15055 / 152 Royal College Street, NW1 0TA

August 2017 / Basement Impact Assessment

Rev	Date	Description
-	27 July 2015	Submission for inclusion in planning application
Addendum	08 April 2016	Submission for inclusion in planning application
A	2 August 2017	Foundations Proposal Ameded

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Summary

This note forms part of a Basement Impact Assessment (BIA), as set out by Camden's Planning Guidance 4 (CPG4) for the proposed basement at 152 Royal College Street, NW1 0TA.

The extent of the proposed basement has been revised following liaison with Thames Water with regards to an underground sewer across the site. The existing sewer will be re-routed to allow for an additional basement to the rear of the site. The proposed works will not load the sewer.

The basement construction methodology has been revised from piled wall to a typical pinned retaining wall following advice from pilling contractors; pilling through the made ground layer was not considered to be a viable solution.

The construction of the basement will not have an adverse impact on adjacent structures and the Thames Water sewer. The construction of the property is feasible, without significantly disturbing local residents and local traffic flows.

Historically the site contained a single storey basement, beneath much of the footprint, until circa the 1970s when it was infilled.

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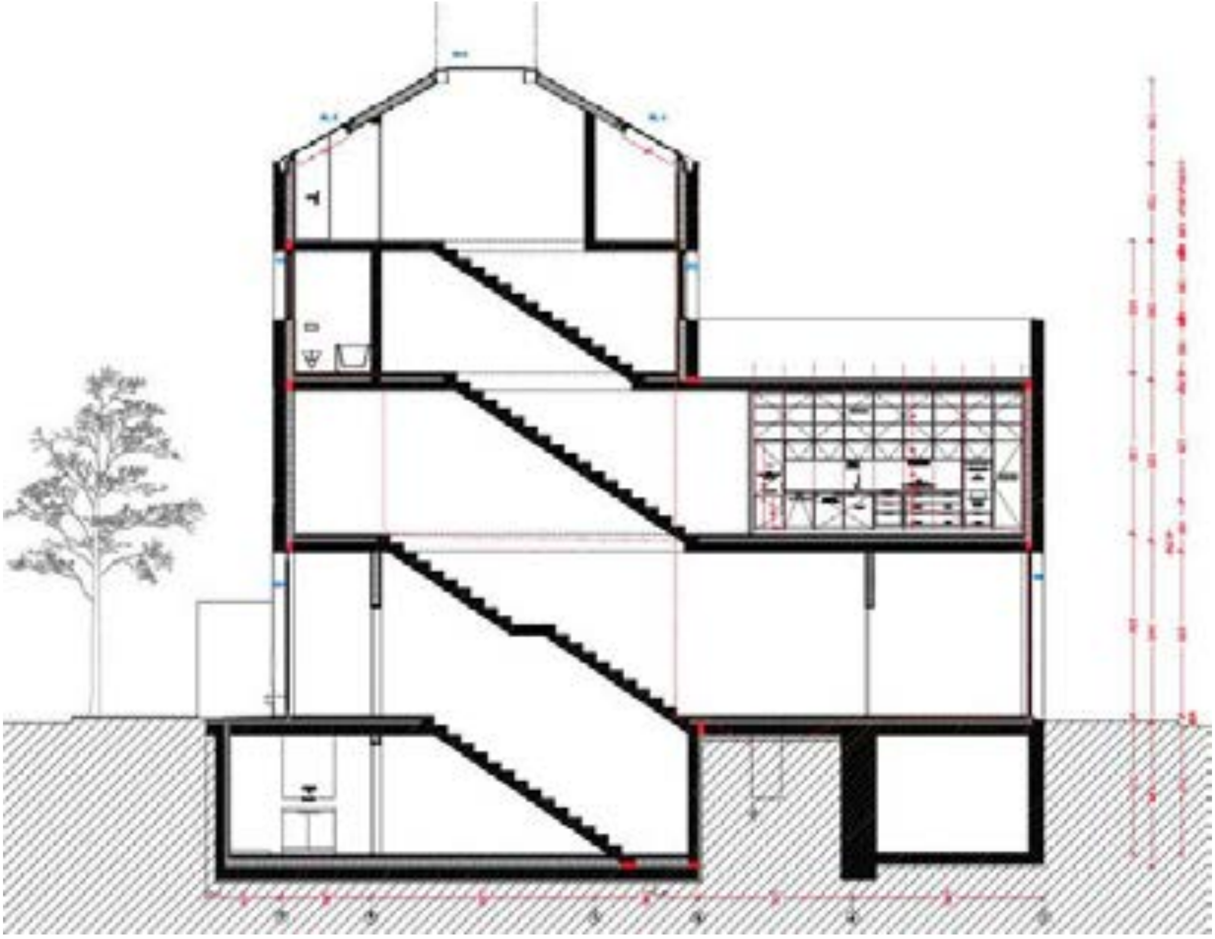
Contents

1.0 Introduction & Proposed Development

The proposed development consists of a single storey basement under the full footprint of the site and three stories above ground, as shown on Henning Stummel Architect's drawings. Indicative section below:



The existing site is vacant, but evidence suggests it used to be a residential property with a basement.

The information contained in this note is based on:

- Site visits
- Ground Investigations and report undertaken by Soil Consultants
- Groundsure Insights Historic Ordnance Survey Maps
- Groundsure Enviroinsight's environmental data report
- Groundsure Geoinsight report
- Nicholas Barton's book, The Lost Rivers of London
- LCC Bomb Damage Maps, 1939-1945
- URS' London Borough of Camden Strategic Flood Risk Assessment (SFRA) – July 2014
- Camden Planning Guidance – CPG4 – Basement and lightwells – September 2013
- Camden geological, hydrogeological and hydrological study – Guidance for subterranean development – Issue 01 – November 2010.

Ground investigations have found approximately 2.1m of made ground (in-filled basement) over London Clay to depth. Groundwater seepage occurred at a depth of approximately 4.5m, well below the proposed basement depth of 3m, and did not rise at the time of the investigations. A groundwater piezometer monitoring visit two weeks later found the level to be standing at 2.9m. The London Clay is defined as a non-aquifer or unproductive strata.

With reference to URS' Strategic Flood Risk Assessment (SFRA) report for Camden, the site is located in an area of very low risk to surface water flooding (< 1 in 1000 years).

2.0 The existing site

The site is on the corner of Baynes Street to the South and Royal College Street to the West.

The site is level and vacant and its surface is mostly hardstanding, photo below taken looking North.

The vertical steel sections on site are the remnants of an advertising hoarding.

To the North of site abuts a Victorian terrace, #154 Royal College Street, which appears to be mostly vacant apart from a Barbers shop at ground floor level. The property is in poor condition and has cracking on the front elevation. It has a single-storey basement, with relatively low headroom. The historic maps contained in appendix A show the building pre-dates 1870. The chimney structures on the gable wall to #154 suggest the #152 site used to contain a property constructed at the same time.

To the East of the site is a vehicular access route for the block of postmodern flats at 1-30 Bruges Place. The historic maps show this block was constructed in circa 1983.

To the South of the site on the other side of Baynes Street is the Regents Canal (also referred to as the Grand Union Canal). The canal is substantially lower (around one storey) than Baynes Street and is accessed via steps and ramps.

Historic maps seem to confirm our assumption that the #152 site contained a Victorian property, similar to #154. The maps show a property to be present on the #152 site prior to 1971 over the whole of the site footprint.

The LCC bomb damage maps (extract below) indicate that the site was not directly affected by wartime bombing. However the website Bomb Sight suggests a WW2 bomb may have hit to the East, further along Baynes Street. From the historic maps, showing the housing to remain present along Baynes Street post WW2 (in 1952), we believe the LCC bomb maps are likely to be correct.

WW2 Bomb Record – No damage recorded

We have approached London Underground and they have confirmed that they have no assets within 50 metres of the site (letter in appendix B).

3.0 Geology

British Geological Survey (BGS) maps (sheet 256 & online) indicate the presence of London Clay directly under the site (pavement level ~ 27m AOD, extrapolated from manhole cover levels) with the base of the clay probably below 0m AOD. Below the clay the BGS section indicates the Lambeth group (mottled clay, pebble beds and sand) with chalk bedrock below this.

In May 2015 two trench trial pits were undertaken on site to establish the depth of the clay and the depth of the historic basement. Mixed made ground containing bricks was found to a depth of around 2.3m, with firm virgin clay below. The trial pits were mostly dry, apart from a small amount of perched water, partly due to the rain at the time (photo below).

In June 2015 Soil Consultants (ground investigation contractors) undertook a 16m deep borehole centred on the site as well as a trial pit against the gable wall to #154 Royal College Street (RCS).

The log from their borehole is contained within appendix A, showing made ground to a depth of 2.1m, with firm clay below, becoming stiff at a depth of around 10m. Ground water seepage occurred at a depth of 4.5m, with no rise noted.

A groundwater monitoring visit two weeks later found the level to be 2.9m below ground level.

The trial pit to the gable wall of #154 found the formation level of the foundation to be at a depth of 2.1m (photo below).

4.0 Site Hydrogeology and Hydrology

As noted above (in section 3.0), the trial pits undertaken on the site were found to be mainly dry. During the borehole works, water was found at a depth of 4.5m and did not rise during the day of the investigation. Over a period of two weeks there had been some minor seepage, probably perched water in the made ground, and the standpipe water level had reached a depth of 2.9m below ground level.

London Clay is generally impermeable to ground water and is defined as a non-aquifer or unproductive strata, i.e. has low permeability and negligible significance for water supply or river base flow. The proposed new basement will therefore not cause localised 'damming' to ground water flow. Negligible ground water was found in the made ground above the London Clay during the open trial pit investigations.

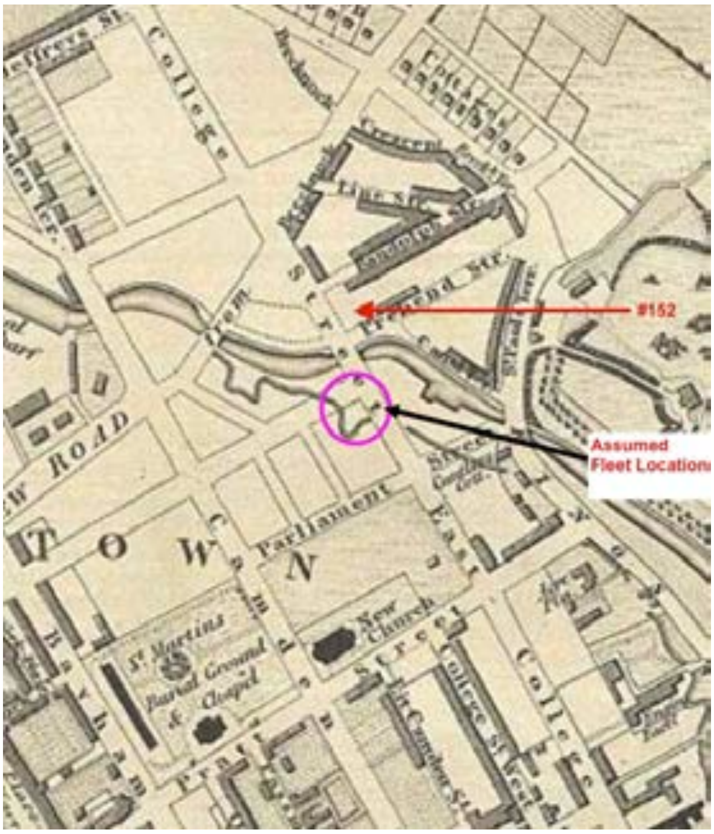
The proposed basement extension will not result in a change in the area of impermeable surface finishes within the site, as the existing site surface is mainly hardstandings, and therefore it is not anticipated that the works will affect the risk of surface water flooding. The proposed building is to contain an area of extensive green roof, therefore naturally restricting the peak rate of surface water discharge during an extreme rainfall event.

The site is located within the Environment Agency (EA) Flood Zone 1, as is the whole of the London Borough of Camden. With reference to URS' Strategic Flood Risk Assessment (SFRA) report for Camden, the site is located in an area of very low risk to surface water flooding (< 1 in 1000 years - extract below).

URS' report, in 5.2.6, suggests the Low, Medium and High bands of surface water flood risk may be substituted in place of EA Flood Zones, 1,2 & 3. The EA exception test is therefore not appropriate and the Planning Practice Guidance (Table 3 Flood Risk Vulnerability and Flood Zone 'compatibility') designates the site as being appropriate to contain a basement.

The Lost Rivers Of London map by Nicholas Barton (below) shows that the river fleet ran close to the site. However another historic map (also below) suggests the river was further South. URS' report states *'The River Fleet became entirely enclosed in the 19th Century and is now fully incorporated into the TWUL sewer network27, eventually out-falling into the River Thames under Blackfriars Bridge'.*

Lost Rivers of London map, by Nicholas Barton. Site near the Fleet



Circa 1840 Map that appears to show the route of the river Fleet

The Regents/Grand Union canal is located around 16m from the site boundary. Being a man-made puddled (tanked) structure, presumably located in the London clay, this will not affect the local hydrogeology.

With reference to the below photo, the canal is over a storey below the #152 Royal College Street site and therefore the canal water level will be below the proposed basement level.

5.0 Effect of Trees on Foundations

Some large deciduous trees are located on the South side of Baynes Street, near the canal, approximately 9m from the site edge (see photo above). The trees appear to be Sycamore/Maple, which accordance to NHBC guidance can reach a potential mature height of up to 22m. Considering this tree height and distance, for clay of high volume change potential NHBC advise a minimum foundation depth of around 1.65m, therefore much shallower than the proposed basement formation depth of around 3m.

The adjacent tree present on Royal College Street is located in a council tree pit and has presumably been planted within the last 10 years. Refer to the photo below taken in November 2015.

The construction of the proposed basement will not compromise the stability of the tree as its root zone is unlikely to extend across to the site as the tree is young, its trunk diameter is small and the soil under the pavement will be highly compacted. NHBC guidance suggests a minimum foundation formation depth of 1.85m, assuming the tree could reach a mature height of 10m (as typical of Council planted fruit species), the tree has a moderate water demand and the clay has a high volume change potential. The 1.85m minimum formation depth is therefore much shallower than the proposed basement formation depth of around 3m.

The location of the large deciduous trees on the other side of Baynes Street (visible in the background in the above image) has been addressed in section 5.0.

6.0 Thames Water Sewer

A plan showing the Thames Water record of the route of the sewer is contained in Appendix F. It is intended that the sewer is re-routed to allow for two separate basements either side. The proposed extent of the basement is shown on the drawings contained in Appendix C. All of the structure over the sewer has been designed to be suspended and Cellcore by Cordek void former will be provided underneath to prevent the sewer being loaded. All pins and trench-fill foundations are to be at least 1m clear of the sewer as stipulated by Thames Water's Developer Services.

7.0 Construction Methodology

Against the party wall with #154, it is proposed that the existing corbelled footing found at a depth of 2.1m be traditionally underpinned to a depth of around 3m. The underpins are not to exceed a length of 1.3m and will be undertaken in a traditional hit and miss sequence.

Against the rest of the full site perimeter, it is proposed that insitu cast retaining walls be constructed. The head of the retaining wall will remain propped until the installation of the ground floor slab and perimeter beams. This will ensure the adjacent highways and structures will be suitably retained throughout construction. Ground movements and a damage assessment have been discussed in more detail below.

By minimising the deformation of the basement walls, the soil movement adjacent to the excavation will be limited, minimising the potential for damage and disruption to neighbouring properties.

It is proposed the perimeter garden walls be demolished and rebuilt, all subject to party wall agreement.

The basement slab, reinforced top and bottom and founded onto the stiff clay, will be designed to resist hydrostatic pressures (albeit small) and will form a suitable spread foundation for the internal loadbearing walls and columns. Considerations of ground heave are discussed in more detail below.

The basement will be protected from water ingress using the methods detailed in BS8102:2009. The walls and slab are to be designed for a maximum water depth of 1m below ground level, considering the potential for leaking drains and perched water (albeit a negligible depth has been observed during investigations).

Any nominal perched water on top of the clay and water from precipitation during construction should be removed by sump pumping to a suitable discharge point.

The proposed construction sequence has been carefully considered to minimise disturbance to adjoining structures. Demolition and groundwork contractors would be required to submit detailed method statements and work sequences prior to commencement of the works. Refer to the Construction Management Plan (Appendix G) for an outline works programme and proposed construction sequence.

8.0 Heave Movements

The quoted heave movements within Soil Consultant's report 9819/KOG/SCW (Appendix A) are based on traditional elastic theory by Boussinesq. The calculation sheet in Appendix D provides the inputs and outputs of this analysis.

