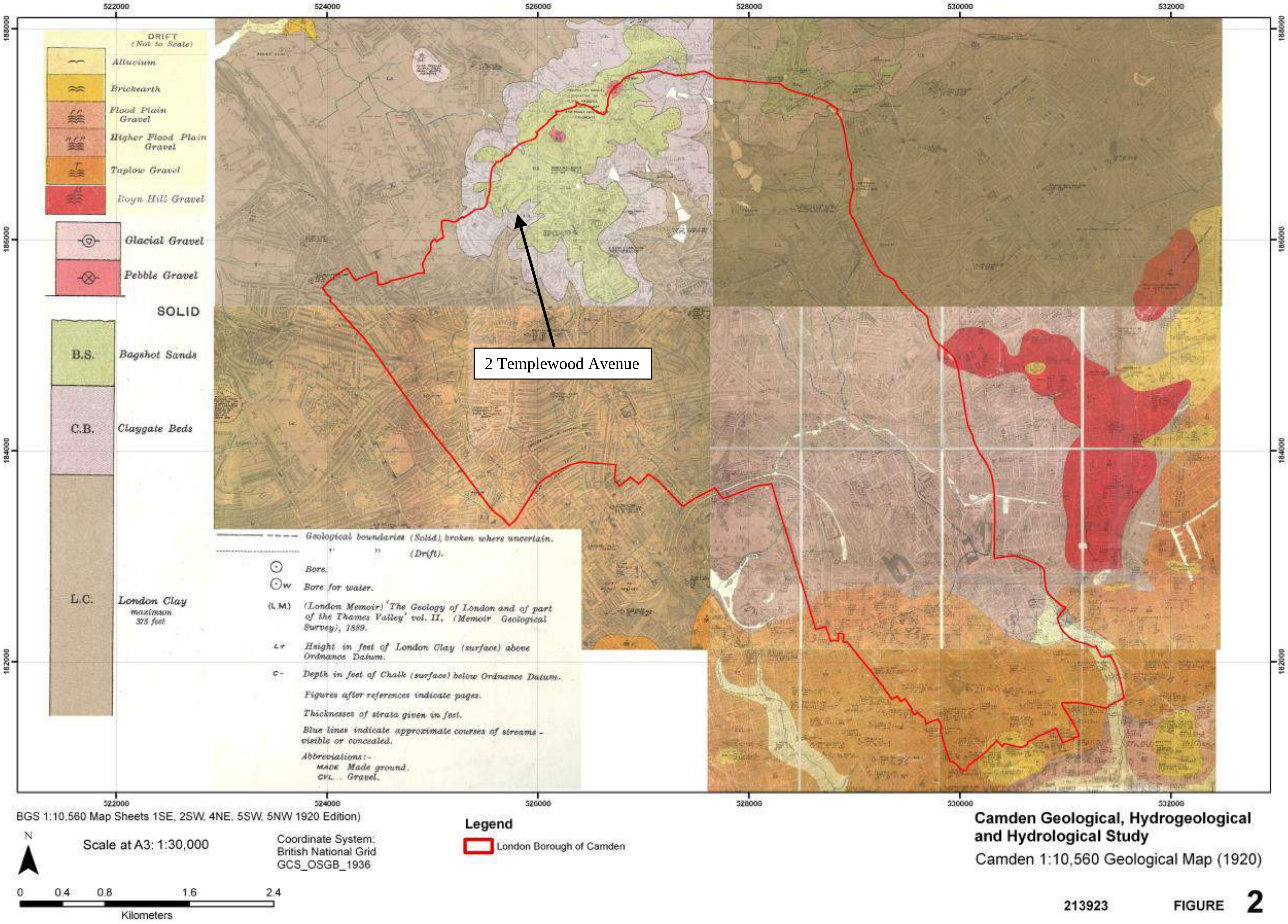


A.6 AQUIFER – GROUNDWATER VULNERABILITY ZONES (1:75,000)

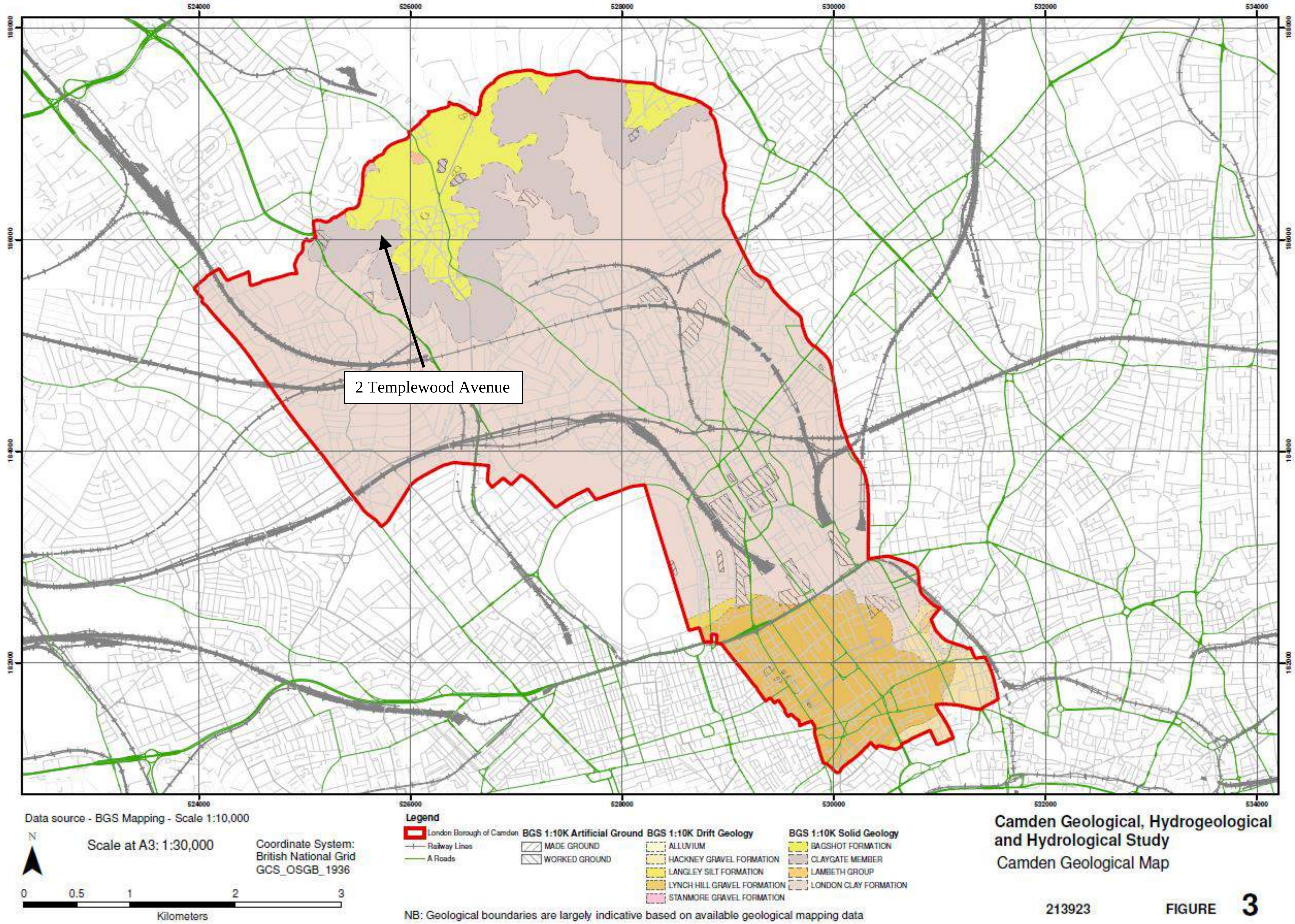


A.7 CGH&HS Study – Fig 1 Administrative Boundaries

PJCE

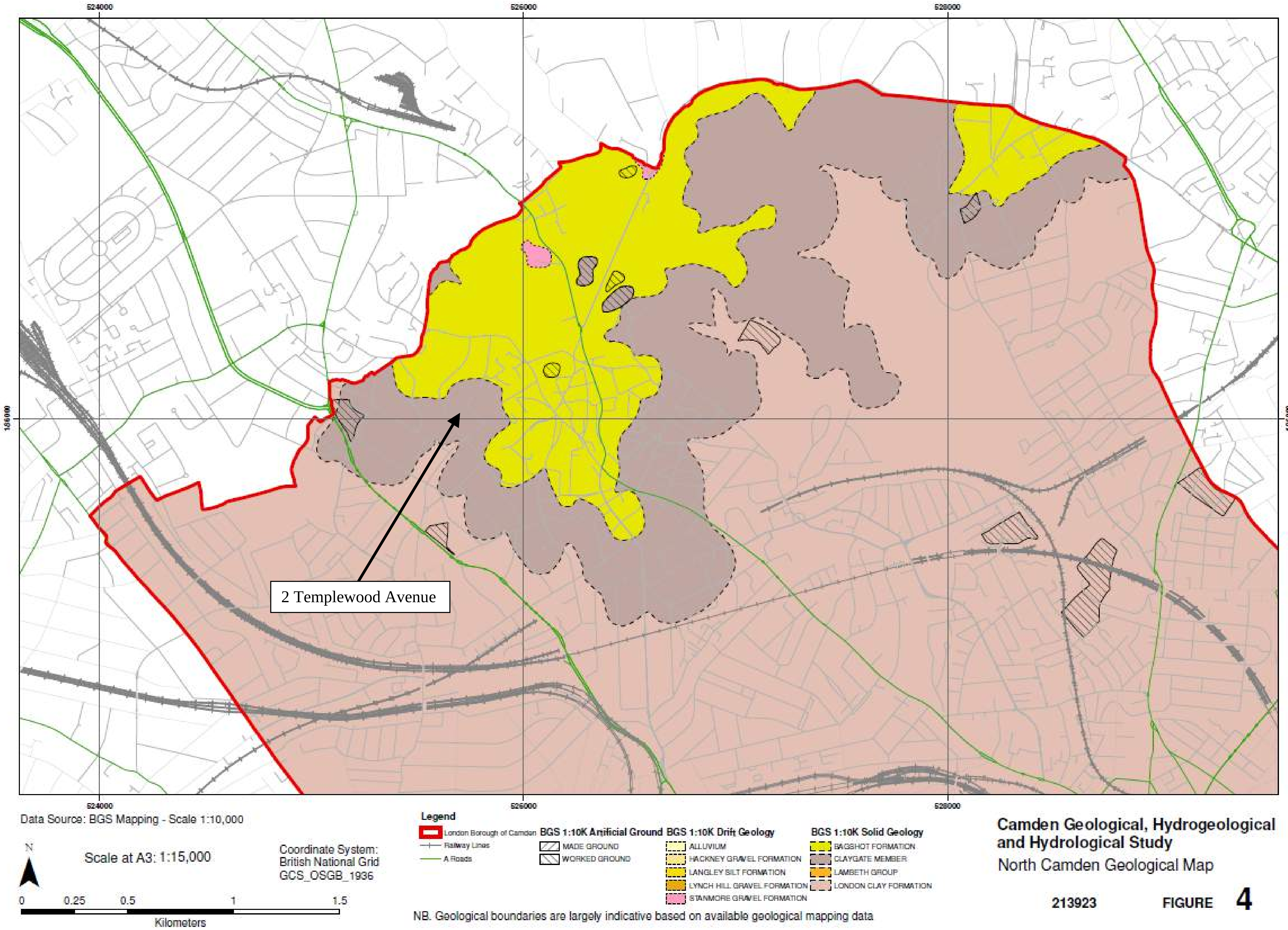


A.8 CGH&H Study – Fig 2 Geological Mapping Data (1920)

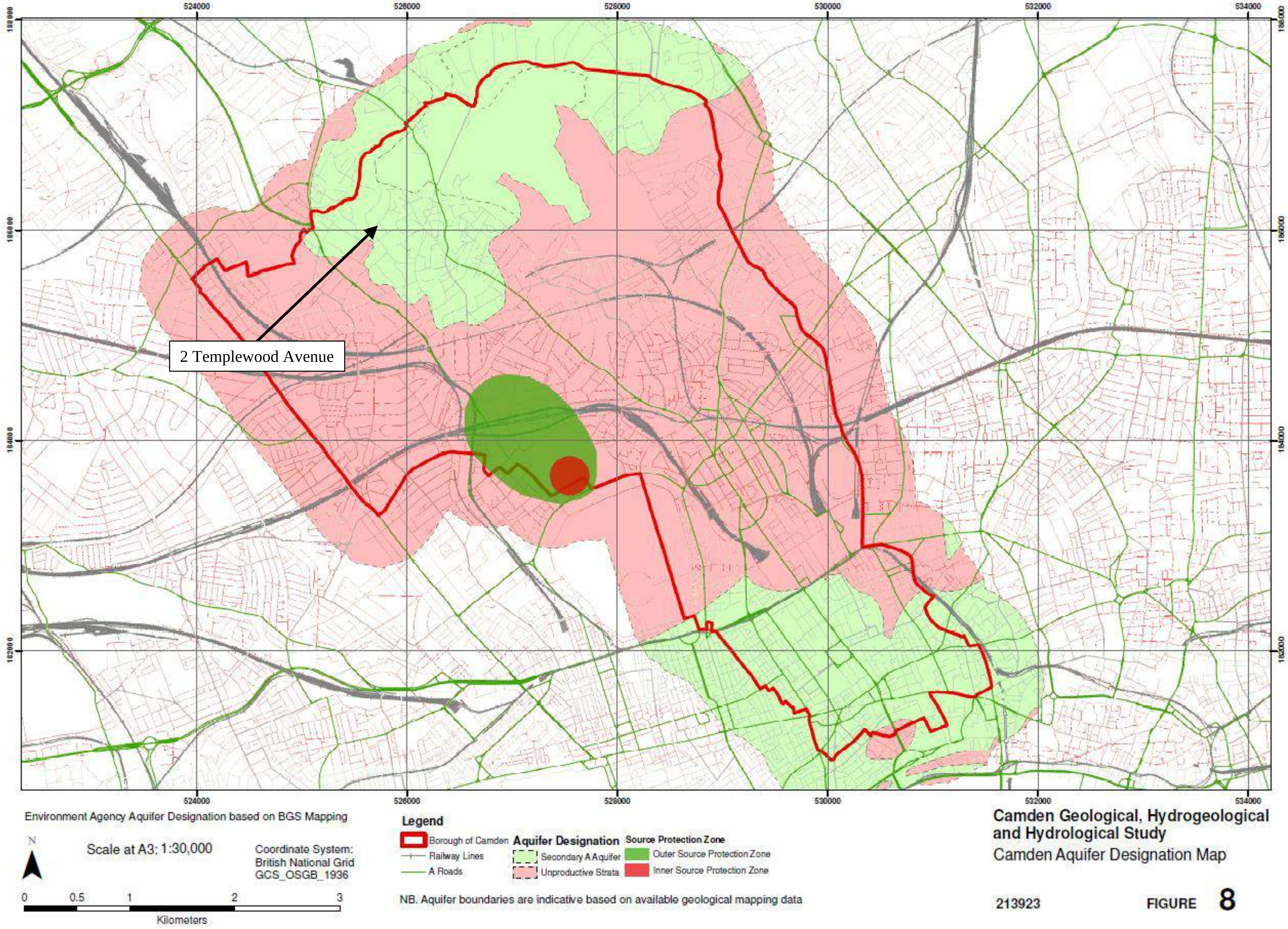


A.9 CGH&H Study – Fig 3 Geological Map

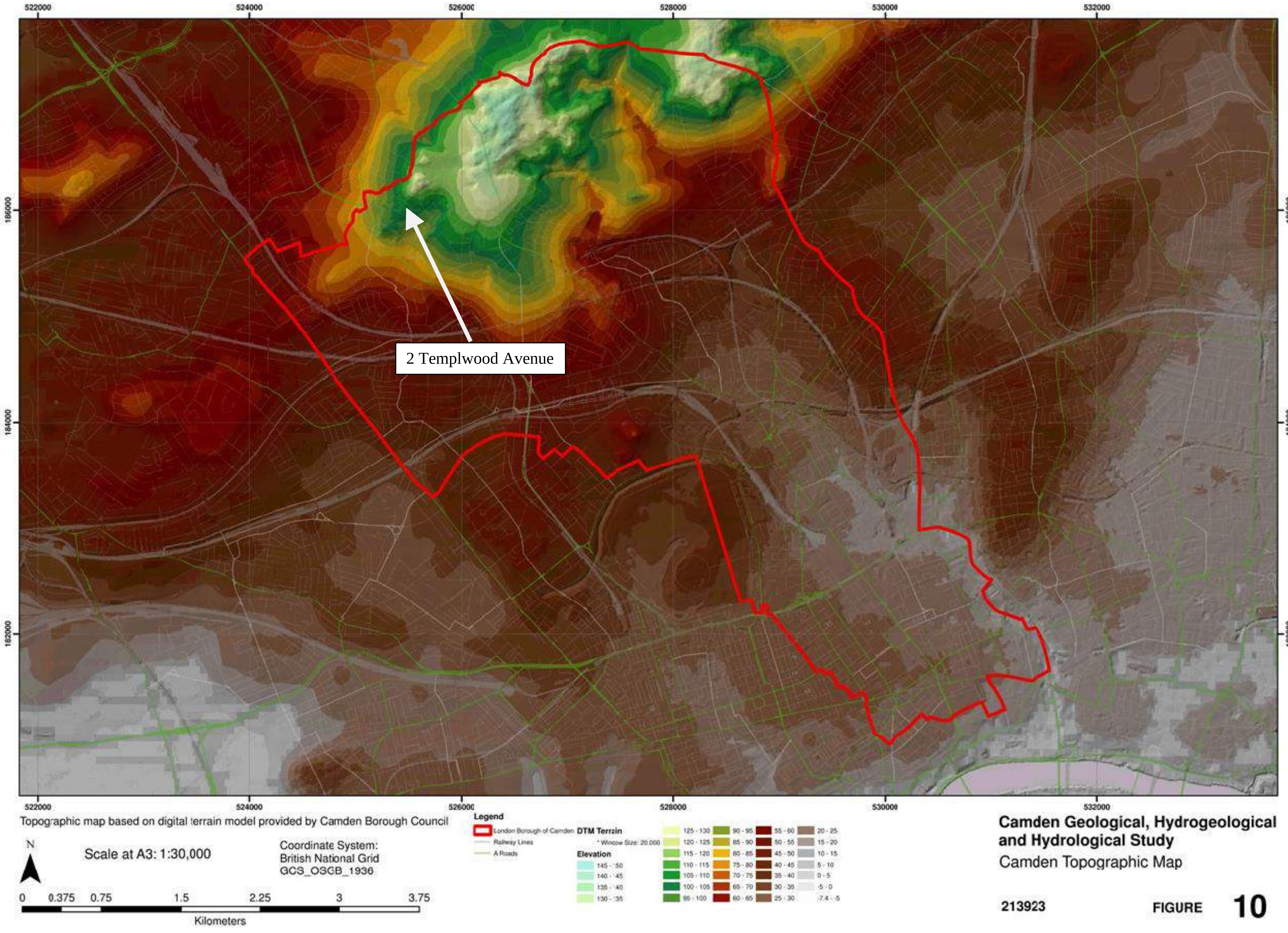
PJCE



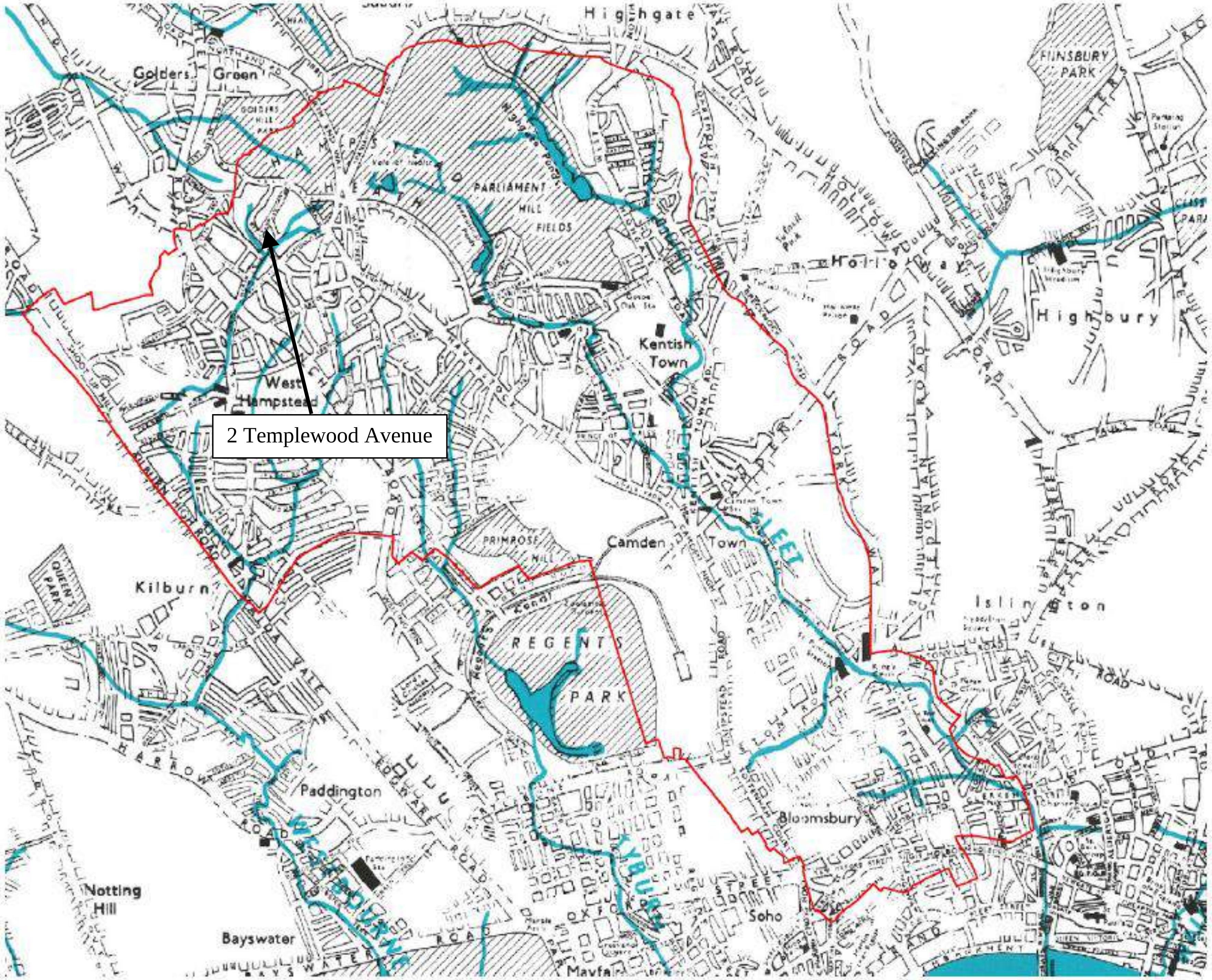
A.10 CGH&H Study – Fig 4 South Camden Geological Map



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



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



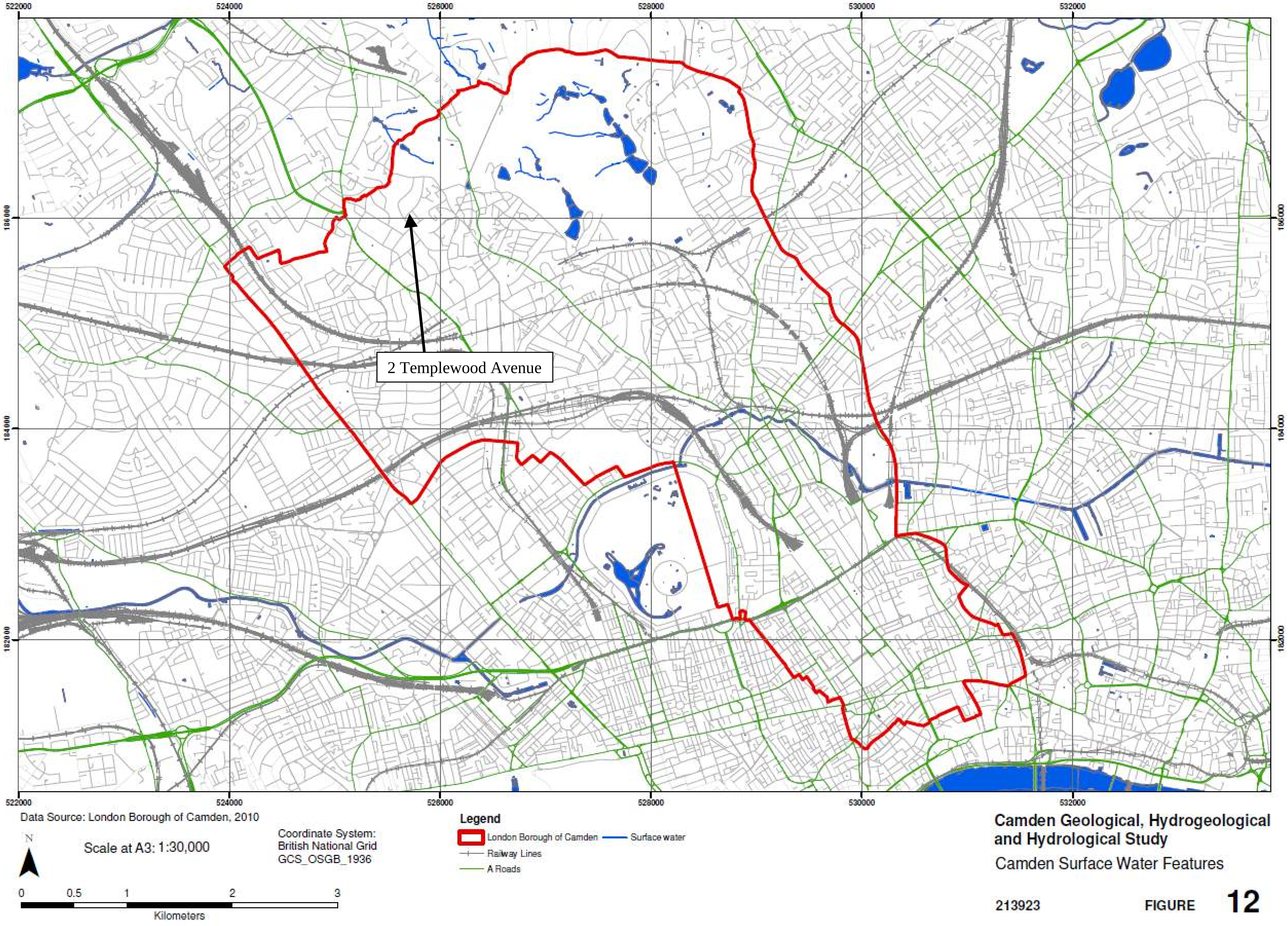
Camden Geological, Hydrogeological and Hydrological Study
Watercourses

