BASEMENT IMPACT ASSESSMENT

FOR

PROPOSED MULTI-PURPOSE DEVELOPMENT

AT

227A Grays Inn Road
London
WC1X 8QF

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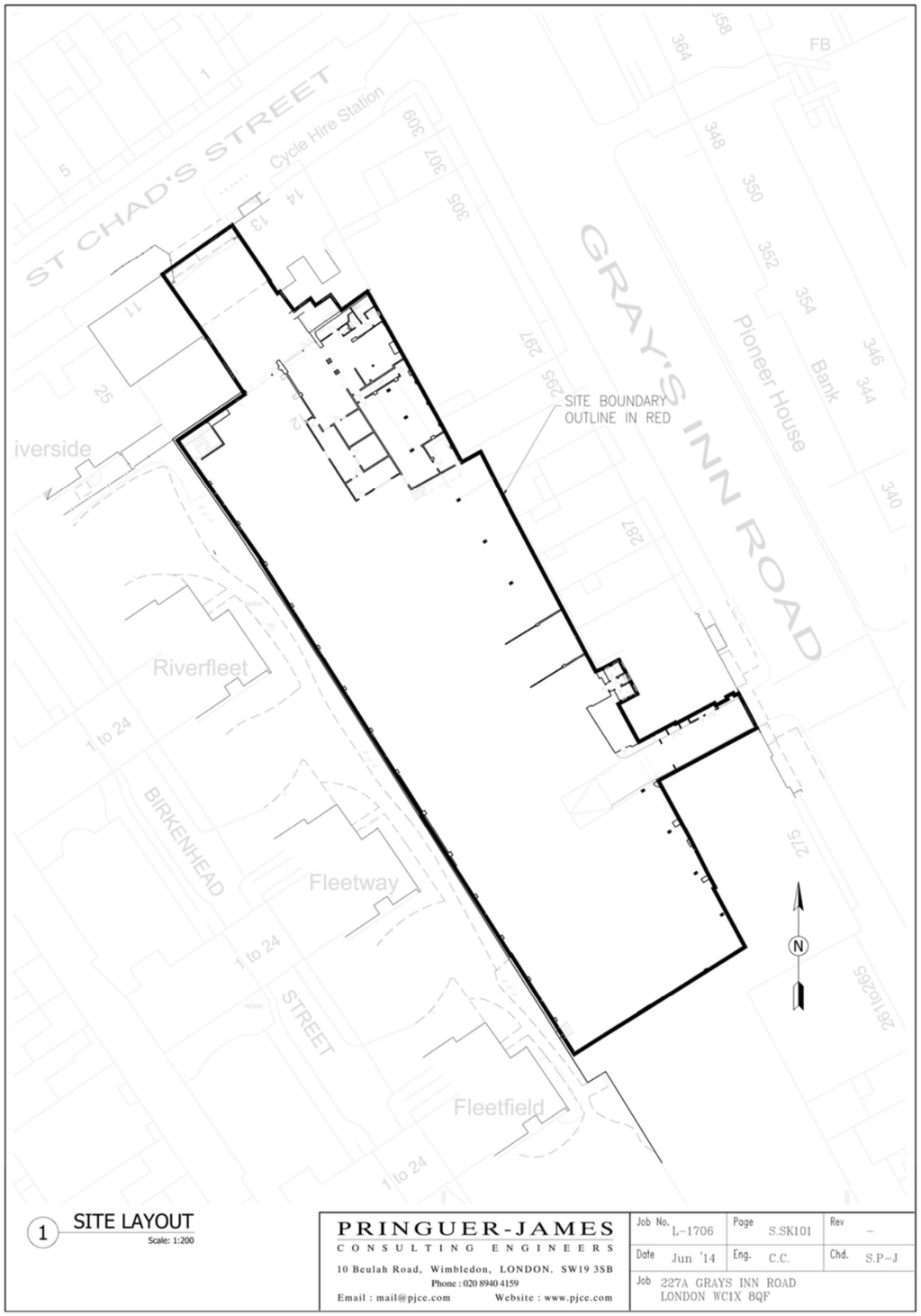

Fig 1 Existing Site

1.0 Introduction

Pringuer-James Consulting Engineers (PJCE) were appointed by Regal GI Ltd. as the Structural Engineers for the proposed development at No.227A Grays Inn Road Kings Cross London.

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

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

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

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

This BIA document is laid out in four stages, from the initial screening process, progressing to a further scoping process which identifies relevant issues for the site and their subsequent potential impacts. The third stage of the process involves gathering site specific data by various means including a desk study and site investigation. From this the relevant information is obtained to enable an accurate assessment of the potential impacts identified in the first two stages of the process.

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

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

2.0 Screening

2.1 Characteristics of the Project

The site is located at No. 227A Gray's Inn Road and is bounded by St Chad's Street to the North, Grays Inn Road to the East, Birkenhead Street to the West and Argyle Street to the South. It is proposed to redevelop the 0.705 acre site located at No.227A Gray's Inn Road to form a multi storey mixed use development. The proposed development will contain a split level basement with a single storey lower ground floor level, dropping down to a deeper storey and a half basement floor level. Above ground level the development will rise to various levels across the proposed development with buildings varying in size and scale from the lesser two storey residential blocks to a seven storey multi-purpose building.

Existing Site Boundaries
To the eastern boundary along Grays Inn Road, the site is directly adjacent to the residential and commercial properties facing out onto Grays Inn Road. These generally consist of four storey terraced brickwork buildings, a large proportion of which have a rear annex which extends back to the eastern boundary of the proposed site. Further south along the eastern boundary the proposed site is adjacent to number 275 Grays Inn Road.

Along the southern boundary, an existing building exists identified as No. 55 Argyle Street which runs along the length of the southern boundary. This property contains an existing lower ground floor level and rises up two stories to the original roof level. A relatively recent extension to the building was undertaken which involved building an additional high level storey on top of the original building. As part of the works undertaken the boundary wall was raised to suit the proportion of the new building. The boundary wall now extends to a level approximately 10.5 meters above existing ground level.

To the western boundary the site is bounded by the Birkenhead Street Estate which contains four individual multi residential buildings each of which contain a single storey basement. The buildings are located approximately 5.0m from the existing site boundary wall. Surrounding the Birkenhead Estate is a communal green area which has an average level of 18.75m along the boundary with the proposed development site.

To the northern boundary the site is accessed directly from St. Chads street with properties each side of the site access. These have been identified as No.11 St. Chads Street and No.13 St. Chads Street. At present, No.11 St. Chads Street is under development with construction of a new lower ground floor level through a series of underpins to the shared boundary walls.

Existing Site
The site contains an existing steel framed warehouse building currently in use as a car park which extends across the full footprint of the site. The car park level is raised relative to the outer road levels with an average level of 19.10m AOD across the site compared to a level of 17.5m AOD to the St. Chads Street exit and 18.10m AOD to the Grays Inn Road exit. The difference in levels is overcome by means of access ramps to each access point. It is proposed to adopt an upper ground floor level of approximately 18.95m AOD across the site for the residential units in order to maintain the relative levels of the area.

The existing building on the site is formed from a combination of materials, including a steel column and roof truss structure which runs down onto concrete pad footings. The boundary walls between the steel columns are formed in typical London brickwork and rise up 6.0m to roof level along the full perimeter of the trussed roof.

Below a section of the carpark at upper ground floor level a basement approximately 10.0m wide exists. This basement area drops down approximately 4.25m to a level of 14.90m AOD. The basement is constructed from a series of brickwork walls supporting brickwork arches overhead which currently support the vehicular loadings generated by the current use of the building. The remainder of the site comprises a single storey steel framed structure. A detailed topographical survey of the building has been carried out and is included as part of this submission. (See Appendix C)

Proposed Development
The proposed development will involve the demolition of the existing building and removal of all the existing hardstanding areas and underground services found within the confines of the site. In addition to the enabling works and reduced levels required for the proposed development it will be necessary to deconstruct the existing brickwork boundary wall along the length of the western boundary in order to safeguard the site and surrounding general access areas of the Birkenhead estate. This is due to the nature of the boundary wall in that the wall is restrained by the steel columns and piers forming the roof truss supports for the existing building. As part of the demolition works, the existing roof trusses and the associated columns will be removed. In doing so, the long term stability of the wall will be compromised and it is thus required that the wall be rebuilt as part of the proposed works at which point the long term stability of the wall can be ensured.

The redeveloped site will make use of the full area of the site and will provide three readily identifiable structural blocks which rise up from an upper ground floor level of 18.95m AOD. The three blocks will include the low level residential "Eastern Block", the high level residential "Western Block" and the high level multi-purpose "Southern Block". A central courtyard is proposed between the three proposed blocks which when considered together will form a continuous structural floor plate across upper ground floor level. The central communal areas between the eastern and western blocks will be dropped by 1.35m to a level of 17.60m to form a split level upper ground floor.