The calculated heave values are conservative as a basement was historically present on this site, which was presumably constructed at the same time as the basement to #154. Any heave may therefore return the clay to its near historic state. The heave analysis does not consider the applied reloading due to the proposed superstructure (~57KN/m^2, considering only 30% of Live Load), which will be similar to the load relief due to the temporary excavation (~60KN/m^2). The calculated long-term heave values (Appendix D) should therefore be discounted and the immediate values considered as the more relevant as the short-term heave values, which will reduce as the clay is reloaded by the building construction.

9.0 Ground Movement and Damage Assessment due to Retaining Walls

With reference to the calculations contained in Appendix E the anticipated ground movements have been assessed at two locations; behind the 3.2m high retaining walls and behind the RC underpinning to the party wall with #154 Royal College Street. Assessments have been carried out in accordance with the guidance outlined in CIRIA report C580.

For the full height retaining wall the anticipated long term vertical movements of the ground due to the wall deflection are 1.3mm. These movements are considered negligible 11.2m from the excavation. The closest existing structure to the new wall is the canal wall, over 9m from the excavation. It can be judged that at this distance the anticipated ground movement will be minimal and as the canal wall runs parallel to the excavation the differential movements, which are critical, across the wall will be negligible. Therefore the risk of cracking and damage to the wall is negligible. Movements due to the installation of the wall are assumed to only effect up to 6.4m behind the retaining wall and thus will not effect the canal wall.

For the underpinning to the #154 Party Wall the anticipated vertical long term movement of the ground due to the underpin deflection is 0.1mm. The combined horizontal movement due to deflection of the pin and load release of the existing wall is 3.3mm. These predicted movements occur directly behind the underpinning and reduce to a negligible value within 5.6m of the excavation. Undertaking a damage assessment for the adjacent terrace construction in accordance with Burland et al (1977) suggests that the interaction of the horizontal strains and vertical settlements would result in Category 0 - 'Negligible' cracking.

The predicted immediate heave movements (Appendix D) are vertical upwards and this will obviously counter the predicted vertical settlements to CIRIA C580 quoted above.

10.0 Movement Monitoring

The full and detailed movement-monitoring regime will be agreed as part of the Party Wall Awards. Outlined below are preliminary proposals for movement monitoring of the adjacent structures, specifically #154 Royal College Street.

Prior to any works taking place and as part of the Party Wall Awards a photographic condition survey should be undertaken of the internal and external faces of the party wall.

It is proposed that a number of prism reflector targets be installed at key locations on the party wall, typically at high level where lines of sight can be more easily maintained during the basement construction works. The prisms will allow movements to be measured in all three directions to an accuracy of ±1mm. Tell-tales will be installed on any significant historic cracks in the masonry party wall to #154 and will be monitored throughout the basement construction works, typically these can achieve an accuracy of around ±0.2mm.

Initial readings would be taken several weeks before construction work commences and then undertaken weekly during the basement construction. Due to the nature of the superstructure construction it will not be possible to continue movement monitoring of the party wall during the later phases of the structural works as the monitoring locations would quickly become obscured by the new structure.

Movements will be logged and trigger and action levels agreed as part of the Party Wall Awards.

11.0 Construction Management Plan

A preliminary Construction Management Plan (CMP) is contained in Appendix G. As is normal the CMP will be developed by the contractor appointed to carry out the works and will be subject to review and amendment during the course of the works. The CMP will be reformatted by the main contractor to be in accordance with Camden Council's CMP pro-forma (v2.0) and will be submitted to Camden Council for their acceptance at a later date along with all other associated approvals (e.g. parking, skips, scaffold).

12.0 Basement Impact Assessment – Stage 1 - Screening

To CPG4 (Basements and lightwells).

The purpose of the screening stage is to determine whether a full Basement Impact Assessment is required and CPG4 provides flowcharts for each of the three disciplines [Groundwater Flow, Land Stability and Surface Flow/Flooding] for this purpose, identifying a series of questions. An answer of 'Yes' or 'Unknown' will require progression to Stage 2 of the CPG4 categories. Answers of 'No' indicate that no further investigation is generally required.

SURFACE FLOW & FLOODING		
Criteria		**Notes**
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No	Ref. fig. 12, Arups *'Camden geological hydrogeological and hydrological study'.* At it's nearest, the site is approximately 2.6km away from the Hampstead Heath pond chains.
2. 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 existing site surface is hard-standings and has been for many years. Part of the proposed building is to have an extensive green roof, therefore naturally restricting the peak rate of surface water discharge during an extreme rainfall event.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No	The existing site surface is hard surfaced.
4. 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	See (2) above.
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	It is expected that there will be no changes to the nature of surface water discharged from site. See (2) above.
6. 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	Refer to section 4.0 of this report.

SUBTERRANEAN (GROUNDWATER) FLOW		
Criteria		**Notes**
1a. Is the site located directly above an aquifer?	No	Site is located above London Clay, defined as a non-aquifer or unproductive strata.
1b. Will the proposed basement extend beneath the water table surface?	No	The lower (chalk) aquifer is estimated to be some 70m below the proposed formation level of the basement. Perched water was not found in the made ground above the London Clay during trial pit construction. Whilst a 16m borehole was undertaken on site, groundwater seepage occurred at a depth of 4.5m, with no rise. Monitoring 2 weeks later found the water had risen to 2.9m below ground level, approximately the same depth as the basement. A basement was previously present on site, until circa the mid 1970's.
2. Is the site within 100m of a watercourse, well (used/disused) or potential spring line?	Yes	The Regents Canal is some 17m to the South East of the site boundary. Being a manmade puddled (tanked) structure, it has only minimal influence on groundwater.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No	Ref. fig. 12, Arups *'Camden geological hydrogeological and hydrological study'.* At its nearest, the site is approximately 2.6km away from the Hampstead Heath pond chains.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No	Site is currently hard-paved.
5. 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	No drainage will be discharged directly into the ground, only into the sewer system.
6. 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 just the pond chains on Hampstead Heath) or spring line.	No	The Regents Canal is over a storey (~3.5m) below the site ground level. Refer to photo in section 4.0 of this report.

SLOPE STABILITY		
Criteria		**Notes**
1. Does the existing site include slopes, natural or manmade, greater than 7^o? (approximately 1 in 8)	No	Site is relatively level.
2. Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7^o? (approximately 1 in 8)	No	Proposed basement will cover the full site footprint and will be level.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7^o? (approximately 1 in 8)	No	Canal cuttings are some 11m away on the other side of Baynes Street, therefore will not be influenced or surcharged by the proposed basement.
4. Is the site within a wider hillside setting in which the general slope is greater than 7^o? (approximately 1 in 8)	No	Ref. fig. 16, Arups *'Camden geological hydrogeological and hydrological study'.* Figure just shows the canal cutting.
5. Is the London Clay the shallowest strata at the site?	Yes	London Clay is the shallowest natural strata, but located approximately 2.1m below ground level. Above the clay is made ground from an in filled basement.
6. Will any tree/s be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?	No	No trees are to be felled as part of the development. On the other side of Baynes Street, next to the canal are some mature sycamore trees (assumed to be 22m high). The road with its sub-base and capping layer will have formed a roof barrier. BS 5837:2005 states the root system is typically concentrated within the uppermost 600mm of soil (probably a similar depth to the road build-up)
7. Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	Yes	The Groundsure Geoinsight report for the site notes the London Clay to have a high shrink-swell potential. The neighbouring building at #154 Royal College Street has some cracking to the front elevation, but this could be evidence of neglect (e.g. possibly rotting timber lintels) rather than necessarily clay movement. To achieve the proposed basement depth the Party Wall against #154 will need to be underpinned by some 1m. The existing formation depth of this wall (~2.1m) should not be influenced by trees (see section 4.0) and the formation strata will remain the same after underpinning, i.e. London Clay. Movements occurring to adjacent structures will continue as existing.
8. Is the site within 100m of a watercourse or a potential spring line?	Yes	The Regents Canal is some 16m to the South East of the site boundary. Being a man-made puddled (tanked) structure, it has only minimal influence on groundwater.
9. Is the site within an area of previously worked ground?	Yes	But only to a depth of 2.1m due to the historic basement on the site, assumed to have been in-filled in circa mid 1970s. Groundsure Geoinsight report report does not note the site to be within an area of previously worked ground.
10. 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 underlain by London Clay, classified as being unproductive. Deep (~2.3m) deep trial pits have been constructed on site and these were dry.
11. Is the site within 50m of the Hampstead Heath ponds?	No	Ref. fig. 12, Arups *'Camden geological hydrogeological and hydrological study'.* At it's nearest, the site is approximately 2.6km away from the Hampstead Heath pond chains.
12. Is the site within 5m of a highway or pedestrian right of way?	Yes	The site immediately abuts the pavement to Baynes Street and Royal College Street. A proposed sequence and method of basement construction to minimise effects on adjacent structures is outlined in section 5.0 of this report.
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	No	As the neighbouring property already has a basement. It is proposed the Party Wall to #154 Royal College Street will be underpinned by approximately 1m (refer to question 7 above).

14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	London Underground have confirmed in writing that they do not have any assets within 50m of the site. With reference to Arups' feasibility study drawings for HS2, the site is a significant distance from the proposed route. The above has been confirmed by the Groundsure Geoinsight report.

12.1 Stage 1 – Screening – Non-technical Summary

The screening in relation to Surface Flow & Flooding did not raise areas of concern or that require further investigation.

The screening in relation to Subterranean (Ground Water) Flow only did not raise any areas of concern. The only 'yes' answer was due to the presence of the Regents Canal some 16m from the site. Being a manmade puddled (tanked) structure presumably located in the near impermeable London clay, it has negligible influence influence on groundwater. Therefore for all intents and purposes scoping an impact assessment on groundwater flow is not required.

The screening in relation to Slope Stability had 'yes' answers in relation to clay being present below the site, history of clay movement in the area, the site being located 16m from the Regents canal, evidence of the ground having been previously worked (there was a Victorian basement on the site until circa 1971) and the site being within 5m to a highway.

13.0 Stage 2 – Scoping

The purpose of Stage 2 is to assess the potential impacts of the proposed scheme that the Stage 1 screening has indicated require further consideration.

Please note site ground investigations have been undertaken in parallel with the screening assessment.

As stated in 12.0 above, the screening in relation to Surface Flow & Flooding and for Subterranean (Ground Water) Flow did not raise any areas of concern and therefore scoping is not required for further investigations in relation to these subjects.

The screening in relation to slope stability had some 'yes' answers, which are addressed below:

Site borehole and trial pit investigations have confirmed London clay to be present at a depth of around 2.1m below the site (Question 5) and therefore the presence of trees (Question 6) and their effect on soil volume change (Question 7) may be an issue. The shrinkage potential of the clay, the presence of nearby trees and the formation depths of foundations needs to be assessed.

Some made ground has been found on site (Question 9), but this is from a historic Victorian basement on the site, assumed to have been in-filled in circa 1971. The potential presence of perched water in the made ground, over the clay, needs to be assessed.

With regard to the impact on adjacent highways / pedestrian right of way (Question 12), the proposed basement will abut against Baynes Street and Royal College Street. The proposed excavation will be within influencing distance of the footpaths along these roads, which needs be considered during the design and construction of the basement structure.

13.1 Stage 2 – Scoping – Non-technical Summary

Further assessment is required in relation to 'slope stability', primarily in relation to the potential movement of the clay soil as well as the retention of the nearby pavements and roads.

14.0 **Stage 3 – Site Investigation and study** (including non-technical summary)

Thorough intrusive ground investigations and an interpretive report have been undertaken by Soil Consultants, in parallel with the screening assessment. Extracts from their factual and interpretive report on their findings are contained within appendix A.

15.0 Stage 4 – Impact Assessment

Information from the ground investigation report and from other desk studies has been consulted to provide further responses to the Slope Stability questions answered yes (No.s 5, 7, 8, 9 & 12).

From the investigations, the confirmed presence of London clay at a depth of around 2.1m below the site (Question 5) and therefore the presence of trees (Question 6) and their effect on soil volume change (Question 7) has been assessed in section 5.0 of this report. Considering the distance to the trees on the other side of Baynes Street, NHBC guidance recommends a minimum foundation depth of around 1.65m, much shallower than the proposed basement formation depth of around 3m and is therefore deemed acceptable.

The zone of influence of the new basement may be assumed to extend upwards and outwards from the basement footprint at formation level, at an incline of 45°. The access road behind the North East boundary of the site is approximately 4.5m wide and therefore the foundations to the 1-30 Bruges Place flats will fall outside this zone of influence.

There will be some initial elastic vertical heave during excavation due to the unloading of the clay, however this will be small and will mostly elastically restore during the proposed building construction. We reiterate a basement used to be present on this site, the evidence suggests constructed at the same time as #154, and therefore the construction of a new basement with similar building loads should restore the clay to it’s near historic state.

Subsidence of soil behind the basement retaining walls, particularly adjacent to neighbouring highways and structures (Question 12), is to be kept to within acceptable limits by the formation of a rigid basement box stiffened by lateral supports. In all cases the basement retaining walls are to be propped at their head - during construction with a capping beam/edge slab strip, and in the permanent condition by diaphragm action of the ground floor slab.

All adjacent buildings will be monitored under Party Wall procedures.

Clay subsidence/heave will not be onerous for the proposed basement and from the basement influencing neighbouring structures.

15.1 Stage 4 – Impact Assessment – Non-technical Summary

Clay movement (subsidence/heave) will not be onerous for the proposed basement and from the basement construction influencing neighbouring structures.

16.0 Conclusions

From the available information we consider that the risk to ground stability from this development should be low. This is on the condition that the works are undertaken by reputable, experienced and competent contractor and the temporary and permanent works are adequately designed and implemented with due consideration to the geology and hydrogeology of the site and surrounding areas. Ground movements should thus be kept within normal tolerable limits.

Appendix A - Soil Consultants Ground Investigations Report Extracts

SITE INVESTIGATION REPORT

PROPOSED REDEVELOPMENT:

152 ROYAL COLLEGE STREET, LONDON, NW1 0TA

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Report ref:	**9819/KOG/SCW**
Date:	**23rd July 2015 [Rev 0]**

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SITE INVESTIGATION REPORT

PROPOSED REDEVELOPMENT:

152 ROYAL COLLEGE STREET, LONDON, NW1 0TA

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1.0 INTRODUCTION

A new two/three storey building incorporating a single level basement is proposed to be built at the site. In connection with the proposed works, Soil Consultants Ltd [SCL] were commissioned to carry out a ground investigation to include the following elements:

- Desk Study to identify site history and potential contaminative uses
- Identification of ground sequence
- Provision of recommendations for geotechnical design
- Contamination appraisal, risk assessment and conceptual model

This report describes the investigation undertaken, gives a summary of the ground conditions encountered and then provides geotechnical related design recommendations. In addition, an outline contamination appraisal and conceptual model are provided. Photographs of two trial pits carried out by the Client have also been included.

2.0 SITE DESCRIPTION

The site at No.152 comprises a vacant plot of land situated at the junction of Royal College Street and Baynes Street in a mixed residential and commercial area of Camden in North London centred at approximate National Grid Reference 529265E 184100N. The site is rectangular in shape and measures approximately 7m x 17m.

The site is empty of any structure apart from a small single storey partly derelict outbuilding in the north-eastern margin, this area being overgrown with bushes and shrubs. The ground surface is sensibly level and is covered in concrete hard standing. A metal fence is present around the roadside perimeter whilst the flank wall of an adjacent building along Royal College Street forms the northern boundary. This adjacent property comprises a three storey Victorian age brick building with the ground floor used as a Barbers shop. The Client has determined that this building has a single level basement. Preliminary trial pits carried out by the Client prior to our fieldwork has confirmed the location of an underground sewer traversing across the north-eastern part of the site. There is a semi-mature deciduous tree presently growing in the pavement along Royal College Street close to the south-western corner, and there other deciduous trees [presumed Sycamore species] presently growing along the canal-side pavement of Baynes Street. Regents Canal [branch of Grand Union] is present beyond Baynes Street.

OS benchmark data [canal bridge parapet opposite the site] indicates an OD level of 27.3m. An approximate uniform ground level of +27m OD has therefore been assumed for the site surface.

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

3.0 SITE HISTORY AND GEOLOGICAL/ENVIRONMENTAL INFORMATION

3.1 GroundSure historical map pack and reports

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

Historical development of site and surrounding area

Map date	The site	Significant development / features in surrounding area [generally within 250m]
1870 to present	The earliest map of 1870-73 shows the property outline as at present at the junction of Great College Street and Prebend Street. Two buildings are shown, one occupying the south -western part and another smaller building in the north-eastern part. The 1916 map indicates that a single building occupies the whole of the site. Great College Street is renamed Royal College Street by 1948 and Prebend Street is renamed Baynes Street by 1938. The map of 1968-71 is the last which shows a shaded outline for the building at No.152 The Engineer states that to their knowledge the building was demolished during the 1980's	The surrounding areas are largely residentially developed with terraced streets. A railway viaduct is shown about 65m to the north with Camden Road railway station about 115m to the north-west, and the St Pancras railway goods depot/yard about 150m to the south-east. [This same area is shown to have a coal depot on the 1916 map] Small printing works about 160m west on 1916 map The Regents Canal is shown about 15m to the south with some wharfs along the southern side indicating the industrial/commercial usage of this waterway A pianoforte manufactory is shown about 105m to the south-west along Lyme Street. The 1896 map shows a tramway along Great College Street and a smithy about 175m to the south-east Maps from the early part of the 1950's show a warehouse about 50m from the site at the eastern end of Baynes Street and a sheet metal works about 85m to the east Maps from the latter half of the 1960's indicate significant clearance of buildings immediately to the east of the site between Randolph Street and St Pancras Way to make way for vehicle parks. Maps from the mid 1980's show the former vehicle park areas to be again residentially/commercially developed.