Source – Barton, Lost Rivers of London

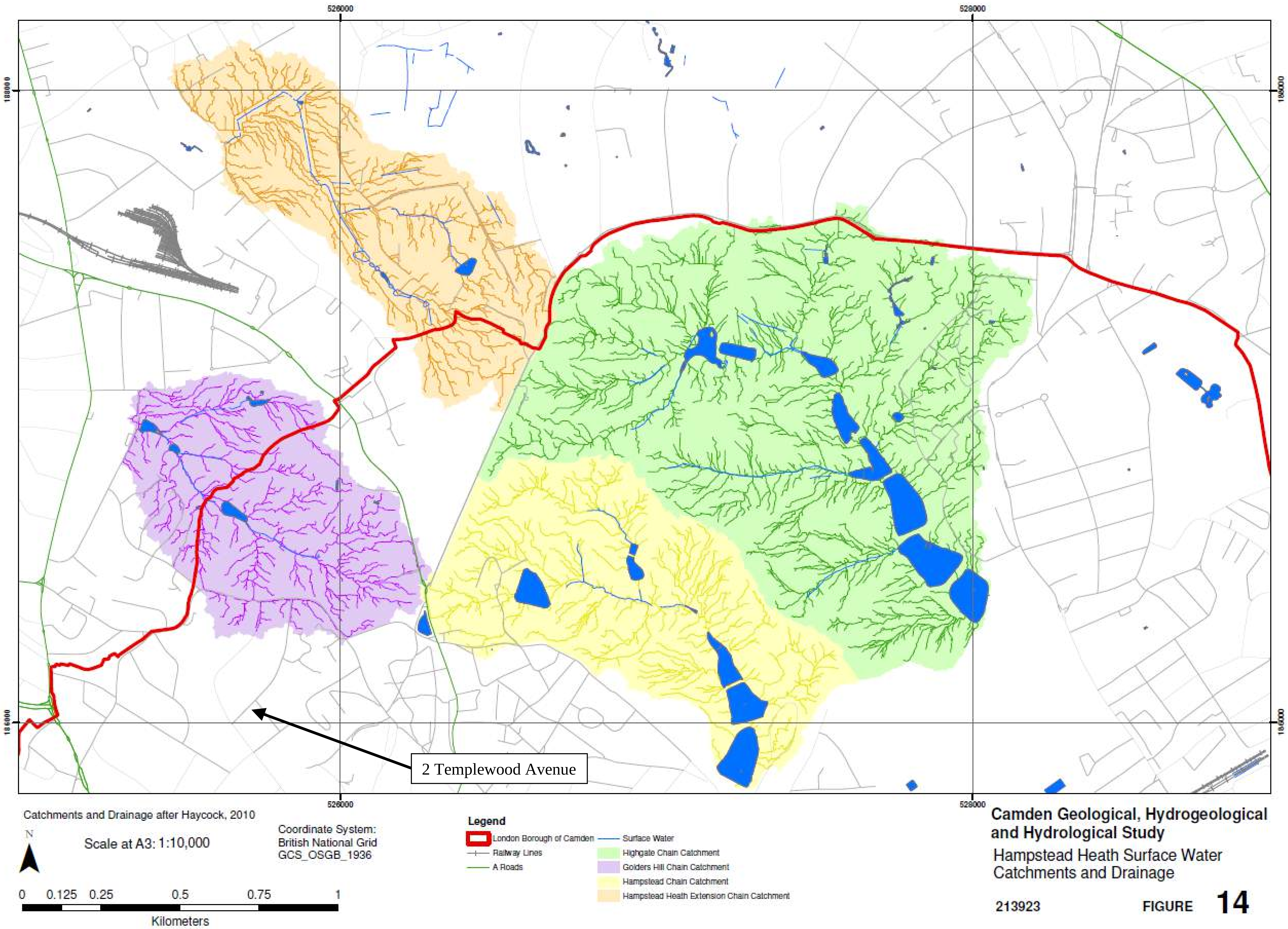
213923

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

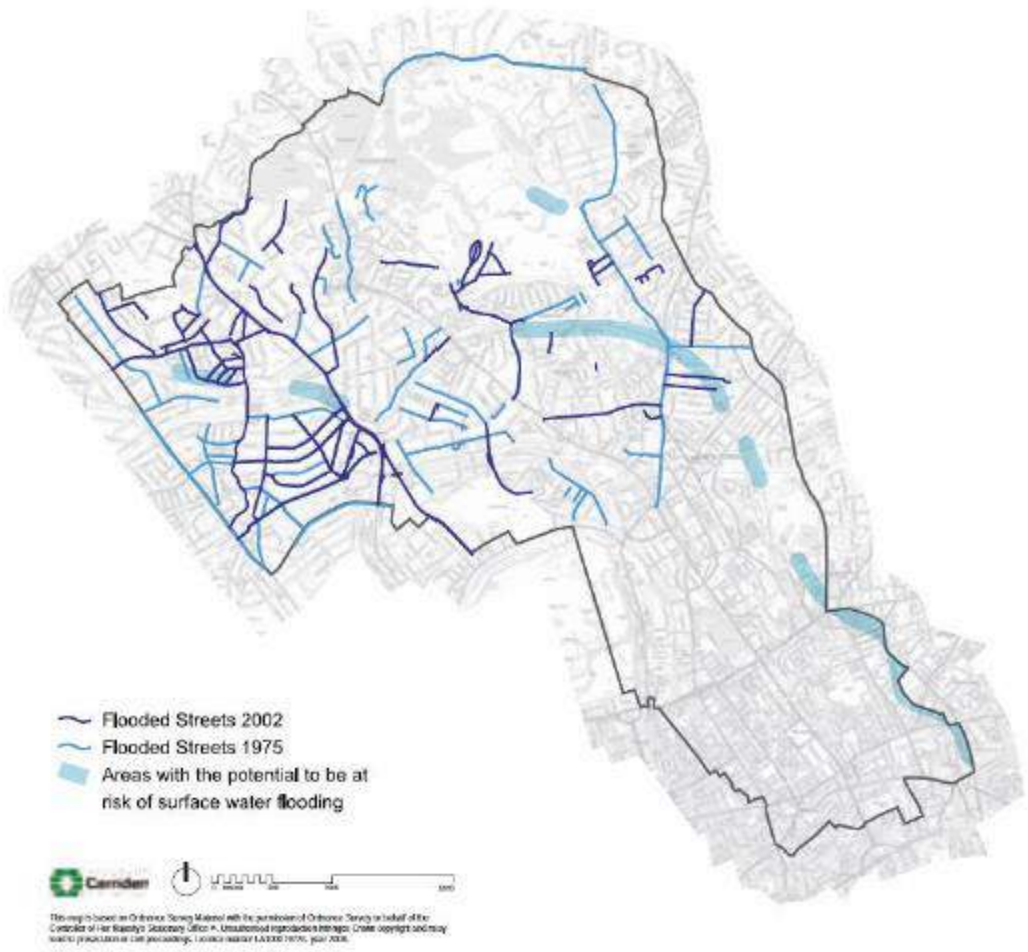
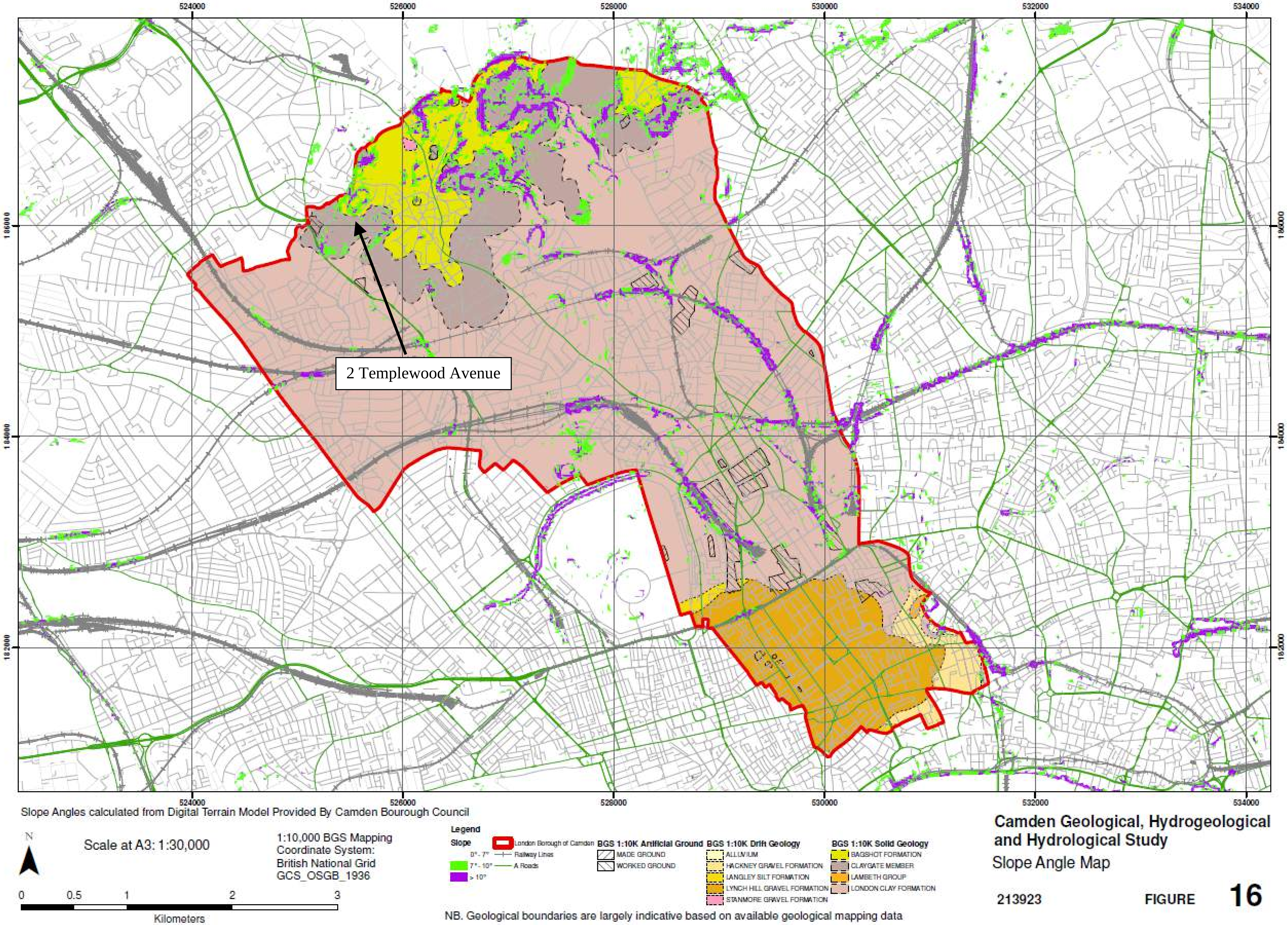


Figure 5 from Core Strategy, London Borough of Camden

Camden Geological, Hydrogeological and Hydrological Study
Flood Map

213923 FIGURE **15**

A.16 CGH&H Study – Fig 15 Camden Flood Map and EA extent of surface water flooding



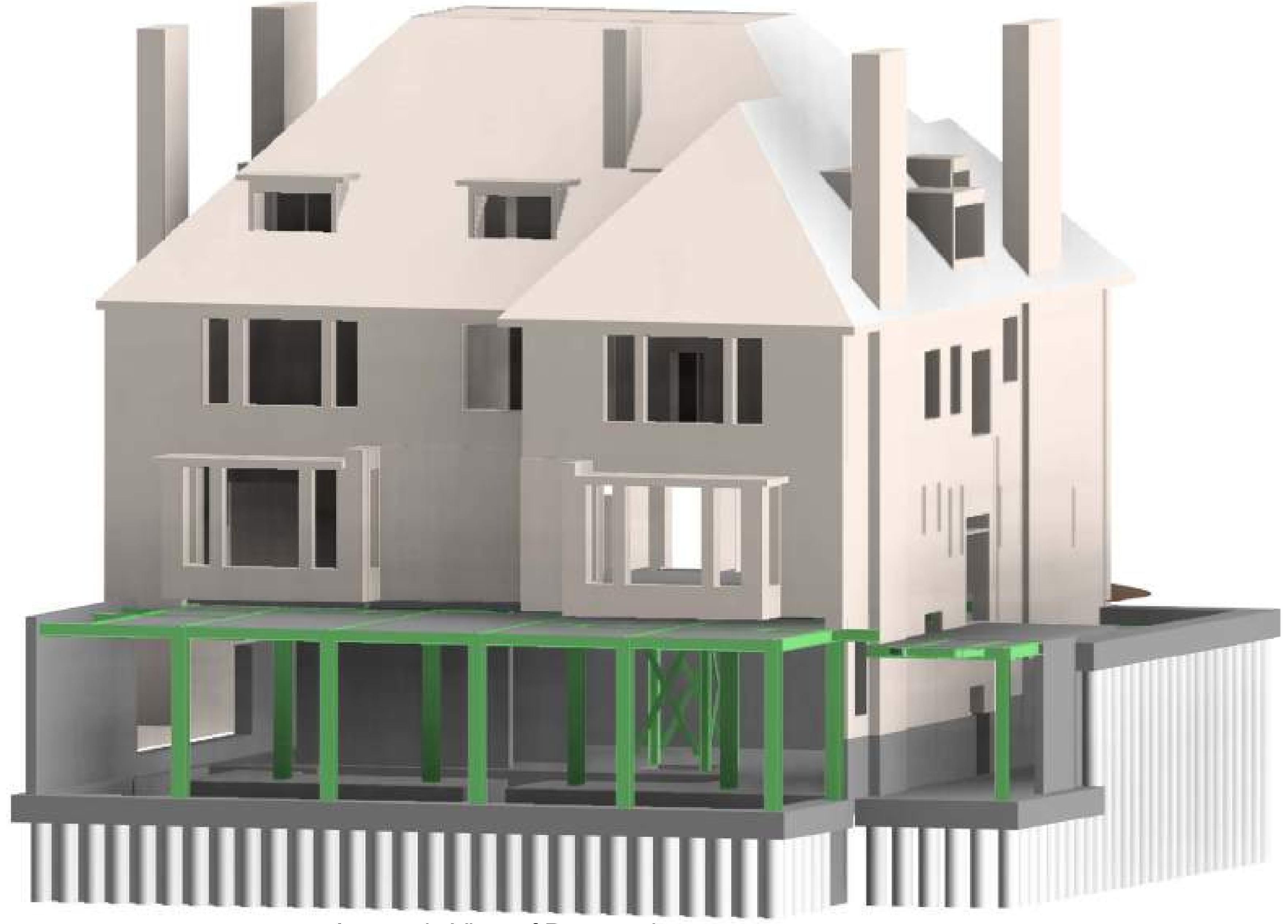
A.17 CGH&H Study – Fig 16 Camden Slope Angle Map

Appendix B

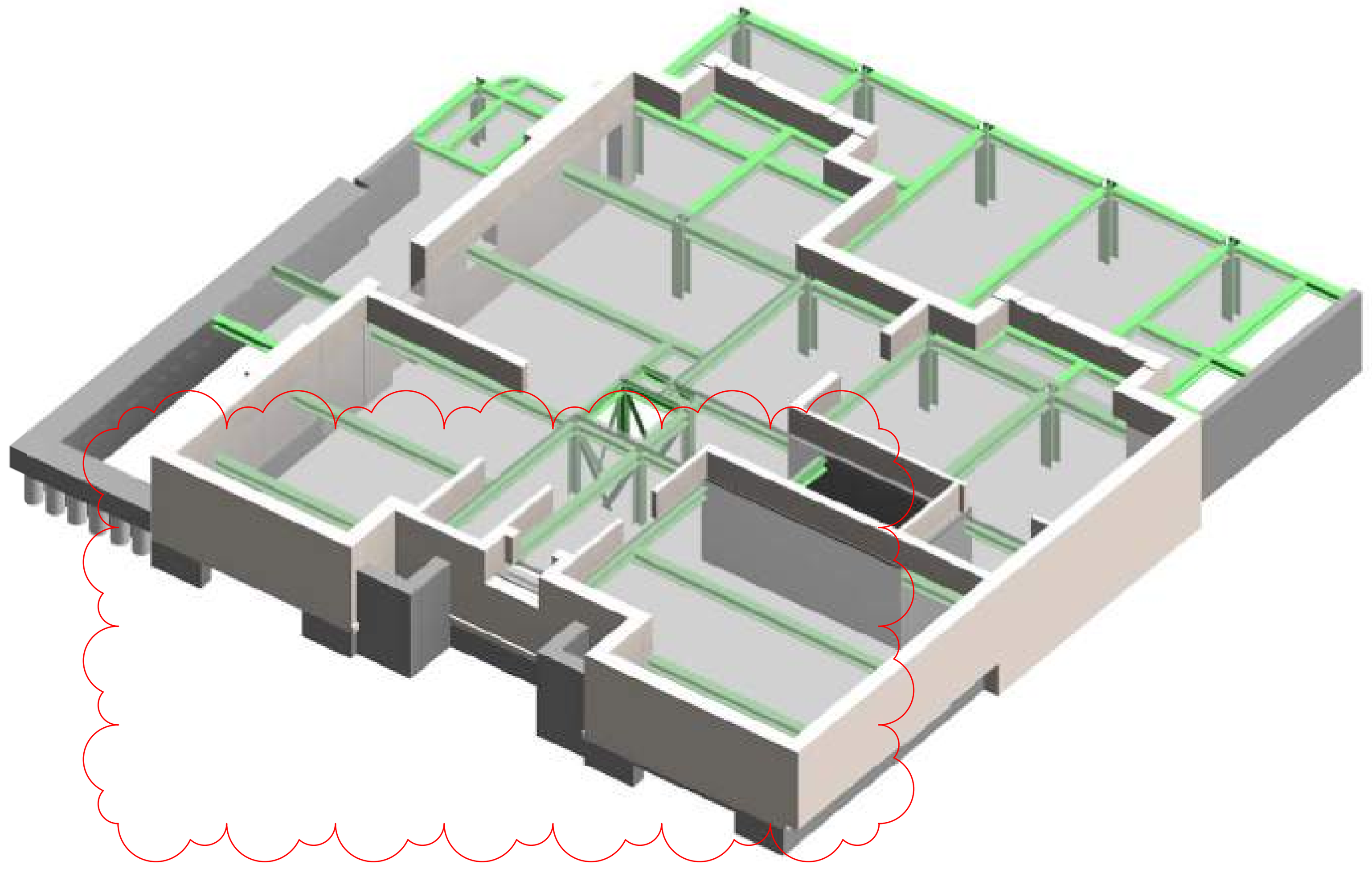
Pringuer-James Consulting Engineers
Basement Impact Assessment

Preliminary Structural Drawings

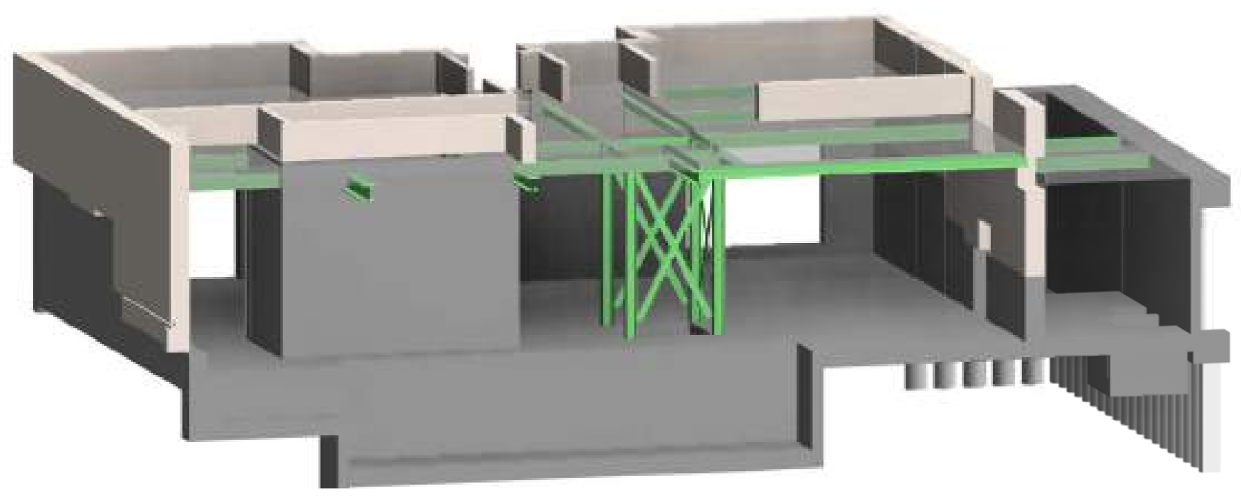
Isometric View of Existing



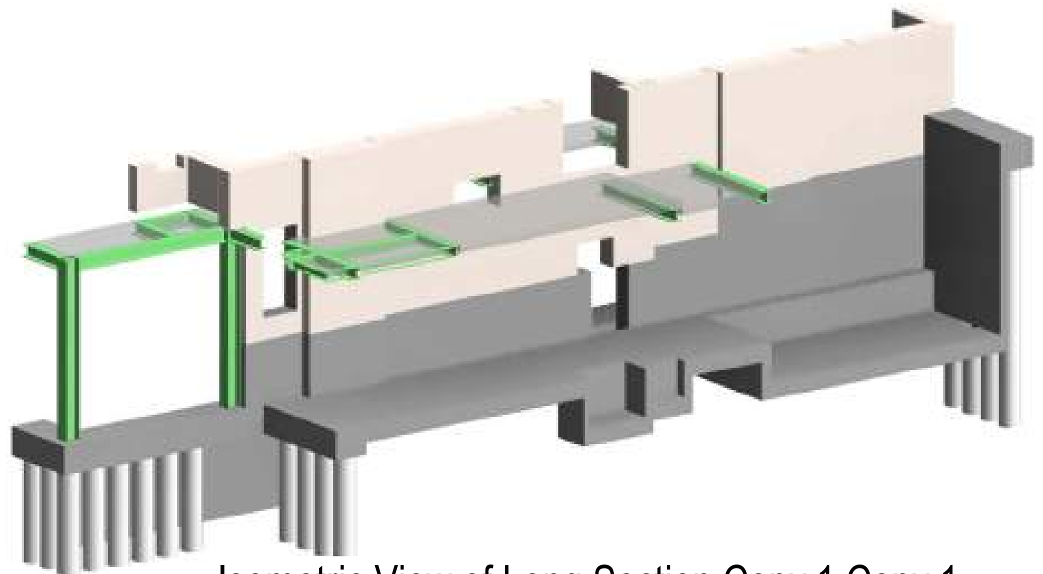
Isometric View of Proposed



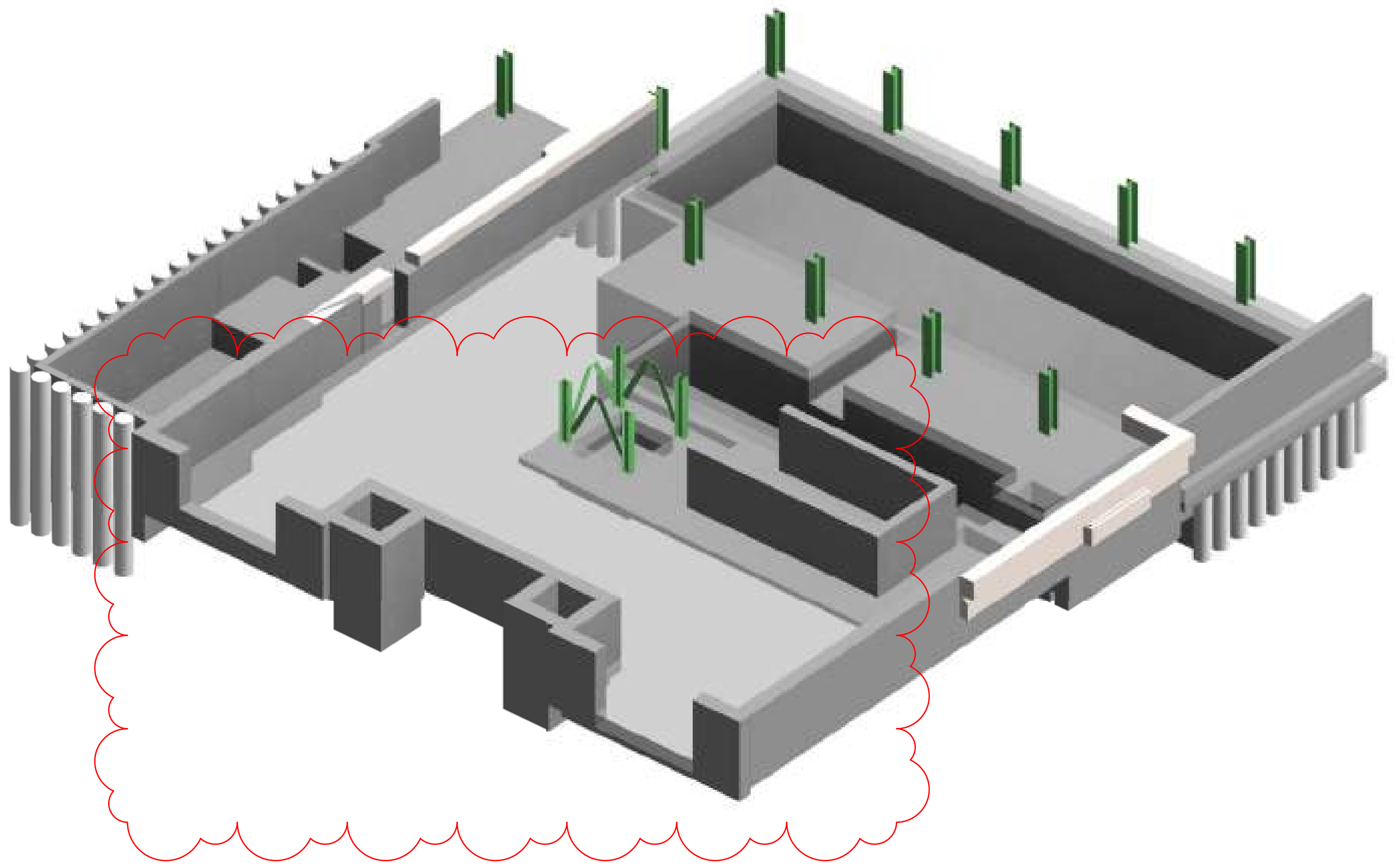
Isometric View of Ground



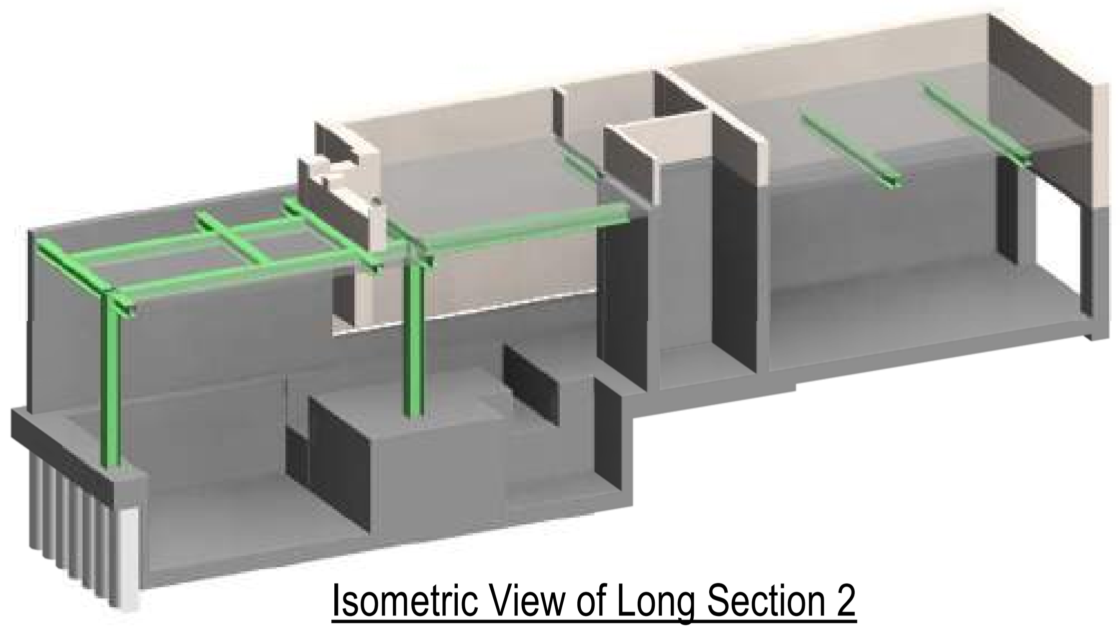
Isometric View of Cross Section



Isometric View of Long Section Copy 1 Copy 1



Isometric View of Basement



Isometric View of Long Section 2

For General Notes refer to PJCE drawing L2658-S-15-020

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.