Below the upper ground floor level the site will maintain the split level characteristic of the proposed development with a split level substructure. The various levels will be identified separately as lower ground floor and basement level (to the central courtyard area and the full footprint of the southern block). The lower ground floor will be formed at a level of 16.10m AOD with the lower basement levels adopting a level of 14.30m AOD.

Above upper ground floor level the proposed development extends two storeys above ground level to form the low level "Eastern Block" residential properties. Directly across the courtyard, the "Western Block" adopts a stepped form when rising from a minimum of three storeys up to six storeys above ground level with the floor plates stepping as they rise to the top level. The third "Southern Block" will extend from a basement level of 14.30m AOD up seven storeys above ground level. In similar fashion to the "Western Block" the building will step back as it rises up with a considerable reduction (approx 40%) in the overall footprint of the block at first floor level.

2.2 Physical Form of the Development

The proposed structural concept for the development is based on a concrete framed slab and column scheme for the superstructure to each block taken down onto a reinforced concrete basement box from ground floor level down to basement with a suitable piled foundation solution taking the loads through to the founding strata below.

Below the existing ground floor levels the perimeter of the site is required to adequately retain the excavated soil and resist all the lateral earth pressures generated as part of the subterranean development. With a development of this scale and with a site located adjacent to a wide variety of large and small buildings, a single structural solution for the basement construction is not sufficient in trying to accommodate the development potential of the site and also satisfying the architectural brief for the project.

Perimeter Boundary Treatment - Embedded Retaining Walls
Across a significant proportion of the site an embedded retaining wall solution is required in order to provide the necessary structural integrity to the excavated boundary. Typically this will consist of a series of tightly placed concrete contiguous bored piles with a reinforced concrete facing wall to the internal face, the contiguous piles being designed to retain the earth and withstand the lateral earth forces. This method of perimeter boundary retention is proposed for the southern and western boundaries and a section of the eastern boundary running form the southeast corner along the extent of the boundary forming the lower levels of the southern block.

Perimeter Boundary Treatment – Underpinning
Across the remaining sections of the site boundary it is envisaged that a suitably designed scheme of concrete underpinning with a reinforced concrete retaining wall lining the inside face will be suitable in order to provide the necessary structural integrity to the boundary. The intent of the concrete underpin will be to transfer the existing vertical loads from the boundary walls to be retained below the levels of the proposed basement in order to prevent additional load being applied to the existing foundations from the proposed structure. The internal reinforced concrete lining wall will then provide the required resistance to any potential earth pressures or lateral forces acting on the proposed boundary walls.
This method of boundary treatment is proposed for the northern and eastern boundaries with a small section of the western boundary likely to be suitable to underpinning given the current levels under the existing basement.

Basement
The proposed development adopts a stepped level to the basement/lower ground floor levels. The basement will be formed as a reinforced concrete structure suitably designed to resist the various forces and pressures exerted on it. The anticipated excavation to form the basement level is expected to be in the region of 5.75m from existing levels on site of 19.10m AOD. As mentioned previously, the boundary treatment in areas surrounding the basement excavation will be formed using a combination of contiguous concrete piles with reinforced concrete lining walls. It is expected that during the construction of the basement a scheme of temporary propping will be used to ensure the stability of the boundary during construction. In the permanent condition the basement level floor slab will be designed to act as a rigid diaphragm providing a permanent horizontal restraint to the base of the piled boundary, transferring the earth pressures exerted on the structure across the site.

The basement floor is expected to be underlain by a suitable scheme of bored pile foundations located to support the concentrated loads transferred from the floors above. The piled foundation will consider all forces both negative (gravitational) and positive (heave and hydrostatic) in their design. In anticipation of a negative upward thrust due to ground heave of the clay bearing stratum, a layer of compressible material is proposed as part of the design allied with a scheme of tension piles to counteract the upward pressures from the soil.

Lower Ground Floor
The lower ground floor level forms the upper part of the basement excavation. A step up to this level of approximately 1.80m is proposed reducing the anticipated excavation to a depth of 4.0m.
The lower ground floor slab will maintain the structural concept of the basement slab and will provide lateral restraint to the retaining structural elements around the perimeter. A suitably designed reinforced concrete slab will be designed in order to serve this purpose. In similar fashion to the basement slab, the lower ground floor will be supported by a suitable scheme of bored pile foundations with ground heave protection measures included in the scheme.

Ground Floor
The ground floor slab forms the top level of the structure which covers the full footprint of the site with the upper levels taking the form of the three identifiable structural blocks to the east, west and south of the site. The ground floor slab follows the stepped profile of the lower floor levels at basement and lower ground. The upper ground floor level is found across the footprint of the residential units to the ease and west blocks with a drop of 1.35m to the central courtyard area and the ground floor level of the south block.

The ground floor slab will be formed in reinforced concrete and will be designed as a flat slab transfer structure with a scheme of suitably located walls and columns taking the loads generated by the superstructure above. In addition the ground floor slab will act as a rigid diaphragm providing the necessary permanent propping support to the top levels of the retained boundary perimeter structure.

Upper Floors
Each of the high level blocks will be built as a traditional concrete framed building with reinforced concrete stability cores forming the liftshafts and stairwells to each block. The floor plates at each floor level will adopt a flat slab construction wherever possible with downstand beams provided where transfer structures are necessary as the building footprint steps back.

The low level “Eastern Block” rises up two storeys and has the potential to be built by a number of materials. This includes, a lightweight timer framed structure, a steel beam and column structure with infill floor plates (timber or concrete), or possibly a load-bearing masonry structure with infill floor plates (timber or concrete).

2.3 Mitigation Measures Being Considered

As with any development involving the construction of a basement, the proposed construction methods and sequencing of works must be chosen whilst ensuring suitable consideration is given to the inherent risks associated with a deep excavation, and more specifically in this case, excavation in close proximity to existing buildings and their foundations.

Given the close proximity of the adjacent buildings along three of the four boundaries, the proposed development will be designed to limit the risk of adverse impact to the adjacent properties. This is catered for by proposing the use of contiguous piled walls to the majority of the boundary perimeter to be installed with a scheme of temporary works designed in accordance with an agreed set of movement limits for each boundary.

In order to ensure this is achievable a scheme of movement monitoring will be put in place pre-construction which will be monitored over the lifetime of the project and until such a time as the retaining structural elements have attained suitable restraint form the permanent structure

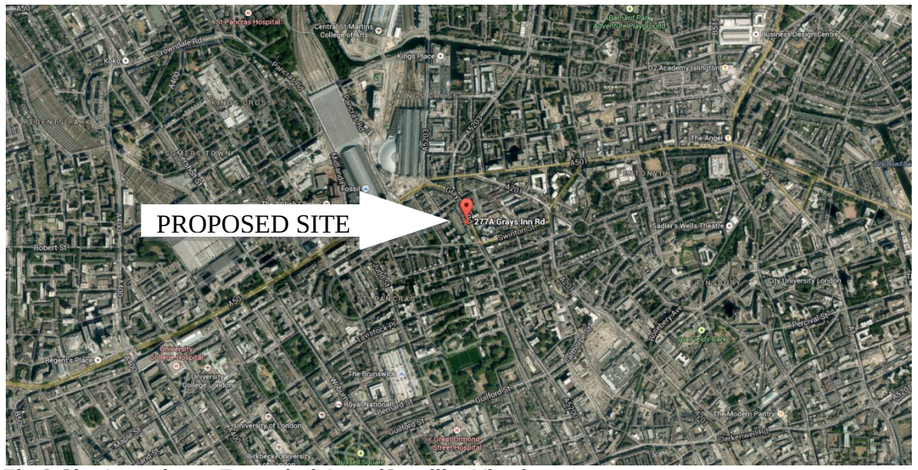

Fig 2 Site Location – Extended Area (Satellite View)

Fig 3 Site Location – Immediate Area (Satellite View)

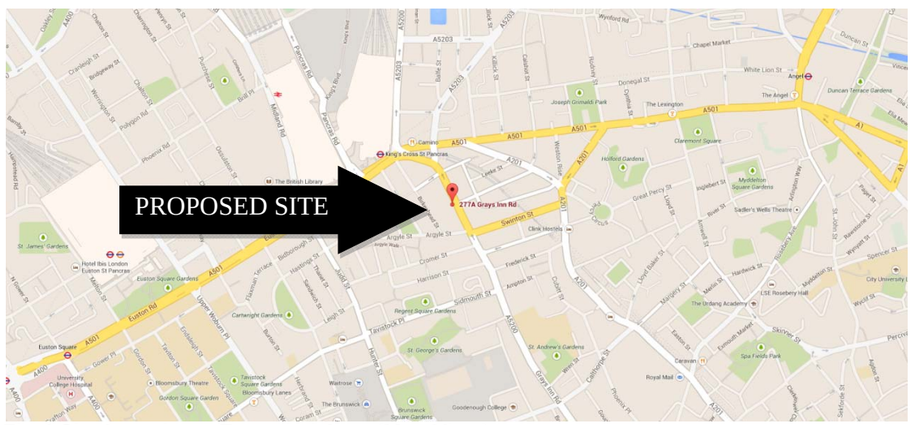

Fig 4 Site Location – Extended Area (Map View)

2.4 Location of the Project

The site is located in the Kings Cross area of Camden at the junction of Grays Inn Road and St. Chads Street, facing east towards Grays Inn Road behind a row of street-front properties including 307 Grays Inn Road south as far as 265 Grays Inn Road and extends North onto St Chads Street. To the south the site is bounded by 55 Argyle Street and to the east the site is bounded by the Birkenhead Street Estate.