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

The GroundSure Report includes information from a database of local activities encompassing a range of subjects related to land use, pollution, and geological/hydrological conditions. A summary of contaminative uses and other environmental issues covered by the desk study within the site and its immediate surroundings [within 250m unless otherwise stated] are given below. The full report should be read in conjunction with this and fully understood within the context of our summary.

Environmental Permits, Incidents and Registers

Records of Part A [2] and Part B Activities and Enforcements:-

Heaven dry cleaners, 112m NW –Current with no enforcement notices notified

Records of National Incidents recording System:-

95m W on the 31 July 2001 categorised as a minor to no impact incident

Landfill and other Waste Sites- none within 250m

Current Land Use

- Potentially contaminative uses: 34 no. records within 250m, mainly likely commercial office/retail premises including published goods, vehicle cleaning and repair facilities, moorings and unloading facilities. Nearest electrical features/sub-station 166m S
- Petrol and Fuel station sites [500m buffer]– 1 no entry 192m N for Mark Kass – Obsolete
- National Grid High Voltage Underground Electricity Transmission Cables

  4 no entries for between 13m and 15m to south of site [next nearest entry 72m W]
- Information provided by the client indicates that a sewer is present below the site.

Geology

- Artificial/Made Ground: None [see later note]
- Superficial deposits: None
- Bedrock/Solid Geology: London Clay Formation [very low to moderate permeability]
- Bedrock Faults [500m buffer]: No record
- Radon: The property is not in a Radon Affected Area [<1% of properties are above action level] - no protective measures required
- Historical underground Workings:

  Canal – various entries with nearest 14m SE

  Tunnel – various entries with nearest 438m NE
- Current ground workings: – None within relevant distance

- Mining: – none relevant
- Natural Ground Subsidence: On-site, Negligible to Very Low risk for all categories except for shrink/swell clays which is classified as a Moderate to High risk
- Borehole Records Map: 12no boreholes, nearest 106m W
- Railways: Various entries for railways and sidings [historical and current] with nearest relating to railway viaduct identified in map review. Nearest entry 59m N
- Tunnels: None
- High Speed 2 rail project: The site is located within 5km of the High Speed 2 rail but not within 500m of the Crossrail project

Hydrogeology and Hydrology

- Aquifer within Superficial deposits: None
- Aquifer within bedrock deposits: 'Unproductive' [London Clay Formation]
- Groundwater Abstraction [2000m buffer]: Nearest entry, 649m E for Kings Cross Concrete plant
- Surface water abstraction [2000m buffer]: Nearest entry 692m SE for Camley Street Nature Park
- Potable Water Abstraction [2000m buffer]: Nearest entry 754m NW for Kentish Town Sports centre
- Source Protection Zones [500m buffer]: None
- Source Protection Zones within confined aquifer [500m buffer]: None
- Ground water vulnerability/soil leaching: No data
- River Quality: Grand Union Canal 106m W, latest 2009 Biological grade E
- Detailed River Network: Records for the Grand Union Canal [Regents Canal] 18m S, Culvert 39m SW [possibly River Fleet]
- Surface Water Features: 3 no entries for between 16m and 31m south to south west [presume Grand Union Canal]

Flooding

- Risk of flooding: Very Low
- Flood defences: No records
- Groundwater Flooding Susceptibility Areas: Not prone to flooding

Designated Environmentally Sensitive Areas

- Records of Local nature Reserves – None within relevant distance

3.2 Walk-over survey

No obvious sources of contamination were noted during our walkover survey undertaken at the same time as our fieldwork on the 23 June 2015. The surrounding areas, where assessable and visible, were consistent with an inner city built environment.

4.0 EXPLORATORY WORK

Our fieldwork was carried out between 23 and 25 June 2015 and comprised the following elements:

Borehole

A single cable percussive borehole [BH1] using a standard tripod drilling rig was constructed to a depth of 16m. In situ Standard Penetration testing [SPT] was carried out where appropriate and representative samples [both disturbed and undisturbed] were taken for geotechnical testing and contamination analyses.

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

A water level observation pipe [50mm internal diameter] was installed to a depth of 6m in the borehole upon completion to enable future ground water/gas monitoring. We have interpolated an OD level of +27m for the borehole based on nearby benchmark data as previously discussed.

Trial pit

A single trial pit [labelled as TP3 to coincide with Client's previous excavations] was excavated with the aid of a tracked mini-digger to a depth of 2.3m in order to determine foundation details of the adjoining property.

The records of trial pits carried out by the client prior to our fieldwork have also been assessed and these records are included in Appendix A.

Geotechnical laboratory testing

The following geotechnical laboratory testing was completed:

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

Contamination testing

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

General soil suite	2 no samples

The borehole/trial pit records and the laboratory test results are included in Appendix A and the exploratory locations are shown on the Site Plan.

Groundwater and Gas Monitoring

Two monitoring visits to measure ground water [26 June and 9 July 2015] and a single visit to monitor ground gas [9 July 2015] have been undertaken.

5.0 GROUND CONDITIONS

The 1:50,000 scale British Geological Survey map indicates that the site is underlain by the London Clay Formation. Our investigation has confirmed the presence of the London Clay below a layer of made ground or old basement infill.

5.1 Made ground

Below the concrete hard standing [100mm to 150mm thick] made ground [resulting from infill of a former basement] was met in both the borehole and trial pits to depths ranging from 1.9m to 2.3m. The made ground mainly comprised an obvious demolition waste consisting of brick and stone rubble with a sandy and silty matrix. In TP3, a steel joist was also noted within this layer. In BH1 below about 1.80m depth, a layer of mottled brown silty and sandy clay containing brick fragments was noted. An in-situ [SPT] strength test in this lower clay layer indicates a firm consistency and a medium strength classification. The adjoining brick wall footing was revealed, as discussed in section 5.4 below.

Similar demolition fill appears to be shown on the clients earlier trial pit photographs, notably however some in situ masonry walls relating to this former basement are also shown.

5.2 London Clay

Met between 1.9m and 2.3m depth, this deposit initially comprises weathered brown fissured clay which grades into a grey brown colour below 9.00m and dark grey below about 10.40m. Selenite crystals were noted within the brown and grey brown clay and a claystone nodule was met during drilling at a depth of 4.45m. The dark grey clay contained occasional fine sand and silt partings.

SPT [N_{60}] and laboratory strength testing are shown in the Appendix and these indicate a gradual increase in strength with increasing depth [typical of the London Clay] from a medium strength classification to a very high strength classification below 10.40m.

Atterberg Limit tests classify the London Clay as a high to very high plasticity clay and High Volume Change potential (NHBC)

5.3 Groundwater

Apart from a slight seepage of trapped ground water around the claystone nodule in BH1 at a depth of 4.45m, ground water inflows were not met during our fieldwork. The installed standpipe in BH1 was also dry [to 6m depth] on our monitoring visit of the 26th June. On the second visit on the 9th July a water level of 2.86m was recorded. This water we attribute to that most likely collected as a result of seepage from the base of the made ground. This is confirmed by the evidence from the Client's preliminary trial pit photographs which shows water accumulating in the made ground in one of the excavations. Seasonal variations in water levels are likely to occur and additional monitoring may be considered.

5.4 Existing foundations

Prior to our fieldwork the Client had identified the presence of a basement below the adjacent building along Royal College Street [approximately 2m depth bgl]. In TP3 the foundations of the adjoining building were noted to comprise a brick corbeled footing with the underside at a depth of 2.1m, bearing within the London Clay. A hand shear vane test in this clay indicated a medium strength classification.

The Client's trial pit photographs indicate that some buried walls and foundations relating to the previous development of the site are likely still present.

5.5 Environmental observations

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

6.0 GEOTECHNICAL APPRAISAL

Current redevelopment proposals include the construction of a two/three [including roof space] storey building occupying the entire area of the site and incorporating a full footprint single level basement. The proposed development plans are included in Appendix A and these show the basement excavation to extend to a depth of about 3m below existing ground level [after allowing for the basement slab construction thickness].

Conventional panel excavation and underpinning of the adjoining building foundations along the north-western side of the site is proposed. We understand that in order to maximise the proposed basement area and due to the close proximity of highways the remaining perimeter of the basement excavation is to be supported by a contiguous piled retaining wall.

We have noted that the adjoining building along Royal College Street is supported on conventional spread foundations at existing basement level and clearly these will need to be underpinned to the same depth as the foundations for the new structure. The lateral extent of the previous basement has not been fully defined although the evidence to date suggests that it may cover most of the proposed building area. In this situation, made ground is therefore likely to be present for most of the basement excavation with the London Clay present at the formation level. The London Clay is a competent stratum which should be capable of supporting the likely underpinning loads and should allow a traditional basement construction. Obstructions should also be expected and it is possible that the former basement walls may be present.

Although only minor groundwater seepage was noted within the London Clay during our fieldwork the Client's trial pit photographs and subsequent monitoring of the installed standpipe indicates that infiltrated surface water is likely present in the made ground. Whilst this water is likely dependent on seasonal variations in rainfall we recommend that groundwater control measures are allowed for.

Although desiccation effects were not noted during our investigation [limited in this regard], there are nearby trees and the presence of high volume change London Clay would require the design of foundations and retaining walls to be in accordance with NHBC Standards Chapter 4.2 [2010] "Building near trees". The depth of foundations below basement level are likely to be below any potentially root affected zone. Although mainly granular [non-shrinkable] made ground was noted within the area of the former basement, such soils may not be present outside this area if previously undeveloped. In this situation we recommend that some allowance for the provision of a proprietary compressible layer forming a lining to the external faces of the basement walls where these are embedded into in root [or potentially root affected] clay.

6.1 Basement excavation and construction

Although the majority of the basement excavation is expected to be within the former basement infill, natural soils may be met in areas where there was no previous basement. Ground water inflows from more permeable pockets of the made ground and at the interface of the made ground and the London Clay should also be expected.

In this situation, traditional underpinning excavation/ panel construction should be feasible as envisaged along the north-western side of the site next to the adjacent property.

Small alternate sections ["hit and miss"] are usually employed to avoid opening of large unsupported faces, which would increase the risk of significant settlement and lateral movement. Ground water inflows met with the made ground should be controlled [i.e., by sump pumping].

The underpinning to the foundations of the adjacent building along Royal College Street would act as the basement retaining structure along this side during construction and it will clearly be essential to specify an adequate level of lateral support to maintain stability and prevent excessive deflections.

As most ground movement problems on basement construction projects occur due to construction issues, the excavation work, underpinning must be carried out diligently and properly sequenced by well-established specialists who have extensive experience with this type of construction.

Along the remaining perimeter of the site an embedded retaining wall is proposed. Steel sheet piles are unlikely to be practical at this site due to the noted obstructions in the ground and a contiguous bored pile retaining wall may be appropriate if the obstructions are not removed. A piled wall may allow the construction of a more integrated support structure with much more predictable overall stability.

Careful selection of the appropriate design parameters is needed, incorporating allowances for factors such as the presence of groundwater and the possibility of soil softening – CIRIA Report C580 provides further details.

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

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

Recommended retaining wall design parameters

Stratum	**Depth to base**	**Effective angle of friction [ϕ']**	**Effective cohesion (c')**	**Bulk unit weight [γ_b]**
Made ground – beyond old infilled basement	2.30	assume 25° [unknown soil beyond the old infilled basement]	$0kN/m^2$	$20kN/m^3$
London Clay	Below made ground to >16m	Typically 20°	Typically $0kN/m^2$; $5kN/m^2$ after 5m embedment	$20kN/m^3$

The wall designer should use these parameters to derive the active and passive earth pressure coefficients, Ka and Kp. The determination of appropriate earth pressure coefficients, together with factors such as the pattern of earth pressure distribution, will depend upon the final type/geometry of the wall and the overall design approach.

The known presence of the former basement structure indicates that obstructions in the ground should be expected. In addition, consideration should be given to the potential for heave forces due to the reversal of desiccation effects on the back of the wall where natural clay deposits could occur at shallower depth.

6.2 Basement slab

The proposed excavation for the single level basement will require the removal of up to about 3m of overburden and the excavation will therefore result in an overall stress reduction of about $60kN/m^2$.

Prediction of heave below the new basement slab is complicated by the unloading/loading history of the site. Heave due to the previous basement excavation is unlikely to have been totally reversed by infilling. Any new heave associated with this latest excavation is therefore unlikely to be of the same magnitude, but for design purposes we have ignored the previous unloading/loading cycle. In this worst case situation therefore, we assess that the potential long-term heave beneath the single level basement [7m x 17m] area and associated uplift/heave would be of the order of 10mm to 15mm. For an infinitely stiff slab the maximum heave stress would be in the order of about 30kPa but this would reduce as the slab deflects. For a slab of intermediate stiffness a value of 15kPa would be appropriate.

It will be necessary to consider uplift of the slab due to potential hydrostatic pressures and in this respect the guidelines incorporated in BS8102:2009 should be followed. The London Clay will be present at the basement level. The slab design should allow for water within the made ground and also take account of accidental conditions [leaking drains, burst water mains etc.] or long term ground water level rises. In this situation we consider that a water level at 1m below ground level is appropriate; however this should be confirmed with local building control and current design standards. This preliminary design level would result in a hydrostatic uplift pressure of $20kN/m^2$ on the basement slab. It is important to note that the water pressures will not be additional to any soil heave pressures, but will be the minimum uplift pressure for design purposes, because our model assumes hydrostatic conditions and uses total stresses throughout and this includes the water pressure in the uplift pressures/stresses.

6.3 Spread foundations at basement level

At the proposed basement excavation to 3m depth, the firm brown London Clay will be present [based on BH1]. Any internal columns or load-bearing at basement slab level would be supported either by separate pad/strip foundations or by properly specified pad/strip thickenings within the slab. We recommend that a maximum allowable bearing pressure of 125kN/m^2 is adopted for the design of these new foundations and for any underpinning of existing foundations. At this pressure the Factor of Safety against bearing capacity failure should be >3 and settlements should remain within tolerable limits. For foundations extended/underpinned to a depth of say 4.25m bgl [or 1.25m below the base of the basement excavation] then an increased safe baring pressure of 150 kN/m^2 may be adopted.

If a basement raft is adopted this would be a significantly stiffer structure than an alternative conventional basement floor slab and would be designed to effectively distribute the loads more evenly over the whole basement. Raft construction should be such that it is directly bearing on the undisturbed London Clay.

We recommend that the foundation excavations are inspected prior to concrete pour to ensure that competent soils are present.

6.4 Piled foundations

We understand that in order to maximise the basement area the contiguous bored piled walls are also to be designed to carry the load bearing perimeter walls of the new building in these areas. The following parameters may be used for preliminary design:

Shaft adhesion

Stratum	Depth/level [see note a]	Undrained cohesion [from strength profile]	Ultimate unit shaft Resistance 'q_s'
All soils above basement level	Above 3.00m depth [about +24m OD]	N/A	Ignore
London Clay	Below 3m depth [+24m OD]	Increases linearly from 60kN/m^2 at a rate of 10 kN/m^2/m	Increases linearly from 30kN/m^2 at a rate of 5kN/m^2/m [incorporates α = 0.50, See noted b]

Notes:

a] OD level based on interpolated value of +27m for BH1 and this should be checked

b] Undrained cohesion is the average value over the pile shaft [see design line on appended strength profile]

c] The average shaft adhesion over the pile length should be limited to 110 kN/m2.

d] The maximum value for unit shaft adhesion should be limited to 140 kN/m2.

Ultimate End bearing

Stratum	Depth/level [see note b]	Undrained cohesion [from strength profile]	Ultimate unit base resistance 'q_b'
London Clay	Below 12m depth [+15m OD]	Increases linearly from 60kN/m^2 at a rate of 10kN/m^2/m	Increases linearly from 1350kN/m^2 at a rate of 90kN/m^2/m [incorporates Nc = 9]

Notes:

a] Undrained cohesion is the value at pile toe level [see design line on appended strength profile]

b] OD level based on interpolated value of +27m OD for BH1 and this should be checked

Within the London Clay an overall Factor of Safety of 2.6 should be appropriate when applied to these ultimate parameters, in line with the current guidelines by the London District Surveyors Association [LDSA]. As a guide to the use of the above coefficients, we have calculated the following capacities for various diameter single piles terminating at various depths.