Any discrepancies noted on site are to be reported to the engineer immediately.

Rev	Date	Drawn	Chk	Amendment
03	14.02.22	PE	MS	Issued For Information
02	24.01.22	DA	MS	Issued For Information
01	18.01.22	DA	MS	Issued For Information
-	12.01.22	DA	MS	Issued For Information

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KAROLINA & GIAN FAZIO

2 TEMPLEWOOD AVENUE, LONDON

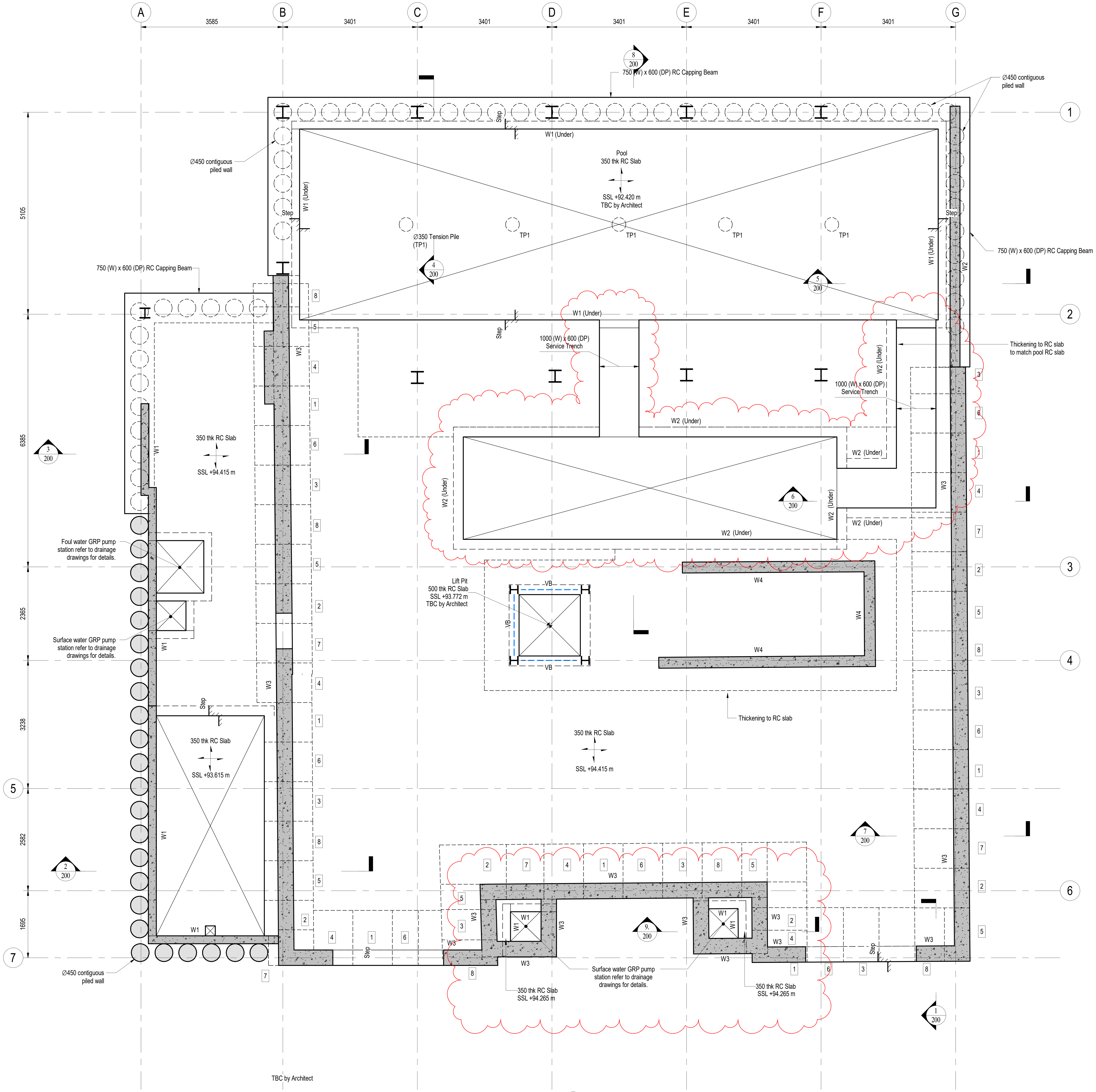
ISOMETRIC VIEWS SHHET 1

Status: **INFORMATION**

Scale: @ A1 | Date: JAN 2022

Drawn: DA | Engineer: MS | Checked: JG

Drawing No: **L2658-S-07-001** | Revision: **03**



Basement

(Scale 1 : 50)

Underpinning 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 C30/37. Concrete shall be left for at least 24 hours before dry packing. The concrete of the underpins shall be stopped off 75mm below the underside of the existing footing. Contractor to ensure tight bearing of existing members on new structure elements.

3. The underside of all underpins to be dug to a strata capable of sustaining a permissible ground bearing pressure of 160kN/m² at depth of 4.0m BLG.

4. The underside of the existing strip foundation shall be trimmed and cleaned of all mud and debris before dry packing. The underpinning shall be carried out in short sections of about 1 metre in length in the sequence of construction as typically detailed below. The dry pack shall be a 1:3 sharp sand/cement well rammed home in horizontal layers not exceeding 75mm thick. Dry packing shall be left for at least 48 hours before commencing excavation for any adjacent underpins.

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

6. Backfilling behind retaining walls shall be a grade C16/20 concrete (if required).

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

8 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.

9. Reinforcement in pins to be pushed into adjacent soil to ensure continuity between the pins. Contractor to ensure site bending of bars to be allow these works to be carried out.

6	1	4	7	2	5	8	3	6	1	4

TYPICAL UNDERPINNING SEQUENCE

Notes:-

1. The underpin numbering is for identification purposes only. The sequence of underpinning is to be agreed on site with the district surveyor & temporary works designer, but at all times the minimum requirement for the time lapse between the construction of adjacent pins must be adhered to. See underpinning notes for minimum sequence requirements.

2. See waterproofing specialist details for extent of waterproofed concrete & for type of waterproofing additive manufacturer. All details & waterproofing responsibility by others.

3. All penetrations through members to strictly comply with waterproofing additive manufacturer's details & recommendations.

Temporary Works Support for Internal Retained Walls:

The internal brick walls, at ground floor level, will require temporary support during the formation of the new basement level. PJCE propose that this is undertaken in the following sequence:
1. Install movement monitoring system to monitor the level of the existing structure during the installation of the temporary works. This is to be retained until the basement is complete and the columns extended to the basement level. Details to be developed.
2. Install small diameter plunge columns with embedded steel stanchions, to ground floor level.
3. Install steel grillage, as needle support to retained internal structural walls. This will be typical of needle process but will "free-up" the basement for construction.
4. Stability will be based on the perimeter walls so not required in the plunge column steelwork. Outline temporary works scheme to be developed and detailed.

Wall Schedule

Ref	Type
W1	200 thk R.C wall
W2	250 thk R.C wall
W3	390 thk R.C Underpin
W4	275 thk R.C wall

For General Notes refer to PJCE drawing L2658-S-15-020

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-	07.01.22	DA	MS	Issued For Information

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KAROLINA & GIAN FAZIO

2 TEMPLEWOOD AVENUE, LONDON

GENERAL ARRANGEMENT OF LOWER GROUND FLOOR

Status: INFORMATION

Scale: 1 : 50@ A1 | Date: DEC 2021

Drawn: DA | Engineer: MS | Checked: SP-J

Drawing No: L2658-S-20-090 | Revision: 03

For General Notes refer to PJCE drawing L2658-S-15-020

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

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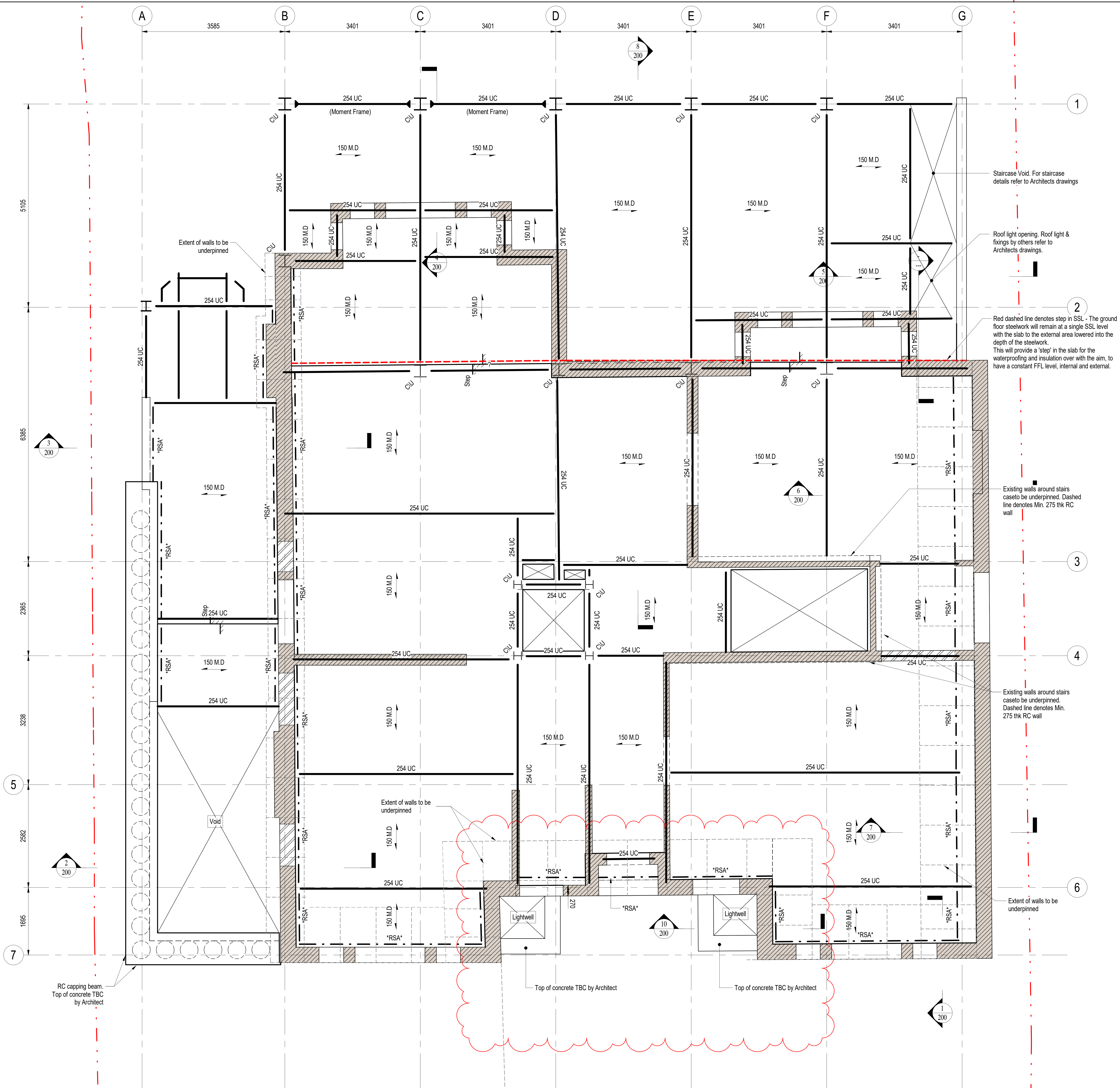
Legend:

RSA	Denotes continuous RSA fixed into wall with Hilti injection mortar + M10 HIT-Z anchor rods @ 450mm horizontal centres installed to manufacturer's guidelines, (80mm embedment). • To concrete - HY200 A • To masonry - HY170
150 M.D	Denotes 150mm deep RC Slab on Comflor 60, 1.2mm, corrugated metal sheeting with A252 mesh top and H10 bars in each trough.



Ground Floor
(Scale 1 : 50)

Rev	Date	Drawn	Chk	Amendment
02	14.02.22	PE	MS	Issued For Information
01	18.01.22	DA	MS	Issued For Information
-	07.01.22	DA	MS	Issued For Information

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2 TEMPLEWOOD AVENUE, LONDON

GENERAL ARRANGEMENT OF GROUND FLOOR

Status: INFORMATION

Scale: 1 : 50@ A1 | Date: DEC 2021

Drawn: DA | Engineer: MS | Checked: SP-J

Drawing No: L2658-S-20-100 | Revision: 02

For General Notes refer to PJCE drawing L2658-S-15-020

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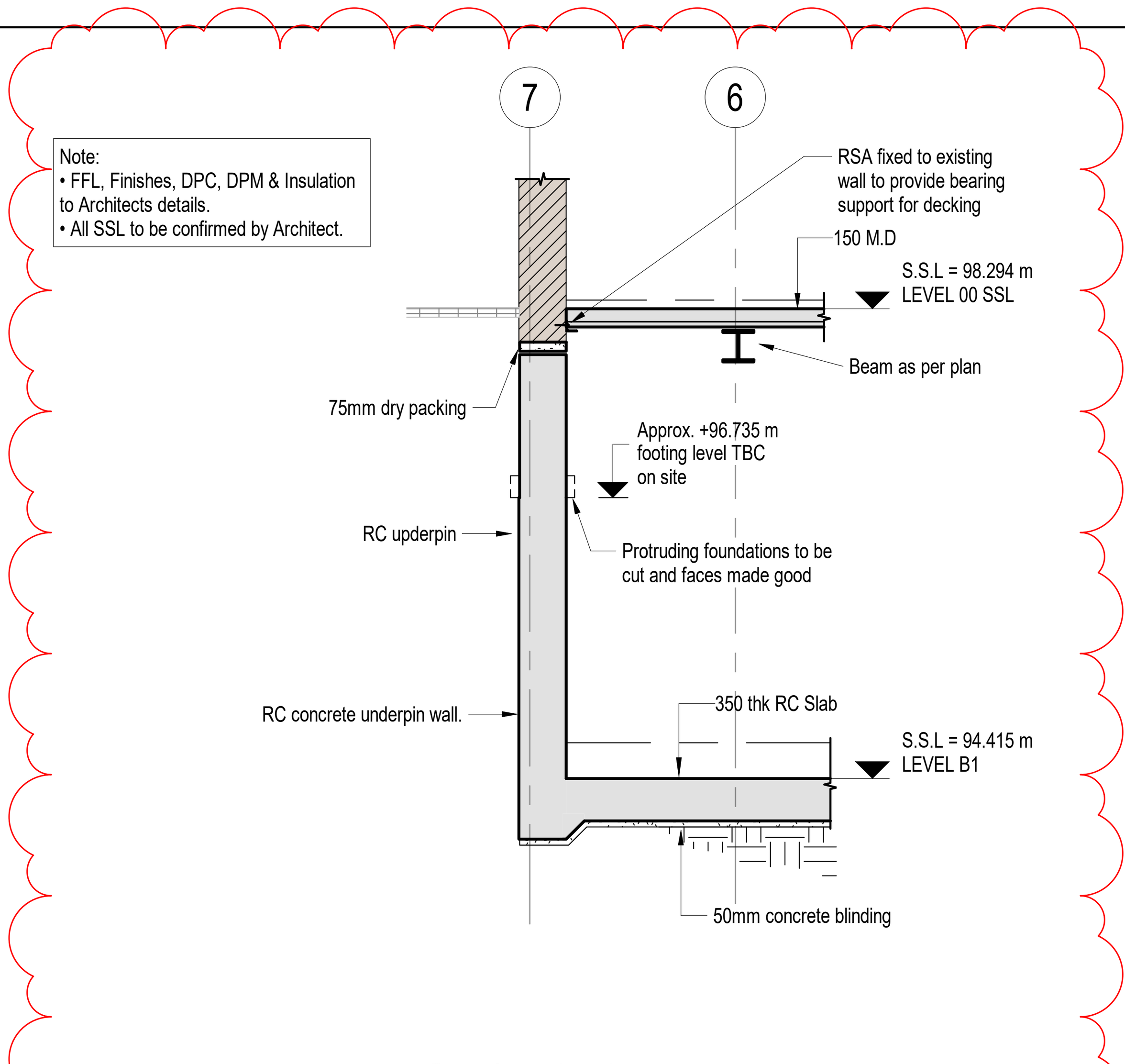

Section 1 - 1

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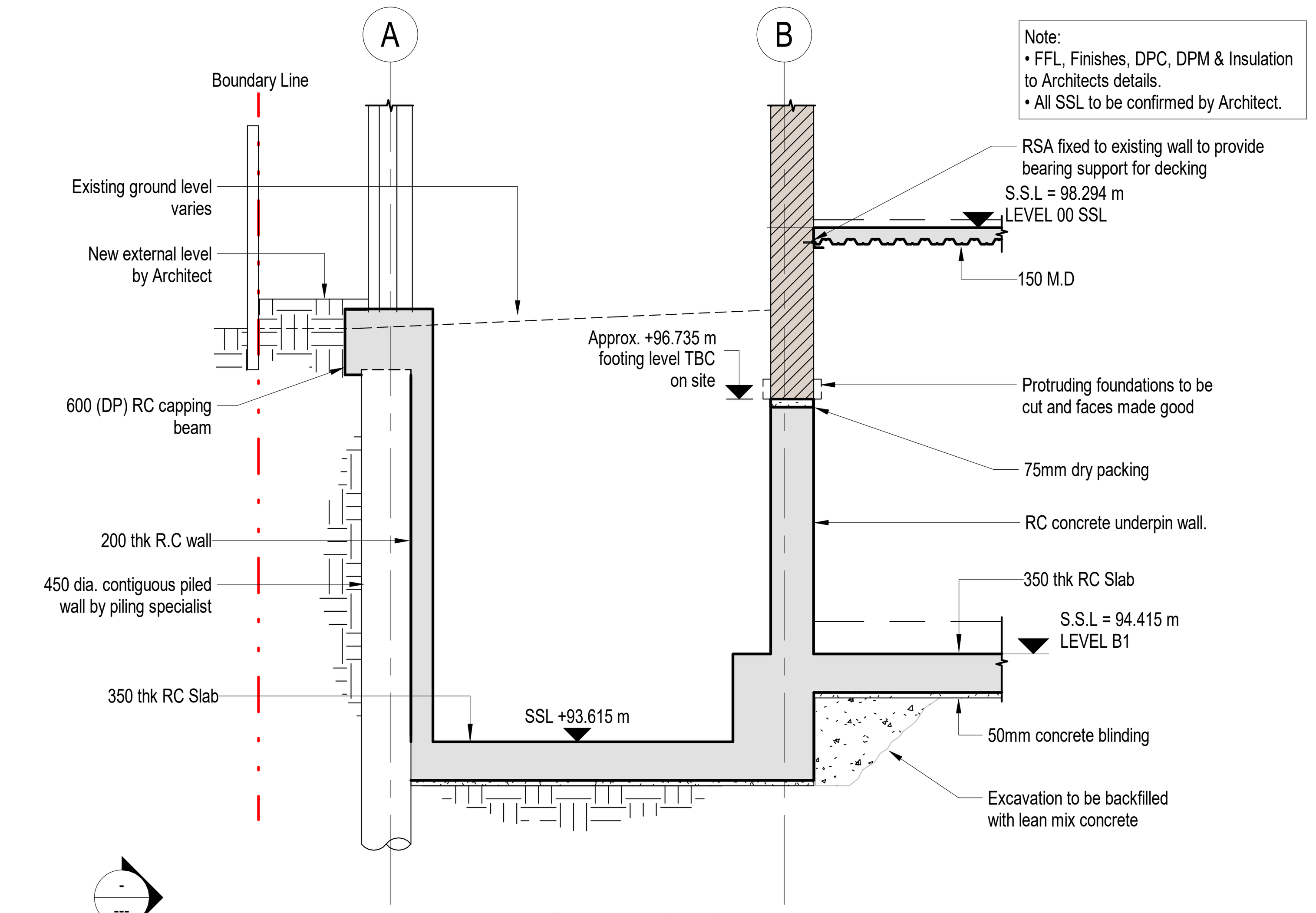

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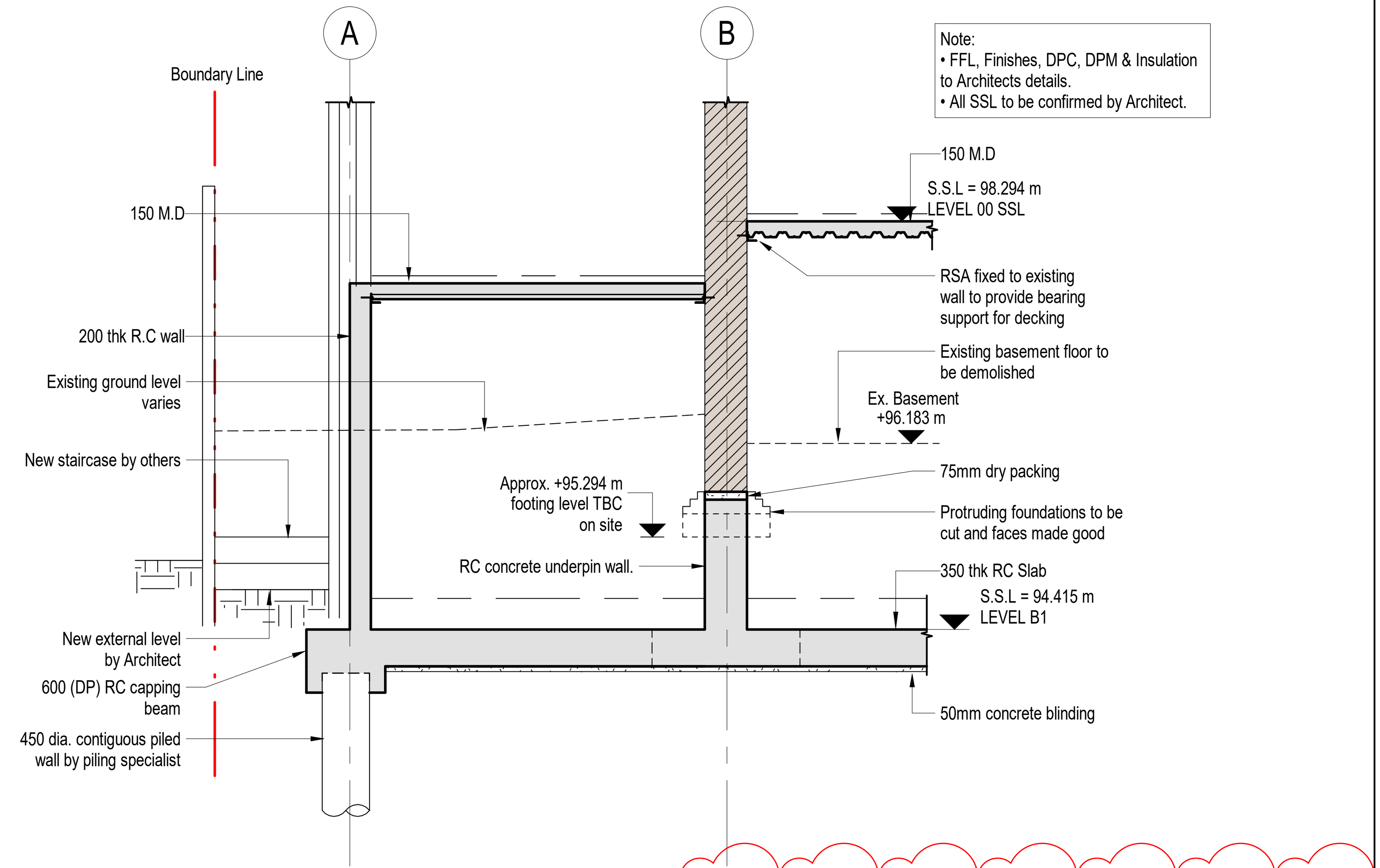