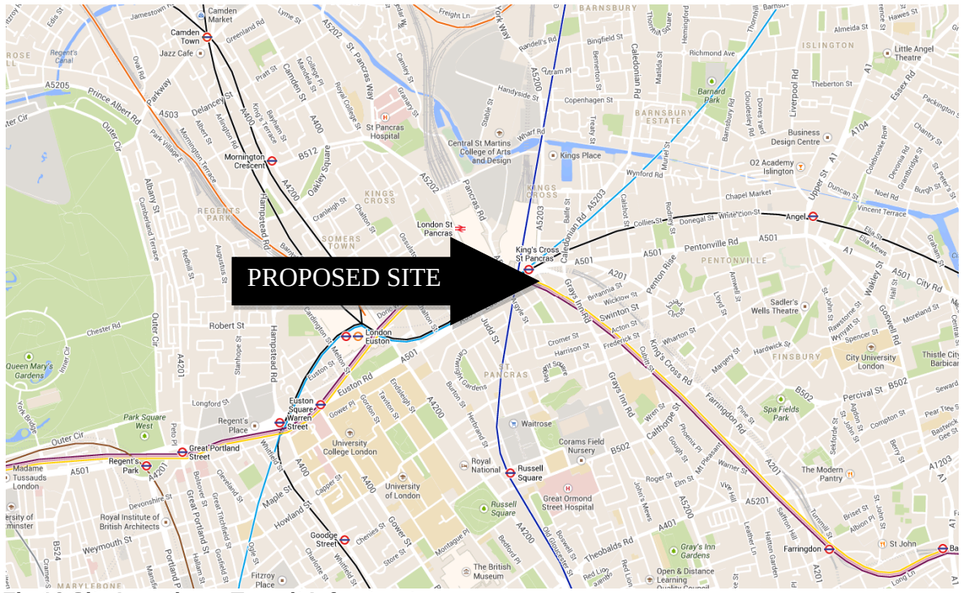

Fig 16 Site Location – Transit Infrastructure

The site is located 150m to the south east of Kings Cross Rail Station. Beyond the immediate boundaries outlined above, the site is also bounded by a number of railway lines and stations, including Kings Cross Station (175m North West), Euston Station (900m East), Euston Square (1100m South West), Russell Square (735m South), Angel Station (1100m East), Caledonian Road & Barnsbury Station (1500m North West).

Beyond the immediate boundaries outlined above, the site is also bounded by a number of railway lines as indicated on the following plans.

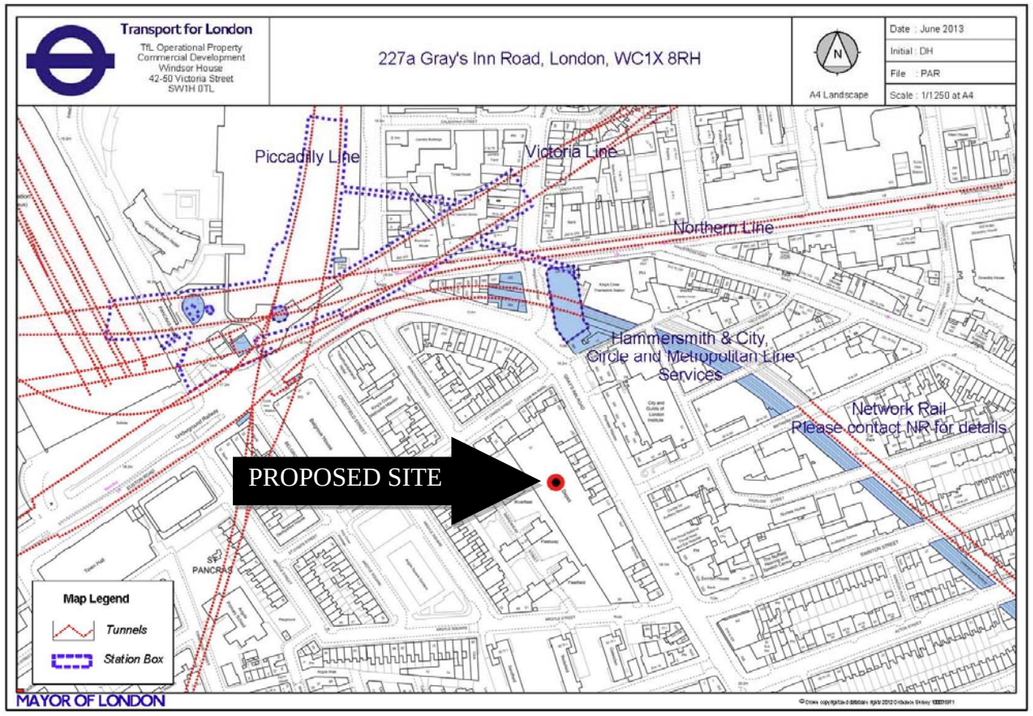

Fig 5 Site Location – Underground Infrastructure

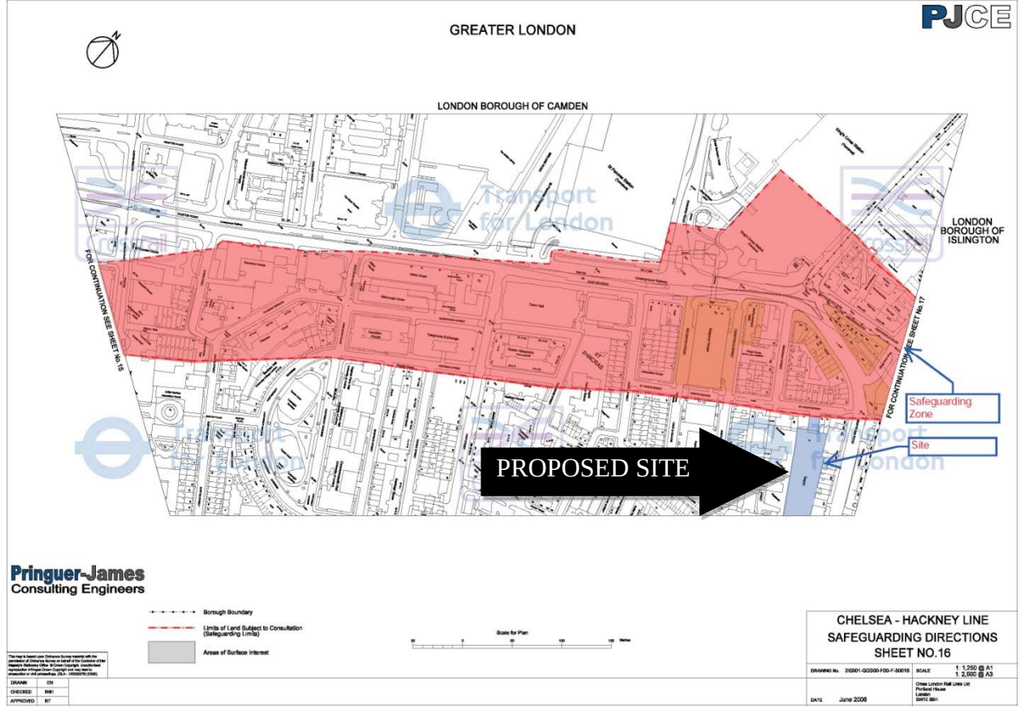

Fig 6 Site Location – Crossrail II Protection Zone

With the congested nature of the rail networks in the area a desktop search was undertaken to determine the underground infrastructure locally. This search identified a number of underground rail lines including the Hammersmith & City, Circle, and the Metropolitan lines running south east from the intersection of Grays Inn Road and Euston Road. The lines follow a similar path to that of Grays Inn Road tapering away from the proposed site as they travel south. (See Fig 5)

In addition to the existing infrastructure in the area the Crossrail II High Speed Rail Network has a safeguarding zone in the vicinity to facilitate the proposed Chelsea – Hackney Line. Review of the specified safeguarding zone indicates that the site does not enter into the zone but does run tight up to the proposed safeguarded zone.