Pile diameter [mm]	**Pile toe depth [m]**	**Ultimate load [kN]**	**Working load [kN]**
300	12	540	210
	14	705	270
	16	885	340
450	12	885	340
	14	1135	435
	16	1420	545

Notes:

a] Working load is calculated using F_{shaft} and F_{base} = 2.6

b] Concrete stress should be considered in the final design

c] Depths are based on a ground level of +27 m OD at BH1 - this is approximate and should be confirmed

d] These examples are not intended to constitute recommendations as to pile length or diameter to be adopted but merely illustrate the use of the design coefficients some reduction in capacity would need to be applied for pile grouping

Eurocode 7 adopts a different approach, applying partial factors to the ultimate pile capacity in accordance with EC7 [BS EN 1997-1:2004 and UK National Annex] for the ultimate limit state GEO Design Approach 1, Combinations 1 and 2. The following partial factors, as recommended in the UK National Annex, are applied:

a] Model Factor, γ_{Rd} = 1.4 [Combinations 1 and 2]

b] Factor on shaft resistance, γ_s = 1.6 [Combination 2]

c] Factor on base resistance, γ_b = 2.0 [Combination 2]

When designing to EC7, the engineer must ensure that the correct comparisons are made between the Design Actions and Design Resistances.

We recommend that a specialist piling contactor is consulted at an early stage to advise on the design parameters and to ultimately provide the final pile design.

6.5 Foundation concrete

Moderate [max 1030 mg/l] concentrations of soluble sulphates [due to noted selenite crystals within the London Clay] were measured in selected soil samples with near neutral to slightly alkaline pH values. Overall, a Design Sulphate Class DS-2 [Table C2 given in BRE Special Digest 1:2005, 3rd Edition, 'Concrete in aggressive ground'] is considered to be applicable for the site. We assess the site to have mobile groundwater conditions [water within the made ground] and our recommendation is that buried concrete should be designed in accordance with ACEC Site Class AC-2.

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

7.0 ENVIRONMENTAL APPRAISAL

This appraisal adopts the current UK practice which uses the Source-Pathway-Receptor methodology to assess contamination risks. For a site to be designated as contaminated a plausible linkage between any identified sources and receptors must be identified, i.e. whether significant pollution linkages [SPLs] are present. In considering the potential for contamination to cause a significant effect, the extent and nature of the potential source are assessed and pathways/receptors identified; without an SPL there is theoretically no risk to the receptors from contamination. The assessed risks to the various potential receptors are summarised in the tabulated Conceptual Site Model which forms Section 7.6 of this report.

7.1 Environmental setting and context

Below the basement infill the site is underlain by the London Clay which is classified as **Unproductive.** The Environment Agency records indicate that there are no ground water/surface water abstraction points within a relevant distance of the site and it is not located within a source protection zone. The Grand Union Canal is present in close proximity to the site.

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

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

The desk study historical map review has indicated that from the earliest records [late 19th century] the site was developed with an end terraced building presumably similar in style and mixed residential/commercial usage as at present.

The history of predominantly mixed residential/commercial usage [both within the site and its vicinity] indicate a **Medium** risk Potential of contaminative sources which could affect the site.

7.3 Contamination testing

In order to identify whether known or unknown sources within [and outside] the site have caused contamination, we have carried out testing including a general suite of analysis on two samples from BH1 recovered during our investigation. The results were assessed where relevant against the DEFRA Soil Guideline Values [SGV] and the LQM/CIEH Generic Assessment Criteria [GAC] for Human Health Risk Assessment in which LQM/CIEH have derived additional SGVs from the current CLEA Model [2nd Edition, 2009]. There are currently no published SGV’s or GAC’s for Extractable/Total Petroleum Hydrocarbons and the results were compared with the frequently used EA remedial target of 1,000mg/kg. The SGV for Lead contamination was withdrawn as of 2008 but new Category 4 Screening Levels [C4SLs] have been introduced by DEFRA recently, which can be useful values for comparison with recorded results. C4SLs have also been useful for comparison with several other results.

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

For the soil tests we have used, where relevant, the trigger levels for **residential development without home grown produce** to assess the results of the contamination testing. Using these criteria almost all of the soil contaminant concentrations were found to be below guidance values or test detection levels. The exception was the sample of made ground from BH1 at 1m depth where the Lead concentration at 738 mg/kg is above the recommended threshold but the BGS 'normal background concentration' [in urban domains] of 820mg/kg was not exceeded. Notwithstanding this test result the proposed scheme does not involve any change in use, and the basement excavation will fully remove any made ground below the site in order to construct the new basement. The implications of these results are addressed in the site specific Risk Assessment and Conceptual model below.

It should be noted that the investigation provided limited coverage of the site and there may of course be areas of undetected contamination. Although ACM [Asbestos-Containing Materials] were neither observed on site nor identified in the samples examined, we note that buildings [especially those constructed before 2000] are a potential source of ACM and demolition rubble from such a structure is likely to have been used to backfill the former basement. These matters should be addressed by the Project Health & Safety.

7.4 Soil Disposal

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

7.5 Ground gas monitoring

A single monitoring visit was made on 9th July 2015 to measure the water level and ground gas concentrations. No significant concentrations of ground gas were recorded and there was no detectable emission rate on this occasion.

7.6 Risk Assessment and Conceptual Model

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

Source/ hazard	Pathway	Receptor	Mitigation measures/explanation	Assessed Risk level
Contaminated soil: on-site and off-site sources	Ingestion/ contact	Site end users and construction workers	Elevated Lead concentration in sample from BH1 but the BGS 'normal background concentration' [in urban domains] of 820mg/kg was not exceeded Risks to construction workers will be controlled by the use of appropriate PPE and dust surpression Any made ground will be removed from the building footprint during basement excavation. A careful watching brief should be kept during construction and if obvious or suspected contamination is encountered this should be dealt with prescriptively	**LOW**
Contaminated soil: on-site sources	Migration of contaminated ground water and/or surface run-off through contaminated fill into aquifer	Aquifer and surface water	The site is underlain by "unproductive" London Clay Infiltrated surface water is likely present in the made ground and minor seepages of ground water may be met in the London Clay Elevated Lead concentration noted in BH1 but no potential contaminative uses identified The site does not lie within a Source Protection Zone and there are no relevant nearby abstraction points Any made ground below the existing building footprint will be removed during basement excavation	**LOW**
Ground gas: on-site and off-site sources	Migration	Construction workers	A single gas reading taken after completion of our fieldwork has noted no elevated hazardous gas concentrations. We consider the site to be at low risk of being affected by ground gas The desk study states that no Radon protection measures are required	**LOW**

In conclusion, based upon the information reviewed and the results of the investigation, our assessment is that the with appropriate mitigation measures the risks to potential receptors should be **LOW**. It is self-evident that there may be zones of contamination within the site which were not encountered in our borehole or trial pit. A careful watching brief should be kept during construction to ensure that any potentially contaminated soil encountered is disposed of in a safe and controlled manner. Site workers should observe normal hygiene precautions when handling soils. If material suspected of being contaminated is identified during construction, this material should be set aside under protective cover and further tests undertaken to characterise the contamination present and a contingency should be in place for this circumstance. If contamination is found, further site wide assessment may be required subject to local regulatory requirements.

◆ ◆ ◆

GENERAL INFORMATION, LIMITATIONS AND EXCEPTIONS

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

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

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

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

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

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

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

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

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

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

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

[Rev_1_08_03_2013]

APPENDIX A

Fieldwork, in-situ testing and monitoring

- Borehole record
- SPT results
- SPT hammer calibration certificate
- Trial pit record [including Client’s Trial Pit records]
- Ground water/gas monitoring sheet

Laboratory testing

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

Contamination testing [QTS Environmental]

- General soil suite and soluble sulphate/pH results

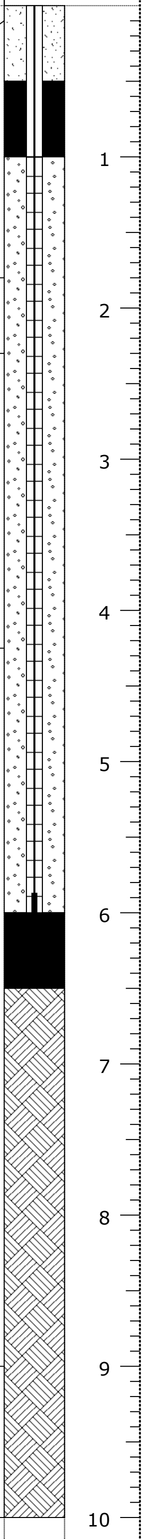
Plans & drawings

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

Site & Location:	**152 Royal College Street, London, NW1 0TA**			Borehole No:	**BH1**
Client:	**Henning Stummel Architects Ltd**	Coordinates:	529263E, 184098N	Sheet 1 of 2	
Engineer:	**Michal Hadi Associates Ltd**	Ground Level:	+27.00mOD	Report No:	9819/KOG

Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions
	Type	Depth (m)		Depth (m)	Level (m)		
BH commenced: 24/06/15							CONCRETE
				0.10	26.90		MADE GROUND: brick and stone rubble with sandy silty clay matrix
BH/casing dia: 150mm							
	D	0.50					
Inspection pit to 1.20m	D	1.00					
	SPT/S	1.50	N=12 N_{60}=15				
				1.80	25.20		MADE GROUND: brown mottled silty sandy clay with brick fragments
	D	2.00					
	D	2.30		2.30	24.70		Firm brown fissured CLAY
	SPT/S	2.50	N=9 N_{60}=11				
	D	3.00					
	U	3.50					
	D	4.00					
				4.25	22.75		Stiff brown fissured CLAY with occasional fine selenite crystals *...claystone between 4.45m and 4.60m*
Ground water seepage at 4.50m, no rise	SPT/S	4.50	N=25 N_{60}=32				
	D	5.25					
Standpipe [50mm ID] installed to 6.0m depth	U	6.00					
Standpipe reading 26th June- Dry	D	6.50					
	D	7.25					
	SPT/S	7.50	N=21 N_{60}=27				
	D	8.25					
	U	9.00		9.00	18.00		Stiff grey brown fissured CLAY with occasional fine selenite crystals
	D	9.55					
				10.00	17.00		

Backfill / Installation



Continued on next sheet

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa]
PP = Pocket Penetrometer [kg/cm²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: Approximate coordinates and ground elevation interpolated from OS mapping

Borehole No: **BH1**

SoilConsultants

Site & Location:	**152 Royal College Street, London, NW1 0TA**	Borehole No:	**BH1**
Client:	**Henning Stummel Architects Ltd**	Coordinates: 529263E, 184098N	Sheet 2 of 2
Engineer:	**Michal Hadi Associates Ltd**	Ground Level: +27.00mOD	Report No: 9819/KOG

Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
	D	10.25					Stiff brown fissured CLAY with occasional fine selenite crystals	
				10.40	16.60		Very stiff dark grey fissured CLAY with occasional silt/fine sand partings	
	SPT/S	10.50	N=24 $N_{60}=30$					
	D	11.25						
BH cont. 25/06/15 at 12.00m, casing at 2.50m, Dry	U	12.00						
	D	12.50						
	D	13.25						
	SPT/S	13.50	N=28 $N_{60}=35$					
	D	14.25						
	U	14.50						
	D	15.00						
	SPT/S	15.50	N=29 $N_{60}=37$					
BH complete: 25/06/15 at 16.00m, casing at 2.50m, Dry				16.00	11.00		End of borehole at 16.00m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa]
PP = Pocket Penetrometer [kg/cm²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: Approximate coordinates and ground elevation interpolated from OS mapping

Borehole No: **BH1**

Soil Consultants

Site & Location	**152 Royal College Street, London, NW1 0TA**	Report No:	**9819/KOG**

STANDARD PENETRATION TEST SUMMARY

BH ID	Depth [m]	Test type	'N' value and blow-counts [Seating blows/Test blows]	N_{60}	N_{60} - ext	Casing depth [m]	Water depth [m]	Remarks
BH1	1.50	S	N = 12 :1 2/ 4 2 3 3	15		1.50	DRY	
BH1	2.50	S	N = 9 :1 1/ 1 2 3 3	11		2.50	DRY	
BH1	4.50	S	N = 25 :4 6/ 7 7 6 5	32		2.50	DRY	
BH1	7.50	S	N = 21 :3 4/ 5 5 5 6	27		2.50	DRY	
BH1	10.50	S	N = 24 :3 4/ 5 6 6 7	30		2.50	DRY	
BH1	13.50	S	N = 28 :5 5/ 6 7 7 8	35		2.50	DRY	
BH1	15.50	S	N = 29 :5 6/ 6 7 7 9	37		2.50	DRY	

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

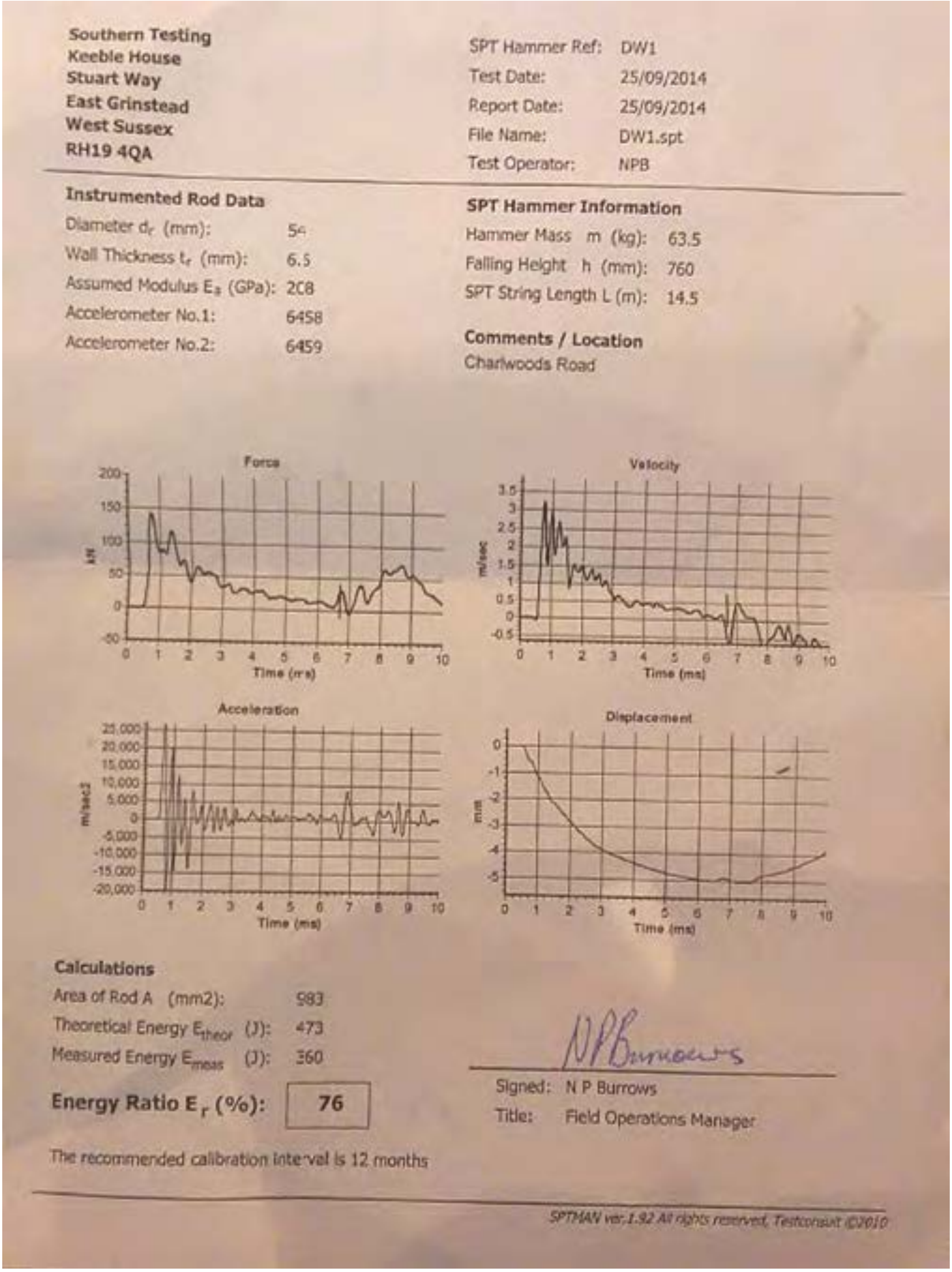
* where full penetration not achieved, the reported N_{60} is based on maximum uncorrected blow-counts of 50

** extrapolated N_{60} value where full penetration not achieved - this is indicative only and should be used with caution