Section 3 - 3

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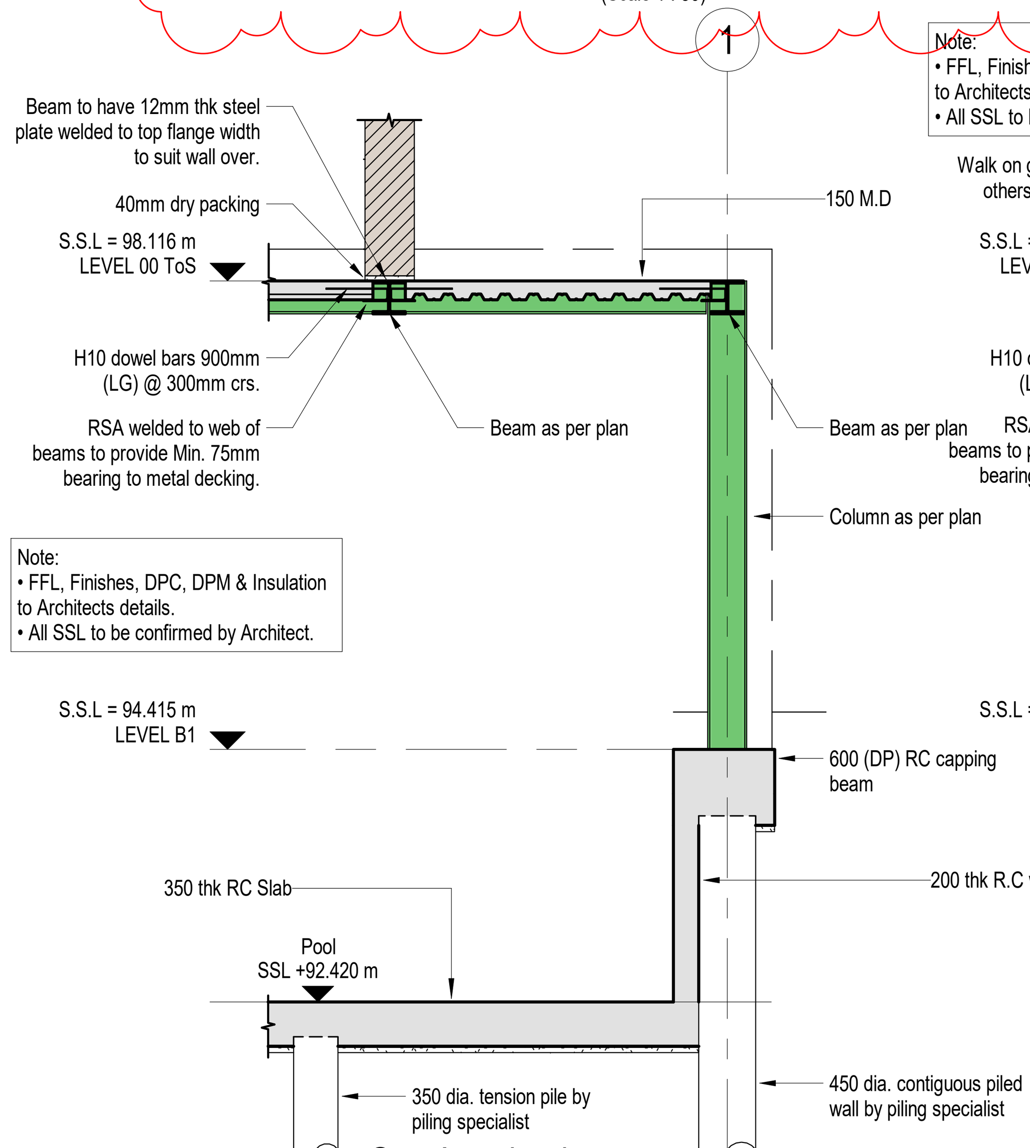

Section 4 - 4

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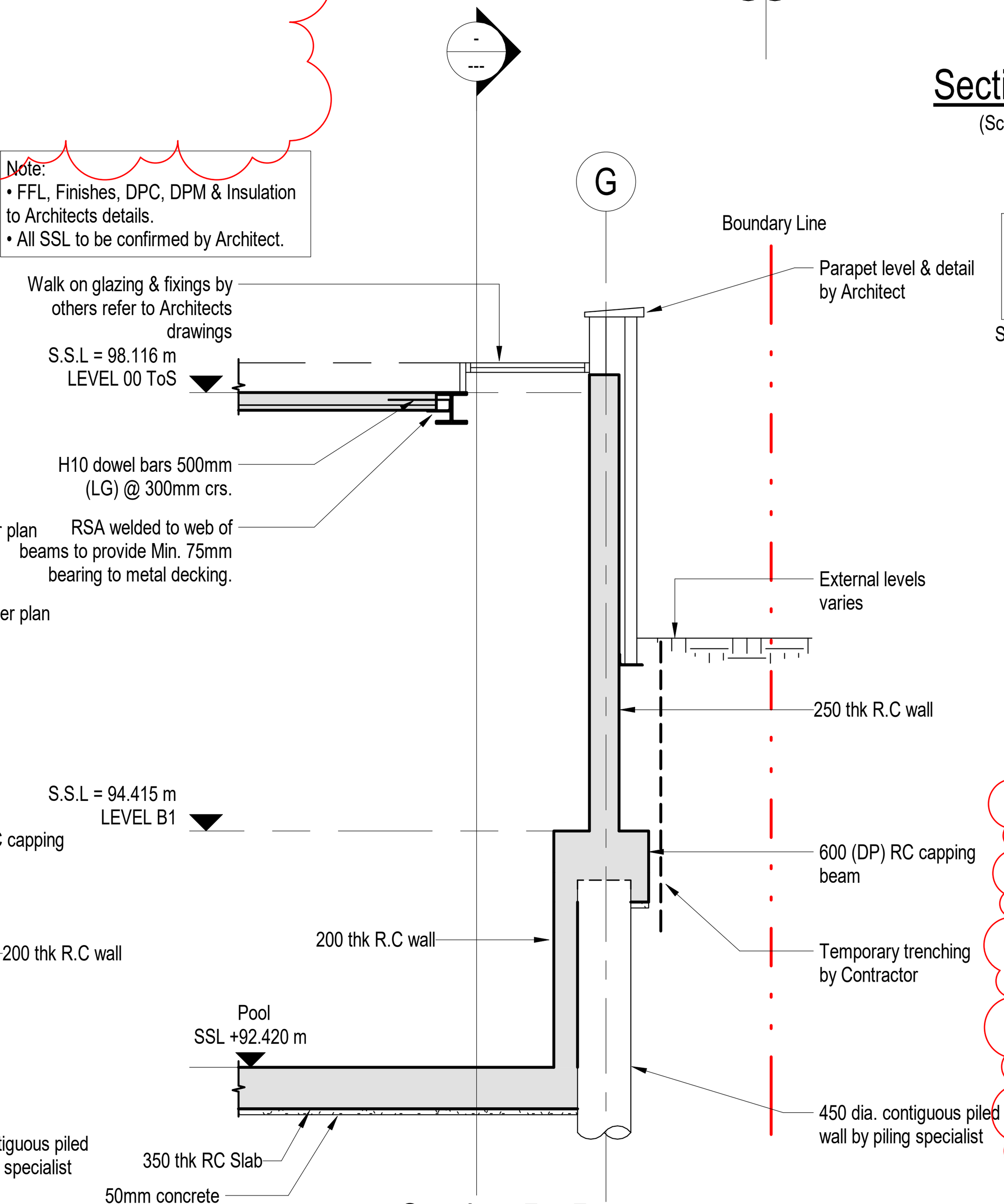

Section 5 - 5

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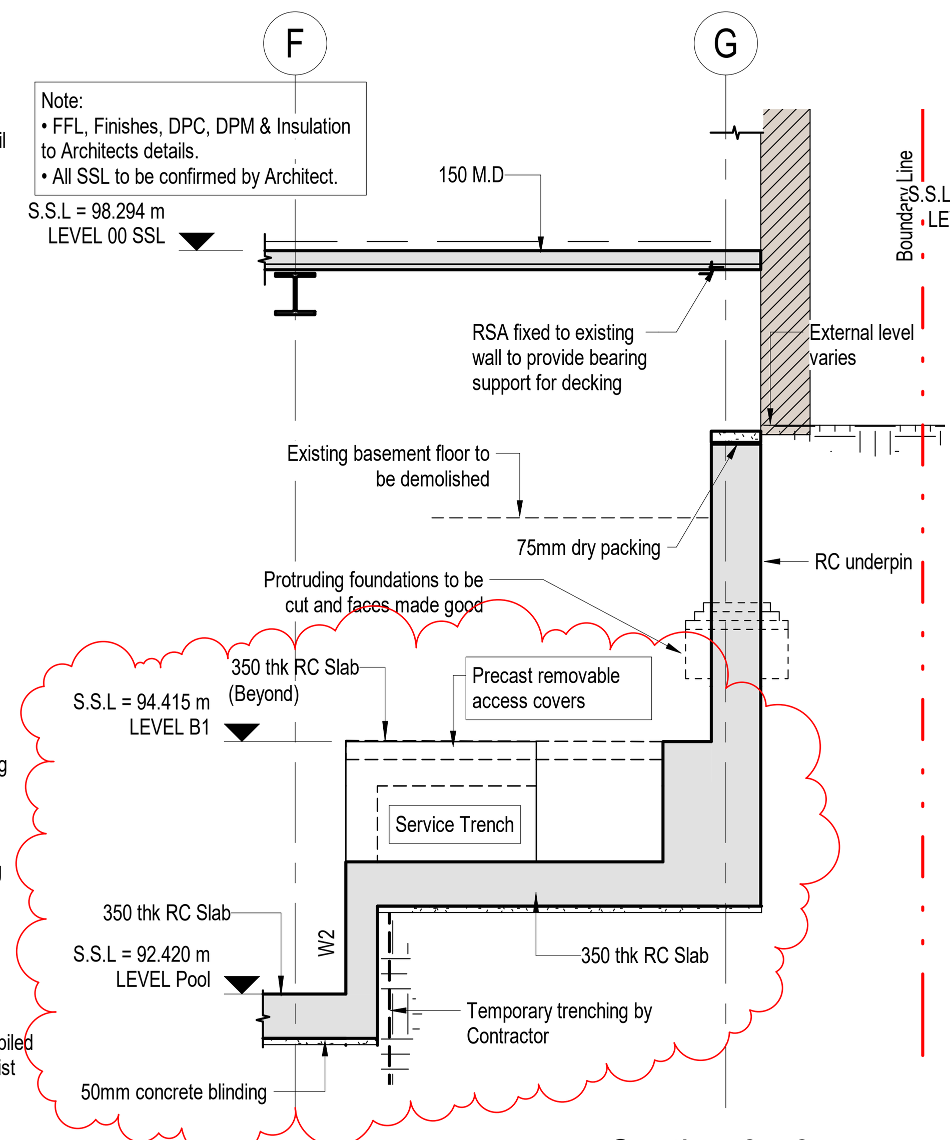

Section 6 - 6

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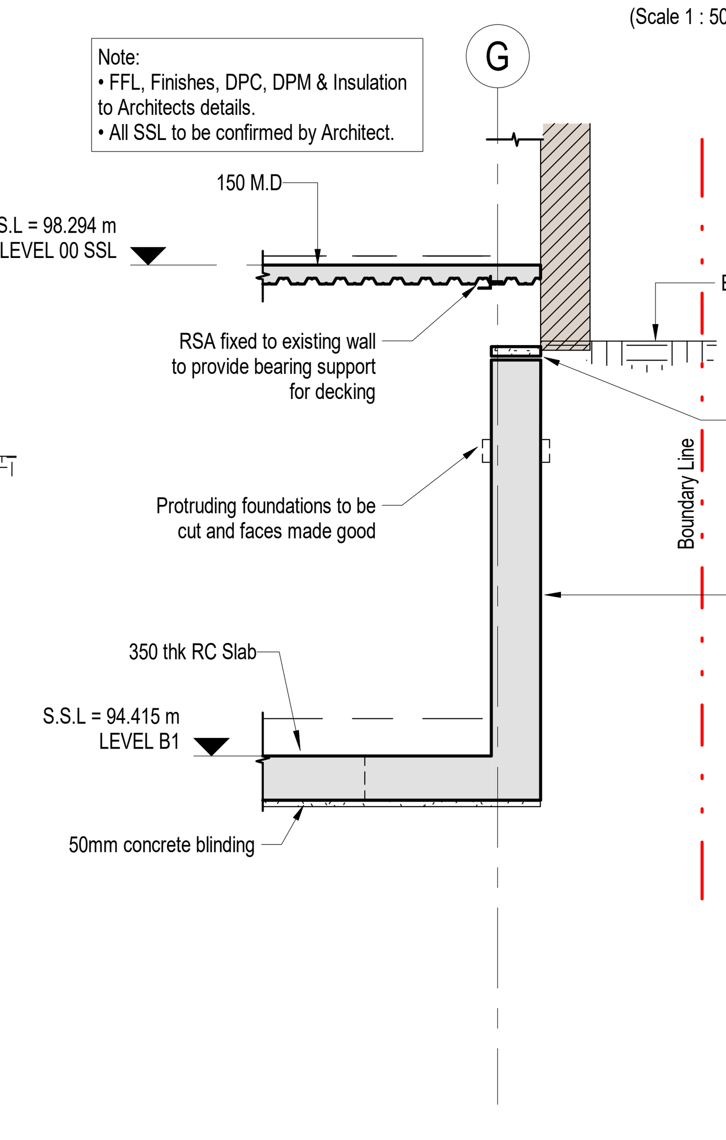

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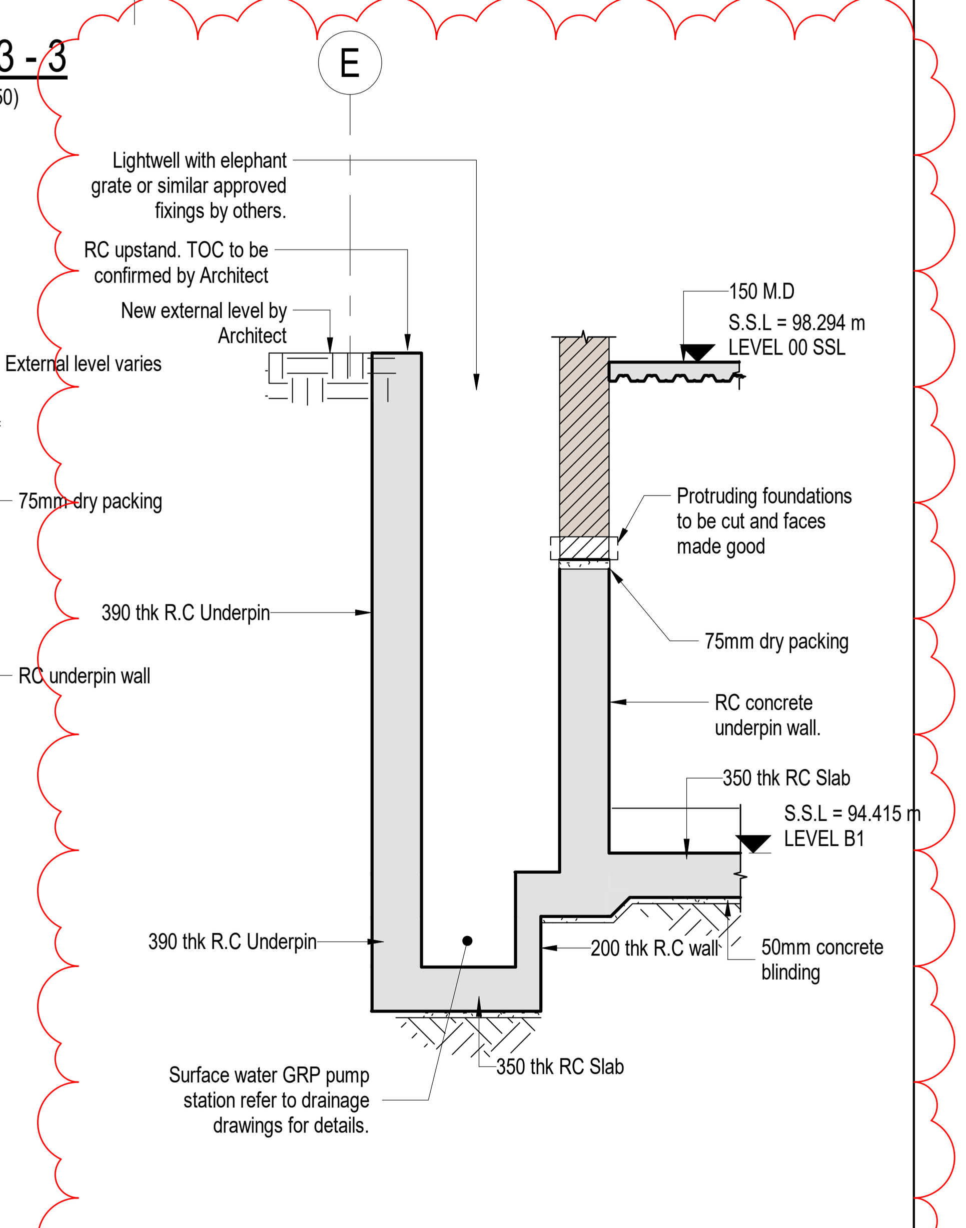

Section 9-9

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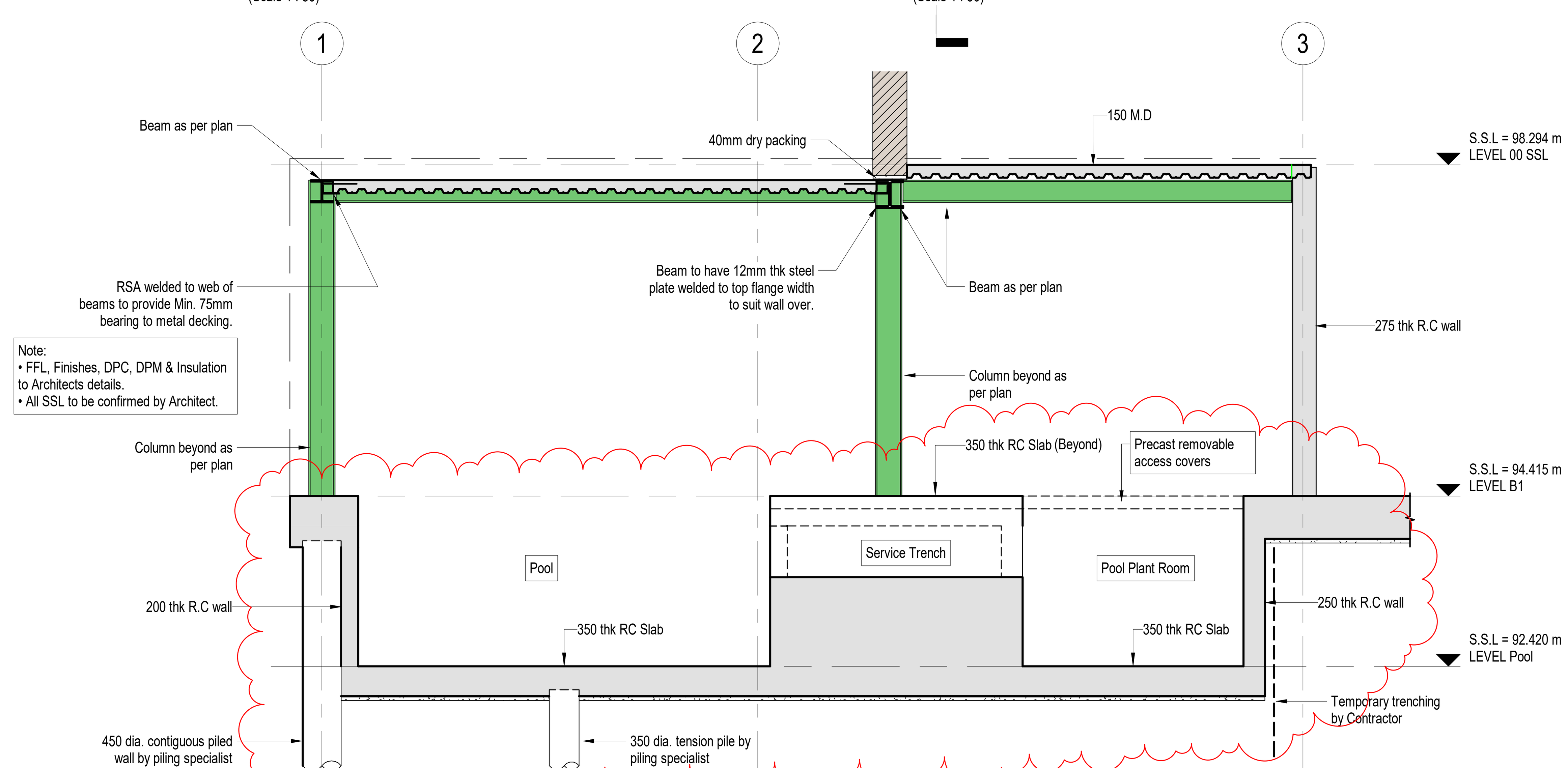

Section 8 - 8

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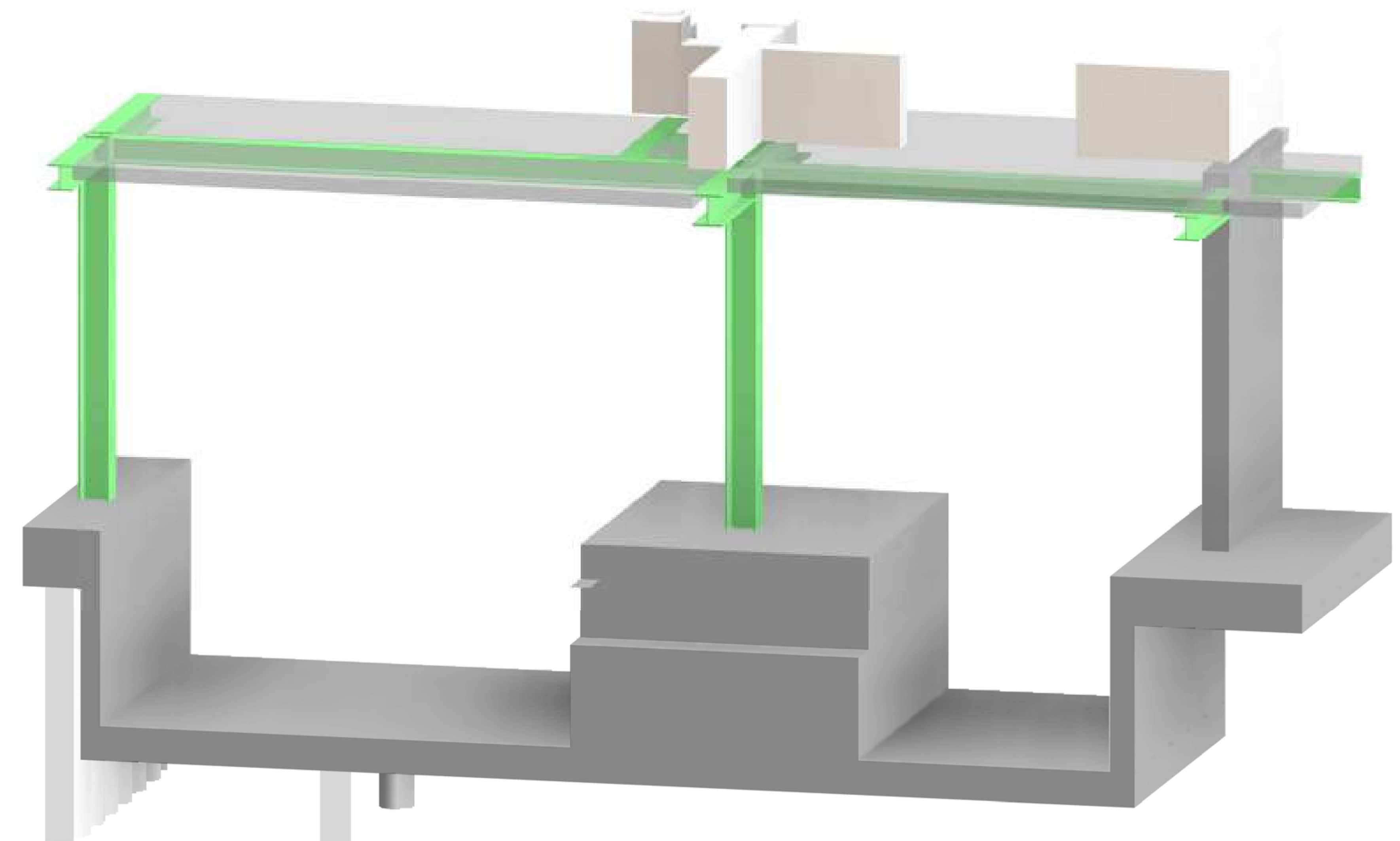

Isometric View of Section 8

Rev	Date	Drawn	Chk	Amendment
03	14.02.22	PE	MS	Section 1-1,6-6,8-8 & 9-9 revised.
02	24.01.22	DA	MS	Section 6 - 6 & 8 - 8 Revised
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-	07.01.22	DA	MS	Issued For Information

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Phone:+44 (020) 8940 4159 Email:mail@pjce.com Website:www.pjce.com

