Below the ground floor levels forming the central courtyard and the ground floor commercial/office space a single storey substructure is proposed. When added to the initial 1.65m excavation required to reach the proposed ground level the total excavation for the basement storey is anticipated to extend to a depth of approximately 6.10m from existing warehouse slab level to underside of basement slab level.

The proposed basement and lower ground floor structure will be constructed as a reinforced concrete structure rising and dropping as required to suit the proposed substructure layouts and levels. The basement and lower ground floor structure will rise up from a piled foundation arrangement consisting of a suspended reinforced concrete slab spanning between the pile caps. The slab will be designed to withstand the various forces and loads resulting for the proposed use and potential uplift forces generated by hydrostatic forces and the heave action of the underlying clay strata. Given the reduced risk of hydrostatic forces being generated in the London Clay an uplift pressure of 35kN/$m^2$ has been adopted and is in keeping with recommendations proposed in the interpretative geotechnical report prepared by Soil Consultants Ltd.

The site investigations and geotechnical assessments, laboratory tests and desktop studies carried out for the site have determined that a stiff London Clay is the prevalent geological formation across the extent of the site underlying a depth of inert fill material. The fill material extends to a depth of approximately 2.5 – 3.0m and is a consequence of the historical evolution of the site. The site has been used as a Horse Depository, a bottling warehouse and a commercial waxworks previously and in recent times a carpark.

The characteristics of the underling bedrock soil strata are identified as a firm to stiff Clay material with increasing bearing capacity as you extend deeper. For the anticipated formation levels of the proposed basement and lower ground floor levels a safe bearing capacity of 150kN/m2 has been suggested.

The site investigation tests have also identified the underlying clay material to have a relatively high plasticity and in order to account for this a compressible void forming material will be installed below the underside of the RC slabs to accommodate any potential movement of the soil arising from the shrink/swell characteristics of the clay soil.

The developed scheme will be supported on a suitably designed scheme of bored piles which extend down to bear on the high shear capacity clay soils below. Given the size and scale of the proposed development a raft slab bearing on a clay soil with a bearing capacity of 150kN/m2 was not considered feasible and an alternative bored pile foundation solution was chosen for the scheme. Soil testing undertaken has identified the soil design parameters required for pile design and a safe pile load capacity has been developed for a number of potential pile diameters and depths.

The scheme has been developed for a single pile capacity in the order of 710kN, consistent with a 600mm diameter pile driven to a depth of up to 15m. An appropriately designed pile foundation scheme with suitable pile cap foundations has been developed by PJCE and included in the appendices of this document. The associated pile loads for the final design will be incorporated into the pile design prepared by a specialist piling contractor and submitted for approval as part of a building control submission for compliance with Part A of the building regulations.

**Site Boundaries**

The proposed basement structure will involve excavation in close proximity to adjoining site boundaries and as such a series of earth retaining structures to the boundary perimeter have been developed. The site is adjacent to a series of varied types of buildings with existing footing levels and types changing along the site boundaries.

Southern Boundary – Embedded Retaining Wall

To the South the site is bounded by the property at No.55 Argyle Street. From the information available and from a walkthrough of the property the building is considered to consist of a steel framed building with concrete encased beams and columns supporting an infill concrete floor. The building includes a single storey basement which extends down to a depth of approximately 3.50m below a ground level of approximately +19.450m AOD.

A contiguous piled wall is proposed to retain the boundary perimeter installed to resist the various horizontal pressures and forces arising from the basement excavation. The contiguous piled wall will also be designed to support the permanent vertical superstructure loads arising from the proposed development. A reinforced concrete lining wall will be cast inside of the piled wall to resist the permanent horizontal pressures and provide a suitably designed basement structure in accordance with relevant standards.

Eastern Boundary – Embedded Retaining Wall

Across a portion of the eastern boundary to the southern end of the site the proposed development will involve excavation to the basement level in close proximity to the properties forming 275 and 277 Grays Inn Road. An embedded retaining wall comprising a contiguous bored pile wall with reinforced concrete lining wall has been proposed as a solution to retain the site boundary and form the proposed basement structure. The piled wall will provide vertical load bearing support to the concrete structure above and will also be designed to resist the various horizontal forces and pressures arising from the excavation for the basement. The reinforced concrete lining wall will be designed for the permanent horizontal forces and pressures arising due to retained earth, potential hydrostatic pressures and loads due to adjacent structures.