2.5 Characteristics of Potential Impacts

2.5.1 Subterranean (Groundwater Flow)

The prevalent geological characteristics of the Camden/Kentish Town area consist of a stiff London Clay overlying the Lambeth Group, Thanet Sand, and Chalk bedrock formation. A deep borehole (Ref: TQ38SW4250) obtained from the British Geological Survey has been included in the appendices of this document which outlines the various formations encountered to a depth of 50.0m.

Over the extended Camden Borough region the upper levels of the clay layer contain relatively small regions of River Terrace Deposits defined by outcrops of Claygate Formation and Bagshot Sands. In these areas of permeable material it is not uncommon to come across a raised groundwater table due to the presence of a perched aquifer or historic river channel. The attributes of the groundwater in these areas is varied, 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 include altering the water table levels and/or diverting the existing flowpaths of the groundwater. The effect of these changes needs to be taken into consideration in the early planning stages of a development to ensure that adverse effects for both the proposed development and the existing buildings in the vicinity are accounted for and wherever possible eliminated.

Adverse effects of a high groundwater table may include:-

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

2.5.2 Slope/Land Stability

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

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

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

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

Additional effects which must be considered in the planning and design of a project are the inevitable ground movements which will be experienced. With any excavation there is a degree of ground movement which must be allowed for and this is generally done by specifying agreed design parameters for any piling element of the works and incorporating in the construction sequence a suitable scheme for temporary works.

Once the construction stage of a project is complete possible effects which should be considered include the increased stiffness of the new foundations and also the possible increase in the loads transmitted to the bearing strata. Existing foundations within a site or close to an adjacent site may require upgrading to support the new building. Upgrading foundations along party wall lines can give rise to a variation in stiffness between old and new foundations which should be considered as part of the planning and design process.

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

2.5.3 Surface Flow & Flooding

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

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 catered for by the local drainage network.

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

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

2.6 Screening Process

2.6.1 Subterranean Flow

Q1a: Is the site located directly above an aquifer?
→NO
Referring to Figure 8 of the CGH&HS the underlying soil has been classified as "Unproductive Strata" and thus would not be expected to contain any groundwater or aquifer. Further reference to Figure 5 of CGH&HS indicates that the site is located in an area of London Clay. The preliminary site investigation carried out for the site indicates that the site is underlain by a stiff brown slightly silty clay with no indication of a high water table at the time of the investigation.

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 over the extent of the upper basement footprint. Where the building will reduce down to incorporate a lower basement level the maximum anticipated excavation will be 5.75m. Borehole results do not indicate the presence of a high groundwater table and thus it is expected that the proposed basement excavation 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 not within 100m of any existing natural water feature.

Historical records from the Lost Rivers of London suggest that the River Fleet may have previously run its course in the vicinity of the site to the eastern side of Grays Inn Road.
The path of the Fleet River is indicated running down Pancras Road, crossing down Grays Inn Road before continuing down Kings Cross Road. Preliminary review of the mapping suggests the site is located approximately 175m to the south of the course of the river. Preliminary site investigations carried out have not encountered any evidence of a dried water channel. It is therefore assumed that the site will not contain any river channel material. The site is located over an extensive area of London Clay strata with no evidence of an outcrop of claygate formation or bagshot sands in the nearby area. This would suggest that the potential for a spring is minimal.

Q3: Is the site within the catchment of the pond chains on Hampstead Heath?
→NO
Referring to Fig 14 of the CHG&HS the catchment areas for the Hampstead Heath pond chains do not coincide with the site location and are approximately 4.20km to the northwest of the proposed development site.

Q4: Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?
→NO
At present the existing site is fully covered by the existing building and the associated hardstanding areas. It is envisaged that this situation will be maintained once the site is redeveloped, with the full extent of the site being developed in a similar nature to that of the current site.

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 site is fully developed and thus is completely covered by impermeable material. As part of the redevelopment the extent of permeable material across the site is not anticipated to change. The existing drainage system for the site is assumed to drain freely into the local authority drainage network. Any proposed development will utilise the latest SUDS techniques wherever suitable and it is not anticipated that this will increase the levels discharged to the ground. A drainage strategy has been prepared by Peter Brett Associates and forms part of this planning application.

Q6: Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not the pond chains on Hampstead Heath) or spring line?
→NO
The lowest point of the proposed excavation will be approximately 5.75metres below ground level. This is expected to relate to a level of 13.25m AOD. The site is not in close proximity to any local pond, the nearest pond being Hampstead No.1 Pond located 4.20km to the northwest.

2.6.2 Slope Stability

Q1: Does the existing site include slopes, natural or manmade, greater than 7 degrees (approximately 1 in 8)?
→NO
The existing site has no significant gradient or falls. Topographical data available from existing site surveys suggests the site is relatively flat across the plan area. Over the extended region, the site is located in an area which is not identified as susceptible to landslides or significant soil movements.

Q2: Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8)?
→NO
The site is not anticipated to require any re-profiling to landscaping and is intended to be developed across the full site area.

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 indeed a slope in excess of 1in8.

Q4: Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8)?
→NO
The site is set in a region with a relatively flat slope. Approximate site levels are in the region of 15.0 – 20.0 metres with variance at a maximum of +/-0.3m.

Q5: Is the London clay the shallowest strata at the site?
→YES
The London Clay is the principle defining strata at the site and extends down to the Lambeth Group, Thanet Sand, and Chalk bedrock formation.

Q6: Will any tree/s be felled as part of the proposed development and/or any works proposed within any tree protection zones where trees are to be retained?
→NO
With the site being fully developed there are no trees found within the curtilage of the site boundary. The site is bounded by properties to three of its four boundaries with no trees present. To the western boundary with the Birkenhead Street Estate a number of small trees are present in the communal green area and at present there are no known tree protection orders in place. As part of the proposed development the party wall award procedures will serve to ensure that an agreed method for dealing with any potential trees along the boundary which may be affected will be sufficiently protected.

Q7: Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?
→MAYBE
With the limited information available (no pre condition survey has been carried out to date on the existing buildings either within or adjacent to the site) the effects of seasonal shrink-swell subsidence cannot be accurately established. However given the anticipated geotechnical characteristics of the site it is expected that the characteristics of the London Clay will need to be accounted for.

Q8: Is the site within 100m of a watercourse or a potential spring line?
→NO
The latest available information relating to watercourses in the area would suggest that the site is not within 100m of any watercourse.

Historical records from the Lost Rivers of London suggest that the River Fleet may have previously run its course in the vicinity of the site to the eastern side of Grays Inn Road. Preliminary site investigation carried out on the site has not come across any form of dried water channel. It is assumed initially that the site will not contain any river channel material.

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

Q9: Is the site within an area of previously worked ground?
→NO
The site is not considered to be within an area of previously worked ground. Referring to the historic geological mapping available for the 1920's there is no indication that the area contains any worked ground.

Q10: Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?
→NO
The site is located in an area designated as unproductive strata. Thus it is not expected to be within an aquifer (See Appendix A). Site investigation also shows no signs of a perched water table or any evidence of moisture ingress into the boreholes. It is anticipated that there will be no requirement for any dewatering during the construction of the proposed basement.

Q11: Is the site within 50m of the Hampstead Heath ponds?
→NO
The site is located approximately 4.2 kilometres away from the nearest pond in the Hampstead Heath Pond Chain.

Q12: Is the site within 5m of a highway or pedestrian right of way?
→YES
The site is bounded to the north and east by St Chads Street and Grays Inn Road respectively. The site is setback from Grays Inn Road by more than 10.0m along its eastern boundary behind the various buildings fronting onto Grays Inn Road and whilst the site boundary is tight up to St. Chads Street the proposed development is limited in extent along the site boundary, at less than 6.0m wide.

Q13: Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?
→YES
Across the site, the extent of the lower ground floor level is estimated to extend below the lowest anticipated footing level of the existing buildings by approximately 600mm - 750mm. The deeper basement level involving a proposed excavation in the order of 5.75m will similarly extend to depths below any anticipated footings of the buildings adjacent to the boundary. The expected difference between the neighbouring footings and the proposed basement level is estimated to be approximately 2.0m.

Q14: Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?
→NO
The site is located within a congested rail zone containing a number of London Underground and Overground lines and also in close proximity to the Crossrail II High Speed Rail Network Safeguarding Zone for the Hackney-Chelsea Line. Further analysis of more detailed information received from Transport for London has determined that the site is not expected to be over or within any exclusion zones for rail or underground infrastructure.

2.6.3 Surface Flow & Flooding

Q1: Is the site within the catchment of the pond chains on Hampstead Heath?
→NO
The site is approximately 4.2 kilometres from the Hampstead Pond Chain and is not within the catchment of any of the pond chains on Hampstead Heath.