Site Location
152 Royal College Street, London, NW1 0TA

Report No:
9819/KOG

SPT Hammer Calibration Certificate



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

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

Instrumented Rod Data

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

SPT Hammer Information

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

Comments / Location

Charlwoods Road

Calculations

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

Energy Ratio E_r (%): 76

The recommended calibration interval is 12 months

NPBurrows

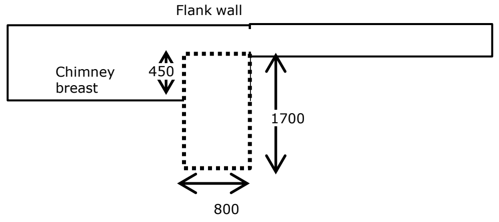
Signed: N P Burrows
Title: Field Operations Manager

SPTMAN ver.1.92 All rights reserved, Testconsult ©2010

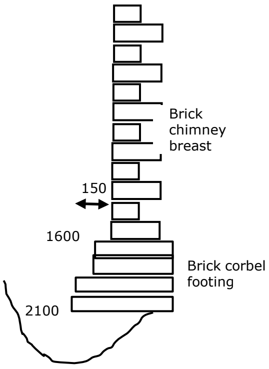
Site Location	**152 Royal College Street, London, NW1 0TA**	Trial Pit No: **TP3**
Client:	**Henning Stummel Architects Ltd**	Report No: **9819/KOG**
Engineer:	**Michael Hadi Associates Ltd**	

All dimensions in mm

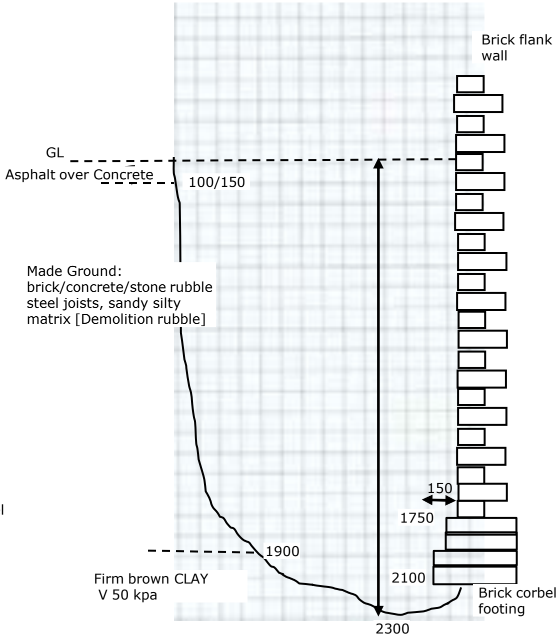
PLAN VIEW



SECTION C-D



SECTION A-B

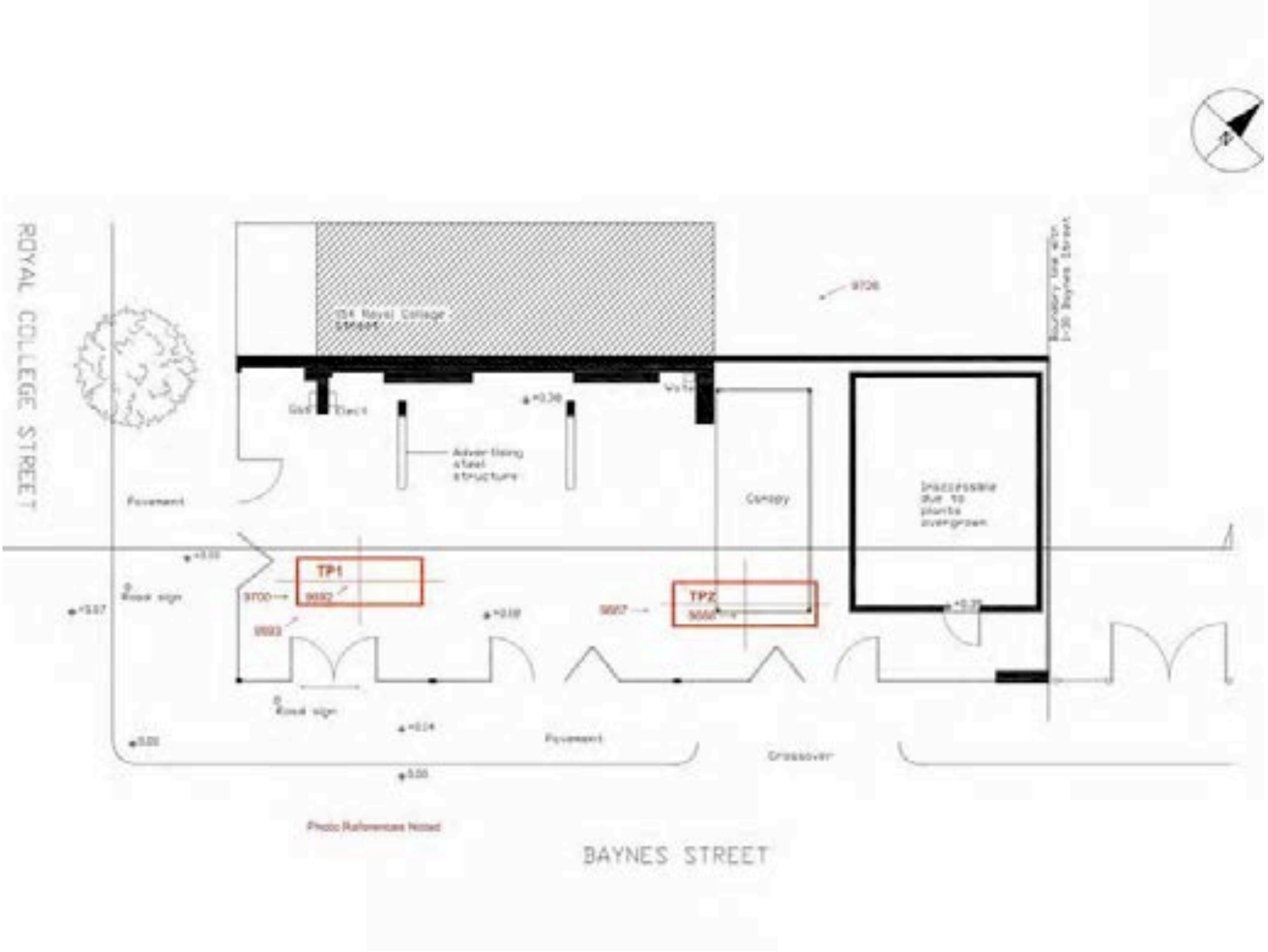


PHOTOGRAPHS OF TRIAL PIT

D = small disturbed sample, B = bulk sample, HV = hand shear vane test [kPa], pp = pocket penetrometer [kg/cm^2]

		Groundwater details	Samples	
Date:	23/06/2015			
Equipment:	Breaker and Hand Tools	• None	D D D	0.50 1.00 2.00
Stability:	Stable			
Remarks:			**Logged by**: KOG	

Appendix C – Trial Pit Excavations from 19/5/15 – for information only



Trial Pit 1

Top Slab - > 150mm
Mixed Fill containing bricks – 2.3m b.g.l
Virgin Clay - > 2.5m

Trial Pit 2

Top Slab - > 150mm
Mixed Fill containing bricks – 2.3m b.g.l
Virgin Clay - > 2.5m

Photo 9687

Photo 9688

Photo 9692

Photo 9693

Photo 9700

Photo 9726

Site Location:	**152 Royal College Street, London, NW1 0TA**	Ref:	**9819/KOG**

Results of Ground Gas/Groundwater Monitoring

Date:	09 Jul 15		
Time [24hr]:	8:20		
Barometric pressure:	1017		
a] Trend [24hrs]:	Rising		
b] At start [mB]:	1017		
c] At end [mB]:	1017		
Recorded by:	MR		
Surface ground conditions:	Dry		
Weather conditions:	Mild		
Ambient air temp [°C]:	12		

Monitoring equipment

Instrument:	GA2000 Plus MC08/0126/00
Calibration check details:	Within monitor tolerance
Next calibration date:	11/11/2015

Notes:

1] Barometric pressure trend and ambient air temperature is recorded from BBC weather website on the day of the monitoring visit

2] Calibration check is performed at start of monitoring against ambient air and also periodically with a 5% CH4, 5% CO2 and 6% O2 gas mixture

3] CH4 = methane; CO2 = carbon dioxide; CO = carbon monoxide; O2 = oxygen; H2S = hydrogen sulphide

Results

Date	Time [24hr]	Borehole	GW Depth	Depth to Base	CH4 [%]		CO2 [%]		O2 [%]		Highest [ppm]		Emission Rate	Relative Pressure	PID
			[m]	[m]	Max	Steady	Max	Steady	Min	Steady	CO	H_2S	[l/hr]	[mb]	
09/07/2015	06:20	BH1	2.86	6.00	0	0	0	0	20.4	20.4	0	0	0.00	0.00	

Site Location	152 Royal College Street, London, NW1 0TA	Report No:	9819/KOG

SUMMARY OF UNDRAINED SHEAR STRENGTH TEST RESULTS

BH ID	Depth [m]	Moisture content [%]	Bulk density [Mg/m^3]	Dry density [Mg/m^3]	Cell pressure [kPa]	$(\sigma_1-\sigma_3)_f$ [kPa]	Failure strain [%]	Failure mode	Undrained cohesion [kPa]	Remarks
BH1	3.50	29	1.94	1.50	100	132	7.00	I	66	
BH1	6.00	30	1.94	1.49	120	200	4.00	I	100	
BH1	9.00	30	1.94	1.49	180	252	4.50	I	126	
BH1	12.00	25	2.00	1.60	240	359	4.50	B	180	
BH1	14.50	27	1.98	1.56	290	274	4.50	B	137	

Testing in accordance with BS EN ISO 17892 UU = unconsolidated, undrained; MUU = multistage, unconsolidated, ur Date: 15 July 15

Unless stated otherwise: Rate of strain = 2mm/min, Standard latex membrame used with thickness = 0.5mm

Failure modes: B = brittle, I = intermediate, P = plastic

Site & Location **152 Royal College Street, London, NW1 0TA**

Report No: **9819/KOG**

SUMMARY OF CLASSIFICATION TEST RESULTS

BH ID	Depth (m)	Type	w (%)	wL (%)	wP (%)	Pass 425 (%)	IP (%)	Mod IP (%)	IL (%)	LOI (%)	Description
BH1	2.30	D	33	73	23	>95	50		0.20		Brown fissured CLAY
BH1	4.00	D	28	74	25	>95	49		0.07		Brown fissured CLAY
BH1	9.55	D	30	67	27	>95	40		0.08		Brown fissured CLAY
BH1	13.25	D	26	67	25	>95	42		0.03		Dark grey fissured CLAY with occasional silt/fine sand partings

Testing in accordance with BS EN ISO 17892 unless specified otherwise

Date: 15 Jul 15

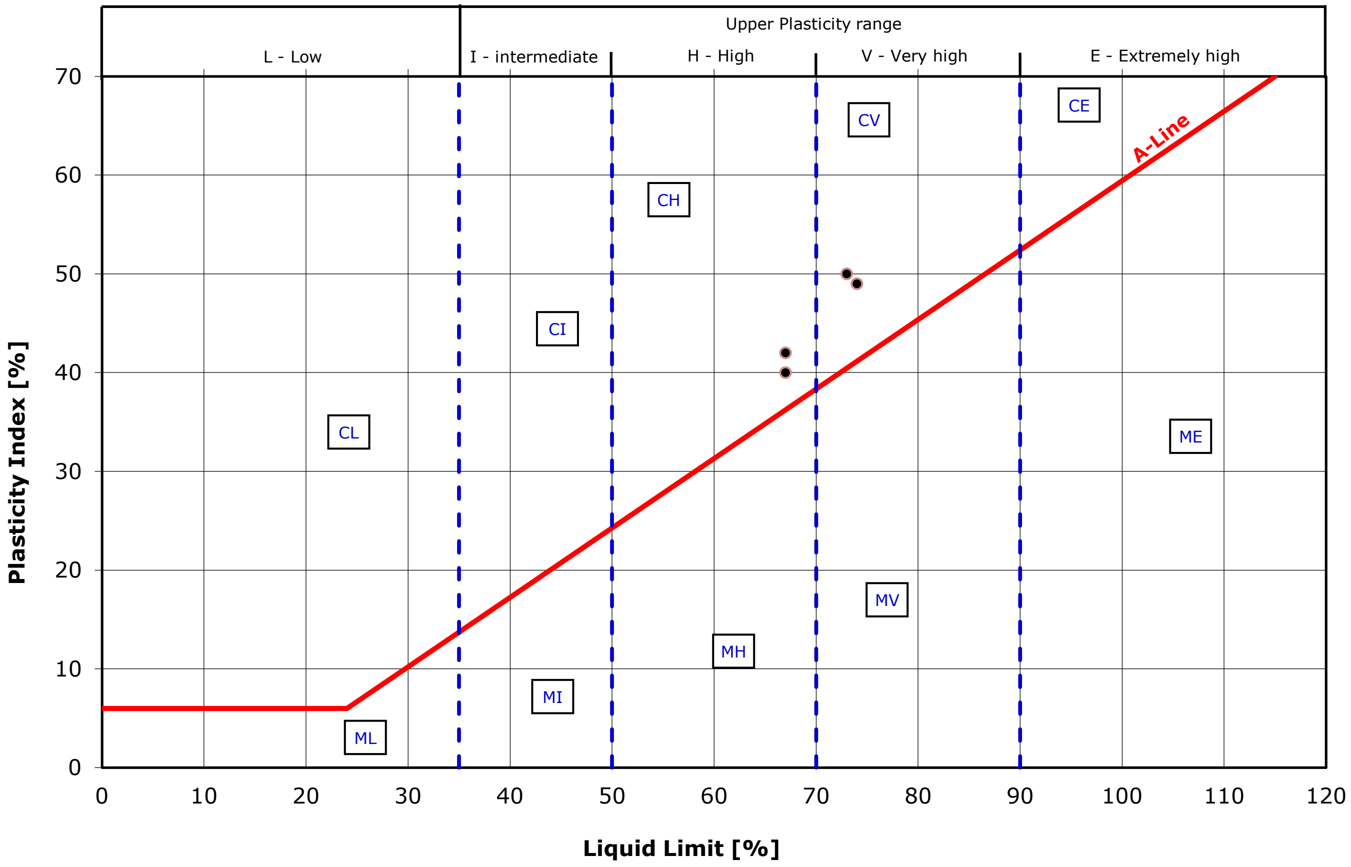
Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)

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

(Classification Sheet 1 of 1)

Site & Location	**152 Royal College Street, London, NW1 0TA**	Report No:	**9819/KOG**

Plasticity Chart

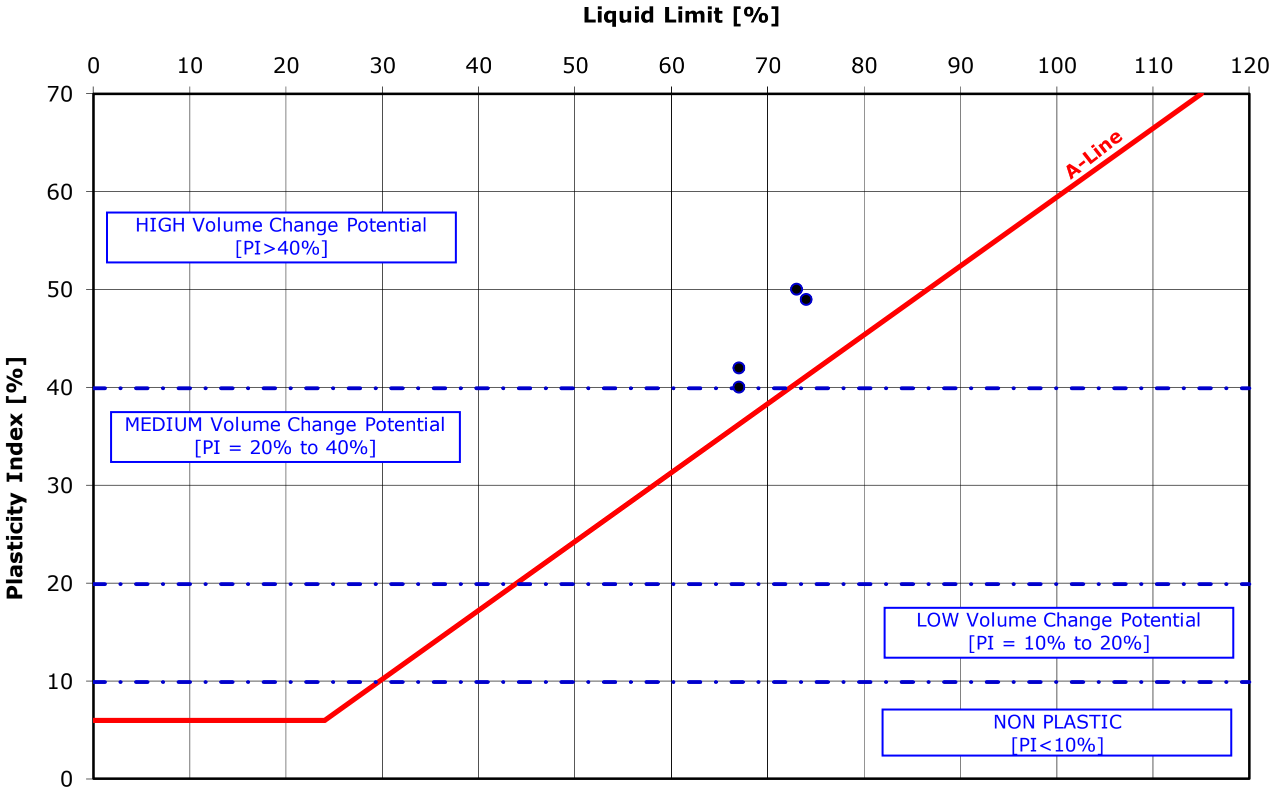


M - SILT [plots below the A-Line}
C - CLAY [plots above the A-Line]