Eastern Boundary – Underpinning

To the central and northern extent of the eastern boundary with Grays Inn Road, the proposed development will require excavation to suit the proposed lower ground floor structural slab level of +15.690m AOD. Given the varied nature of the footings in relation to size, materials and levels, a suitably designed scheme of underpinning has been developed to extend the existing footings down to a level below the proposed structural levels and subsequently ensure the structural stability of the adjacent boundary footings. The load bearing piles proposed for the residential mews building foundations are proposed to be installed setback from the boundary and thus should limit the risk of potential adverse effects on the underpinning footings due to pile installation.

Northern Boundary – Underpinning

To the northern boundary of the site a lone-standing residential property is proposed which will comprise a three storey residential property with single storey basement structure. The proposed building will be constructed adjacent to the existing dwelling at No.13 St. Chads Street. This property is an end of terrace brickwork building with timber floor plates and has an existing single storey basement.

As part of the site redevelopment it is proposed to carry out the construction of the proposed basement by installing a series of mass concrete underpins to the existing foundations. The concrete underpins will be installed in a staggered sequence to limit the potential risk of undermining the existing brickwork boundary wall. The proposed basement structure to the new residential property will then consist of a reinforced concrete raft foundation with reinforced concrete lining walls retaining the adjacent buildings and excavated boundaries. The walls will be propped at ground floor level by a reinforced concrete ground floor slab with traditional loadbearing masonry and precast concrete floor plates rising up to form the superstructure.

Northern Boundary – St. Chads Street

To the northern elevation of the proposed site, the proposed lone standing residential property abutting No.13 St Chads Street will be situated tight against the site boundary facing directly out onto St. Chads Street. Given the proximity to the road, a temporary earth retaining solution is required to safeguard the proposed works and secure the neighbouring roads and properties. An embedded retaining wall solution has been chosen involving a cantilevered contiguous bored pile wall which will resist the associated forces of an excavation in close proximity to a public carriageway. In the permanent condition a reinforced concrete lining wall forming the basement box structure will be designed to resist the pressures and forces resulting from the retained earth and associated forces and pressures generated by the carriageway above.

Western Boundary – Multi-unit Residential Blocks to Lower Ground Floor Level

To the western boundary of the proposed development the site is bounded by the Birkenhead Estate and is directly adjacent to the communal green areas estate. Along a significant extent of the site it is proposed to construct a lower ground floor reinforced concrete structure which will require an excavation of approximately 3.40m to reach the proposed structural slab level of +15.690mAOD. In order to secure the boundary a temporary embedded retaining wall solution consisting of a steel sheet piled wall is proposed which will form an earth retaining structure in the temporary condition. Inside of the steel sheet piled wall, a reinforced concrete lining wall is proposed which will represent the permanent structural solution for retaining the excavated boundary. The reinforced concrete wall will be designed as a cantilevered retaining wall.

Western Boundary – Mixed Use Block to Basement Level

To the southern extent of the western boundary with the Birkenhead Estate, the larger southern block of the proposed development runs tight up against the site boundary. The proposed block comprises of a ground floor and basement structure with levels linking to the central courtyard areas. A slab level of approximately +17.040mAOD is proposed at ground floor level with a basement level of +13.455m AOD providing a floor to floor retained height of 3.285m. The site levels along the adjacent Birkenhead communal green areas are found at levels of approximately +19.250mAOD resulting in an additional retained height in the region of 2.20m. It is proposed to continue the steel sheet piled wall solution, proposed to the northern extent of the boundary, with the addition of a suitably designed scheme of temporary props and waling beams at required levels to facilitate the excavation and basement construction.

The steel sheet piles will be designed to resist the pressures and forces due to the retained earth for the temporary construction stage of the proposed stage of the development. In the permanent condition, a reinforced concrete lining wall is proposed to resist the permanent loads generated by the retained earth and associated pressures.. The lining wall will act as a propped cantilever with a permanent prop provided by the proposed ground floor slab. Above the proposed ground floor level, a reinforced concrete upstand wall continuing up from the basement lining wall will retain the raised levels of the Birkenhead estate communal green areas.