Q2: As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?
→NO
The site is completely covered by impermeable 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 is expected to be maintained and so the proposed development will not materially change the surface water flows. Additionally the proposed development will utilise the latest SuDs design available in order to minimize the flows generated from the site. For further details on the proposed drainage for the development please refer to the planning report prepared by Peter Brett Associates which outlines the proposed drainage strategy for the development.

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 since the existing site is completely covered in hard-standing surfaces.

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 proposed development will utilise the latest SuDs design techniques available and will adopt a scheme which prevents uncontrolled discharge from the site in order to minimize the flows generated from the site to the existing infrastructure. This also ensures that all surface water generated is directed into the 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.
For further details on the proposed drainage for the development please refer to the planning report prepared by Peter Brett Associates which outlines the proposed drainage strategy for the development.

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 the surface water which will be generated and so will have no subsequent effect on the quality of the surface water received by adjacent properties or downstream watercourses.

Q6: Is the site in an area known to be at risk from surface water flooding, such as South Hampstead, West Hampstead, Gospel Oak and King's Cross, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?

→NO

The site is located along Grays Inn Road. Inspection of the available flooding data suggests that the site is not at risk of flooding of any nature (See Appendix A). For further analysis on Flood Risk Assessment s and the requirements please refer to the report prepared by Peter Brett Associates regarding the drainage strategy for the proposed development.

2.7 Summary

2.7.1 Subterranean (Groundwater) Flow

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

2.7.2 Slope Stability

The screening process has identified four issues which are of initial concern as part of the planning process and require further detailing as part of the scoping process.

1. London Clay is the shallowest strata at the site.
2. History of seasonal shrink-swell subsidence in the local area.
3. Excavation in close proximity to highway and pedestrian right of way.
4. Possible differential depth between foundations of adjacent structures

2.7.3 Surface Flow & Flooding

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

3.0 Scoping

3.1 Potential Impacts of the Proposed Scheme

3.1.1 Subterranean (Groundwater) Flow

Not applicable

3.1.2 Slope Stability

3.1.2.1 London Clay is the Shallowest strata at the site

The shallowest strata at the site is the London Clay Formation. Referring to the BGS Mapping data provided in the attached appendices, notably Fig 5, Fig 10 and Fig 16, it is evident that the London Clay formation would not be considered a shallow formation or indeed have a slope angle which would suggest any potential risk of a landslide.

The site is not anticipated to contain any superficial deposits layers typically encountered in the northern areas of the borough. Thus it is envisaged that although the London Clay is the shallowest layer of soil it does not represent any inherent risks to be expected with any superficial deposit outcrop found elsewhere.

Preliminary site investigations have determined that the site contains an upper layer of fill material with a depth between 1.50m to 2.90m. The potential impact of the layer of fill material is directly relevant in considering the sequence of works to be undertaken for the basement construction.

3.1.2.2 Seasonal Shrink-Swell Subsidence

The history of the seasonal shrink-swell ground movements in the local area is not readily known, although the clay-based nature of the underlying soil does point to the need to consider the cause and effects of shrink-swell movement in the proposed structural design. It is considered reasonable to conclude that the level of the basement will be below the seasonal shrink/swell zone of the clay subsoil, thus the potential ground movements arising from this are anticipated to be eliminated.

For the proposed development at No.227A Grays Inn Road the expected structural foundations supporting the building will comprise a scheme of concrete piles with a series of concrete pile caps supporting a reinforced concrete basement slab, stepped to suit the various lower levels of the basement. Below the basement slab a compressible void forming material is proposed to account for the high plasticity of the clay subsoil. Should the ongoing groundwater monitoring scheme determine the presence of a perched aquifer or high groundwater table, a suitable system of tension piles and/or release valves to alleviate the hydrostatic forces will be included. At present however this is expected to be an unlikely occurrence given that no groundwater has been encountered in any of the boreholes undertaken to date.

With the existing lack of trees in the site and surrounding area the effects of seasonal shrink/swell subsidence on the surrounding buildings are considered to be negligible.

The characteristic heave potential of the soil has been reviewed as part of the site investigation with an Oedometer test undertaken and attached in the site investigation. (see appendix E)

3.1.2.3 Excavation in close proximity to a highway or pedestrian right of way

The proposed development will result in a significant proportion of the site footprint being excavated by a minimum of 3.50m below ground level. Due to the location of the site, leading directly out onto St. Chads Street along a section of the northern boundary there will be an element of the basement construction which will include excavation close to the public highway.

A proposed scheme of contiguous concrete piles with internal concrete lining wall is proposed to form the basement for the lone-standing property to the St. Chads Street boundary. The slope stability and soil condition along the roadside boundary may be subject to various potential impacts as a result of the proposed development. These can be categorised relative to their scale and an appropriate risk category assigned to each case

The roadside boundary lining St. Chads Street will be subject to an inevitable risk of disruption as a result of the required excavation to form the basement proposed. Given the scale of the excavation and the limited extent along the roadside boundary it is not anticipated that the risks will be disproportionate to the scale of the works. The potential impacts which may occur include the following:

Burland Scale (Category of Damage) – 3: Moderate

Hazard Factor	Risk Factor	Consequence
- Low	– High	- Limited

A nominal degree of horizontal deflection in the temporary works proposed to the excavated boundary with a subsequent minor degree of settlement in the soil immediately beyond the line of excavation. The possible impact of this on the adjacent road and footpath is not anticipated to be more than a minimal separation at the interface between the footpath and boundary line.

Burland Scale (Category of Damage) – 4: Severe

Hazard Factor	Risk Factor	Consequence
- Medium	– Average	- Limited

An increased level of horizontal deflection in the proposed temporary works leading to higher degree of settlement in the retained soil. The anticipated impact of this situation would include a greater separation between the neighbouring pavement, road and the proposed site. This in turn could possibly lead to deterioration in the condition of the footpath itself and potentially the road surfacing. Any underground services (ie: drainage, water supply, communications, power and lighting) in the footpath or road may be adversely affected particularly joints in any rigid piping.

Burland Scale (Category of Damage) – 5: Very Severe

Hazard Factor	Risk Factor	Consequence
- Large	– Low	–Localised damage

A failure in the temporary works scheme leading to excessive deflections of the retaining structure can lead to a partial or extended collapse of the excavated boundary. The potential impact of this situation would include a more severe level of damage to the road, footpath and any underground services (ie: drainage, water supply, communications, power and lighting). Additionally due to the deep excavation involved along the St Chads Street, an increased level of deflection in the retaining structure could possibly have some adverse effects on the properties to the opposing side of the road. These may include some minor cracking of brittle elements in the building (ie: plastered blockwork and plasterboard clad timber partitions). The frequency and magnitude of expected cracking to the adjacent building would not be expected to compromise the overall stability of the building or indeed the capacity of the structural elements which could be affected.

A set of preliminary structural calculations have been prepared for the proposed scheme based on the results of the site investigation and associated soil testing. (Refer to section 5.0 and associated appendices for discussion and analysis).

The piled boundary perimeter and reinforced concrete walls proposed to retain the highway boundary will be designed to adequately retain the excavated faces and as part of the design will take into consideration the requirements of the Highways Agency for both the temporary and permanent conditions. These will be submitted to the highways agency for approval prior to commencement of works on site.

3.1.2.4 Differential Depth Between Foundations

The proposed excavation levels for the project will encounter varying levels of foundation between adjacent properties and a maximum differential level of 1.0m is expected between parts of the boundary which will be excavated for the lower ground floor levels. Along sections of the site boundary with proposed excavations down to the lower basement level the maximum differential level is anticipated to be in the order of 2.0m. The slope stability and soil condition within neighbouring sites and adjacent areas may be subject to various potential impacts as a result of the proposed development. These can be categorised relative to their scale and an appropriate risk category assigned to each case.

Northwest Boundary (No.11 St. Chads Street)
The existing property at No11 St. Chads Street is a brickwork three storey building currently being redeveloped. When complete the property will contain a lower ground floor basement level which will reduce the differential depth between the existing foundations. The underside of the proposed basement to the adjacent property will be at an approximate level of 14.150m AOD potentially eliminating the differential depth between the proposed levels of the existing and proposed footings. The proposed development will provide a lower ground floor slab level of 16.10m AOD.

Burland Scale (Category of Damage) – 2:Slight

Northeast Boundary (No.13 & 14 St. Chads Street)
The existing properties at No.13 and 14 St Chads Street have limited information available relating to their current extent and levels. It is known that both contain a lower ground floor which will serve to reduce the potential differential depth between the existing boundary wall and the proposed levels for the lower ground floor locally. On this basis it is expected that a scheme of underpinning will satisfy the need to accommodate the differential depth between the adjacent footings and the proposed lower ground floor level.