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

Site & Location	**152 Royal College Street, London, NW1 0TA**	Report No:	**9819/KOG**

Plasticity Chart



Modified Plasticity Index, I'p:

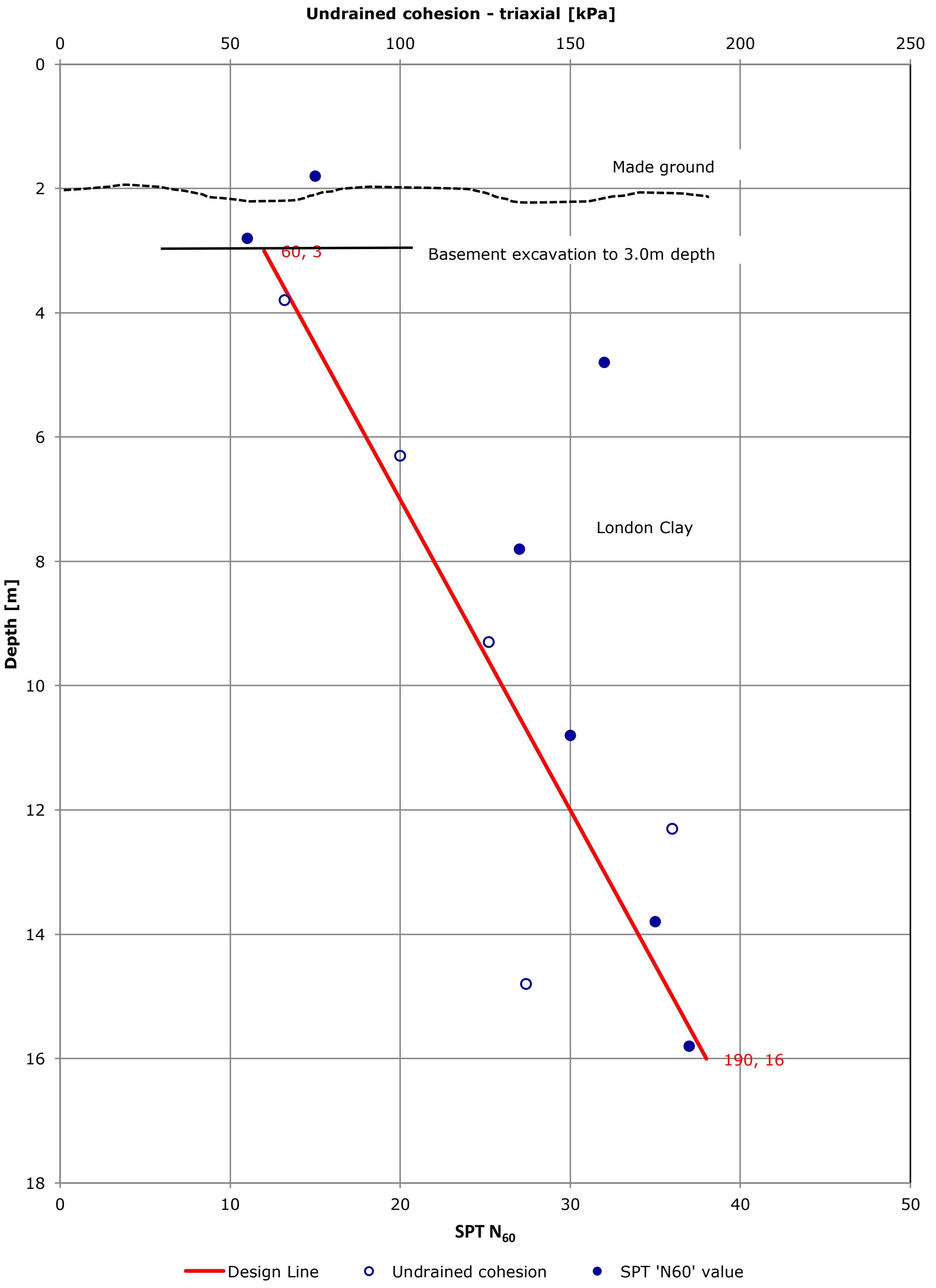
$$I'p = \frac{Ip \times (\% \text{ passing } 425mm)}{100\%}$$ [where Ip = Plasticity Index]

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

Site & Location **152 Royal College Street, London, NW1 0TA**

Report No: **9819/KOG**

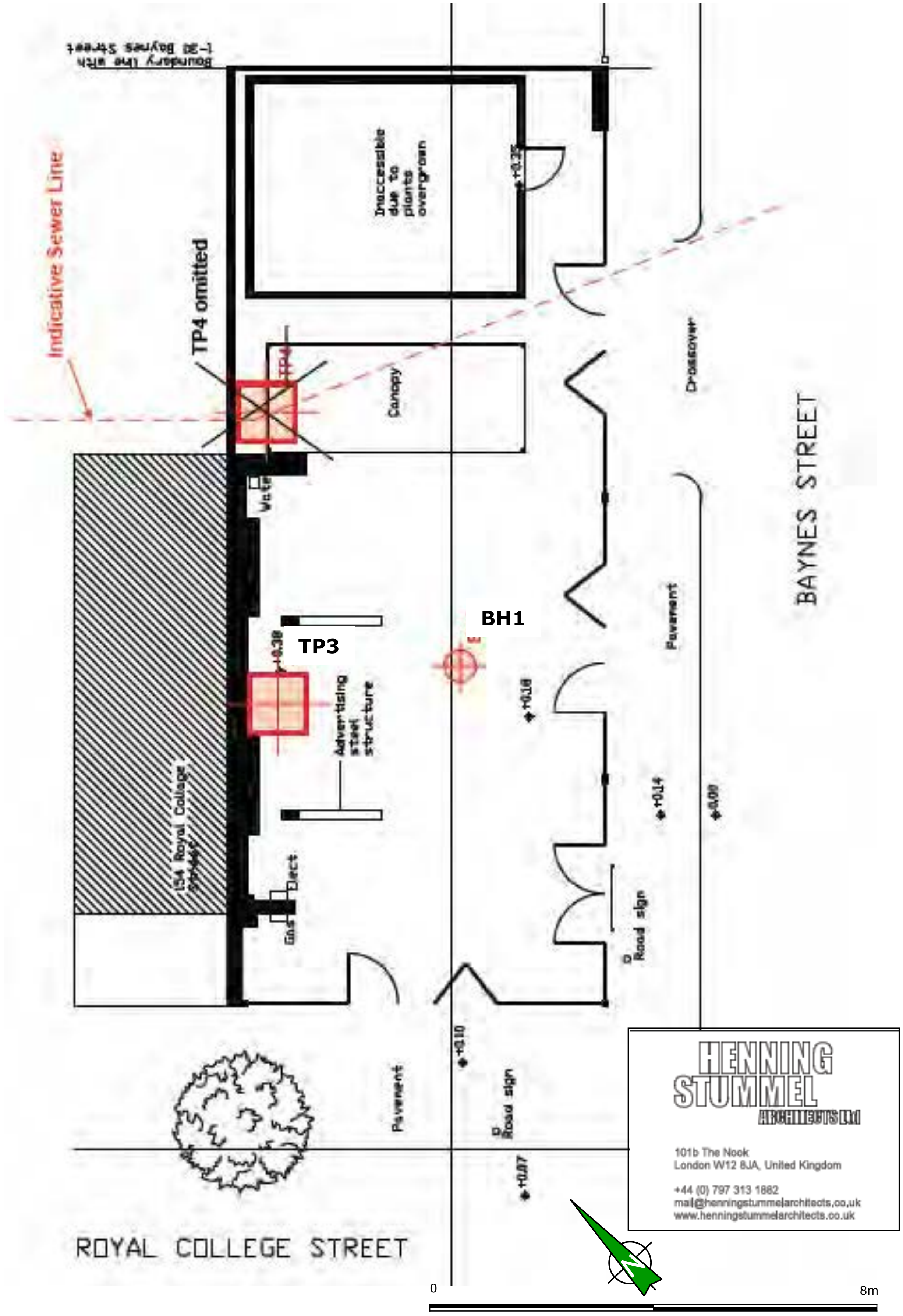
Undrained cohesion and SPT [N60] vs depth



Design Line Δcu = 10kPa/m

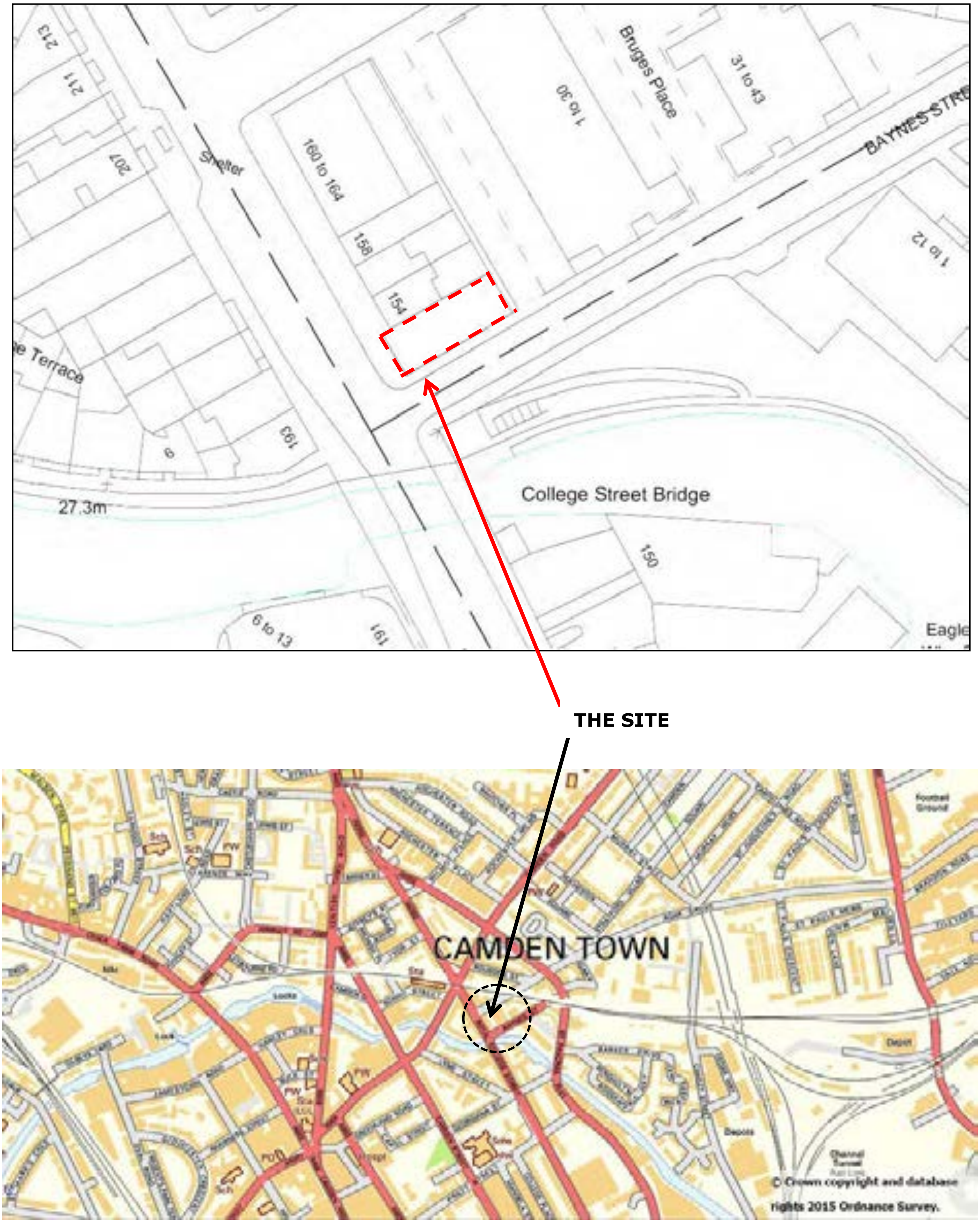
Note: this plot may incorporate extrapolated results, generally where 'N' >50
- these are indicative only and should be used with caution

Site plan


Boundary line with 1-30 Baynes Street
Indicative Sewer Line
TP4 omitted
TP4
Inaccessible due to plants overgrown
+0.25
Canopy
Crossover
BAYNES STREET
Vent
BH1
TP3
+0.38
Advertising steel structure
+0.18
+0.14
+0.09
Pavement
154 Royal College Street
Duct
Gas
Road sign
+0.10
Pavement
Road sign
+0.07
ROYAL COLLEGE STREET
HENNING STUMMEL ARCHITECTS Ltd
101b The Nook
London W12 8JA, United Kingdom
+44 (0) 797 313 1882
mail@henningstummelarchitects.co.uk
www.henningstummelarchitects.co.uk
0
8m
Scale = 1:100@A4

Site Location	**152 Royal College Street, London, NW1 0TA**	Report No: **9819/KOG**

Location plan



APPENDIX B

- GroundSure historical maps [Ref SCL-2184572]
- GroundSure EnviroInsight Report [Ref SCL-2184570]
- GroundSure GeoInsight Report [Ref SCL-2184571]

Ground Investigation
Geotechnical Analysis
Contamination Assessment

Site Details:

152, ROYAL COLLEGE STREET,
LONDON, NW1 0TA

Client Ref: 9819
Report Ref: SCL-2184572
Grid Ref: 529265, 184100

Map Name: 1056 Scale Town Plan

Map date: **1870-1873**

Scale: 1:1,056

Printed at: 1:1,056

N
W E
S

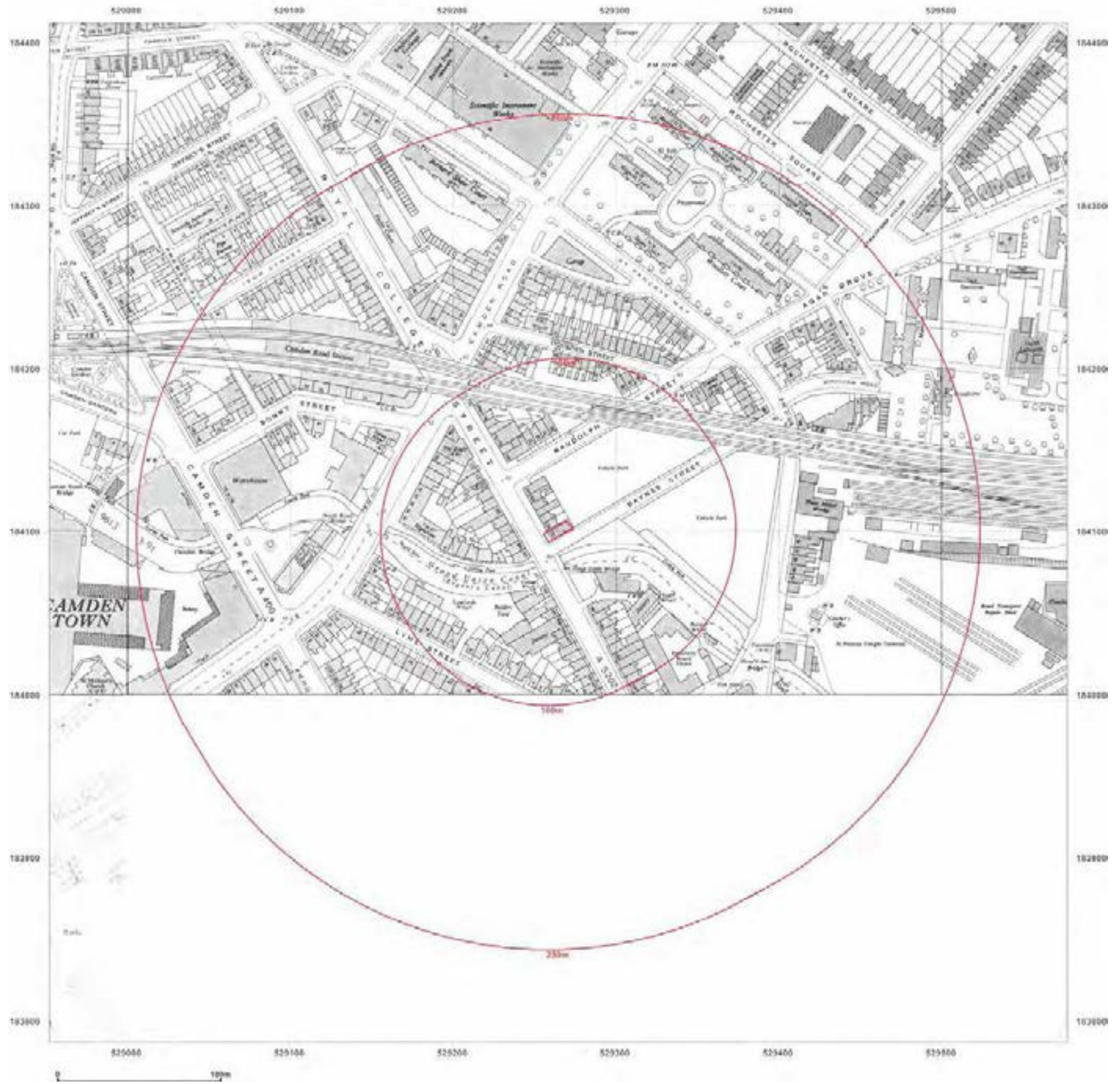
Surveyed 1870
Revised N/A
Edition 1873
Copyright N/A
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Produced by
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 17 June 2015