**Mitigation Measures**

The proposed basement development involves an extensive exercise of subterranean construction in close proximity to adjacent buildings and structures. As a result it is evident that there is considerable need to ensure that every reasonable measure to protect the adjacent structures is investigated and adopted where possible. As part of the measures to safely construct the proposed basement structure PJCE have proposed a number of mitigation measures to protect the neighbouring properties and secure the stability of the retained boundaries and existing foundations.

The primary mitigation measure proposed is a significant system of temporary works measures and sequence of works for the construction of the subterranean structures. Details of the temporary works are included in the appendices and are designed to limit potential deflections along the boundary thus minimizing the potential risk of damage to adjacent structures.

A secondary mitigation measure proposed by PJCE to minimize the potential risks to adjacent structures involves an extensive scheme of vibration and movement monitoring. The proposed vibration monitoring system has been developed in accordance with current Eurocode recommendations and serves to limit the potential ground borne vibrations arising from construction methods anticipated for the basement construction to levels identified below those which can cause damage to existing structures. The limits have been set after consideration of the type of buildings identified and their sensitivity to vibrations covering a range of anticipated values.

In addition to the vibration monitoring system a comprehensive scheme of movement monitoring has been proposed, detailed and specified to limit the allowable movements of the associated basement structural elements to reasonable levels and to monitor the adjacent buildings around the site over the lifetime of the construction programme thus ensuring that any potential movement arising from the proposed works are identified an recorded to ensure any movement is not ongoing.

**Lateral Stability**

The lateral stability of the superstructure will be provided by a series of reinforced concrete shear cores throughout the scheme which form the stairwell and lift cores for the various blocks rising up across the site. The horizontal loads acting across the building elevation will be transferred to the stability cores through the diaphragm action of the reinforced concrete flat slab floors. The subsequent lateral loads will be dissipated through the stability cores down to the foundations at basement level.

**Disproportionate Collapse**

The superstructure and substructure rise up to eight storeys above ground floor level and are therefore categorised as a class 2B structure for disproportionate collapse. The structure will be designed with horizontal and vertical “ties” required to satisfy the Class 2B classification for each type of building material used. At first floor level in the larger multi-storey western residential blocks the format of the residential units changes and in the larger southern block the proposed use changes from residential to commercial/office with a subsequent change in the structural load paths down to the foundations. In areas where it has not been possible to align the vertical load bearing structure a series of transfer structures will be proposed at first floor level to support the discontinuous columns over. The structural elements supporting the transfer structures will be designed and detailed as “key” elements in accordance with building regulations requirements to satisfy disproportionate collapse requirements.

## 5.0 Temporary Works

The temporary works for any project is a critical part of the construction process and must be undertaken by a suitably qualified engineering organization and subsequently carried out by a quality assured contractor capable of ensuring the necessary procedures and mitigation measures are followed.

A system of temporary works will be required to support the retained boundaries for the proposed development during the construction stage of the project until the permanent works have been installed and have attained sufficient strength to act as a horizontal diaphragm supporting the boundary retaining walls as necessary.

For the proposed project a construction scheme involving phased excavations and a sequence of works for the installation of suitable temporary works elements including waling beams and flying shores has been proposed. The preliminary temporary works scheme has been developed taking account of the ground conditions within the site and the characteristics of the soil determined as part of the site investigation carried out. The scheme has been developed with the following intent:

- Securing the retained boundaries and limiting the anticipated horizontal movement during the basement excavation. (The allowable deflection of the proposed embedded retaining wall to the boundary will be agreed as part of a subsequent party wall agreement between the relevant parties to each side of the party wall boundaries. Preliminary piling design carried out indicates a maximum horizontal deflection of 12mm is anticipated for the scheme proposed).
- Undertaking a phased excavation to mitigate against any potential adverse effects resulting from the ground movement due to heave. As noted in the recommendations of the geotechnical report, there is a potential heave anticipated in the centre of the site as a result of total unloading due to demolition of the existing structures and excavation of the required volume of soil.