The various impacts associated with the proposed works and a differential depth of foundation of 1.5m may include:

Hazard Factor	Risk Factor	Consequence
- Low	– High	- Limited

A nominal degree of horizontal deflection in the temporary works scheme proposed would possibly result in a reduction in the active pressure exerted by the temporary works on the retained material allowing some lateral deflection of the underpinning/retaining wall which could result in vertical settlement of the foundations. The result of this would be some minor cracking of brittle elements in the adjacent building (ie: plastered blockwork and plasterboard clad timber partitions). The frequency and magnitude of expected cracking to the adjacent building would not be expected to compromise the overall stability of the building or indeed the capacity of the structural elements which could be affected.

Hazard Factor	Risk Factor	Consequence
- Medium	– Average	- Localised damage

Should the temporary works along the boundary be subject to an increased level of horizontal deflection it is expected that the potential impact would be somewhat similar to those outlined above in terms of cracking but would be more frequent and more prevalent in the adjacent boundary wall and its connecting elements.

Hazard Factor	Risk Factor	Consequence
- Large	– Low	– Damaged Structure

In the event of a more severe situation such as the complete or partial failure of the temporary works it is possible that the bearing capacity of the underlying soil below No.1 Hartland Road would be reduced significantly. It is possible that a situation of this magnitude would result in:

- major cracking to primary structural elements bearing on the foundations with similar effects propagating throughout the secondary supported elements.
- excessive subsidence below the foundation to the existing building. The consequences of this would be a reduction in the integrity of the building and/or foundations to unacceptable levels requiring large scale repair works or deconstruction and replacing of similar suitable structure.

Eastern Boundary (297-305 GIR; 295 GIR; 285-287 GIR; 281-283 GIR)

The properties along the eastern boundary of the proposed site are typically four storey brickwork buildings with lower ground floor levels below each. The property at 297-305 Grays Inn Road has previously been redeveloped to provide a multi storey building containing a combination of apartments and office space. The basement floor level contains predominantly office space and is anticipated to extend to a depth of approximately 3.0m below road level extending back to the rear boundary onto the proposed development site. On this basis the underpinning scheme for reducing the levels within the development site is expected to be suitable with an anticipated differential depth of no more than 1.0m to the new proposed foundations.

In similar fashion, the remainder of the eastern boundary as far as the existing road access to the site is known to have lower ground floor levels and is thus suitable to the proposed use of a full scheme of underpinning along the boundary given that the anticipated depth is not expected to extend by more than 1.50m from existing footing levels. A trial pit was carried out along this section of the easern boundary and is attached in the attached appendices for reference. The trial pit confirms that the existing boundary wall drops to a level of approximately 2.30m from existing ground levels before encountering a form of concrete strip footing.

The various impacts associated with the proposed works and a differential depth of foundation of 1.0m will include:

Hazard Factor	Risk Factor	Consequence
- Low	– High	- Limited

A nominal degree of horizontal deflection in the temporary works scheme proposed would possibly result in a reduction in the active pressure experienced by the temporary works and a subsequent settlement of soil material immediately beyond the line of excavation.

At worst it would be expected to find some minor cracking of brittle elements in the adjacent building (ie: plastered blockwork and plasterboard clad timber partitions). The frequency and magnitude of expected cracking to the adjacent building would not be expected to compromise the overall stability of the building or indeed the capacity of the structural elements which could be affected.

Hazard Factor	Risk Factor	Consequence
- Medium	– Average	- Localised damage

Should the temporary works along the boundary be subject to an increased level of horizontal deflection it is expected that the potential impact would be somewhat similar to those outlined above in terms of cracking but would be more frequent and more prevalent in the adjacent boundary wall and its connecting elements.

Much the same as the increased levels of deflection, the potential impacts due to an increased level of vibration during construction would be expected to consist of more frequent instances of cracking in the building structure, particularly those clad with brittle finishes.

Hazard Factor	Risk Factor	Consequence
- Large	– Low	– Damaged Structure

In the event of a more severe situation such as the complete or partial failure of the temporary works it is possible that the bearing capacity of the underlying soil below the eastern boundary would be reduced significantly. It is possible that a situation of this magnitude would result in

- major cracking to primary structural elements bearing on the foundations with similar effects propagating throughout the secondary supported elements.
- excessive subsidence below the foundation to the existing building. The consequences of this would be a reduction in the integrity of the building and/or foundations to unacceptable levels requiring large scale repair works.

Eastern Boundary (275 Grays Inn Road)

The property at No275 Grays Inn Road is an existing four storey brickwork building with an existing basement floor level below. Initial investigation of available information indicates that the building contains a lightwell providing natural daylight to the basement across the full extent of the building back to the shared boundary with the proposed development site. Additional site investigation in the form of a trial pit investigation undertaken by PJCE has determined that the brickwork boundary wall extends to a depth of 2.45m below existing slab level giving a known depth of brickwork down to 16.610m AOD.

The proposed development will have a basement level of 14.30m AOD thus a differential depth between the existing footings and the proposed basement level of 2.0m is expected. In order to overcome this variance in level a contiguous piled wall scheme to the boundary wall is proposed with an associated scheme of temporary works to be undertaken to secure the excavated boundary during the construction phase. In the permanent condition the permanent structure will include a reinforced concrete facing wall to the internal face fo the contiguous piled wall with the concrete floors at each level providing the required propping to ensure a propped wall design.

The various impacts associated with the proposed works and a differential depth of foundation of 2.50m are similar in nature to those for the underpinning scheme however the anticipated scale of the deterioration would be considerably greater. The risks are categorised as follows:

Hazard Factor	Risk Factor	Consequence
- Low	– High	- Limited

A nominal degree of horizontal deflection in the temporary works scheme proposed would possibly result in a reduction in the active pressure experienced by the temporary works and a subsequent settlement of soil material immediately beyond the line of excavation.

At worst it would be expected to find some minor cracking of brittle elements in the adjacent building (ie: plastered blockwork and plasterboard clad timber partitions). The frequency and magnitude of expected cracking to the adjacent building would not be expected to compromise the overall stability of the building or indeed the capacity of the structural elements which could be affected.

Hazard Factor	Risk Factor	Consequence
- Medium	– Average	- Localised damage

Should the temporary works along the boundary be subject to an increased level of horizontal deflection it is expected that the potential impact would be somewhat similar to those outlined above in terms of cracking but would be more frequent and more prevalent in the adjacent boundary wall and its connecting elements.

Much the same as the increased levels of deflection, the potential impacts due to an increased level of vibration during construction would be expected to consist of more frequent instances of cracking in the building structure, particularly those clad with brittle finishes.

Hazard Factor	Risk Factor	Consequence
- Large	– Low	– Damaged Structure

In the event of a more severe situation such as the complete or partial failure of the temporary works it is possible that the bearing capacity of the underlying soil below the eastern boundary would be reduced significantly. It is possible that a situation of this magnitude would result in

- major cracking to primary structural elements bearing on the foundations with similar effects propagating throughout the secondary supported elements.
- excessive subsidence below the foundation to the existing building. The consequences of this would be a reduction in the integrity of the building and/or foundations to unacceptable levels requiring large scale repair works.

Southern Boundary (55 Argyle Street)

The property at No55 Grays Inn Road is an existing two storey building with an existing basement floor level below and an recent additional top level storey which was added in recent years. Initial investigation of available information indicates that the basement exists across the full footprint of the shared site boundary.

A trial pit investigation was carried out to the southeast corner of the site. The trial pit determined that the boundary wall extends down to a depth of 2.45m before encountering a concrete slab. This gives a relative site level of 16.610m, leaving an anticipated differential depth between neighbouring footings of approximately 2.30m. The proposed solution to overcome this difference in level is to install a contiguous piled wall along the boundary continuing the boundary treatment around from the eastern boundary.

A scheme of temporary works will be required to secure the excavated boundary during the construction phase. In the permanent condition the permanent structure will include a reinforced concrete facing wall to the internal face of the contiguous piled wall with the concrete floors at each level below ground providing the required lateral restraint and acting as a rigid diaphragm transferring the horizontal loads across the site.

The various impacts associated with the proposed works and a differential depth of foundation of 2.50m are similar in nature to those for the underpinning scheme adopted elsewhere across the site however the anticipated scale of the deterioration would be considerably greater given the depth of excavation. The risks are categorised as follows:

Hazard Factor	Risk Factor	Consequence
- Low	– High	- Limited

A nominal degree of horizontal deflection in the temporary works scheme proposed would possibly result in a reduction in the active pressure experienced by the temporary works and a subsequent settlement of soil material immediately beyond the line of excavation.