To view map legend click here *Legend*



Soil Consultants
Ground Investigation
Geotechnical Analysis
Contamination Assessment

Site Details:

152, ROYAL COLLEGE STREET,
LONDON, NW1 0TA

Client Ref: 9819
Report Ref: SCL-2184572
Grid Ref: 529265, 184100

Map Name: National Grid

Map date: **1968-1971**

Scale: 1:2,500

Printed at: 1:2,500

Groundsure

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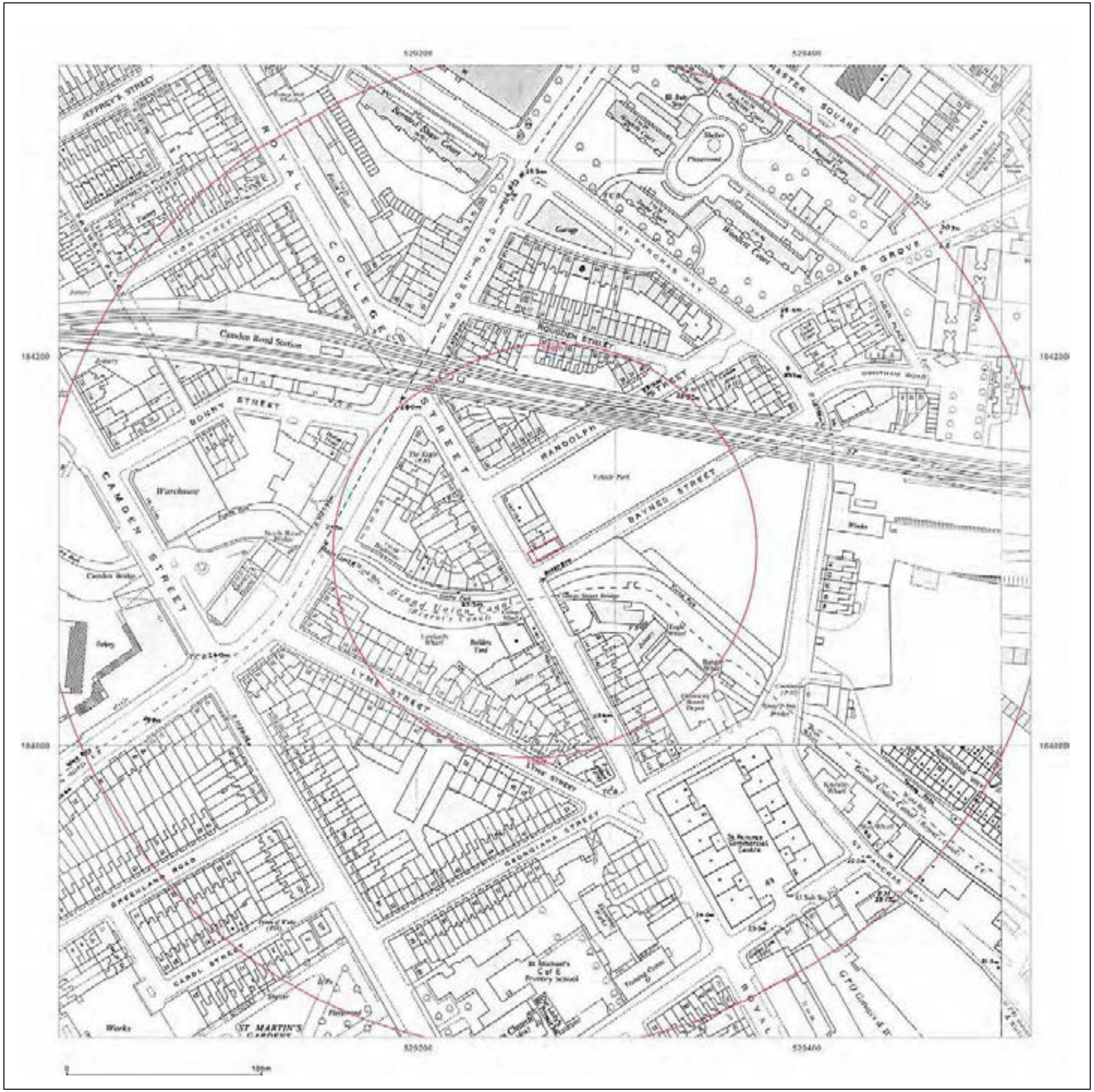


Site Details:

152, ROYAL COLLEGE STREET,
LONDON, NW1 0TA

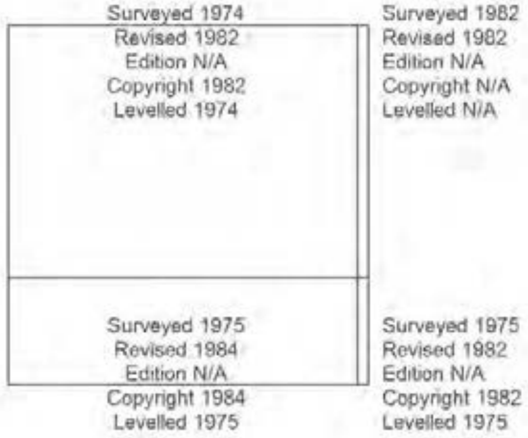
Client Ref: 9819
Report Ref: SCL-2184572
Grid Ref: 529265, 184100

Map Name: National Grid

Map date: **1982-1984**

Scale: 1:1,250

Printed at: 1:2,000



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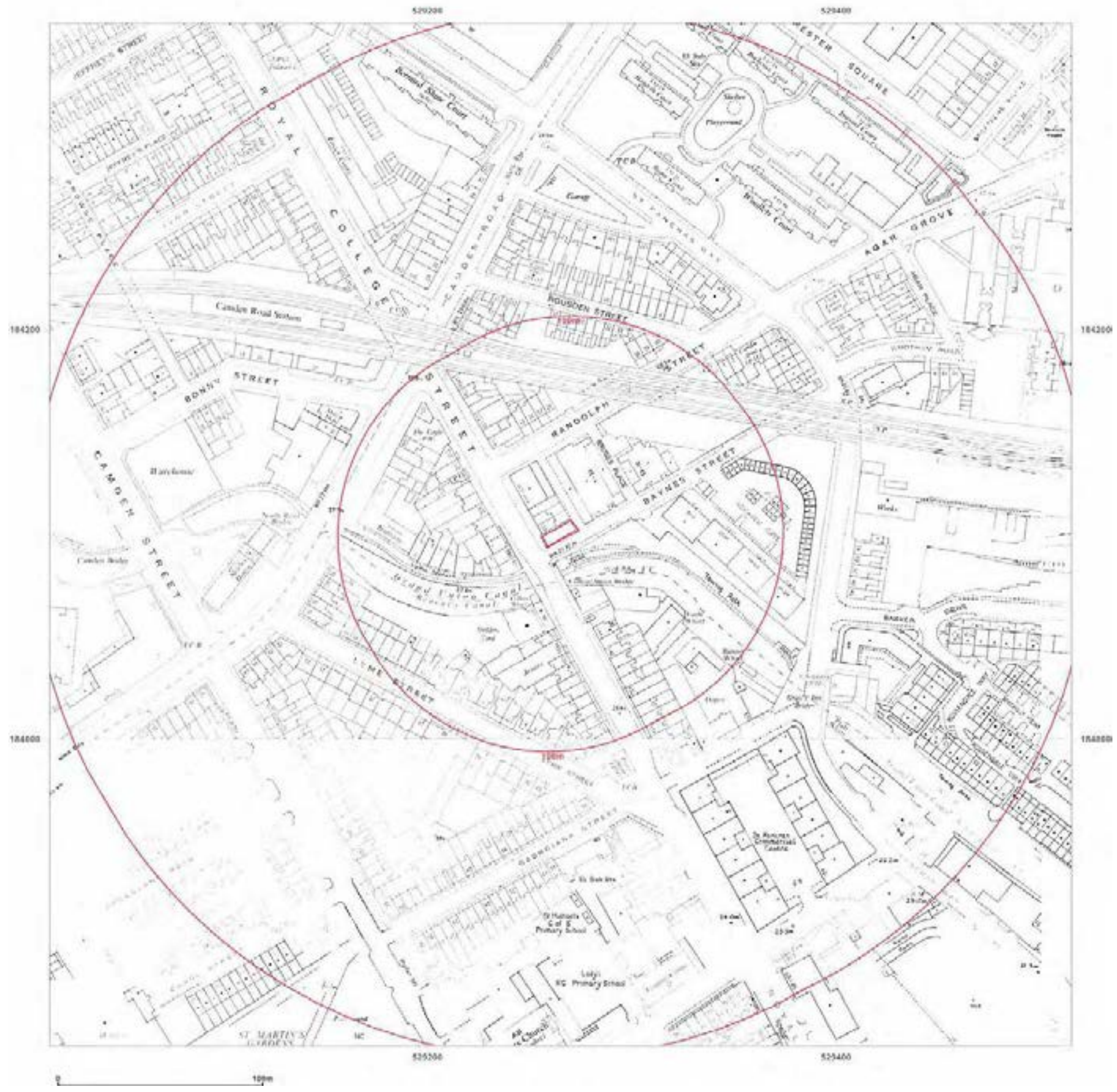
W: www.groundsure.com

Production date: 17 June 2015

To view map legend click here *Legend*



Soil Consultants
Ground Investigation
Geotechnical Analysis
Contamination Assessment

Site Details:

152, ROYAL COLLEGE STREET,
LONDON, NW1 0TA

Client Ref:	9819
Report Ref:	SCL-2184572
Grid Ref:	529265, 184100
Map Name:	National Grid
Map date:	**1984-1987**
Scale:	1:1,250
Printed at:	1:2,000

N
W E
S

Surveyed 1974 Revised 1986 Edition N/A Copyright 1986 Levelled 1974	Surveyed N/A Revised N/A Edition N/A Copyright N/A Levelled N/A
Surveyed N/A Revised N/A Edition N/A Copyright 1987 Levelled 1975	Surveyed 1975 Revised 1984 Edition N/A Copyright 1984 Levelled 1975

Produced by
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 17 June 2015

To view map legend click here *Legend*

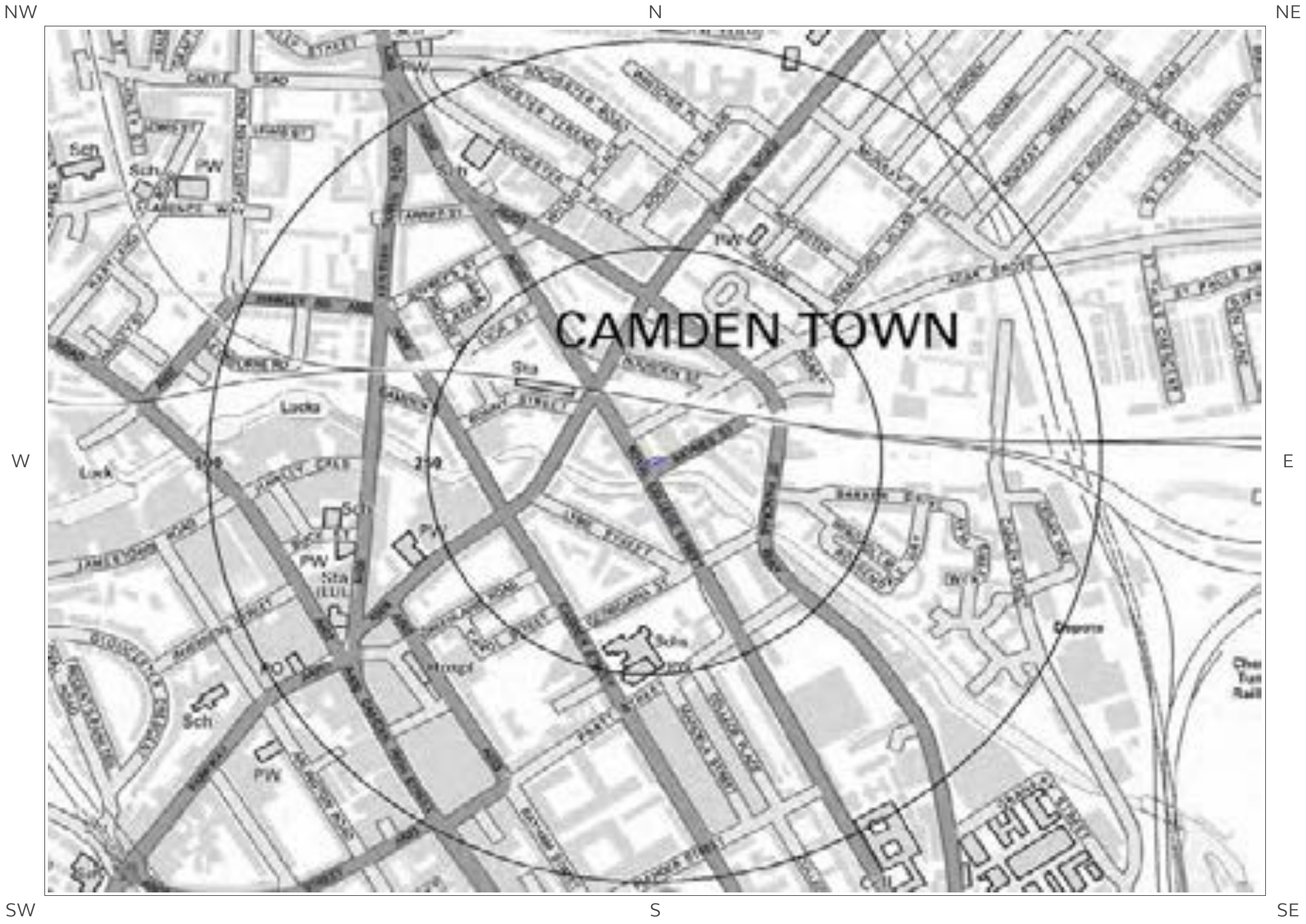
Groundsure Enviroinsight

Address:	**152, ROYAL COLLEGE STREET, LONDON, NW1 0TA**
Date:	**17 Jun 2015**
Reference:	**SCL-2184570**
Client:	**Soil Consultants Ltd**

Aerial Photograph Capture date:	20-Apr-2013
Grid Reference:	529265,184100
Site Size:	0.01ha