**Southern Boundary**

The boundary to 55 Argyle Street will involve the installation of a contiguous piled wall to support the various horizontal loads arising from the basement excavation. The contiguous piles will be designed as a propped cantilever with support provided across the top of the piled wall in the form of a reinforced concrete capping beam. The capping beam will be designed to span between prop locations. The propping system for the capping beam has been designed adopting a system of diagonal props which span across the width of the site thus transferring the lateral pressures through to the site boundaries. The sequence of works to install the piled wall, capping beam and diagonal props has been detailed by PJCE and is included in the appendices.

**Western Boundary**

The proposed temporary woks to the western boundary along the Birkenhead Estate adopt two differing variations of a steel sheet piled wall. The lesser of these is the extent of the proposed development which is excavated down to lower ground floor level. In this instance, the steel sheet piles will be installed and designed as a cantilevered embedded retaining wall. To the southern end of the Birkenhead boundary the proposed basement excavation extends to a depth of approximately 6.50m and thus requires a propped system to the upper level of the sheet piles to limit deflections to the boundary and limit the section size required to withstand the various forces and pressures from the extended excavation depth. The steel sheet piles will be propped at the new ground floor level by a steel waling beam which runs along the length of the sheet pile wall. The waling beam will be propped by a series of

flyshore props which span across the site transferring the lateral loads from one boundary through to the other boundary as an axial force in the props. Details of the prop and waling system are indicated in the temporary works drawings attached in the appendices. A specialist temporary works propping contractor has been proposed to undertake the prop design and installation. Further detailed design drawings and calculation of the propping system will become available prior to installation and will be reviewed and checked by PJCE to ensure compliance with the temporary works design scheme.

**Eastern Boundary**

To the eastern boundary shared with the properties facing Grays Inn Road a combination of temporary works systems have been detailed and designed to accommodate the varying relationships between the existing properties and the proposed development.

Along the portion of the eastern boundary to the south, the larger basement excavation for the multi-purpose block will adopt a contiguous piled wall to retain the excavated material and resist the lateral forces arising from the adjacent building foundations and associated horizontal forces. The contiguous piled wall will be designed as a propped cantilever with support to the top of the wall provided by a reinforced capping beam which is propped by a series of flyshore props located at designated centres. The props will span across the site and serve to equalise the various forces arising from the excavation of the Birkenhead estate boundary along the western boundary of the site. Details of the sequence of works required to install the embedded retaining walls and to secure the existing footings along this portion of the site are detailed in the PJCE temporary works drawings.

Moving North along the Grays Inn Road boundary the proposed development involves a single storey excavation for the residential mews properties. A series of trial pits encountered various forms of footing below the boundary wall and thus a series of mass concrete underpins will be installed in a staggered sequence below the existing footings to appropriate levels which will eliminate the risk of the proposed works undermining existing footings along the boundary. A preliminary series of temporary works to secure the boundary have been proposed which involve the installation of high level steel walers and props supported by a series of plunge columns. The plunge columns will be designed as a series of cantilever sections transferring the anticipated temporary support loads from the props and walers into the soil below. The temporary works will be installed and maintained on site until the permanent boundary works required to secure the boundary walls are in place. Details of the phasing and sequence required to install the temporary works and their interaction with the permanent works are detailed on the attached PJCE temporary works drawings.

To the northern most point of the eastern boundary an existing basement structure exists which has been investigated and the level of the existing footings are known to extend to depths below the proposed footing levels. In this instance a series of high level props are proposed to secure the adjacent boundary walls during construction but no enabling or temporary works are required as the existing footings are not at risk of being undermined.

**Northern Boundary**

Along the northern boundary for the main block development the existing basement is located below the proposed lower ground floor levels. A piled foundation arrangement inset of the adjacent footings will be provided to support the building loads above. The boundary walls will be supported with a series of reinforced concrete lining walls which serve to support the structural loads above and transfer the loads back to the inset piled foundations. There is subsequently no requirement to provide temporary works to secure the boundary walls as they will at no point be undermined by the proposed construction works.

**St Chads Street Residential Block**

Facing north onto St. Chads Street a lone-standing building is proposed tight against the carriageway and abutting the adjacent property at No.13 St. Chads Street. The adjacent building is known to have an existing basement level and thus the risk of potential differential depth between foundations is considered to be low. A series of mass concrete underpins are proposed to the underside of the neighbouring property to eliminate any risk of the proposed basement structure undermining the existing building footings. The underpins will be carried out in a staggered sequence to limit the potential risk of damage to the existing walls over.