KAROLINA & GIAN FAZIO

2 TEMPLEWOOD AVENUE, LONDON

PERIMETER SECTIONS SHEET 1

Status: INFORMATION

Scale: 1 : 50@ A1	Date:
Drawn: DA	Engineer: MS	Checked: JL

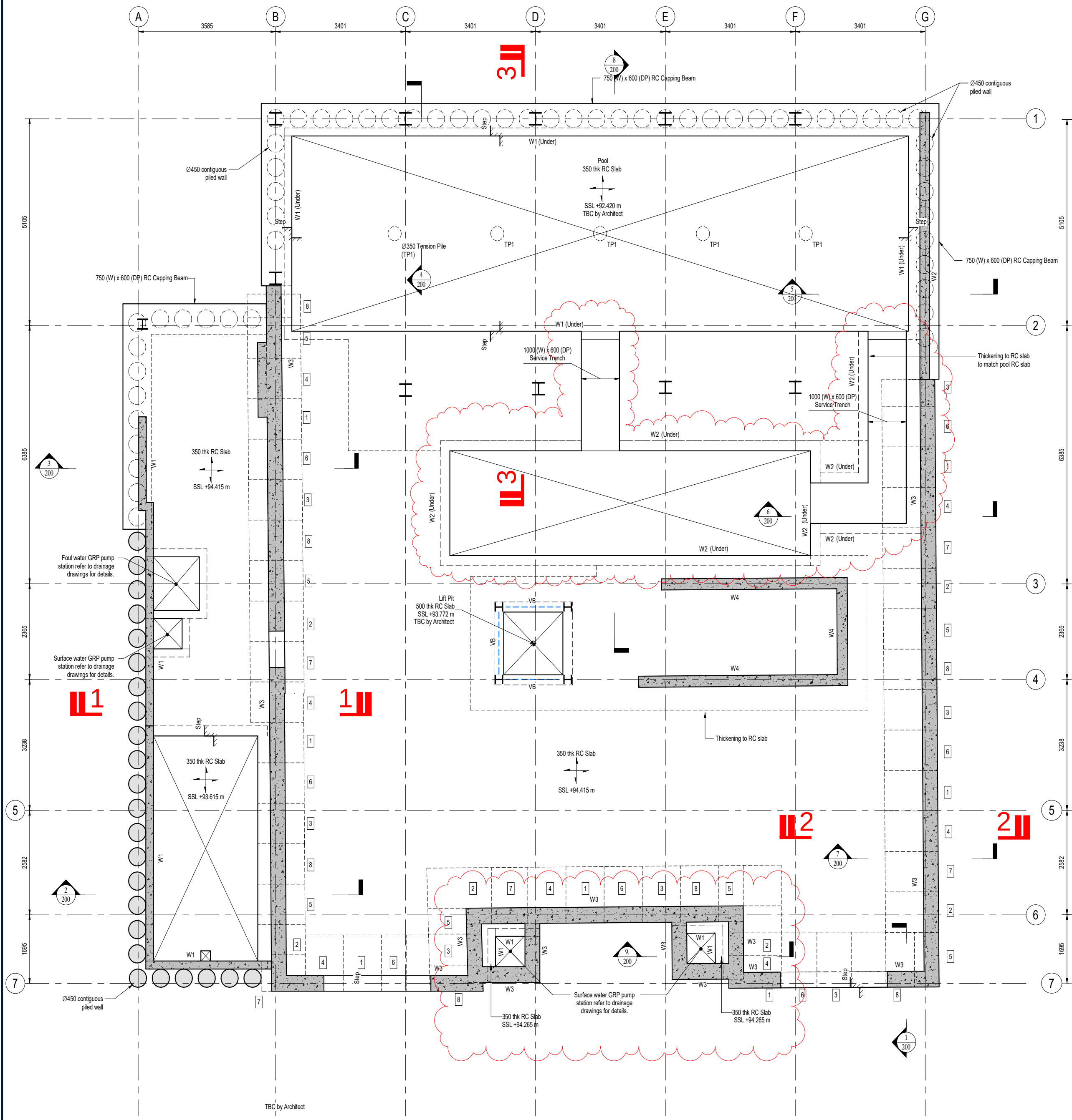
Drawing No: L2658-S-21-200

Revision: 03

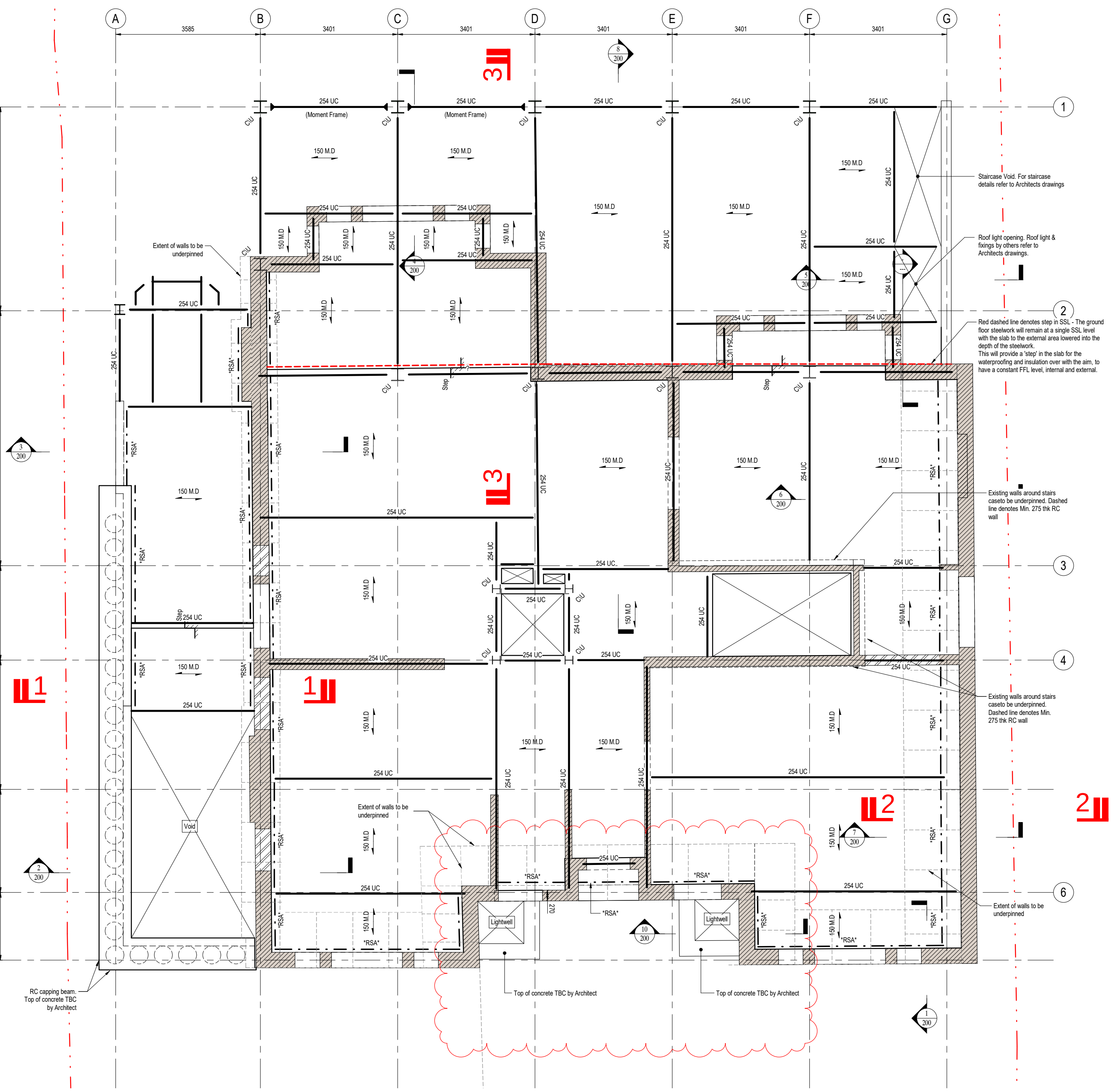
Appendix C

Pringuer-James Consulting Engineers
Basement Impact Assessment

Temporary Works Proposals



Lower Ground Floor GA



Ground Floor GA

Key

1-1 - Refer to following pages for construction sequence of lower ground floor and ground floor typical section 1-1 (2-2 & 3-3)

1 General
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2 Steel
All steelwork to be grade S275 to BS EN 10025. (UNO)

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All welds to be minimum 6mm leg length continuous fillet welds unless specifically noted otherwise.

All steelwork to be blast cleaned to SA2. All steelwork coatings to be as specification and in accordance with BS EN ISO 12944 (1998). All durability categories are to be high (H).
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LOCATION	CATEGORY	PAINT SYSTEM
[illegible]	[illegible]	[illegible]
[illegible]	C3 – Medium	[illegible]
[illegible]	C3 – Medium C4 – High	[illegible]

3 Concrete
Concrete to be in accordance with BS EN 206-1 and as follows:
Blinding - C16/20
Mass concrete - C25/30
Reinforced concrete - C28/35

4 Masonry
All loadbearing blockwork to have a minimum characteristic strength of 7.3N/mm². All loadbearing brickwork is to have a minimum characteristic strength of 20N/mm².

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All timber members to be grade C16 to BS EN 1995 unless noted otherwise. Timber to be pressure impregnated with preservative and cut ends brush treated.

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All padstones to be concrete, min grade C25/30 using max 20 mm aggregate. Nominal size to be 440 long x 215 dp x width of wall (UNO). All steel beams on padstones to be bolted to padstones with min 2 No. M10 HAS Anchor rods with Hilti Hit-HY 200 Injection Adhesive (OSA).

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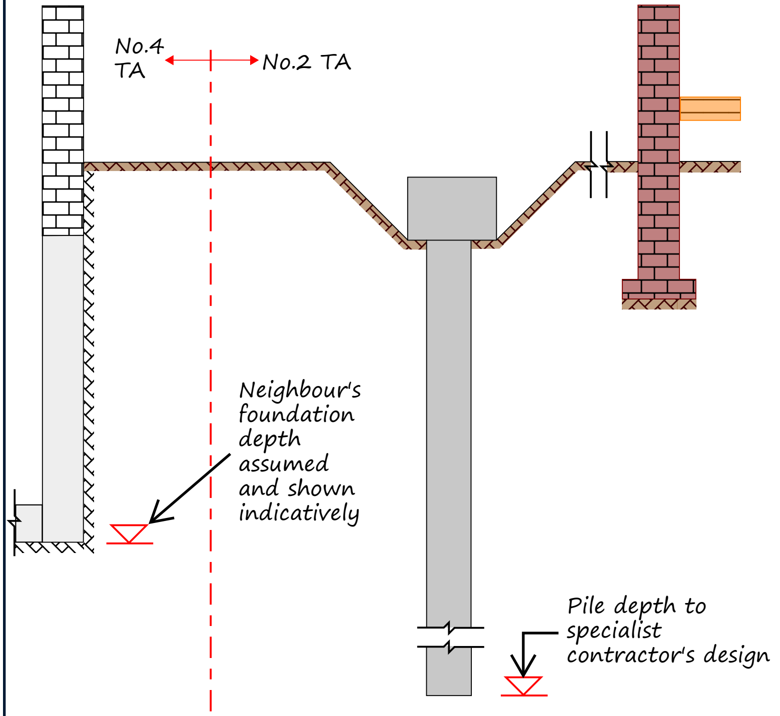
L2658-S-08-001

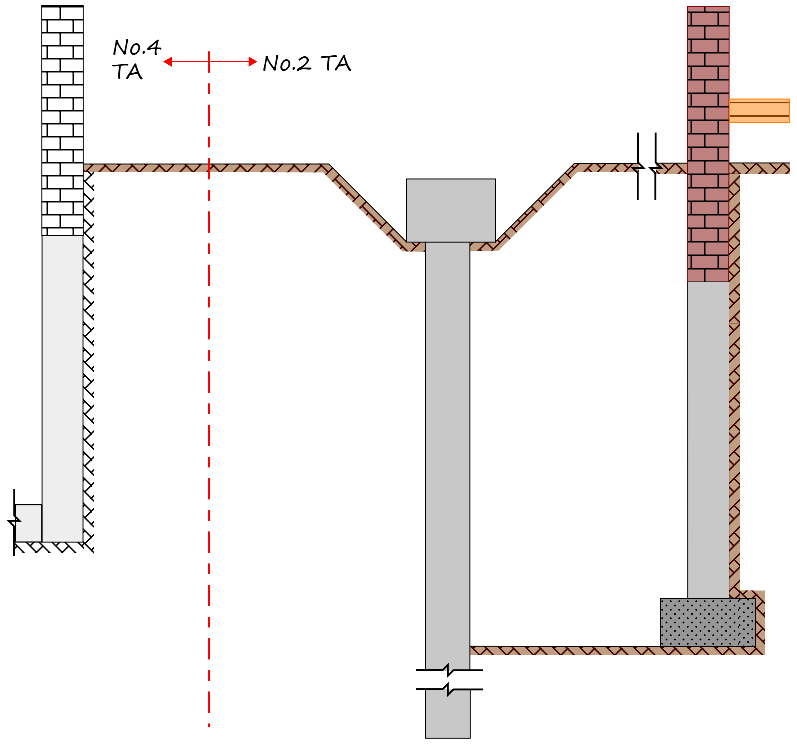
2 TEMPLEWOOD AVENUE, LONDON NW3 7XA

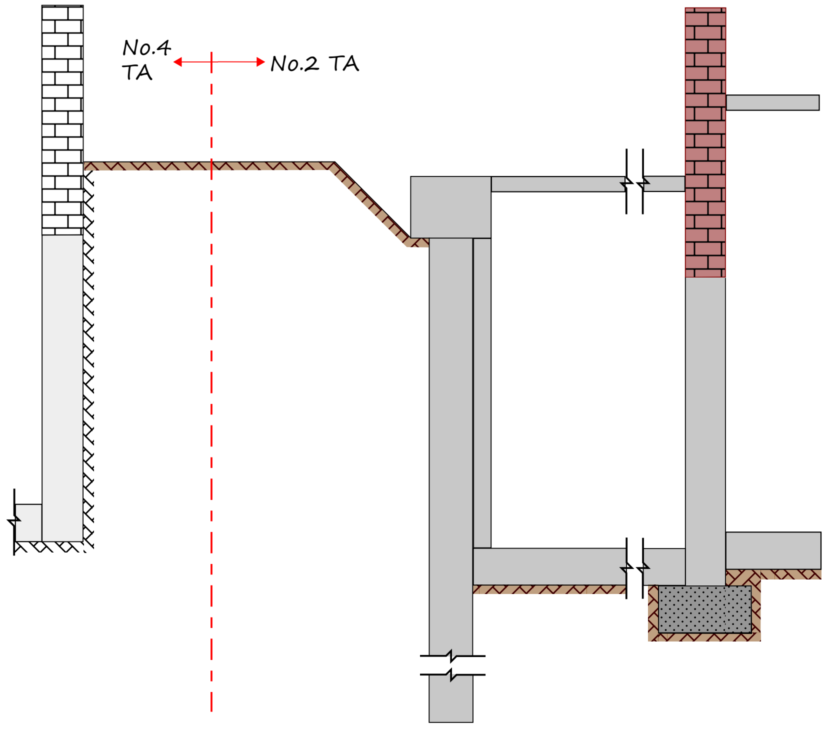
TEMPORARY WORKS PROPOSALS LOWER GROUND FLOOR AND GROUND FLOOR GA

STATUS: INFORMATION

DATE: 05/01/2022 REV: 01







Stage 0 - Existing condition

Stage 1 - Install piles

Install embedded contiguous piled retaining wall to extent shown on basement plan.

Locally excavate for capping beam construction. Temporary works for excavation support by contractor.

Stage 2 - Mass concrete foundation

Cast mass concrete strip foundation to match width of existing corbelled footing above.

Stage 3 - Underpin

Commence excavation for RC underpins in indicated hit and miss sequence, installing all local props and shoring as required. Maximum excavation width 1200mm.

Protruding corbelled footings to be cut and made good.

Contractor to ensure all edge protection as necessary.

Once RC underpins are fully cast and cured, dry pack to underside of existing wall over.

Stage 4 - New structure

Install external base slab, ground floor slab and liner wall to piled retaining wall.

Stage 5 - Internal excavation

Excavate internal area once full perimeter underpins and piling is complete.

Stage 6 - Lower ground floor structure

Install ground floor and basement slab to internal area.

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[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

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Concrete to be in accordance with BS EN 206-1 and as follows:
Blinding - C16/20
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5 Timber
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6 Padstones
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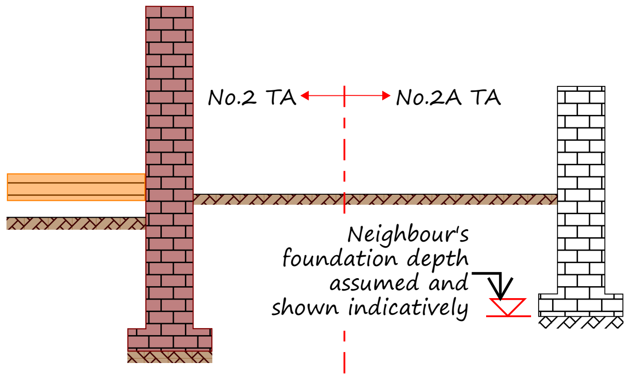
L2658-S-08-002

2 TEMPLEWOOD AVENUE,
LONDON NW3 7XA

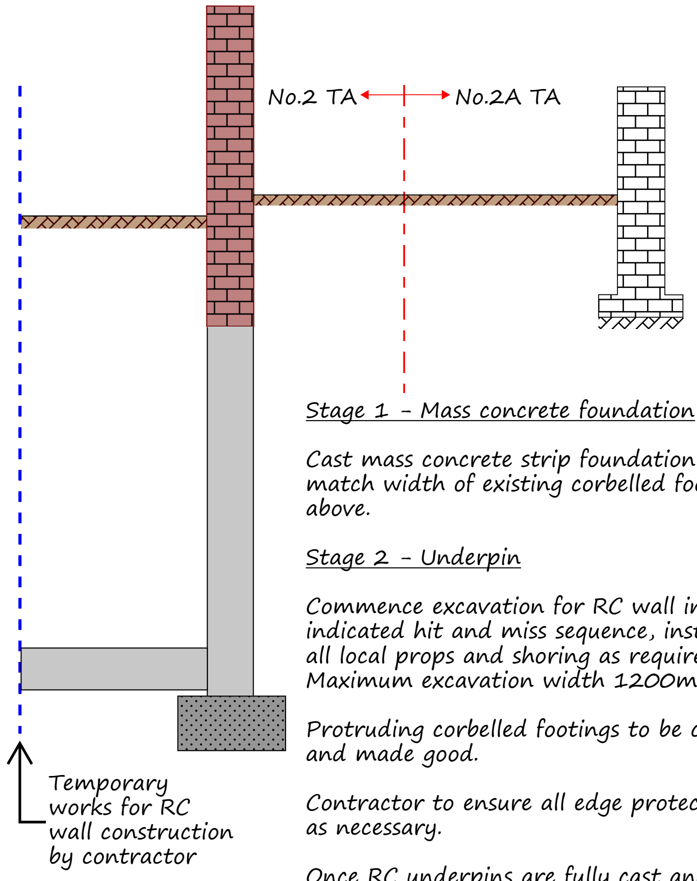
TEMPORARY WORKS PROPOSALS
SECTION 1-1

STATUS: INFORMATION

DATE: 05/01/2022 REV: 01



Stage 0 – Existing condition



Stage 1 – Mass concrete foundation

Cast mass concrete strip foundation to match width of existing corbelled footing above.

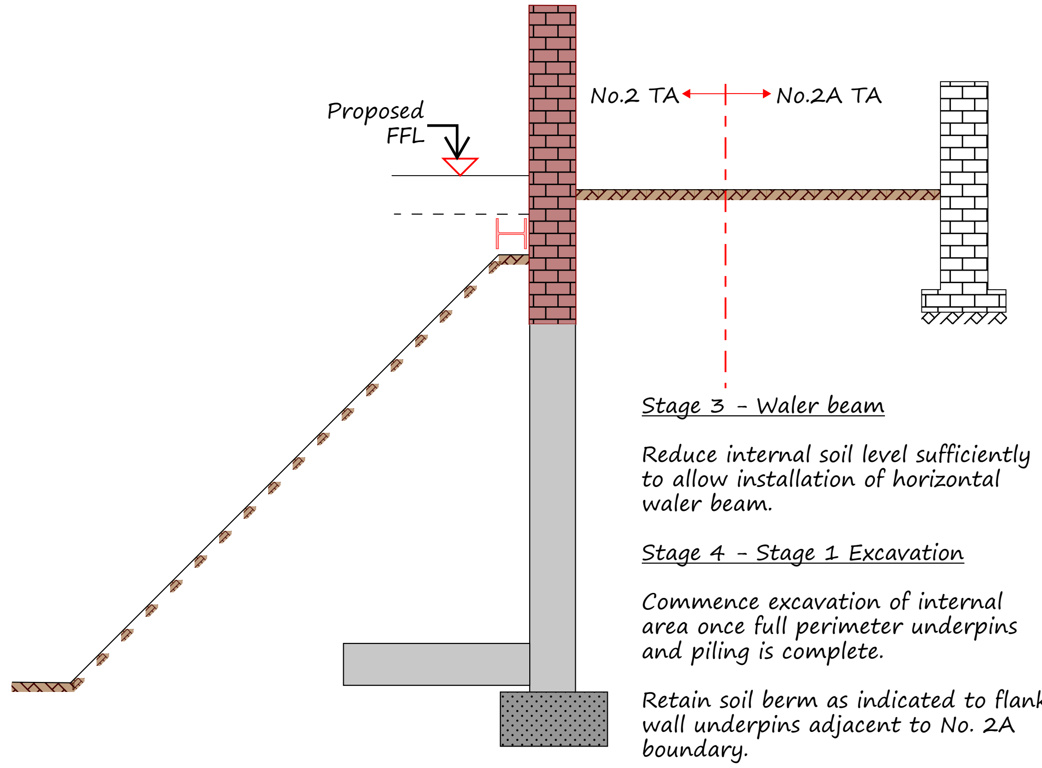
Stage 2 – Underpin

Commence excavation for RC wall in indicated hit and miss sequence, installing all local props and shoring as required. Maximum excavation width 1200mm.

Protruding corbelled footings to be cut and made good.

Contractor to ensure all edge protection as necessary.

Once RC underpins are fully cast and cured, dry pack to underside of existing wall over.



Stage 3 – Waler beam

Reduce internal soil level sufficiently to allow installation of horizontal waler beam.

Stage 4 – Stage 1 Excavation

Commence excavation of internal area once full perimeter underpins and piling is complete.

Retain soil berm as indicated to flank wall underpins adjacent to No. 2A boundary.

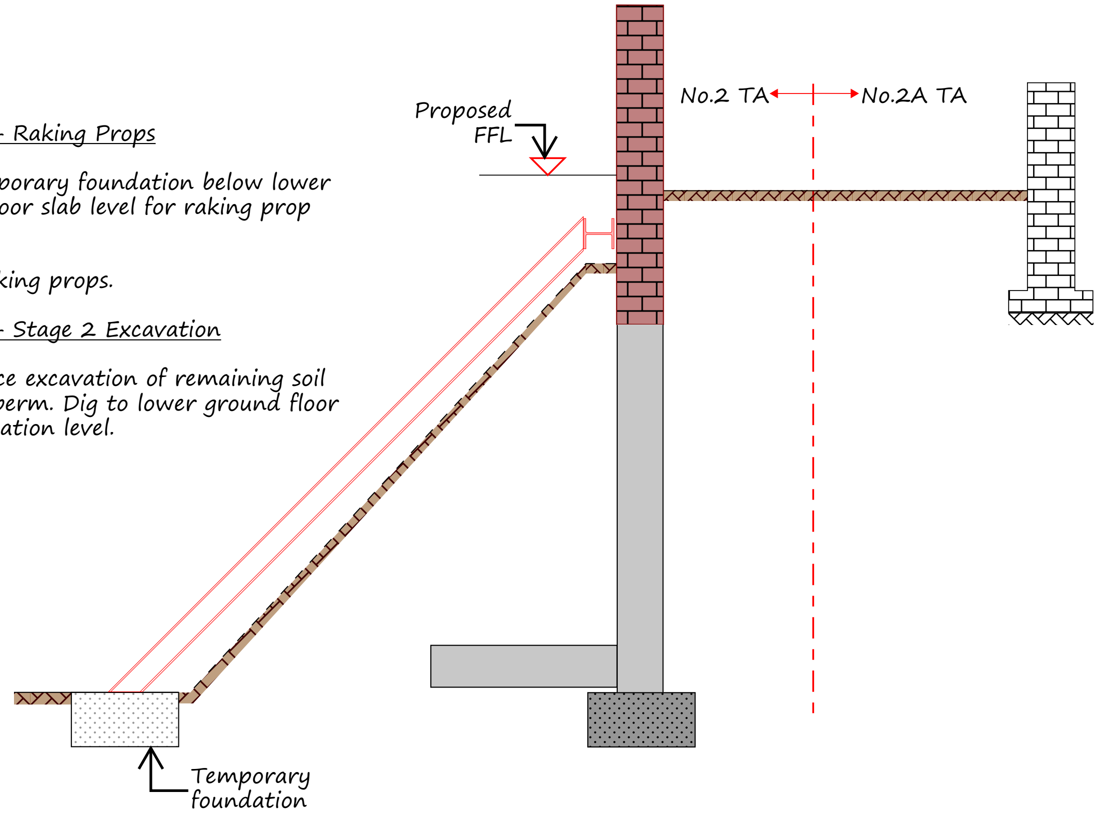
Stage 5 – Raking Props

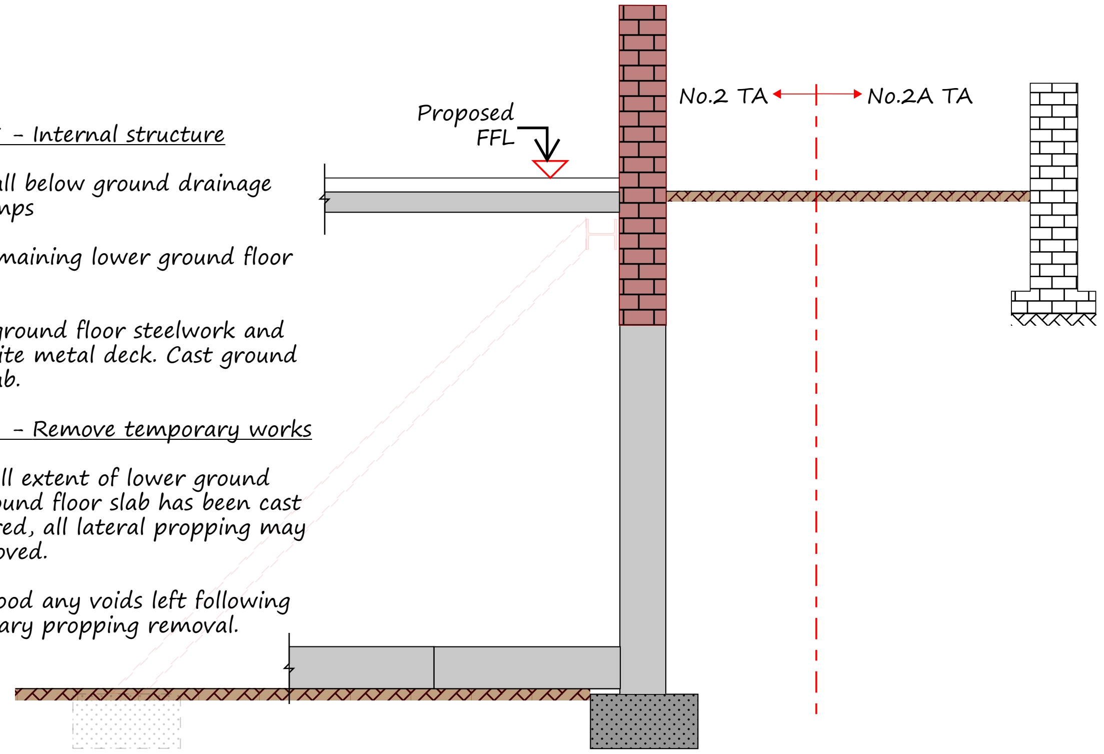
Cast temporary foundation below lower ground floor slab level for raking prop support.

Install raking props.

Stage 6 – Stage 2 Excavation

Commence excavation of remaining soil forming berm. Dig to lower ground floor slab formation level.





Stage 7 – Internal structure

Install all below ground drainage and sumps

Cast remaining lower ground floor slab.

Install ground floor steelwork and composite metal deck. Cast ground floor slab.

Stage 8 – Remove temporary works

Once full extent of lower ground and ground floor slab has been cast and cured, all lateral propping may be removed.

Make good any voids left following temporary propping removal.