At worst it would be expected to find some minor cracking of brittle elements in the adjacent building (ie: plastered blockwork and plasterboard clad timber partitions). The frequency and magnitude of expected cracking to the adjacent building would not be expected to compromise the overall stability of the building or indeed the capacity of the structural elements which could be affected.

Hazard Factor	Risk Factor	Consequence
- Medium	– Average	- Localised damage

Should the temporary works along the boundary be subject to an increased level of horizontal deflection it is expected that the potential impact would be somewhat similar to those outlined above in terms of cracking but would be more frequent and more prevalent in the adjacent boundary wall and its connecting elements.

Much the same as the increased levels of deflection, the potential impacts due to an increased level of vibration during construction would be expected to consist of more frequent instances of cracking in the building structure, particularly those clad with brittle finishes.

Hazard Factor	Risk Factor	Consequence
- Large	– Low	– Damaged Structure

In the event of a more severe situation such as the complete or partial failure of the temporary works it is possible that the bearing capacity of the underlying soil below the eastern boundary would be reduced significantly. It is possible that a situation of this magnitude would result in

- major cracking to primary structural elements bearing on the foundations with similar effects propagating throughout the secondary supported elements.
- excessive subsidence below the foundation to the existing building. The consequences of this would be a reduction in the integrity of the building and/or foundations to unacceptable levels requiring large scale repair works.

Western Boundary (Birkenhead Street Estate)

The boundary to the west of the site is shared with the Birkenhead Street Estate. An existing 6.0m high solid brickwork wall lines the boundary at present. The wall is restrained at 6.0m intervals by a series of encased steel columns which support the steel framed warehouse structure covering the existing site. As part of the proposed development it is proposed to deconstruct the brickwork boundary wall during the construction stage to be reinstated at a later date once the basement works are completed and the construction of the superstructure to the western block is sufficiently progressed. The purpose of deconstructing the wall is to ensure that as part of the site demolition to be undertaken, including the removal of the steel warehouse structure and the supporting steel columns, the brickwork wall panels are not left standing with insufficient lateral restraint. The safest method of ensuring this is to take down the existing wall and rebuild it on a suitable footing with suitable levels of lateral restraint provided.

A trial pit investigation was carried out to the western boundary in order to determine the existing footings below the brickwork boundary wall. The trial pit determined that the boundary wall extends down to a depth of 1.50m at which point a corbelled brickwork footing supports the weight of the brickwork wall above. Additionally at the column locations, the existing pad footings were exposed to provide the relevant information regarding their extent and nature. Details of the trial pits carried out are included in the appendices.

With the proposed removal of the boundary wall it is no longer necessary to consider the potential difficulties arising from a differential depth between foundations. As a result the contiguous piled wall solution is proposed along the extent of the western boundary in order to retain the excavated boundary perimeter and secure the site during the construction process. As part of this a scheme of temporary works will be put in place to ensure the deflection along the retained boundary is minimized and controlled.

In the permanent condition a reinforced concrete lining wall will provide the long term structural solution to support the basement box and retain the lateral pressures exerted along the boundary by the excavated soil profile. Given the proposed unrestrained nature of the lightwells forming the lower ground floor green areas the concrete lining wall will be designed as a cantilevered retaining wall and will thus not rely on the ground level floor plate providing any lateral restraint.

3.1.3 Surface Flow & Flooding

Not applicable

3.2 Summary

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

The scoping process has highlighted the particular areas which pose the highest risk for potential impact on the adjacent properties. These are the slope stability characteristics of the excavated boundaries particularly the boundaries along which an extended basement excavation is proposed and where existing buildings are in close proximity to the site boundary.

The choice of foundation solution to the boundaries is critical in order to ensure the safety of the surrounding properties bounding the site. The combination of underpinning and contiguous piled walls proposed to the various boundaries is deemed the most reasonable and suitable solution to satisfy the structural requirements for the proposed development. The design of these elements has been developed in subsequent sections of this document.

HERTS & ESSEX SITE INVESTIGATIONS

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Appendix No. 2
Sheet No. 4
Job No. 12138
Date Aug 2014

277a Grays Inn Road, London WC1X 8QF

Borehole D

Description of Strata	Depth	Thickness (m)	Legend	Installation Installed	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	Casing Depth (m)
Cobbles over concrete reinforced	0.20	0.20								
Sandy brick rubble FILL	1.30	1.10		Bentonite Seal						
Soft brown silty slightly peaty CLAY	4.40	3.10		Solid Pipework		1	D	1.50		
						2	D	2.40		
						1	U	3.00		
						2	U	4.00		
Firm becomming stiff brown slightly silty CLAY	6.95	2.55		50 mm Slotted Pipework Response Zone	DRY	3	U	5.00		
						4	U	6.50		
Stiff grey slightly silty CLAY		8.05				5	U	8.00		
						6	U	9.50		

Remarks:

Scale 1:50

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼ –Water Struck D –Disturbed Sample ▽ –Water Standing W–Water Sample P–Piston Sample N–S.P.T. N–Value V–Vane Strength (kN/m²)

4.0 Site Investigation & Study

A geotechnical site investigation has been carried out by Herts & Essex Site Investigations in May 2014 with further investigation undertaken in September 2014 to determine the existing soil conditions within the site and provide and interpretative report with details of structural design parameters and geotechnical analysis. The site investigation (attached in appendix has been used to interpret the feasibility of various structural solutions to develop the proposed structure.

Exploratory Work - Fieldwork
Two 15.0m investigation boreholes were carried out at agreed locations within the site. In-situ Standard Penetration Tests [SPT] and sampling were carried out at appropriate levels with groundwater monitoring standpipes installed in each borehole. A window sample borehole was carried out to a depth of 6.0m providing a broad cross section of the soil profile across the site.

Laboratory Work – Testing
Geotechnical laboratory testing was carried out to establish the following soil characteristics:

- Natural moisture content
- Index properties (Atterberg Limits)
- Particle size distribution tests (wet sieve method)
- Unconsolidated undrained triaxial compression tests

Ground Conditions
The geological sequence beneath the site comprises a predominantly stiff London Clay with no superficial deposits identified. A desk study has identified the site has previously been used as a North London Horse Depository, later used as a Bottling Warehouse. The site is currently used as a warehouse/parking area. The site is overlain by a layer of brick/rubble fill material approximately 2.0-3.0 meters below existing ground level. Details of the investigative boreholes are attached in Appendix E of this document.

Made Ground
The upper levels of the two boreholes undertaken encountered various layers of concrete consistent with the current use of the building. Below the upper layers, the fill material extended to depths of 2.90m and generally consisted of soft sandy clay with brick fragments. Borehole D encountered fill material to a depth of 1.50m with soft peaty clay material identified to a depth of 4.40m. This has the potential to be un-compacted clay material reinstated historically. No obvious visual evidence of contamination was noted.

London Clay
The London Clay was encountered below the fill material and extended to the full depth of each borehole. The formation typically comprised firm becoming stiff brown slightly silty clay to depths of approximately 6.0m to 7.0m. Below the upper firm layers of clay, a stiff grey slightly silty clay was identified in each of the boreholes. This is consistent with the initial desktop study carried out which identified a London Clay Formation underlying the full extent of the site.

Groundwater
A desktop study identified the subsoil as an unproductive strata with no groundwater source protection zones within the proximity of the site. In each of the 15.0m boreholes and the 6.0m window sample no groundwater was encountered. A groundwater monitoring standpipe has been installed in each of the two boreholes to allow future readings and identification of potential groundwater fluctuations.

Contamination
Initial testing of the existing soil material did not identify any excessive levels of contamination and the site has been categorised as a class 1 in accordance with BRE Digest.

Existing Foundations
An additional scheme of trial pits has been carried out by PJCE in order to evaluate the existing boundary wall conditions and define the typical anticipated foundations which will be encountered during the construction stages. Details of these trial pits are included in Appendix F.

5.0 Basement Impact Assessment & Conclusion

5.1 Existing Vs Proposed

The existing site is relatively un-developed below ground level. To the three site boundaries along the east south and north the adjacent properties have developed below ground floor spaces maximising their potential floor space for the given footprints. As a result the existing site lends itself to a below ground basement development when considered on a risk based approach to the structural design element. The site boundaries vary considerably, adjoining local roads, existing brickwork buildings and existing multi-storey buildings with basements.

The redeveloped site will contain a single storey basement (typically 3.50m deep) across 60% of the site with a storey-and-a-half basement (typically 5.50m deep) over the remaining 40% of the site. When complete the site will be fully lined with RC facing walls in front of a combination of concrete underpins and contiguous piled walls. The retaining elements will be under varied pressures depending on their depths and restraint conditions. Each element will be carefully designed to account for the temporary and permanent forces and pressures which it will experience. At each floor level up to ground level the floor plate construction will be a robust structure and when considered over the long term timescale the impact of this proposed development would not be considered to pose any adverse risk or impact on the surrounding area.