*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 $\varepsilon_{lim}$ (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 08 – Classification of visible damage to walls**

## 6.0 Conclusions

**Stability of Existing Buildings & Surrounding Ground**

The temporary works will be required to protect the neighbouring properties adjacent to the site boundary. A set of preliminary design calculations for the embedded retaining wall have been developed for the anticipated boundary condition next to the sensitive boundary with No.55 Argyle Street and is included as part of the preliminary calculations contained in the appendices of this document. This represents the more onerous design situations requiring a 6.5m excavation close to the boundary. The design of the piles has been undertaken to reduce the potential lateral movement to appropriate levels. This has been limited to a maximum potential deflection of 12mm. As part of the proposed works the installation of bored piles can be expected to introduce vertical ground movements equating to 0.05% of the pile embedment length. For the section of embedded retaining wall identified a maximum vertical movement of up to 5.0mm is anticipated.

**Groundwater**

The site investigations carried out for the site at various stages during the initial planning process and the detailed scheme design stage have not encountered groundwater within the impermeable London Clay substrata. As a result it is reasonable to conclude that the proposed basement will not have any adverse effects on the existing groundwater in the region.

**Burland Damage Category**

The scheme development and design calculations have been prepared taking account of the soil characteristics identified by the geotechnical site investigation and soil analysis. At this stage of the design development it can be anticipated that the category of damage expected to the existing buildings and surrounding ground is between 1 and 2 based on the Boscardin and Cording / Burland Classification of visible damage to walls published in CIRIA C580 and attached below. This is in accordance with current best practice for basement design which suggests that all basement excavations must limit the category of visible damage to category 2 “Slight”.

Report prepared by: Cairbre Costello
*BEng, BA*

Teodor Perfanov
*MSc(Eng), M Eng, C Eng, MICE,*

Date : May 2015

Revision : **-**

**Pringuer-James Consulting Engineers**
**Basement Impact Assessment**

# APPENDIX A

**Site Investigation Report**
**Herts & Essex Site Investigations Ltd.**
**Report Ref: MRS/12138**

## Site Investigation Trial Pit Details

**Site Investigation Report**
**Soil Consultants Ltd.**
**Report Ref: 9708/MC**

**HERTS & ESSEX SITE INVESTIGATIONS**
The Old Post Office, Wellpond Green, Standon,
Ware, Herts, SG11 1NJ
Telephone : Ware (01920) 822233
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16th September 2014 Our Ref : MRS/12138

Regal Homes Ltd
4-5 Coleridge Gardens
London
NW6 3QH

**For The Attention Of P.Eden Esq.:**

Dear Sir ,

**Re: 277a Grays Inn Road, London WC1X 8QF : Site Investigation**

## 1.0 Introduction

1.01 In accordance with your instructions, we visited the above site during September 2014 .

1.02 The purpose of our visit was to carry out an investigation into the subsoil conditions with a view to foundation design.

1.03 The comments and opinions expressed are based purely on the conditions encountered and the subsequent laboratory testing.

1.04 Therefore, it is possible that some special conditions prevailing on site have not been encountered or taken into account.

1.05 All ground water recordings or their absence relate to short term observations and do not allow for fluctuations due to seasonal or other effects.

## 2.0 Description of Site

2.01 The site is situated at 277a Grays Inn Road, London WC1X 8QF.

2.02 At the time of our visit the site was generally flat and a disused warehouse.

## 3.0 Fieldwork

3.01 Two boreholes were sunk to a maximum depth of 15.00m by means of a shell and auger drilling rig.

3.02 The location of the works is indicated on the site plan forming appendix one.

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3.03 The various strata and details encountered were noted and are recorded on the borehole logs forming appendix two.

3.04 Insitu strength tests were carried out in the boreholes, the results of which can be seen on the aforementioned logs.

3.05 A full range of samples were recovered as noted and retained for subsequent laboratory testing.

3.06 The location, type and height of any trees should be taken from a survey for later use with NHBC Chapter 4.20, if required.