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LOCATION	CATEGORY	PAINT SYSTEM
[illegible]	C1 – [illegible]	[illegible]
[illegible]	C3 – Medium	[illegible]
External [illegible]	C3 – Medium C4 – High	[illegible]

3 Concrete
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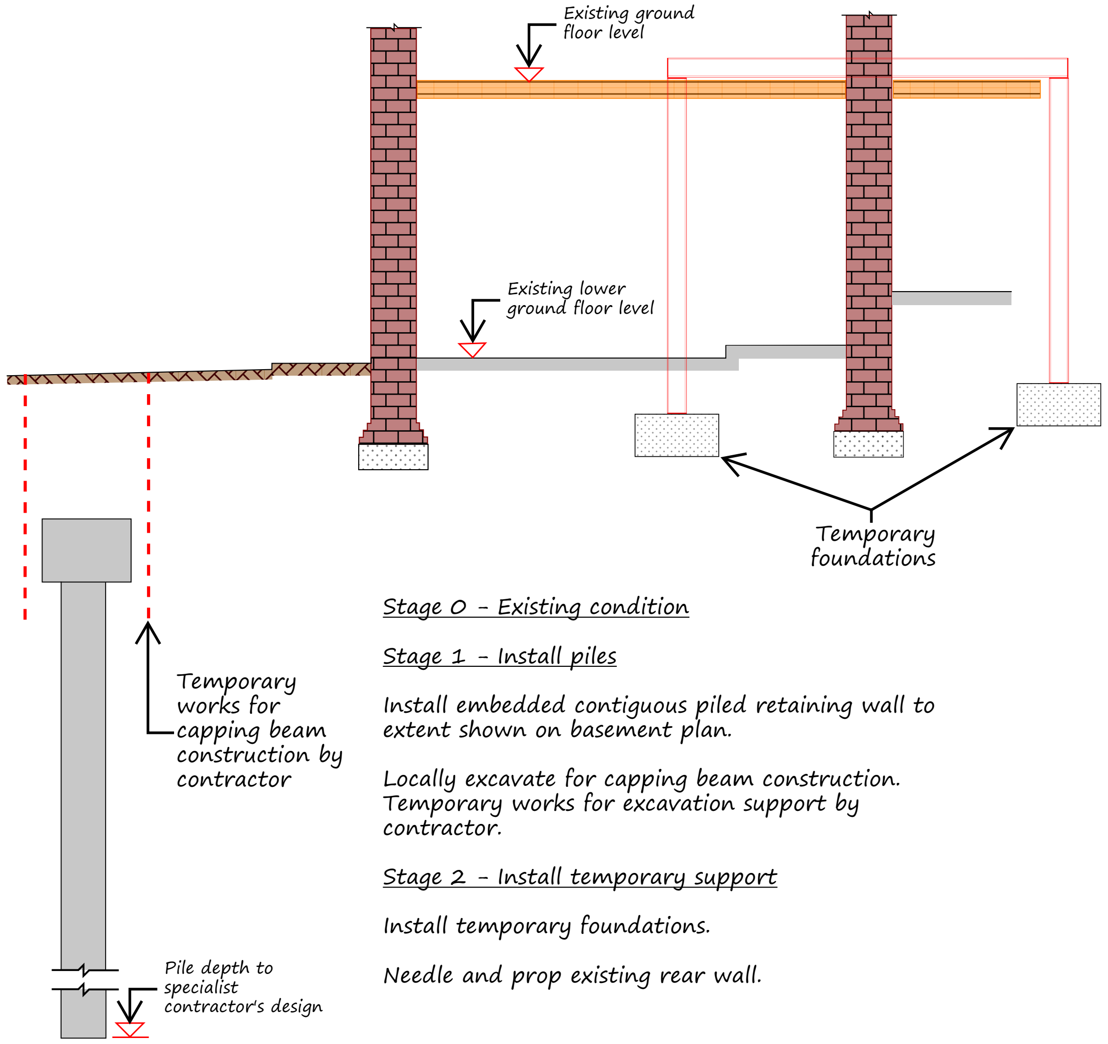
L2658-S-08-003

2 TEMPLEWOOD AVENUE,
LONDON NW3 7XA

TEMPORARY WORKS PROPOSALS
SECTION 2-2

STATUS: INFORMATION

DATE: 05/01/2022 REV: 01



<u>Stage 0 – Existing condition</u>

<u>Stage 1 – Install piles</u>

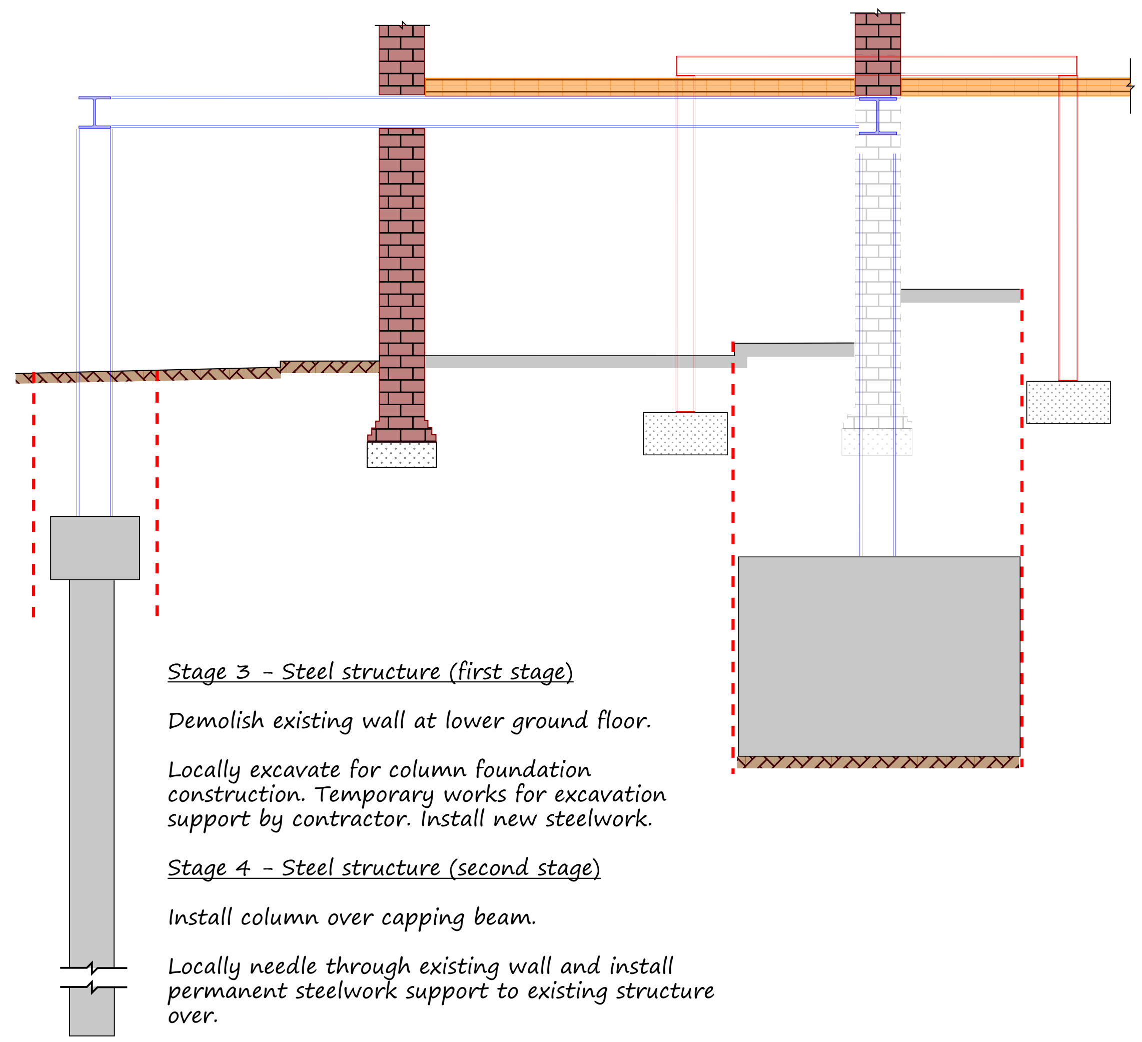
Install embedded contiguous piled retaining wall to extent shown on basement plan.

Locally excavate for capping beam construction. Temporary works for excavation support by contractor.

<u>Stage 2 – Install temporary support</u>

Install temporary foundations.

Needle and prop existing rear wall.



<u>Stage 3 – Steel structure (first stage)</u>

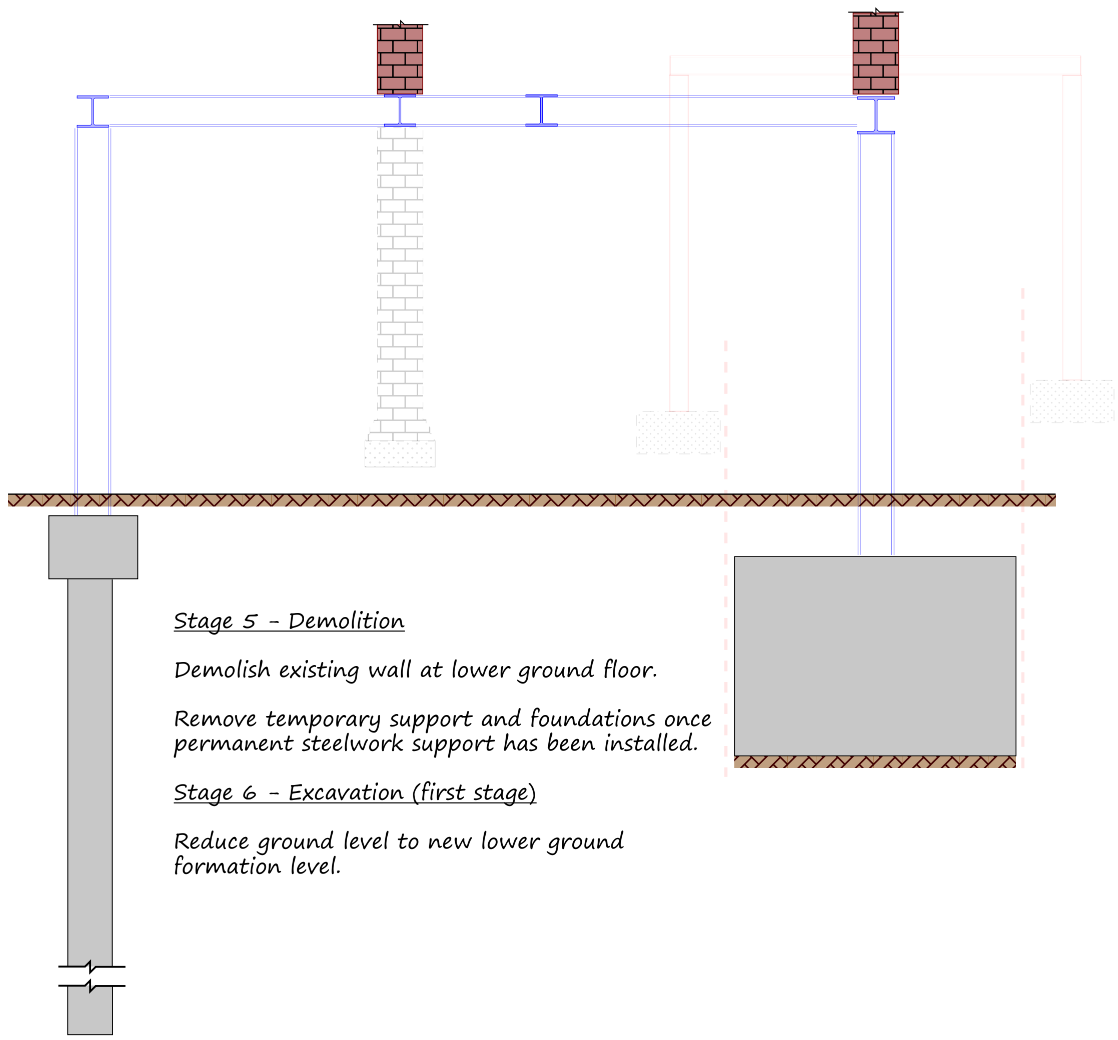
Demolish existing wall at lower ground floor.

Locally excavate for column foundation construction. Temporary works for excavation support by contractor. Install new steelwork.

<u>Stage 4 – Steel structure (second stage)</u>

Install column over capping beam.

Locally needle through existing wall and install permanent steelwork support to existing structure over.



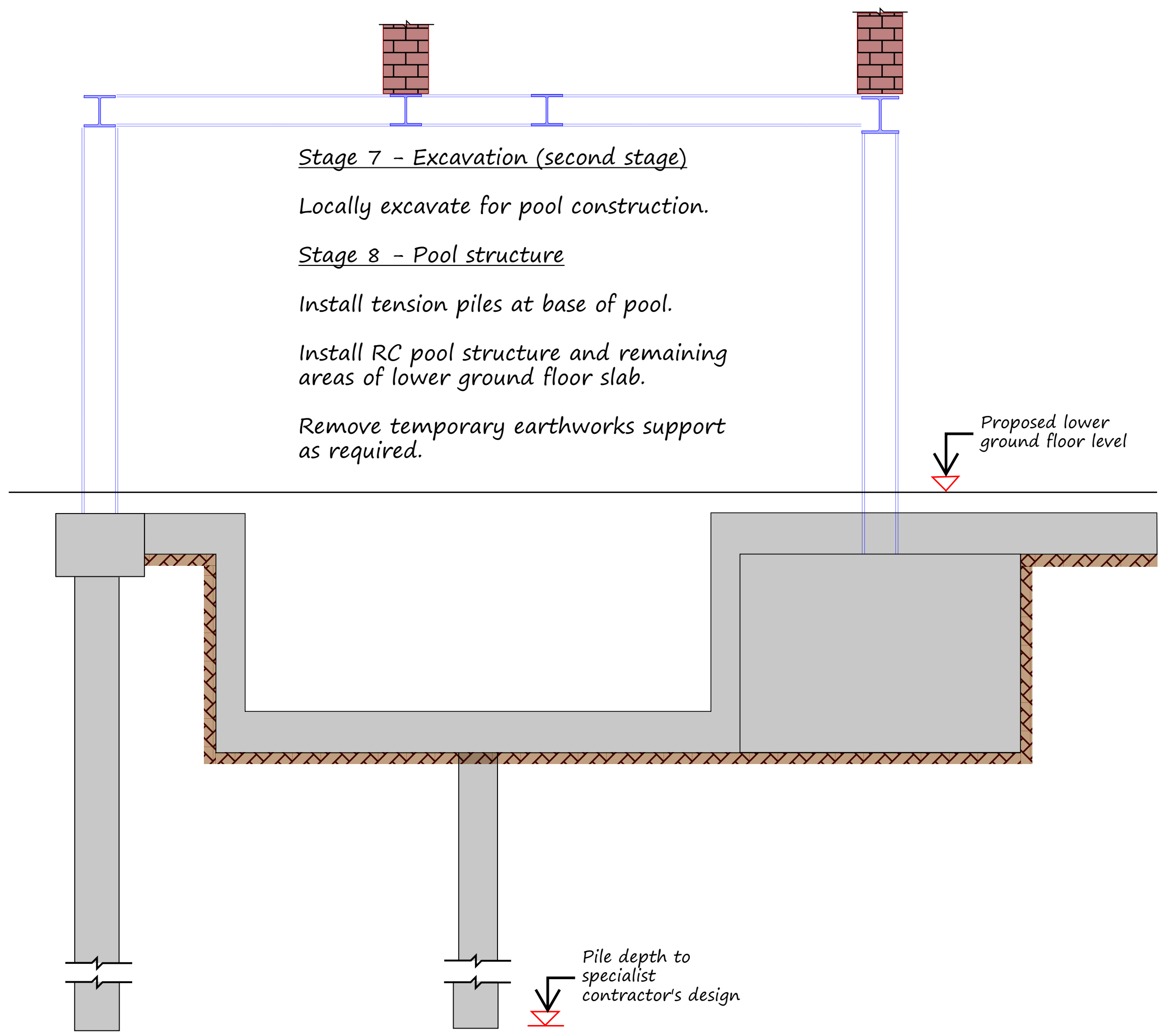
<u>Stage 5 – Demolition</u>

Demolish existing wall at lower ground floor.

Remove temporary support and foundations once permanent steelwork support has been installed.

<u>Stage 6 – Excavation (first stage)</u>

Reduce ground level to new lower ground formation level.



<u>Stage 7 – Excavation (second stage)</u>

Locally excavate for pool construction.

<u>Stage 8 – Pool structure</u>

Install tension piles at base of pool.

Install RC pool structure and remaining areas of lower ground floor slab.

Remove temporary earthworks support as required.

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[illegible]	C3 – Medium	[illegible]
[illegible]	C3 – Medium C4 – High	[illegible]

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L2658-S-08-004

2 TEMPLEWOOD AVENUE, LONDON NW3 7XA

TEMPORARY WORKS PROPOSALS SECTION 3-3

STATUS: INFORMATION

DATE: 05/01/2022 REV: 01

Appendix D

Pringuer-James Consulting Engineers
Basement Impact Assessment

Paddock Geo Engineering Ltd
Geotechnical Site Investigation Report
Preliminary Contamination Risk Assessment

PADDOCK
GEO ENGINEERING

2 Templewood Avenue,

London, NW3 7XA

Ground Investigation

Karolina and Gian Fazio

December 2021

P21-336gi

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T: 44 (0) 1908 764032
M: 44 (0) 7377 422528
E: matt@paddockgeoengineering.co.uk
W: www.paddockgeoengineering.co.uk

Company Number: 8613165
VAT Number: GB 166 8087 72

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Continues

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<tr><th>ISSUE</th><th>DATE</th><th>Written by</th><th>Comment</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">15/12/2021</td><td>Stephen Fisk BSc FGS</td><td rowspan="3">-</td></tr>
<tr><td>Reviewed and approved by</td></tr>
<tr><td>Matt Paddock MSc FGS</td></tr>
<tr><td colspan="4">For and on behalf of Paddock Geo Engineering Limited</td></tr>
</table>

1.0 INTRODUCTION

Paddock Geo Engineering Limited (PGE) were instructed by Karolina and Gian Fazio (the Client) to undertake a Ground Investigation and Generic Site Contamination Assessment as Stage 2 Tier 2 (formerly referred to as Phase 2) of a Site Contamination Assessment in relation to the proposed residential redevelopment for the subject site, referred to as 2 Templewood Avenue, London, NW3 7XA.

The overall objective of the Ground Investigation was to inform the Client of the ground conditions and potential ground-related risks associated with the development of the site. The Risk Assessment undertaken relates to the proposed refurbishment and reconfiguration of the existing property on site including lowering and extension of the existing partial lower ground floor. The private gardens on site will be maintained as part of the proposed scheme

1.1 Terms of Reference

- British Standards BS 10175:2011 Investigation of Potentially Contaminated Sites – Code of Practice.
- Land Contamination: Risk Management (LCRM), 2020, Environment Agency.
- PPG23 (PPS23) Planning and pollution control (contaminated land aspects), 2002
- GPLC1 Guiding Principles for Lan0d Contamination, 2010, Environment Agency
- Environmental Protection Act: 1990 – Contaminated Land Statutory Guidance, April 2012, DEFRA
- BS EN 1997-2, Eurocode 7. Geotechnical design. Ground investigation and Testing
- BS EN ISO 22475 Series (1-3), Geotechnical investigation and testing. Sampling methods and groundwater measurements.
- NHBC Standards Chapter 4.2 2006, Building Near Trees
- TRL Laboratory Report 1132:1984 – The Structure of Bituminous Road, Appendix C Table C1
- BS 5930:1999+A2:2010 Site Investigation Code of Practice
- BS EN 1997-2, Eurocode 7. Geotechnical design. Ground investigation and testing
- BS EN ISO 22475 Series (1-3), Geotechnical investigation and testing. Sampling methods and groundwater measurements.
- NHBC Standards Chapter 4.2 2006, Building Near Trees
- BRE412 1996 Desiccation in Clay Soils
- BRE240 1993 Low Rise Buildings on Shrinkable Clay Soils: Part 1
- BRE241 1990 Low Rise Buildings on Shrinkable Clay Soils: Part 2
- BS 8485:2015 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings
- CIRIA C665 Assessing risks posed by hazardous ground gases to buildings. CIRIA 2007

- NHBC report No 10627-R01(04) Guidance on development proposals on sites where methane and carbon dioxide are present (March 2007)
- CL:AIRE Research Bulletin RB17 A pragmatic approach to ground gas risk assessment (November 2012)
- CIRIA C735 Good practice and verification of protection systems for buildings against hazardous ground gases.

1.2 Objective

The objective of the Ground Investigation for the site comprised the following elements:

- An Intrusive Investigation
- A Geotechnical Appraisal
- A Site Contamination Assessment, Generic Human Health Risk Assessment including an initial Ground Gas Risk Assessment (if found to be necessary via the associated PRA)
- An Assessment of Waste soils for Disposal off site

The scope of work was based on the specification drawing reference E21-087 S-08-001 2 Templewood Avenue Geotechnical Site Investigation provided by Pringuer James Consulting Engineers. The scope was amended slightly with two additional hand excavated trial pits added at the request of the Client's Project Manager to investigate the presence of roots along the site boundary. The scope of works was discussed and agreed with the Client prior to commencement and amended on site to account for restrictions and considerations on site.

The investigation was carried out in order to provide data on the sub-soil characteristics of the site, existing foundation arrangements, the groundwater regime and also to recover samples for geotechnical laboratory testing and geochemical analysis. This data was employed to derive a ground model for the site, foundation design criteria including basement design criteria, a generic human health contamination risk assessment and a ground gas risk assessment (where deemed warranted by the PRA report) for the site. The investigation was also undertaken to allow an assessment of potential waste soils for disposal off site.

2.0 THE SITE

2.1 Site Description

The subject site is in a moderately densely populated residential area in north London. The site is located within an area typified by large detached residential dwellings and lies some 300m south of Golders Hill Park and 1.1km west of Hampstead Heath.

The study area covers an area of approximately 0.15 hectares, with the centre of the site at approximate national grid reference 525730, 186010 and postcode NW3 7XA.

The site is a rectangular shaped plot of land occupied by a three-storey, detached, brick-built residential property which dates to the early-1900s. The site also contains front and rear soft landscaped residential gardens and a driveway. Access onto the site is via a private gated entrance onto a private driveway off Templewood Avenue to the northwest of site.

The site is located within a residential setting with residential properties and gardens surrounding the site to the immediate northeast and southwest and beyond Templewood Avenue to the northwest. To the southeast is a small wooded area with a children's playpark some 30m southeast.

Site Location Plans and an Aerial Photograph are presented in Appendix A.

2.2 Proposed Development

The proposed development includes the lowering and extension of the existing partial lower ground floor, including the localised lowering of the lower ground floor to the rear of dwelling for installation of a swimming pool. The new lower ground floor is to extend to the rear (southeast) of the existing building line and form a roof terrace. In addition, the proposals involve the reconfiguration and renovation of the existing property with the existing loft space to be converted into a play room.

The proposed also include provision for a new garden studio structure on the southwest corner of the rear garden.

Private soft landscaped garden areas will remain at the front and rear of the property. On this basis the soil contamination exposure characteristics for the proposed development will be analogous to residential with plant uptake.

Proposed development plans are presented within Appendix A.

3.0 PRELIMINARY CONTAMINATION RISK ASSESSMENT SUMMARY

An associated Preliminary Contamination Risk Assessment (PRA) have been carried out for the site by PGE reference P21-336pra dated December 2021, with which reference should be made. Salient data from the PRA are summarised and extracted from the PRA and presented in the following Sections.

3.1 Geology, Hydrogeology and Hydrology

Information on the geology underlying the site has been obtained from the British Geological Survey and indicates Claygate Member typically found to comprise dark grey clay with sand laminae. This is likely to be underlain by the main London Clay Formation mudstone deposits at depth, of which the Claygate Member is a named member near to the upper boundary of the parent London Clay Formation.

No superficial deposits are not indicated to be present on site or in the immediate vicinity on the BGS mapping.

The geological maps provided within the Envirocheck Report identifies no areas of Worked Ground or Made Ground within 250m of the site. Several small areas of worked ground (undivided) are indicated some 300m south, west and northeast of the site.

The groundwater vulnerability maps for the site and the surrounding areas indicates the Claygate Member bedrock is designated as a Secondary A Aquifer. The Claygate Member is one of the upper members of the London Clay Formation. The main London Clay unit of the formation indicated to underly the site at depth is classified as unproductive strata.

The site and surrounding area are not located within a groundwater Source Protection Zone (SPZ).

No groundwater abstractions are located within 1km of the site.

Given the hydrogeological status of the site, the groundwater beneath the site is considered to be of low to moderate sensitivity with regards to near surface contamination given the underlying likely limited depth of bedrock deposits classified as a Secondary A Aquifer, the underlying unproductive strata at depth and the lack of abstractions and SPZs within the vicinity of the site.

The BGS groundwater flood susceptibility mapping indicates that the site is limited potential for groundwater flooding to occur on site.

The nearest surface water feature to be located 406m to the west of the site. No water features are identifiable in this location in current mapping; however, a former reservoir was located in this area. Several small ponds and stream located in Golders Hill Park and Hampstead Heath to the north and east respectively at least 430m distant from the site.

No pollution incidents to controlled waters are recorded by Envirocheck within 1km of the site and no surface water abstractions are located within 1km of the subject site.

No discharge consents to groundwater are recorded within 1km of the site.

The site and surrounding area do not fall within a flood risk zone and is not at risk of flooding and / or at risk of extreme flooding from rivers or seas without defences. The site and surrounding area do not benefit from flooding defences and there are not flood water storage areas nearby.

3.2 Historic Land Use on the Site and Surrounding Area

The available historical maps span a period of 142 years, dating back to 1871. Since this time, the site and general area has undergone a significant development, with the setting changing from that of rural to a moderately densely populated residential area.

In the earliest historical maps, the site formed part of two fields and remained as undeveloped land until the current property was constructed on site within the early-1900s with similar structures present to the northeast and southwest along Templewood Avenue. The stone flagged area and brick line walkway appears to have been added to the site some time before 1934, however, the mapping of these external feature was not consistent through the mapping extracts.

Minor alterations and extensions to the surrounding dwellings along with some infill development of residential dwellings / flats to the south in c.1966 were noted. A small area of apparent earth works was noted 100m east in the later 1960s / early 1970s. This appears to have been associated with the later use of this area as a children’s play park.

No significant changes have occurred on site since this time.

No significant commercial or industrial activities have been identified within a 100m radius of the site. No commercial and light industrial activities were recorded within 250m of the site.

3.3 Landfill Sites

The PRA Report indicates that there are no Local Authority or BGS recorded landfill sites, Historical Landfills sites, or Local Authority Recorded landfill sites located within 1km of the subject site.

3.4 Radon

The property is indicated within the Envirocheck Report to be in a lower probability radon area, with less than 1% of homes estimated to be at or above the action level. Therefore, no radon protection measures are necessary in the construction of any new dwellings, buildings, or extensions on site.

However, as no standardised test produced or guidance is available to assess radon risk to subterranean development, it is becoming common place to assume a significant Radon risk for subterranean development within Greater London, other large cities and some other areas and to include radon protection measures within such development as a precaution. The current requirements of the local authority building control should be confirmed prior to final design and before starting development.

3.5 Potential Contaminant Sources Summary

The potential contaminants are based on the data within CL8, Department of the Environment (DoE) Industry Profiles, the current and historic site uses.

Potential Contamination Sources

Current Potential On-Site Contaminant Sources	Potential Contaminants
Residential property (2 Templewood Avenue)	Asbestos and potential asbestos-containing materials (ACM) due to the age of the structure. Asbestos, metals and PAH from deleterious material within Made Ground from construction of existing dwelling.
Historic Potential On-Site Sources	**Potential Contaminants**
Residential property (2 Templewood Avenue)	Asbestos, metals and PAH from deleterious material within Made Ground from construction of existing dwelling.
Current Potential Off-Site Contaminant Sources	**Potential Contaminants**
Residential properties immediately adjacent to site and within wider area.	No significant contaminants.
Historical Potential Off-Site Contaminant Sources	**Potential Contaminants**
None noted within a distance considered viable to impact the site and the proposed development	Not applicable

3.6 Conceptual Contaminant-Pathway-Receptor Model

The information gathered from the associated Preliminary Contaminated Land Risk Assessment was compiled to produce a Contaminant-Pathway-Receptor (C-P-R) model, which has been extracted and presented below.