5.2 Site Attributes & Features Affected

The screening process identified a number of potential impacts which may arise as part of the proposed basement construction. These were investigated further as part of the subsequent scoping process to identify the various potential impacts which may be caused as a result of the basement construction. A risk based assessment was provided to ascertain the hazard factor, the risk factor and the probable consequence of each occurrence. Given the soil design parameters established as part of the site investigation undertaken it is possible to prepare a suitable method of basement construction with associated temporary works which minimize the potential impacts and minimize the potential damage

5.2.1 Subterranean Flow

An analysis of preliminary site investigation results and an initial interpretation of the information obtained from various additional sources (British Geological Service, Environment Agency, Camden Geological Hydrogeological and Hydrological Study) would indicate that the presence of groundwater in the area is minimal and thus the potential impacts to the groundwater as a result of the development would safely be considered negligible. This is based on a number of factors including, site location, the regional geology of the site, groundwater flows and groundwater source zones. (See appendix A). The subsequent site investigation carried out has identified no perched groundwater levels during the investigative works. A scheme of groundwater monitoring has been put in place to inspect the monitoring standpipe in the coming months.

5.2.2 Slope Stability

The slope stability of the area has been identified as a principle source of risk due to the proposed basement construction.

5.2.2.1 Excavation in close proximity to a highway or pedestrian right of way

A series of preliminary design checks have been carried out for the proposed retained boundary proposals adopting design parameters developed from the site investigation carried out (see appendix F). The anticipated movements and deflections of the boundary are expected to be less than 14mm horizontally and 3.6mm vertically for a 450mm diameter 9.0m deep pile.

For the anticipated calculations of the boundary perimeter design it is reasonable to conclude that the potential damage as a result of the basement works would be categorised as level 3 (Moderate) on the Burland Scale with separation and some cracking to the footpath locally.

5.2.2.2 Differential Depth Between Foundations

Following the initial risk based qualitative assessment the site investigation has been carried out to establish the properties of the soil and the potential load bearing capacity and tendencies for movement below both a typical underpinned foundation and a contiguous piled wall foundation.

Underpinning
A typical scheme of underpinning has been proposed to a large proportion of the northern boundary. This will entail the “hit and miss” underpinning procedure typical of this type of construction. The attached calculations indicate the minimum required size of the underpinning footings to support the anticipated loads over. These have been based on allowable bearing pressures determined as part of the site investigation carried out. The bearing pressures proposed adopt a factor of safety of 3.0 and limit the potential settlement below any footing to 20mm settlement and a category 2 (Slight) Category of Damage on the Burland Scale.

Contiguous Piled Wall.
The more onerous case to the site boundary and the differential depth of foundations relates to the 5.0m basement excavation adjacent to No. 55Argyle Street. An existing 3.65m deep basement has been identified below the adjacent building and it is proposed to excavate for the proposed development an additional 1.50m to a depth of 14.10m OD. The preliminary retaining wall design undertaken for the contiguous piled wall has been attached in Appendix G which indicates and anticipated horizontal deflection of 11mm. The vertical deflection resulting from the installation has been developed in accordance with the recommendation with CIRIA C580 with an anticipated vertical settlement of 4.0mm for a 10.0m pile.

The cumulative impact of each of these anticipated ground movements is considered to be minimal with damage to the adjacent structures limited to a level 2 (Slight) category for the level of damage expected.

Temporary Works
A proposed scheme of temporary works has been considered for the basement development in order to limit the potential ground movements and potential damage to the buildings and structures to each of the retained boundaries. The sequence of works will comprise underpinning the adjacent boundary walls where necessary and subsequently installing a series of temporary buttress piles along the retained perimeter with a number of waling beams installed at suitable levels to retain the existing boundary walls. Once the existing walls are suitably restrained, the upper levels of fill material identified in the borehole investigations will be excavated. On reaching the underlying clay material it will then be feasible to undertake a bermed excavation for the deeper central basement areas and take the permanent structure up out of the excavated basement in a phased sequence with the temporary works. Initial sequence of works details have been attached in appendix C of this document.

5.2.3 Surface Flow & Flooding

The existing site has been fully developed as regards impermeable surfaces and thus the construction of a basement is anticipated to have negligible effects on the volume and quality of surface water generated by the redeveloped site.

Analysis of the available material in relation to flooding has been carried out as part of the drainage strategy prepared by Peter Brett Associates. This has deemed the site to be in an area not considered at high risk of flooding.

5.3 Conclusion

The basement impact assessment for No227A Grays Inn Road 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 have been dealt with in this assessment including, subterranean (groundwater) flow, slope stability, and surface runoff and flooding. At each stage of this assessment these three criteria have been considered and any requirements for each category have been incorporated into the projects proposed development scheme. The proposed development of the site has been considered by Pringuer-James Consulting Engineers with preliminary scheme drawings for the development prepared and included in the appendices as part of this document.

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 and surface flow and flooding and would not pose a risk provided it is undertaken with the necessary precautions and by suitably qualified professionals and contractors.

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(on behalf of Soil Consultants Ltd.)

Date : 16.09.2014

Revision : 02

Pringuer-James Consulting Engineers
Basement Impact Assessment

APPENDIX A

Borehole Data

(Ref: MRS12138) **–Site Specific Borehole Logs**

(Ref: TQ38SW4250) **– Local Borehole Logs**

HERTS & ESSEX SITE INVESTIGATIONS

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Appendix No. 2
Sheet No. 4
Job No. 12138
Date Aug 2014

277a Grays Inn Road, London WC1X 8QF

Borehole D

Description of Strata	Depth	Thickness (m)	Legend	Installation installed	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	Casing Depth (m)
Cobbles over concrete reinforced	0.20	0.20								
Sandy brick rubble FILL	1.30	1.10		Bentonite Seal; Solid Pipework						
Soft brown silty slightly peaty CLAY	4.40	3.10		50 mm Slotted Pipework; Response Zone	DRY	1	D	1.50		
						2	D	2.40		
						1	U	3.00		
						2	U	4.00		
Firm becomming stiff brown slightly silty CLAY	6.95	2.55				3	U	5.00		
						4	U	6.50		
Stiff grey slightly silty CLAY		8.05				5	U	8.00		
						6	U	9.50		

Remarks:

Scale 1:50

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼ –Water Struck D –Disturbed Sample ▽ –Water Standing W–Water Sample P–Piston Sample N–S.P.T. N–Value V–Vane Strength (kN/m²)

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Date Aug 2014

277a Grays Inn Road, London WC1X 8QF

Borehole D ..... continued

Description of Strata	Depth	Thickness (m)	Legend	Installation installed	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	Casing Depth (m)
As above		0.05								
						7	U	11.00		
		8.05		Pea Shingle Gravel; 50 mm Slotted Pipework						
						8	U	12.50		
						9	U	14.00		
	15.00									
Borehole closed at 15.00m										

Remarks:

Scale 1:50

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼ –Water Struck D –Disturbed Sample ▽ –Water Standing W–Water Sample P–Piston Sample N–S.P.T. N–Value V–Vane Strength (kN/m²)

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Appendix No. 2
Sheet No. 6
Job No. 12138
Date Aug 2014

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Borehole E

Description of Strata	Depth	Thickness (m)	Legend	Installation installed	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	Casing Depth (m)
Cobbles over concrete reinforced	0.20	0.20								
Brown sandy topsoil FILL much brick and flint gravel FILL	0.80	0.60		Bentonite Seal						
Sandy brick rubble FILL	3.20	2.40		Solid Pipework						
Firm becoming stiff brown slightly silty CLAY	6.00	2.80		50 mmø Slotted Pipework Response Zone	DRY	1	U	3.20		
						2	U	4.00		
						3	U	5.00		
Stiff grey slightly silty CLAY		9.00				4	U	6.50		
						5	U	8.00		
						6	U	9.50		

Remarks:

Scale 1:50

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼ –Water Struck D –Disturbed Sample ▽ –Water Standing W–Water Sample P–Piston Sample N–S.P.T. N–Value V–Vane Strength (kN/m²)

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Appendix No. 2
Sheet No. 7
Job No. 12138
Date Aug 2014

277a Grays Inn Road, London WC1X 8QF

Borehole E ..... continued

Description of Strata	Depth	Thickness (m)	Legend	Installation installed	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	Casing Depth (m)
As above		9.00		Pea Shingle Gravel 50 mmø Slotted Pipework		7	U	11.00		
						8	U	12.50		
	15.00					9	U	14.00		
Borehole closed at 15.00m										

Remarks:

Scale 1:50

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼ –Water Struck D –Disturbed Sample ▽ –Water Standing W–Water Sample P–Piston Sample N–S.P.T. N–Value V–Vane Strength (kN/m²)