## 4.0 Laboratory Testing

4.01 All samples were tested in accordance with BS:1377:1990 Methods of Test for Soils for Civil Engineering purposes.

4.02 Selected samples were tested to determine their atterberg limits, partical size distribution, triaxial strength, Consolidation & heave parameters, soluble sulphate content and pH value.

4.03 The results of all laboratory testing are summarised in appendix three.

## 5.0 Conclusions and Recommendations

5.01 By inspection of the borehole logs it can be seen that the subsoil consists of a nominal layer of Concrete / Cobbles to 0.20m over a Sandy Topsoil Brick Rubble FILL to between 1.30 - 3.20m where a Firm Becoming Stiff Brown Slightly Silty CLAY overlies at between 6.00 - 6.95m a Stiff Grey Slightly Silty CLAY which is encountered and present to the close of the boreholes. Boreholes A - C were attempted inside the warehouse without success due to a lower layer of concrete.

5.02 No water was encountered upon excavation of the boreholes as described on the borehole logs, however a standpipe was installed at 15m in both boreholes and was still dry 1 week later on the 14th September 2014.

5.03 No significant roots were encountered in the borehole.

5.04 Laboratory testing proved the clays to be of Intermediate to very high plasticity (PI= 28 - 57%) which indicates a high susceptibility to movement associated with moisture content change.

**HESI**

5.05 Triaxial testing proved the CLAYS to have cohesion values between 22 - 186Kn/m² these values are generally seen to increase with depth.

5.06 Therefore when considering the information available we are of the opinion that a the basement can take the form of a reinforced raft with walls designed to take the pressure of the retained soil. A bearing Capacity of 50 Kn/m² at 3m ( BHD ) and 100 Kn/m² at 3m ( BHE ) can be taken for design purposes.

5.07 Heave Analysis :
This was considered two ways, both with and without the softer layer encountered in Borehole D (1.3 - 4.4m)
Expected heave Mid Basement No Soft Layer - 53 mm

Expected Heave Mid Basement With Soft Layer - 57 mm

Please Note the expected Heave will be half this value on the centre of the long side and a quarter this value on the corners.

5.08 Design Parameters ( Retaining Wall )

| | |
|---|---|
| Made Ground | Bulk Density 1700 Kg/Cubic Metre |
| | Effective Cohesion Zero |
| | Effective Friction Angle 20 Degrees |
| London CLAY | Bulk Density 1950 Kg/Cubic Metre |
| | Effective Cohesion Zero |
| | Effective Friction Angle 25 Degrees |

5.09 As the site contains less than 0.50g/L of soluble sulphate it can be categorised as a class 1 site in accordance with BRE Digest, and as such any concrete in contact with the subsoil needs no special precautions.

5.10 We understand piling is to be undertaken on site ane we can give the following general piling designs :
600mm Dia Pile 11.5m Long has a safe working load of 500 Kn
600mm Dia Pile 15.0m Long has a safe working load of 700 Kn
600mm Dia Pile 17.0m Long has a safe working load of 900 Kn

We hope that this is satisfactory, however if you should require any further information, please do not hesitate to contact us.