The risk posed to site construction workers has not been assessed as any risks are considered to be mitigated through good site practices.

Preliminary Contamination Source-Pathway-Receptor Table

Potential Site Contaminant Sources	Potential Pathways	Potential Receptors	Pathway Complete	Risk Level Classification
Current Residential property 2 Templewood Avenue Residential housing surrounding site to north, east, south and west	Dermal / direct contact	Current site users (residential plot)	Yes	Low
	Direct ingestion		Yes	Low
	Direct inhalation		Yes	Low
	Inhalation of Radon		No	
	Inhalation of wind-blown dust		Yes	Low
	Vapour migration		No	
	Ground gas migration		No	
	Dermal / direct contact	Future site users (equivalent to residential use with plant uptake)	Yes	Low
	Direct ingestion		Yes	Low
	Direct inhalation		Yes	Low
	Inhalation of Radon gas		No	
	Inhalation of wind-blown dust		Yes	Low
	Vapour Migration onto the site		No	
	Ground gas migration		No	
	Direct contact	Services (following development)	Yes	Very Low
	Migration of contaminants: non-aqueous phase		Yes	Very Low
	Migration of contaminants: aqueous phase		Yes	Very Low
	Migration of contaminants off-site: non-aqueous phase	Adjacent Properties	No	
	Migration of contaminants off site: aqueous phase		No	
	Vapour migration		No	
	Inhalation of wind-blown dust	Ecological Impacts	No	
	Migration of contaminants: non-aqueous phase		No	
	Migration of contaminants: aqueous phase		No	
	Migration of contaminants from site: non-aqueous phase	Controlled groundwater (Secondary A Aquifer)	Yes	Very Low
	Migration of contaminants from site: aqueous phase		Yes	Very Low
	Migration of Contaminants: non-aqueous phase	Surface Waters	No	
	Migration of contaminants: aqueous phase		No	

3.7 Preliminary Contamination Risk Assessment Conclusions

The preliminary contamination risk assessment has identified complete Contaminant-Pathway-Receptor (CPR) linkages with a maximum **Low** risk level from the potential contamination sources and risk drivers identified on the site and surrounding area.

There are not considered to be minimal potential source drivers representing a risk to the future site users (equivalent to residential with plant uptake). The potential source drivers are considered to be limited to deleterious material within the Made Ground resulting from the development on site. There is no significant evidence to suggest that other contamination exists on site and the anticipated Made Ground from development is likely to comprise minimal quantities based on the site having not been developed prior to the construction of the current residential property. In addition, no nearby off-site current or historical sources of contamination that could likely impact the site are present within a reasonable distance of the site boundary.

Potential contaminants on site are therefore likely to be limited to minor heavy metal or PAH contamination from inclusion of deleterious material such as fragments of brick, asphalt, cement or other construction materials incorporated into the Made Ground soils. On this basis, significant contamination is not considered likely to be present on site.

Given the proposed residential end use of the site there is the potential for proposed site users to come into contact with any potential contaminants through direct contact, ingestion and inhalation pathways. Given the sensitivity of the proposed end user, although unlikely, consideration should be given to investigation to confirm the above assumptions on the contaminations status of the site.

In addition, it is possible that the existing property on site could contain asbestos and ACMs due to the age of construction. Significant restructuring of the dwelling is proposed and as such an asbestos survey will be required prior to the commencement of such work. Given the age of the structure, should ACMs have been utilised in construction, working practices were likely to have been less stringent with regards to control and disposal of such material at this time and there is the potential for asbestos in soil from the original development at the site, although the risk of this is considered to be lower bound.

Given the discussion above, to prevent 'Significant Possibility of Significant Harm' from potential contamination sources to the proposed highly sensitive continued future residential site users it is considered necessary to carry out an intrusive soil contamination investigation at the site.

Should any unexpected contamination be identified during the future groundworks, then a suitably qualified and experienced Geo-Environmental Engineer should be consulted and if necessary further assessment should be undertaken. At this stage, no further work relating to contaminated land risk is required.

Potential Geotechnical Risk Summary

A maximum moderate potential geotechnical risk was identified with the Envirocheck Report. The moderate rating relates to the underlying Claygate Member which is known to comprise fine-grained soils which are likely subject to a volume change potential from changes in moisture content due to tree root action.

On the above basis, it is recommended that a geotechnical appraisal of the site be carried out to derive foundation design criteria.

4.0 INTRUSIVE INVESTIGATION FIELDWORKS

An intrusive investigation was outlined in the Geotechnical Site Investigation specification provided and was refined with reference to the data from the associated Preliminary Contamination Risk Assessment and Geotechnical Desk Study to establish the ground conditions beneath the site in relation to the development of a Ground Model for the proposed development.

The main fieldworks were carried out on 11th November 2021 and comprised the forming of 6no. hand excavated trial pits and 2no. Percussion Liner Sampler boreholes to 6.00m below ground level (bgl) to assess the ground conditions, recover samples, and expose existing foundation arrangements.

The boreholes and trial pits were positioned as specified by the client but amended on site by the Supervising Engineer to be located in open accessible areas and to clear buried services following a Cable Avoidance Tool (CAT) survey and consultation of buried services plans where available.

The Boreholes and Trial Pits were formed to assess the geological succession beneath the site, near surface contamination, existing foundation arrangements, presence of roots and to gather geotechnical and groundwater data to derive geotechnical design parameters and to add data to the Ground Model for the site. The details and rationale of the exploratory point placement is summarised below.

Exploratory Location Details and Rationale

Exploratory Location (Depth)	Location Details
WS1 (6.00m)	In approximate location as specified by client's engineer. In front garden area to northwest of existing property.
WS2 (6.00m)	In approximate location as specified by client's engineer. In rear garden area to southwest of existing property.
FTP1 (1.40m)	On south western corner of existing property at ground level.
FTP2 (0.95m)	On western elevation of wall at rear (southern) end of existing dwelling.
FTP3 (1.00m)	On north eastern elevation of existing dwelling.
FTP4 (1.40m)	On north western elevation of existing dwelling.
TP1 (0.90m)	Along northwestern boundary fence as per position indicate by client's representative in vicinity of Beech tree on adjacent property.
TP2 (0.80m)	Along northwestern boundary fence as per position indicate by client's representative in vicinity of Beech tree on adjacent property.

Soil strength testing was undertaken in the field employing Standard Penetration Test (SPT) carried out at 1.0m intervals within the percussion liner sampler boreholes. Hand vane soil strength testing was also carried out on suitable fine-grained soils.

The depth of the trial pits, sample details, strata descriptions and comments on the groundwater conditions are detailed on the Logs which are presented in Appendix B along with an Exploratory Point Location Plan.

All of the trial pits were backfilled with arisings once logged and tested.

Boreholes WS1 and WS2 were installed with monitoring wells to between 5.90m and 5.70m depth, comprising 5.00m – 6.00m of perforated 35mm internal diameter pipe with a screened 3-6mm gravel pack, with 0.70m to 0.90m of solid pipe at the surface and a wetted bentonite pellet seal. The wells were sealed with a bung and gas tap. The wells were sealed with a bung and gas tap and finished at surface with a stainless steel lockable stopcock cover.

A PID was used to screen samples for VOCs during the siteworks. All arisings and samples were olfactorily screened for the presence of agrichemicals.

A series of photographs taken during the fieldworks are presented in Appendix B.

4.1 Encountered Strata

The exploratory point arisings were logged by a Geotechnical Engineer generally in accordance with BS5930:2015. The geology beneath the site indicated a thin veneer of Made Ground over London Clay Formation, possibly Claygate Member, fine grained soils to the base of the boreholes. The strata encountered is detailed below.

A log of the exploratory holes and Exploratory Point Location Plan showing the positions investigated are presented in Appendix B.

MADE GROUND

Made Ground was encountered across the site within all exploratory holes to depths of between 0.40m and 1.30m bgl.

Made Ground was variable across the site within the foundation trial pits was typically encountered to slightly greater depths than within the boreholes remote from existing structures.

Made Ground within boreholes WS1 to the front of the existing dwelling comprised asphalt surfacing to 0.20m over slightly sandy clayey GRAVEL of brick, flint, concrete and igneous rock comprising sub-base for the roadway to 0.40m depth. This was underlain by soft brown slightly gravelly sandy CLAY with the gravel fraction comprising flint and rare brick to 1.00m likely comprising reworked London Clay deposits.

Borehole WS2 was undertaken in the rear garden in an area of soft landscaping and encountered grass onto brown to dark brown gravelly clayey fine to coarse SAND with a low cobble content to 0.50m depth. The gravel and cobble content comprised brick and flint.

Made Ground was noted within the foundation trial pits to maximum depths of between 0.90m and 1.30m and was variable in nature with a mixture of variably gravelly CLAY, gravelly SAND and sandy GRAVEL with the gravel fraction comprising brick, flint concrete, asphalt, and igneous rock.

From depths of around 0.30-0.80 the Made Ground in the trial pits encountered was more consistently stiff orange brown mottled grey CLAY with inclusion of brick gravel. This lower Made Ground is considered likely to comprised reworked natural London Clay Formation deposits from backfilling of trenches around foundations.

Made Ground within trial pits TP1 and TP2 comprised vegetation onto grey brown slightly gravelly slightly clayey SAND with the gravel fraction comprising flint and brick to 0.65m depth. This was underlain by soft to firm slightly gravelly sandy CLAY with brick and flint considered likely to be reworked Claygate Member to the base of the trial pits at 0.90 and 0.80m bgl respectively.

CLAYGATE MEMBER

Fine grained soils suspected to be of the Claygate Member were encountered underlying the Made Ground across the site and typically comprised firm to stiff brown mottled grey variable sandy CLAY to between 3.90m and 4.00m depth. A band of grey clayey fine to coarse SAND was noted within WS1 between 4.00-4.07m depth bgl.

LONDON CLAY FORMATION

From depths of 3.90-4.07m bgl the soils were generally less sandy and suspected to be of the London Clay Formation. These soils comprised stiff dark grey slightly sandy CLAY. Such fine grained soils were proven to the base of both boreholes at a maximum of 6.00m bgl.

ROOTS

Roots and rootlets were encountered within several of the boreholes and trial pits to a maximum depth of 1.40m depth. Several larger roots were noted within trial pits (TP1 and TP2) adjacent to the northwestern site boundary where mature trees also area present on the adjacent property. Observations on roots encountered are summarised below.

Exploratory Location (Depth)	Root observations
WS1 (6.00m)	No significant roots or rootlets encountered.
WS2 (6.00m)	Roots or rootlets encountered to depth of 1.40m.
FTP1 (1.40m)	Roots and rootlets up to 12mm in diameter up to 0.50m depth and occasional roots and rootlets up to 5mm diameter to 1.00m depth.
FTP2 (0.95m)	Roots and rootlets up to 3mm in diameter up to 0.30m depth and occasional roots and rootlets up to 2mm diameter to 0.90m depth.
FTP3 (1.00m)	Roots and rootlets up to 2mm in diameter up to 0.50m depth.
FTP4 (1.40m)	Frequent roots and rootlets up to 20mm in diameter up to 1.0m depth.
TP1 (0.90m)	Numerous roots and rootlets up to 60mm in diameter up to 0.65m depth and up to 6mm diameter up to 0.80m depth.

Exploratory Location (Depth)	Root observations
TP2 (0.80m)	Numerous roots and rootlets up to 60mm in diameter up to 0.65m depth and up to 6mm diameter up to 0.75m depth.

VISUAL CONTAMINATION

The boreholes and trial pit arisings were assessed for visual contaminants. Such contamination was typically limited to minor fragments of brick and concrete locally with glass fragments. Observation on such contamination is summarised below.

Visual Contamination

Exploratory Location (Depth)	Visual Contamination and Strata
WS1 (6.00m)	Black asphalt at surface. Fragments of brick, flint, concrete and igneous rock in Made Ground to 1.00m depth below existing driveway. No odours or staining observed.
WS2 (6.00m)	Fragments of flint and brick in Made Ground to 0.50m depth. No odours or staining observed.
FTP1 (1.40m)	Fragments of flint, brick and glass within Made Ground to 1.30m depth. No odours or staining observed.
FTP2 (0.95m)	Macadam surfacing. Fragments of brick, flint and concrete within Made Ground to 0.90m depth. No odours or staining observed.
FTP3 (1.00m)	Macadam surfacing. Fragments of igneous rock, asphalt, brick and concrete within Made Ground to 0.95m depth. No odours or staining observed.
FTP4 (1.40m)	Fragments of flint, brick, glass and concrete within Made Ground to 0.80m depth and rare gravel sized brick fragments up to 1.30m depth. No odours or staining observed.
TP1 (0.90m)	Fragments of brick and flint to base of trial pit at 0.90m depth. No odours or staining observed.
TP2 (0.80m)	Fragments of brick and flint to base of trial pit at 0.80m depth. No odours or staining observed.

4.2 Groundwater Conditions

Groundwater was not encountered during the initial hand excavation and drilling works to the maximum depth of 6.00m bgl.

Subsequent monitoring of the groundwater level has been carried out on a total of 3no. occasions within the wells installed in both boreholes which is summarised below.

Exploratory Location (Depth)	Groundwater Level (m bgl) and Monitoring Data			
	11/11/2021 (Siteworks)	30/11/2021	11/10/2021	27/10/2021
WS1 (6.00m)	Dry to 6.0m	3.30	3.10	2.80
WS2 (6.00m)	Dry to 6.0m	1.30	1.20	N/A*
Notes Access to WS2 in rear garden unavailable.				

It should be noted that drilling can mask some minor seepages where present within sandy CLAY with sand partings allowing a preferential pathways for groundwater within the larger impermeable Clay unit. In addition, where such minor seepages enter into the standpipes, due to the impermeable nature of the parent fine grained unit the water is then unable to dissipate. The water levels in the wells are considered to be related to the ingress of such minor seepages, and / or surface water entering the wells and being trapped. As such the subsequent measured groundwater levels are not considered to be representative of the true groundwater table in the fine grained soils beneath the site as no water strikes were noted during the drilling works.

4.3 Ground Gas Conditions

Ground gas monitoring was not carried out as significant drivers were not identified during the associated PRA process. In addition, no significant depths of Made Ground or highly organic deposits were observed during the fieldwork that would constitute a previously unidentified source of ground gas gases.

Both boreholes were installed with monitoring wells to allow future monitoring of groundwater and the well were designed and installed to also be able to be utilised for monitoring of ground gas levels if required at a later date.

4.4 Sampling Strategy

Disturbed samples of the strata encountered were recovered at regular intervals within all of the exploratory points to the full depth of the investigation for geotechnical laboratory testing.

Samples were also recovered in suitable containers for chemical analysis from the top metre of soils from the general site area. Shallow samples were also olfactorily screened for agrichemicals and hydrocarbons, and also screened using headspace analysis and a PID for VOCs.

5.0 CONTAMINATION ASSESSMENT

5.1 Chemical Analysis

A total of 8no. soil samples were sent to an external laboratory to obtain total soil concentrations for a range of priority contaminants.

The suite of analysis was decided based on consultation of the Contamination Exposure Assessment (CLEA) supporting documents and consideration for the former site and surrounding area land uses.

The suite of testing included:

- Asbestos screen, for near surface Made Ground samples
- Metals and Inorganic compounds
- Polyaromatic Hydrocarbons (PAH) USPEA Priority 16 Compounds
- Total Petroleum Hydrocarbons (TPH) EC10-EC40 screen

Results of the chemical analysis are presented in Appendix C.

5.2 Human Health Assessment Criteria

The assessment has been carried out in accordance with the Contaminated Land Exposure Assessment (CLEA) methodology as detailed within LCRM 2020. The assessment criteria employed are based on the proposed final residential land use of the site. For this site, a worst-case proposed land use of 'Residential with Home Grown Produce' will be employed for all areas of the site.

In March 2014 DEFRA published new guidance detailing the Category 4 Screening Levels (C4SL) system for the classification of contaminated land. The C4SL system was published to assist with revised statutory guidance published in 2012 for Part 2a of the Environmental Protection Act.

It introduces a new four category system for the classification of land under Part 2a where a Significant Possibility of Significant Harm to human health has been concluded. The categories correspond to Category 1 – land where the level of risk is clearly unacceptable, to Category 4 – where the level of risk posed is acceptably low. In short, land that passes the category 4 test "should not be capable of being determined as contaminated land under Part 2a".

Currently no statutory chemical guidance levels for land and controlled waters contamination exist in the UK. Therefore, the reported soil total contaminants concentrations will be compared to In-House Generic Assessment Criteria (GAC) used as C4SLs.

These In-House GACs are presented in Appendix C and are generally based on the LQM/CIEH S4UL values.

The S4UL values employed are based on a Soil Organic Material (SOM) concentration of 2.5% for the initial screening.

A S4UL has not been published for lead. The GAC value employed has been derived using the DEFRA C4SL[1] toxicological data and exposure parameters and the CLEA Software V1.071:2015.

The C4SL value employed for the lead GAC, for a residential with plant uptake land use scenario, is based on a blood lead level of 3.5ug/dl for the lower level of toxicological concern employing the Integrated Exposure Uptake Biokinetic model (IEBUK) estimated blood lead concentrations in children and employs the exposure parameters within the DEFRA C4SL report.

[1] DEFRA SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Final Project Report (Revision 2) 2014

A minimal risk approach was employed to derive the S4UL values, whereas the C4SL model uses a lower level for risk model, which is deemed generally less conservative than the minimal risk approach. However, the use of a lower level for risk model screening criteria is considered strongly precautionary and is generally considered appropriate for use within the planning regime.

However, with consideration of the C4SL and S4UL values there still remains some gaps in the available chemical and/or toxicological data for non-priority contaminants and therefore a limited number of previously used CLEA SGVs and ICRCL guideline values have been retained and include those for pH, sulphide, sulphur and water-soluble boron.

Should an exceedance be noted when site priority contaminant concentrations are compared to the employed GACs, a site specific assessment criteria can be derived using CLEA software or similar human health risk assessment software. This can also include consideration of bio-availability of the contaminants if required.

Further to the above, samples of near surface Topsoil and Made Ground are generally screened for asbestos presence. Generic assessment criteria do not exist currently for asbestos presence in soil within the UK. Therefore, where asbestos is identified in soil it is recommended that further risk assessment be carried out by suitably qualified and registered persons.

5.3 Groundwater Assessment Criteria

A detailed controlled water risk assessment was outside the scope of this report.

6.0 GENERIC HUMAN HEALTH SITE CONTAMINATION RISK ASSESSMENT

Statistical analysis of the data set is carried out employing the statistical method detailed in CL:AIRE Document 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', if exceedances are noted on individual comparison of the contaminant concentrations to the employed assessment criteria, which allows a derivation of a true mean concentration (μ).

The statistical analysis also assesses if the data is normally distributed and considers high levels to determine if they are part of the underlying data set due to 'site wide contamination' or due to contamination 'outliers'.

The statistical analysis derives a 95th percentile upper confidence limit of μ for each determinands for comparison to the suitable employed guidance level (GAC) or 'Critical Concentration (Cc)'.

The reported soil sample total contaminant concentrations data set was placed into a single averaging area comprising the near surface soils across the site. Further to the statistical analysis the chemical results were compared individually to the relevant GACs.

6.1 Total Soil Concentrations – Shallow Soils <1.0m Depth

The priority contaminant concentrations from the 8no. samples of shallow soils analysed, and a summary of the results are presented in Appendix C and are detailed in the following section.

Heavy Metals

The assessment of the reported **lead** concentrations within the shallow soil samples analysed indicated 95th percentile upper confidence limit of μ concentrations which were in excess of the relevant Residential with Home Grown Produce GACs employed for all determined.

The comparison of all other reported metal and metalloid concentrations within the shallow soil samples analysed indicated 95th percentile upper confidence limit of μ concentrations which were below the Human Health GAC for a Residential with Home Grown Produce land use employed.

Individual analysis of the heavy metal priority determinand concentration data set to the relevant GAC indicated exceedances of lead within five Made Ground samples of the eight shallow soils samples (WS1, WS2, FTP1, FTP2 and FTP4) subject to testing.

The measures concentrations were also compared to phytotoxicity guidance criteria and individual comparison indicated no elevated phytotoxic zinc or phytotoxic copper concentration in the samples subject to testing.

Elevated concentrations are summarised in the table below.

Metals and Metalloid Exceedances

Determinand	Assessment Criteria (mgkg-1)	Exploratory Position and Depth (m bgl) (strata)	Maximum Reported Concentration (mgkg-1)	95th Percentile Upper Confidence Limit (mgkg-1) (with exceedances removed)
Lead	190	WS1 at 0.30m WS2 at 0.40m FTP1 at 0.30m FTP2 at 0.20m FTP4 at 0.50m	280 260 460 1900 560	862 (386)

Hydrocarbons

The comparison of the reported hydrocarbon concentrations within the shallow soil samples analysed indicated 95th percentile upper confidence limit of μ concentrations which were below the Human Health GAC for a Residential with Home Grown Produce land use employed except for the PAH priority contaminant dibenzo(a,h)anthracene.

Individual comparison of the other priority contaminant concentrations data set to the relevant GAC indicated exceedances of the PAH indicative compounds benzo(a)pyrene and dibenzo(a,h)anthracene in the samples subject to testing.

Hydrocarbon Exceedances

Determinand	Assessment Criteria (mgkg-1)	Exploratory Position and Depth (m bgl) (strata)	Maximum Reported Concentration (mgkg-1)	95th Percentile Upper Confidence Limit (mgkg-1) (with exceedances removed)
Benzo(a)pyrene	2.70	FTP3 at 0.20m	4	1.90 (Not elevated)
Dibenzo(a,h)anthracene	0.28	FTP2 at 0.20m FTP3 at 0.20m	0.36 0.76	0.35 (0.05)

Assessment of the arisings on site using a PID did not indicate any detectable VOCs.

Olfactory assessment of the samples recovered, and soil arisings did not indicate any detectable hydrocarbon odours.

Other Priority Contaminants

The comparison of the reported total other priority contaminant concentrations within the shallow soil samples analysed indicated 95th percentile upper confidence limit of μ concentrations which were below the relevant Residential with Home Grown Produce GACs employed for all determined.

Asbestos

Screening for the presence of asbestos was also carried out on 8no. samples. No asbestos was detected within any of the sample subject to testing.

The laboratory testing results are included within Appendix C.

6.2 Controlled Groundwater Risk Assessment

A detailed controlled groundwater risk assessment was outside the scope of this report.

6.3 Ground Gas Risk Assessment

Ground gas monitoring was not carried out as significant drivers were not identified during the associated PRA process. In addition, no significant depths of Made Ground or highly organic deposits were observed during the fieldwork that would constitute a previously unidentified source of ground gas gases.

6.3.1 Ground Gas Risk Assessment (Radon)

Notwithstanding the risk posed due to ground gases such as carbon dioxide and methane, as the proposed development is to include a basement the risk from Radon should also be considered. The property is indicated within the Envirocheck Report to be in a lower probability radon area, with less than 1% of homes estimated to be at or above the action level. On this basis the guidance indicates no radon protection measures are necessary in the construction of any new dwellings, buildings or extensions on site.

However, as no standardised test has been produced or guidance available to assess radon risk to subterranean development, it is becoming common place to assume a significant Radon risk for subterranean development within Greater London, other large cities and some other areas and to include radon protection measures within such development as a precaution.

The current requirements of the local authority building control should be confirmed prior to final design and before starting development.

6.4 Soil Waste Assessment

The HazWaste online classification system was employed to assess the waste classification employing the total determinand concentrations within samples of the near surface and underlying Natural soils, in relation to groundworks arising disposal. This indicated the near surface soils tested to have a Non-Hazardous classification with EWC code **17 05 04.**

In addition, the eight samples of the Made Ground soils were subject to screening for asbestos. None of the samples subject to testing indicated positive for asbestos.

Waste Acceptance Criteria (WAC) testing was also carried out on composite sample of the near surface Made Ground and natural soils to determine if the soils tested could be disposed of into an inert facility. This indicates that the near surface soils tested had leachable determinand levels generally below the related guidance levels for disposal into an inert facility.

The results of the soil waste classification testing are presented in Appendix C.

On the above basis, it is considered that the near surface Made Ground and natural soils tested would classify as non-hazardous waste and likely be suitable for disposal into an inert facility.

All waste classification should be confirmed with the waste receiving facility prior to disposal. The waste receiving facility, especially if not an inert landfill, may also require the total soil priority contaminant concentrations which are also presented in Appendix C.

6.5 Potable Water Supply Pipe

Guidance on the type of potable water supply pipe to be employed on residential development sites is given by UKWIR, who have published guidance for the type of potable water supply pipework to be employed for new structures on reused land.

The existing dwelling is likely already served by an existing potable water supply which will likely remain following the redevelopment of the site. Should a new potable water supply be proposed or rerouting of the existing supply be required new service runs in a clean soil corridor may be required.

Samples were recovered from both shallow Made Ground and approximate suspected pipe burial depths (c.0.80m depth) on the site. These samples were analysed for a suite of contaminants which are considered to be in accordance with the UKWIR requirements. The analysis results indicated elevated hydrocarbons (TPH(C10-C40) and PAH) concentrations in some shallow Made Ground samples above the relevant guidance values. No elevated hydrocarbons (TPH(C10-C40) and PAH) concentrations were recorded above the relevant guidance values in the sample from suspected pipe burial depths (c.0.80m depth) on the site.

Therefore, conventional PE pipe is unlikely to be suitable for the potable water supply pipework on the site where laid within or penetrating through Made Ground soils and barrier style pipe should be employed.

The classification will be decided by the local water company and their advice should be sought prior to the laying of any potable water supply pipework. The local water company may require furthermore detailed sampling, testing and assessment prior to pipe selection and all pipework should be laid in corridors of clean soil.

6.6 Site Contamination Assessment Discussion

Generally low levels of priority contaminants were noted in the shallow soils from across the site when compared to the employed most stringent residential with plant uptake GACs, with the exception of elevated concentrations of lead in shallow Made Ground across the site and locally elevated indicative PAH compounds. Fragments of brick, flint, asphalt, concrete and glass were observed within the Made Ground in the exploratory positions along with macadam surfacing in the vicinity of FTP2 and FTP3 which are likely the source of the elevated concentrations of lead and PAHs. No odours or staining was observed within the exploratory point. No elevated concentrations were identified within the sample of underlying natural London Clay Formation soils tested.

Given the above, the shallow soils are considered to potentially pose an unacceptable risk to the proposed highly sensitive end site users. Therefore, soil risk reduction or remediation works are potentially necessary in the open areas of the proposed development. The identified contamination was not identified to be volatile and as such remedial works will not be required beneath proposed hardstanding areas such as roadways and the building footprint.

Given the proposed development is to installation of the new lower ground level across the footprint of the existing dwelling and extending to the south of the current building line this will effectively remove a significant portion of the Made Ground soils. Thereby effectively remediating the majority of the site areas.