Yours faithfully,

M. R. Smith M.Sc
Principal Engineer

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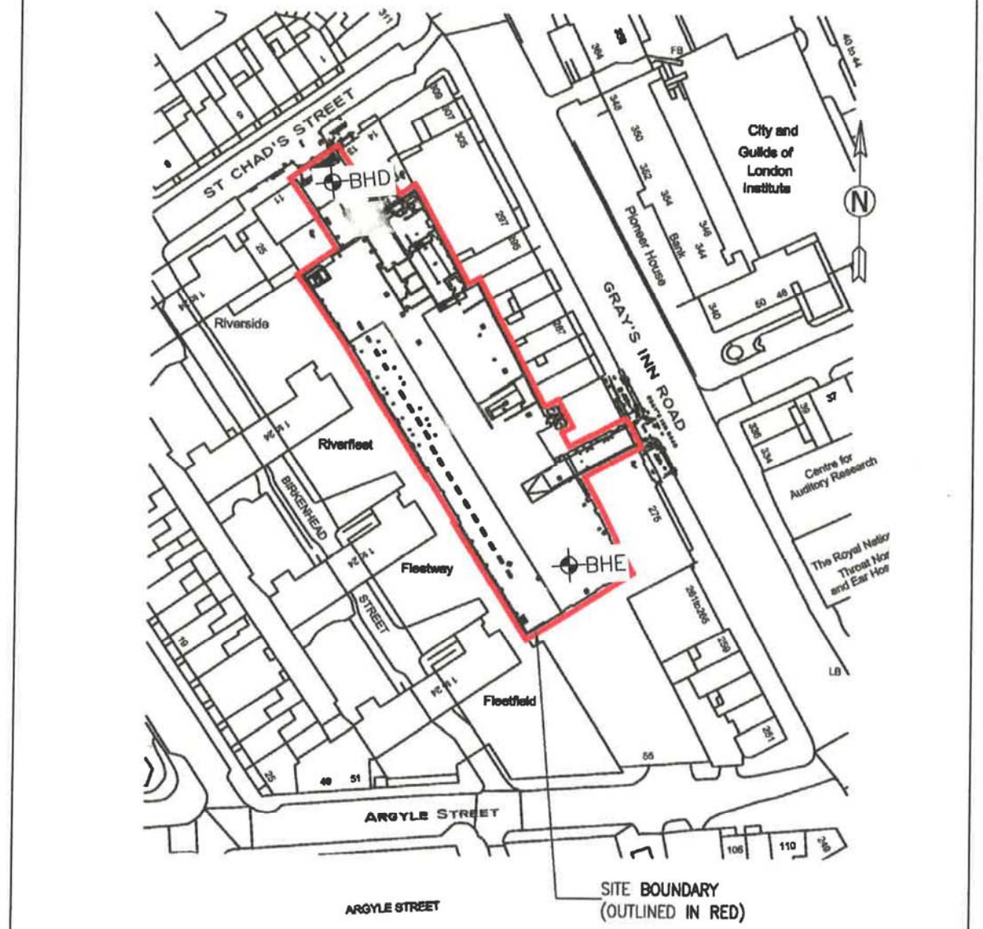
Appendix No. 1
Sheet No. 1
Job No. 14371
Date May 2014

277a Grays Inn Road, London WC1X 8QF

Site Plan




Not to Scale

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Appendix No. 2
Sheet No. 1
Job No. 12138
Date Aug 2014

277a Grays Inn Road, London WC1X 8QF

Borehole A

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|
| Concrete | 0.20 | 0.20 | | | | | | | | |
| Brown sandy gravel FILL with rare concrete fragments | 0.80 | 0.60 | | | | | | | | |
| Concrete | 0.90 | 0.10 | | | | | | | | |
| Borehole closed at 0.90m<br>No further progress | | | | | | | | | | |

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. 2
Job No. 12138
Date Aug 2014

277a Grays Inn Road, London WC1X 8QF

Borehole B

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|
| Concrete | 0.20 | 0.20 | | | | | | | | |
| Brown sandy gravel FILL with rare concrete fragments | 0.80 | 0.60 | | | | | | | | |
| Concrete reinforced | 1.10 | 0.30 | | | | | | | | |
| Brick rubble FILL | 1.20 | 0.10 | | | | | | | | |
| Concrete<br>Borehole closed at 1.20m<br>No further progress | | | | | | | | | | |

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. 3
Job No. 12138
Date Aug 2014

277a Grays Inn Road, London WC1X 8QF

Borehole C

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|
| Concrete | 0.20 | 0.20 | | | | | | | | |
| Brick FILL | 0.30 | 0.10 | | | | | | | | |
| Concrete<br>Borehole closed at 0.30m<br>No further progress | | | | | | | | | | |

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. 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 | | | | | | | | |
| Soft brown silty slightly CLAY | 4.40 | 3.10 | | | | 1<br>2<br>1<br>2 | D<br>D<br>U<br>U | 1.50<br>2.40<br>3.00<br>4.00 | | |
| Firm becomming stiff brown slightly silty CLAY | 6.95 | 2.55 | | | DRY | 3<br>4 | U<br>U | 5.00<br>6.50 | | |
| Stiff grey slightly silty CLAY | | 8.05 | | | | 5<br>6 | U<br>U | 8.00<br>9.50 | | |

Installation: Bentonite Seal; Solid Pipework; 50 mm ø Slotted Pipework; Response Zone

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)