Where the full depth of Made Ground soils is removed from the site as part of the basement excavation / site strip then again, this will effectively remediate these areas of site and no further works will be required. Where Made Ground is to remain on site remedial works will be required, mostly likely comprising separations of the future site end users from the legacy contamination within the Made Ground soils by a combination of excavation and removal of Made Ground and installation of a cover system comprising imported chemically clean Topsoil.

A Remediation Options Appraisal and Method Statement (RMS) would be required by concerned regulatory parties for any soil and ground gas remediation works on the site.

It is possible that Radon protection measures may be required, however, the current requirements of the local authority building control should be confirmed prior to final design and before starting development.

Notwithstanding the above assessment, if any unexpected or previously unidentified contamination is discovered during the site development works, a suitably qualified and experienced person should be contacted so any further assessment required can be carried out.

6.7 Updated Conceptual Site Model

An assessment of the risk posed by the identified contaminant concentrations has been carried out employing the Source-Pathway-Receptor (S-P-R) methodology detailed within the CLEA methodology.

Updated SPR Flowchart

Potential On-Site Contaminant Sources	Potential Pathways	Potential Receptors	Pathway Complete
Elevated lead across the site and locally PAH compound in shallow Made Ground **No asbestos identified within the samples subject to screening.** **Radon protection measures may be required – consultation with local authority building control required.**	Dermal/Direct Contact	Current site users (Residential Property)	Yes
	Direct Ingestion		Yes
	Direct Inhalation		Yes
	Inhalation of Radon Gas		Pending confirmation by LA
	Inhalation of Wind Blown Dust		Yes
	Vapour Migration		No
	Gas Migration		No
	Dermal/Direct Contact	Future site users (equivalent to residential use with plant uptake)	Yes
	Direct Ingestion		Yes
	Direct Inhalation		Yes
	Inhalation of Radon Gas		Pending confirmation by LA
	Inhalation of Wind Blown Dust		Yes
	Vapour Migration		No
	Ground Gas Migration		No
	Direct Contact	Services	Yes
	Migration of Contaminants – Non-Aqueous Phased		No

Potential On-Site Contaminant Sources	Potential Pathways	Potential Receptors	Pathway Complete
	Migration of Contaminants – Aqueous Phased	(following development)	No
	Migration of Contaminants – Non-Aqueous Phased	Adjacent Properties	No
	Migration of Contaminants – Aqueous Phased		No
	Vapour Migration		No
	Inhalation of Wind Blown Dust	Ecological Impacts Services (following development)	No
	Migration of Contaminants – Non-Aqueous Phased		No
	Migration of Contaminants – Aqueous Phased		No
	Migration of Contaminants from site – Non-Aqueous Phased	Controlled groundwater (Unproductive strata) Adjacent Properties	No
	Migration of Contaminants from site – Aqueous Phased		No
	Migration of Contaminants – Non-Aqueous Phased	Surface Waters	No
	Migration of Contaminants – Aqueous Phased		No

The risk to construction workers has not been assessed as generally any risks posed to site construction workers from identified contamination can be mitigated through good site practices and robust sitework risk assessment following guidance stated in CIRIA Report 132: 'A Guide for Safe Working on Contaminated Sites' and CIRIA Report C741: 'Environmental Good Practice on Site' during development works. Adequate standard personal protective equipment should be available and the implementation of basic hygiene measures should be ensured.

Works carried out on sites where asbestos fibres have been identified **must** be carried out by a suitable contractor and a site specific Health and Safety Plan for site construction workers must be produced in line with CAR 2012[2].

[2] Control of Asbestos Regulations 2012

7.0 FOUNDATION DESIGN CRITERIA

7.1 Geotechnical Laboratory Testing

Representative samples were sent to an external laboratory following visual assessment and logging of the exploratory point arisings. The testing programme was designed to classify the properties of the encountered soils and to determine the chemistry of the soil in relation to the design of buried concrete.

7.1.1 Atterberg Limits

The results of 7no. Atterberg Limit determinations carried out on samples of fine-grained soils encountered are presented in Appendix D.

The soils tested have been assessed for their volume change potential (VCP) in accordance with NHBC Standards Chapter 4.2 and are detailed in the table below.

Atterberg Limit Testing

Exploratory Point and Strata	Depth (m)	Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing 0.425mm	NHBC Modified Plasticity Index	NHBC Volume Change Potential
WS1	0.90	19	27	17	10	95	9.5	Non-Plastic
WS1	2.90	25	44	19	25	100	25	Medium
WS2	3.70	25	51	21	30	100	30	Medium
FTP1	1.40	21	54	20	34	100	34	Medium
FTP2	0.90	21	55	18	37	100	37	Medium
FTP3	1.00	19	41	18	23	98	23	Medium
FTP4	1.40	21	55	18	37	100	37	Medium

A sample of Made Ground from WS1 has a Modified Plasticity Index (MPI) of 9.5% and therefore can be classified as **Non-Shrinkable** Volume Change Potential employing the NHBC and LABC classification scheme.

The samples of fine-grained London Clay Formation and possible Claygate Member soils have Modified Plasticity Indices (MPI) of between 25% and 37% and therefore can be classified as **Medium** Volume Change Potential employing the NHBC and LABC classification scheme.

7.1.2 Natural Moisture Content

A test was performed to determine the natural moisture content (NMC) of the fine-grained soil samples from those samples subjected to Atterberg Limit testing.

7.1.3 Particle Size Distribution

Particle Size Distribution (PSD) testing was not carried out as no suitable soils were identified during the site works.

7.1.4 pH and SO_x

The level of pH, sulphate and other determinands within the BRE SD1 Suite have been determined for selected samples from above and at the proposed likely shallow foundation invert level, to assess the appropriate Design Sulphate Class for buried concrete in accordance with BRE Special Digest 1 Table 2. The results of the analysis are presented in Appendix C along with the chemical laboratory results.

The table below summarises the reported pH values, Total Sulphate and 2:1 Water Soluble Sulphate concentrations.

The assessment assumes that all of the Total Sulphate (%) is in a suitable form that following ground disturbance could oxidise.

Design Sulphate Class for Site

Borehole	WS1	WS1	WS1	WS2	WS2	WS2	WS2	FTP1	FTP4
Depth	0.80	1.90	3.90	0.70	1.70	2.70	4.70	0.80	1.40
Strata	MG	LCF	LCF	LCF	LCF	LCF	LCF	MG	LCF
pH	7.9	7.6	7.1	7.2	7.5	7.8	8.3	8.3	7.7
Total Sulphate (%)	0.0094	0.016	0.013	0.013	0.0098	0.018	0.049	0.012	0.049
Water Soluble Sulphate (2:1 Water Extract) (mg/l)	17	5.2	34	14	11	19	240	22	160
Appropriate Design Sulphate Class	DS-1	DS-1	DS-1	DS-1	DS-1	DS-1	DS-1	DS-1	DS-1

Note
MG Made Ground
LCF London Clay Formation (including Claygate Member)

The assessment assumes that all of the Total Sulphate (%) is in a suitable form that following ground disturbance could oxidise.

The Design Sulphate Class was consistent between the Made Ground (reworked London Clay) and natural London Clay Formation soils across the site and with depth. The results indicated a classification of **DS-1**.

A worst case Aggressive Chemical Environment for Concrete (ACEC) site classification is **AC-1s.**

7.2 In-Situ Testing

Standard Penetration Testing (SPT) was carried out at 1.0m centres to full depth within boreholes and N-values values are presented with the Exploratory Point Logs within Appendix B and are tabulated in Appendix D. A Hand Vane was employed on fine grained soils within the intact borehole arisings and trial pits to assess the shear strength of the fine-grained soils encountered. The hand vane results are presented on the Exploratory Point Logs within Appendix B.

No SPTs were undertaken in what is considered to be Made Ground soils. The fine-grained Made Ground – reworked London Clay Formation soils were generally of low to medium strength with a hand shear vane readings of 26kPa at 0.90m in WS1.

The SPT N values within the shallow fine grained natural Claygate Member soils and deeper London Clay Formation soils the SPT N values ranged from 6 to 9 at 1.00m and from 10 to 19 at 2.00m to 5.00m corresponding soil strength of 30kPa to 45kPa at 1.00m and 50kPa to 95kPa below, employing the correction by Stroud and Butler, 1975 for soils with a PI<40%.

A Hand Vane was employed on fine grained soils within the intact borehole arisings and trial pits to assess the shear strength of the fine-grained soils encountered. The shallow natural Claygate Member soils and deeper London Clay Formation soils were generally of medium to high strength at depths of below 0.90m with hand shear vane readings of between 59kPa and 117kPa.

The hand shear vane strengths from the borehole indicate a drop in strength with increasing depth in both boreholes. The borehole WS1 is located within influencing distance of several large trees and shrubs and WS2 was undertaken in the vicinity of a mature oak tree and several other trees. As such the reduction in shear strength could potentially indicate over stiffening of the near surface soils due to desiccation resulting from the action of the tree roots. The SPT N-value results are generally consistent with a slight increase in depth contrary to the in-situ hand vane testing.

The fine grained soil shear strength derived from hand shear vane testing is generally considered more accurate than those from SPTs.

8.0 ENGINEERING EVALUATION

8.1 Introduction

The proposed development includes the lowering and extension of the existing partial lower ground floor, including the localised lowering of the lower ground floor to the rear of dwelling for installation of a swimming pool.

The new lower ground floor is to extend to the rear (southeast) of the existing building line and form a roof terrace. In addition, the proposals involve the reconfiguration and renovation of the existing property with the existing loft space to be converted into a play room.

The proposed also include provision for a new garden studio structure on the southwest corner of the rear garden.

8.2 Foundation Design Considerations

Made Ground was encountered across the site within all exploratory holes to depths of between 0.40m and 1.30m bgl, generally up to a maximum of 1.00m remote from structure and up to 1.30m within the trial pit adjacent to structures. Below depths of between 0.30m-0.80m the Made Ground appear to comprise reworked London Clay Formation deposits, likely disturbed during the initial groundworks and development of the existing dwelling.

Fine grained soils likely to be of the Claygate Member deposits were encountered underlying the Made Ground across the site and typically comprised firm to stiff brown mottled grey variable sandy CLAY to c.3-4m and stiff dark grey slightly sandy CLAY likely of the London Clay Formation was encountered to the base of the boreholes at a maximum of 6.00m depth bgl.

Groundwater was not encountered during the initial hand excavation and drilling works to the maximum depth of 6.00m bgl. Subsequent monitoring of the groundwater level within the wells installed in WS1 and WS2 indicated groundwater levels of between 1.20m and 3.30m depth.

It should be noted that drilling can mask some minor seepages where present within sandy CLAY with sand partings allowing a preferential pathways for groundwater within the larger impermeable Clay unit. In addition, where such minor seepages enter into the standpipes, due to the impermeable nature of the parent fine grained unit the water is then unable to dissipate. The water levels in the wells are considered to be related to the ingress of such minor seepages, and / or surface water entering the wells and being trapped. As such the subsequent measured groundwater levels are considered unlikely to be representative of the true groundwater table in the fine grained soils beneath the site as no water strikes were noted during the drilling works.

Within the natural shallow Claygate Member soils and deeper London Clay Formation soils the SPT N values ranged from 6 to 19 at depth ranging from 1.0 to 5.0m depth in the boreholes indicating corresponding soil strength of 30kPa and 95kPa employing the correction by Stroud and Butler, 1975 for soils with a PI<40%. The fine-grained soils were generally of high strength at depths of below 0.90m with hand shear vane readings of between 59kPa and 117kPa. The hand shear vane strengths from the borehole indicate a drop in strength with increasing depth in borehole WS2 which was undertaken within the vicinity of a mature oak tree and several other trees and potentially indicates over stiffening of the near surface soils due to desiccation resulting from the action of the tree roots.

The fine grained soil shear strength within the fine grained soils encountered were typically medium to high strength from a depth of 1.0m bgl. The shear strength profile shows a slight reduction in strength with increasing depth in both boreholes.

WS1 is located within influencing distance of several large trees and shrubs and WS2 is adjacent to a mature oak tree and this is potentially indicative of near surface stiffening due to desiccation.

The London Clay Formation deposits were confirmed by laboratory testing to be of a Medium volume change potential (VCP).

8.3 New Structure Foundation Design Criteria

8.3.1 Soil Volume Change Assessment

The current proposals for the redevelopment of the main dwelling basement involve lowering of the basement slab. This lowered basement slab is indicated to be at a level of c 94.7mAOD which is c.3.70m below existing ground level to the front (north) and c. 1.50m below ground level to the rear (south) of the property. On this basis the formation level of the slab is likely to lie at depth of between c.2.00m to 4.20m bgl assuming a construction of c.0.50m thickness for the basal slab construction. In addition an addition 1-2m of excavation is likely to be undertaken for the area of the proposed swimming pool to the rear of the property. The proposed basement is considered likely to be constructed using hit and miss sequenced underpinning.

In addition, a new garden studio is proposed at the southern end of the garden which may require foundations, as opposed to a shed on slabs for example, dependent upon the nature and style of construction of the unit.

Therefore, the basal level of the proposed basement at the front (north) is considered likely to be below the depth of tree root interaction with the medium VCP London Clay Formation soils.

However, the potential shallow foundation of the garden studio and the basal level of the proposed basement at the rear (south) of the property is considered to potentially be within influencing distance of tree root interaction with the medium VCP London Clay Formation soils.

Given the medium VCP soils present beneath the site consideration of the possible effects of soil volume change should be considered on the basal slab and external walls of the basement.

As a minimum, a foundation depths assessment should be carried out to assess the depth of potential influence of the exiting trees using an approved method and a medium VCP for the London Clay Formation soils with data from a current Arboricultural Survey, a final detailed development layout and details of the proposed planting and final assessment of the tree species and those to be retained.

8.3.2 Shallow Excavations

Excavations should be readily achieved within the near surface soils using conventional plant.

Generally a thin cover of Made Ground soils was encountered within the boreholes and trial pits (maximum 1.30m bgl) with Made Ground from around c.0.50 being essentially reworked London Clay deposits. The Made Ground soils generally were noted to be in a firm state. On this basis shallow excavations within the Made Ground are at a potential risk of instability and shoring should be considered.

Groundwater was not encountered during the drilling works to a depth of 6.00m bgl. Subsequent monitoring of the groundwater level has been carried out on 3no. occasions within the wells installed in both boreholes and encountered steady levels of between 2.80m and 1.20m in WS1 and WS2 respectively. Therefore, the measured groundwater is suspected to be either inflow from surface or near surface via the Made Ground strata or due to potential minor groundwater seepages within sand horizons in the London Clay insufficient to result in measurable groundwater build up during drilling / excavation. As such, significant groundwater is not considered likely to be encountered at shallow depth within Made Ground or deeper London Clay Formation strata. Groundwater resulting from minor seepages should be easily controlled by nominal groundwater control.

Due to the impermeable and low permeability of the underlying Claygate Member and London Clay Formation soils inflows from rainfall or surface run off will not dissipate and dewatering of excavations may be required during inclement weather.

At no time should any excavations be entered by personnel without correct shoring and only after an assessment of whether the task can be completed without entry to the excavation has been completed.

8.3.3 Floor Slabs

In accordance with the NHBC standards, where not underlain by basement, as fine grained soils of high volume change potential are present at formation level across the site, it is recommended that suspended floor slabs with an underfloor void be adopted.

8.4 Foundation Options Discussion

The proposals involve the lowering of an existing basement and construction of a new basement to the front of the site beneath the current building footprint. For small domestic basements of this type the preferred construction method is typically hit and miss underpinning of some of the existing structure for the installation of the proposed basement.

Foundations of the proposed lowered basement underpins and basal slab are considered likely to bear onto the medium VCP London Clay Formation soils at a level of 94.7mAOD which is some c.2.00m to c.4.20m bgl, assuming c.0.50m for the slab construction thickness.

Conventional foundations are likely to be suitable for the garden studio on the southwest of the site. Conventional foundation, such as spread and isolated pads, placed into variable soils and potentially desiccated soils are generally subjected to increased risk of settlement, especially differential settlement. A detailed building near trees assessment should be undertaken for any proposed structures to be founded on the fine grained shallow Claygate Member soils that are in the vicinity of existing trees to be retained or proposed planting assuming a medium VCP for fine grained soils beneath the site. For conventional foundation outside the influence of any trees and bearing onto the medium VCP Claygate Member soils a minimum foundation depth of 1.25m bgl should be employed to be protective of new planting.

Groundwater was not observed within any of the exploratory positions during the site works and significant groundwater is not anticipated to be encountered during excavation on site. Nominal groundwater control may be required and should be sufficient for control of minor groundwater seepages and ingress of rainwater and surface water due to the impermeable nature of the underlying London Clay Formation deposits.

The above foundation options and design approaches are subject to detailed Structural Engineer design and regulator agreement.

8.5 Bearing Capacity

For new strip foundations, such as the underpins and proposed basement retaining walls, bearing on soils at a depth of 2.00-4.00m below existing ground levels, an conservative allowable bearing capacity would be in the order of **160kPa**.

For a raft foundation or ground bearing floor slab, such as the floor slab for the proposed basement, bearing on soils at a depth of c. 2.00-4.00m below existing ground levels, a conservative allowable bearing capacity would be in the order of **160kPa**.

These estimates include a factor of safety of 3 against general shear failure and should keep settlements within tolerable limits.

All excavations for the footings should be inspected by a suitably qualified person to assess the variability of the soils and groundwater conditions. If, following inspection, the soil conditions differ from those identified within this geotechnical appraisal the recommendations may require reassessment.

Any roots, organic matter, and in particular any 'soft/loose', or otherwise unsuitable material encountered at the founding depth, should be removed prior to pouring of any concrete.

8.6 Retaining Structures Design Criteria

It is considered that retaining structures may be required for the proposed basement works. Groundwater was not encountered during the site works to 6.00m bgl with subsequent monitoring recording groundwater levels at depths of between 1.20m bgl and 2.80m bgl. However, this is considered likely to be surface inflows or minor groundwater seepages within sand horizons resulting in slow build up of groundwater that cannot dissipate due to the impermeable nature of the underlying London Clay Formation deposits and not an accurate representation of the true groundwater table.

Site specific testing was not carried out for the derivation of retaining structure design coefficients. However, much geotechnical data is available for the strata encountered beneath the site from published sources such as BS8004:2015, best practice, and PGE's experience of similar ground conditions in the area of the site.

Therefore, the most appropriate effective stress design coefficients have been selected and are summarised below. The design values may be taken as 'worst credible' following the guidance of CIRIA C580 Embedded retaining walls – guidance for economic design: 2003.

Retaining Structure Design Criteria

Strata	Bulk Density (Mgm^{-3})	Effective Cohesion (c') kNm^{-2}	Effective Friction Angle (φ') (degrees)
Made Ground	1.60	0	20°
Claygate Member and London Clay Formation	1.90	0	22°

8.7 Basement Excavation

Excavations should be readily achieved within the near surface soils using conventional plant or by hand.

On the basis of the investigation and monitoring data obtained to date it is considered that an excavation up to a depth of c. 4.00m bgl are not considered likely to encounter significant groundwater at its base. However, some minor groundwater seepages within sandy horizons may be encountered but should be controlled by nominal dewatering.

8.8 Excavation Heave

The basement finished floor slab is to lie at a level of 94.7mAOD with excavation likely to vary between c.1.50m and a maximum of approximately 4.00m depth below existing lower ground floor or ground level at the southern and northern end of the site respectively. These levels assume c.1.50m to 3.70m bgl between existing and proposed basal slab level and c.0.50m for concrete floor slab and blinding), and this soil removal is likely to result in the unloading of the formation soils by some 40 kN/m^2 to 70kN/m^2 across the footprint of the dwelling and this should be considered in basement slab design.

As a result of the excavation the stress reduction could potentially result in heave movements within the London Clay Formation.

No groundwater was encountered to the maximum depth of excavation at 6.00m bgl and groundwater level recorded subsequently are likely to be due to minor seepages or surface inflow and not considered to be representative of the true groundwater table. Some minor groundwater seepages within sandy horizons may be encountered but should be controlled by nominal limited dewatering.

On this basis there is unlikely to be significant hydrostatic pressures from groundwater at the proposed basement depth of c.2.00-4.00m bgl.

The site is located within an area listed as having limited potentially for groundwater flooding to occur. The slab design should however take into account potential accidental flood conditions.

In addition to the above, as potential over stiff soils have been encountered at shallow depth within the boreholes on site, suggesting potential desiccation of these soils, it is considered that the rear lower proposed floor lowering area is likely within the influence of a number of trees especially a large Oak tree centrally in the rear garden and Beech trees on an adjacent site. It is recommended that a NHBC style 'building near trees' assessment be carried out for the proposed structure employing the species and location data for the impacting trees and a medium VCP for the Claygate Member and London Clay Formation soils. This assessment may indicate that deepening of the basement basal level locally is required to beyond the zone of potential impact of these trees, if plausible, to mitigate any associated fine grained soils heave pressures resulting from changes in soil moisture content.

8.9 Sub-Surface Concrete

The Design Sulphate Class for the site was consistent across the site and with depth indicating a classification of DS-1.

A worst case Aggressive Chemical Environment for Concrete (ACEC) site classification is AC-1s.

8.10 Foundations of Existing Structures

Hand excavated Trial pits were undertaken on the existing property to investigate existing foundation arrangements. Trial pits FTP1 and FTP2 was undertaken externally on the rear southwest corner of the dwelling. Trial pit FTP3 was undertaken on the northeast elevation and trial pit FTP4 was located on the northwestern corner of the existing dwelling.

Schematic sections of the foundation exposures are presented within Appendix B.

9.0 CERTIFICATION

This report is produced for the sole use of the Client, and no responsibility of any kind, whether for negligence or otherwise, can be accepted for any Third Party who may rely upon it.

The conclusions and recommendations given in this report are based on our understanding of the future plans for the site and based on a scope of works agreed by the Client and afforded by the agreed budget. No responsibility is accepted for conditions not encountered, which are between exploratory points or outside of the agreed scope of work.

If the future plans for the site are changed, such as the site is developed for a more or less sensitive use, then a different interpretation might be appropriate.

The report has been prepared generally following the guidelines and principles established in the British Standards, BS5930:1999+A2:2010, BS 10175:2011, entitled 'Investigation of Potentially Contaminated Sites – Code of Practice' and the DEFRA/EA Contaminated Land Reports CLR7 and CLR8.

It necessarily relies on the co-operation of other organisations and the free availability of information and total access. No responsibility can, therefore, be accepted for conditions arising from information that was not available to the investigating team as a result of information being withheld or access being denied.

This report may suggest an opinion on a suspected configuration of strata or conditions between exploratory points and below the maximum depth of investigation. However, this is for guidance only and no liability can be accepted for its accuracy. Comments on the groundwater conditions are based on observations made at the time of the investigation unless otherwise stated. It should be noted, however, that groundwater levels might vary due to seasonal or other effects.

It should be noted that this report is based solely on the samples collected in the borehole locations investigated. During the works and following general site clearance, should the sub-soil conditions in other areas of the site appear to be inconsistent with those found in the areas sampled then this geotechnical appraisal and site contamination assessment may need to be reviewed.

This report is prepared and written in the context of the proposals stated in the introduction to this report and it should not be used in a differing context. Furthermore, new information, improved practices and changes in legislation may require an alteration to the report in whole or in part after its submission. Therefore, with any changes in circumstances, or after one year from the date of the report, the report should be referred back to Paddock Geo Engineering Limited for re-assessment (and, if necessary, for an estimate for the cost of such).

REFERENCES

Investigation of Potentially Contaminated Sites – Code of Practice, British Standards Institution BS 10175:2001.

Code of Practice for Site Investigations, British Standards Institution BS5930: 1999

Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination, R&D Technical Report P5-066/TR, 2000, Environment Agency.

National House-Building Council, NHBC Standards Chapter 4.2 'Building near Trees', 2003

CLR8 Potential Contaminants for the assessment of Land, 2002, DEFRA/Environment Agency.

Health and Safety Executive, Protection of workers and the general public during the development of contaminated land, HMSO, London 1991.

BRE Special Digest 1 'Concrete in Aggressive Ground', 2001.

Contaminated Land Exposure (CLEA) Model version 1.03 developed by the Environment Agency, Department for Environment, Food and Rural Affairs and the Scottish Environment Protection Agency. 2008

CLR7 Assessment of Risks to Human Health from Land Contamination, 2002, DEFRA/Environment Agency.

CLR8 Potential Contaminants for the assessment of Land, 2002, DEFRA/Environment Agency.

Land Contamination Risk Management (LCRM), 2020, Environment Agency

Rudland, D., Lancefield, R.M., Mayal, P.N. (2001) Contaminated Land Risk Assessment: A Guide to Good Practice. CIRIA C552. UK.

Method for Deriving Site-Specific Human Health Criteria for Contaminants in Soil, SNIFFER, 2003.

Technical evaluation of the Intervention Values for Soil/Sediment and Groundwater, RIVM Report 711701 023, National Institute of Public Health and the Environment, 2001.

Tonks D M and Whyte I L 'Dynamic soundings in site investigation: some observations and correlations', Proceedings of ICE Geotechnology Conference, Paper 10, 1988.

The Water Supply (Water Quality) Regulations. HMSO. 2000

Code of Practice for Investigation and Mitigation of Possible Petroleum –Based Land Contamination, 1993, Institute of Petroleum, London.

Contaminated Land Management – Ready Reference, J Nathanail, P Bardos and P Nathanail, Land Quality Press, 2002.

BRE Digest 412 'Desiccation in Clay Soils', 1996

DTI/CIRIA Publication 'Engineering in Chalk'

http://www.silsoeresearch.org.uk/ Silsoe Research Organisation. Viewed July 2007.

Hydrogeological Risk Assessment for Land Contamination Remedial Targets Worksheet, release 3.1 – October 2006

Assessing risks posed by hazardous ground gases to buildings – CIRIA C665, 2007 – Wilson, Oliver, Mallet, Hutchings and Card

NHBC & RSK Group publication 'Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present' (March 2007).

Mobilising Natures Army: Monitored Natural Attenuation – dealing with pollution using natural processes, Environment Agency. 2004

Remediation Targets Methodology: Hydrogeological Risk Assessment for Land Contamination, Environment Agency. 2006

BRE Report BR211 - Radon: Protective measures for new dwellings, November 2007

Assessing risks posed by hazardous ground gasses to buildings – CIRIA Report C659, December 2007

GPLC1 - Guiding Principles for Land Contamination Environment Agency, 2010

Environment Agency Landfill Environmental Permit EPR/FP3399VV

Perimeter soil gas emissions criteria and associated management. Industry Guidance v1.01. BIFFA et al. January 2011

Environment Agency, Briefing Note – Monitoring Frequencies and Non-Compliance Recording

LFTGN03. Guidance on the Management of Landfill Gas. Environment Agency. 2003

Environment Agency, Final R&D Technical Report P1-471 Techniques for the Interpretation of Landfill Monitoring Data – Guidance Notes

CIRIA C580 Embedded Retaining Walls: Guidance on Economic Design. CIRIA 2003

APPENDIX A – MAPS AND PLANS

Site Location Plan

Site Plan

Aerial Photograph

Proposed Development Plans