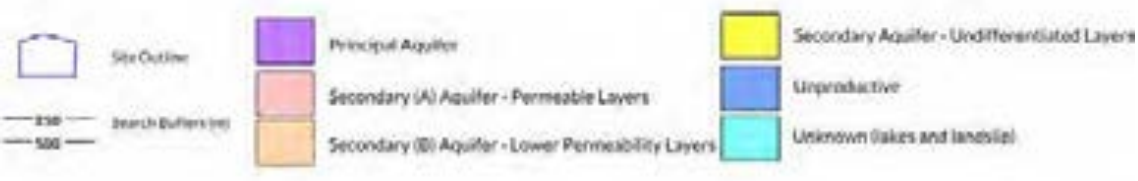
5. Hydrogeology and Hydrology

5a. Aquifer Within Superficial Geology



Aquifer Within Superficial Geology

Mapping sourced from Ordnance Survey



5b. Aquifer Within Bedrock Geology and Abstraction Licenses

Aquifer Within Bedrock Geology and Abstraction Licenses

Mapping sourced from Ordnance Survey

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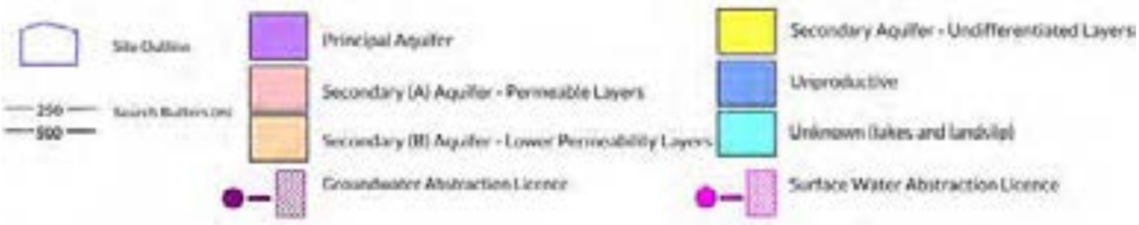
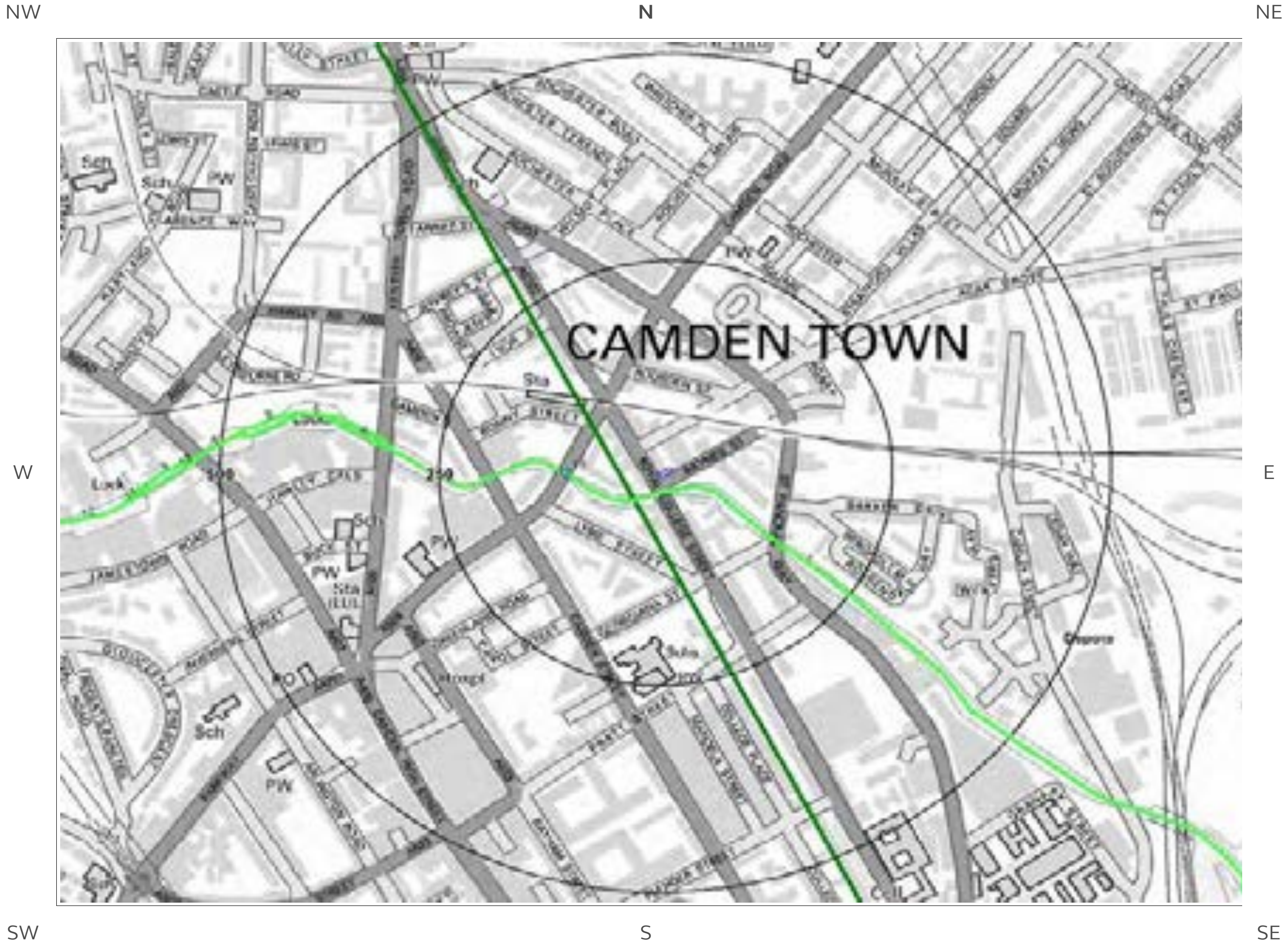


5e. Hydrology – Detailed River Network and River Quality



Hydrology – Detailed River Network and River Quality

Mapping sourced from Ordnance Survey

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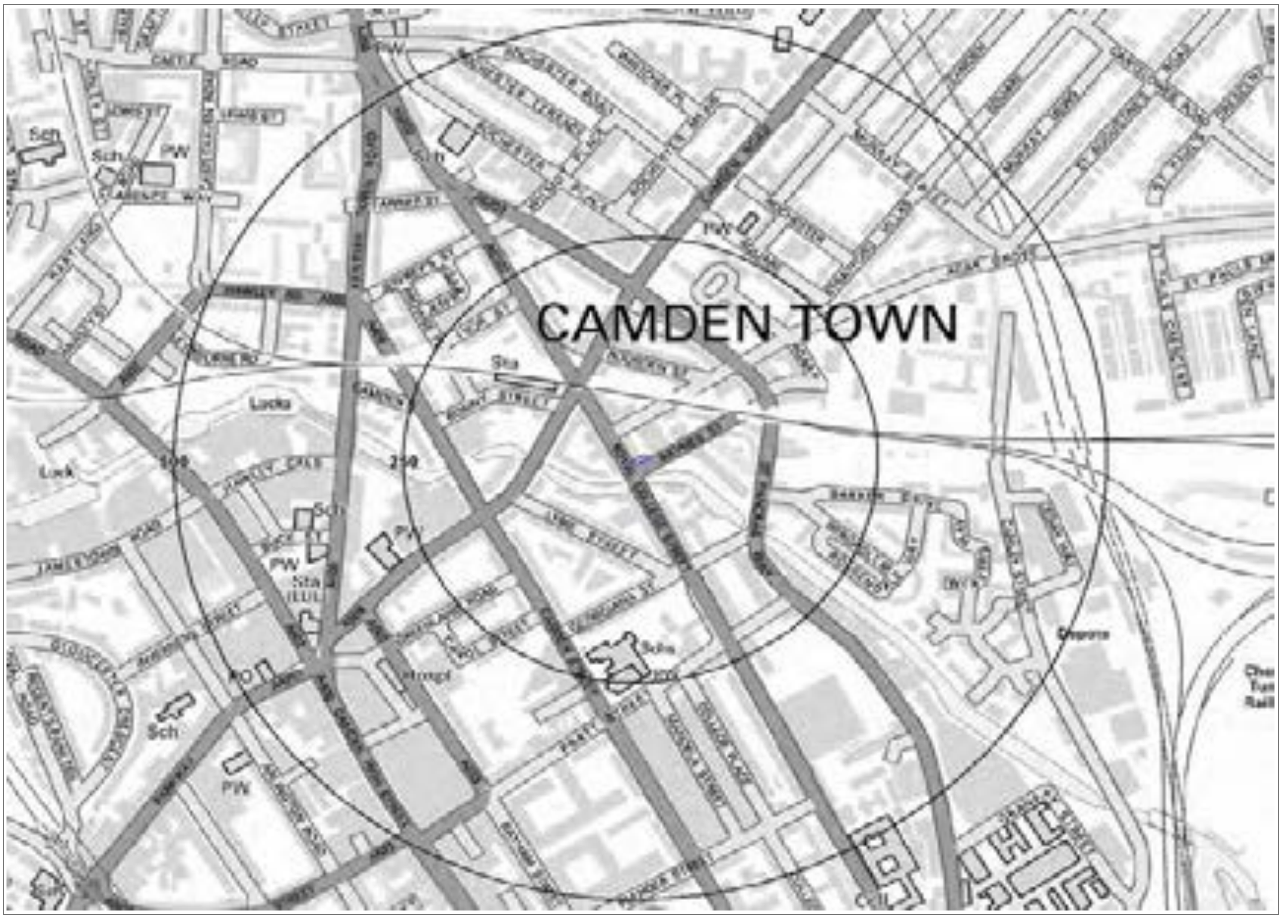
Report Reference: SCL-2184570
Client Reference: 9819

1.2 Superficial Deposits and Landslips Map



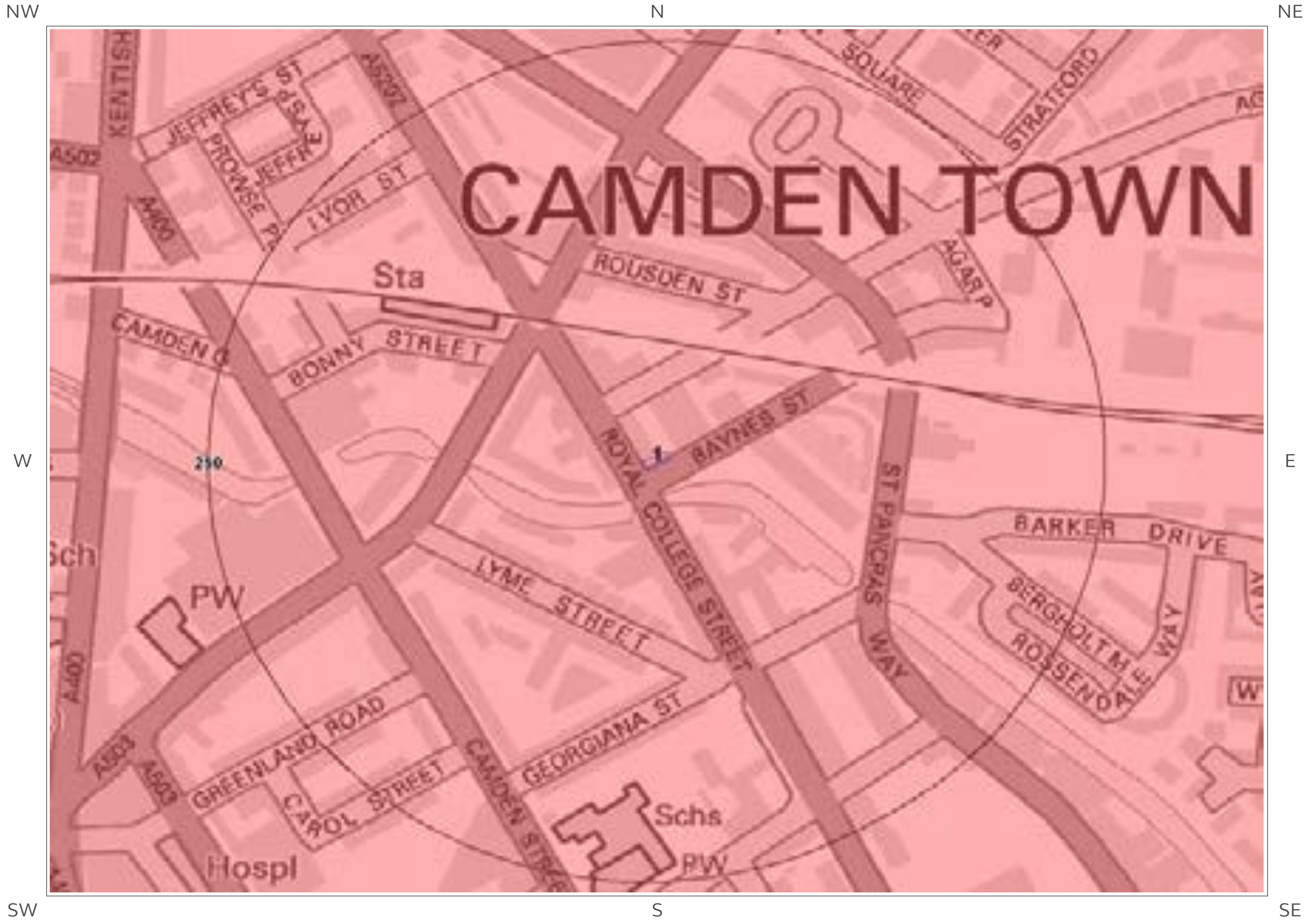
Superficial Deposits and Landslips Legend

Mapping sourced from Ordnance Survey

▭	Site Outline
— 500 — — 1000 —	Search Buffers (m)

4 Natural Ground Subsidence

4.1 Shrink-Swell Clay Map

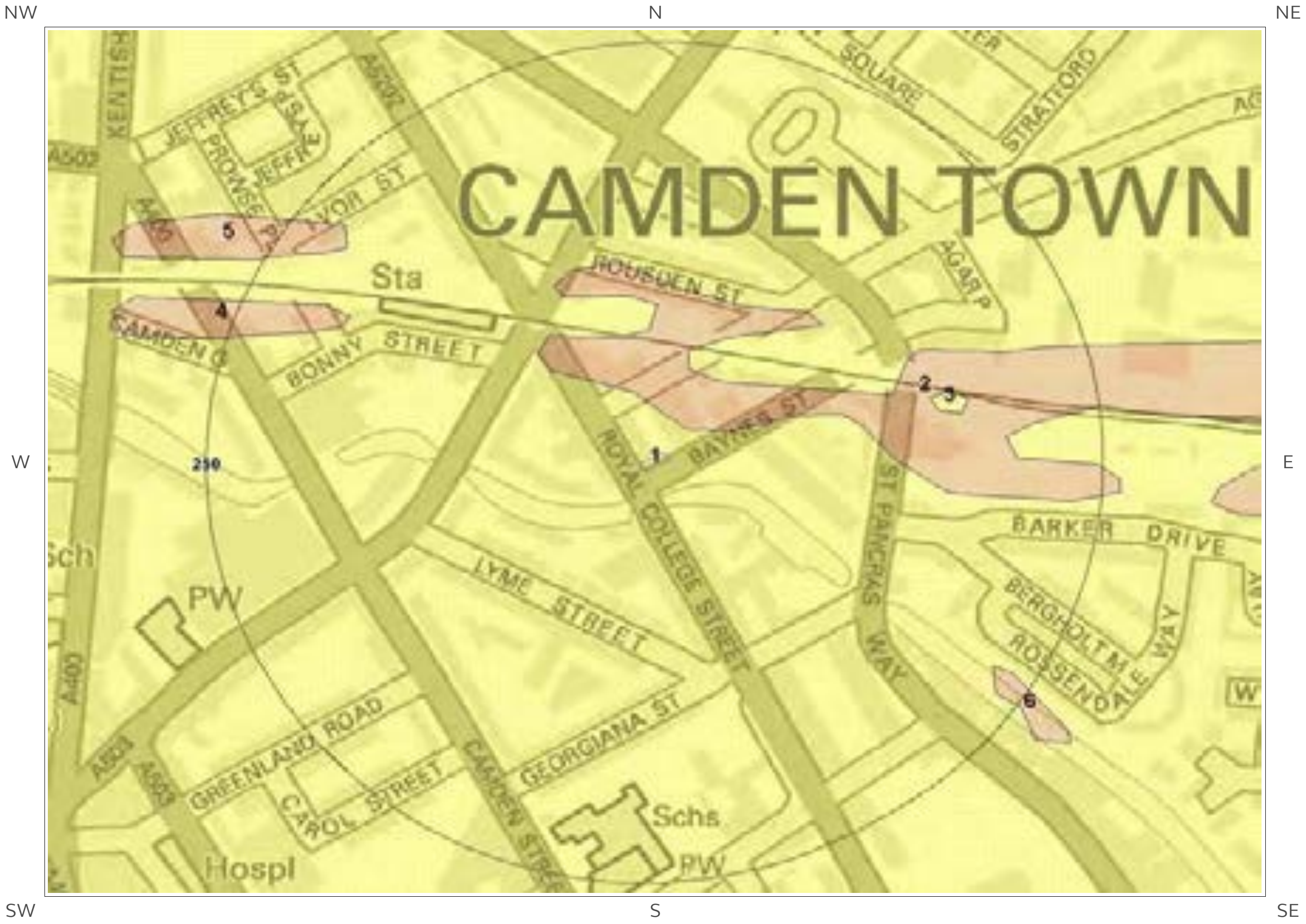


Shrink Swell Clay Legend

Mapping sourced from Ordnance Survey

⬠	Site Outline	☐	No Data / Null	🟧	Low
— 125 — — 250 —	Search Buffers (m)	🟨	Negligible	🟥	Moderate
		🟨	Very Low	🟫	High

4.2 Landslides Map



Landslides Legend

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⬠ Site Outline

125 / 250 Search Buffers (m)

☐ No Data / Null

🟨 Negligible

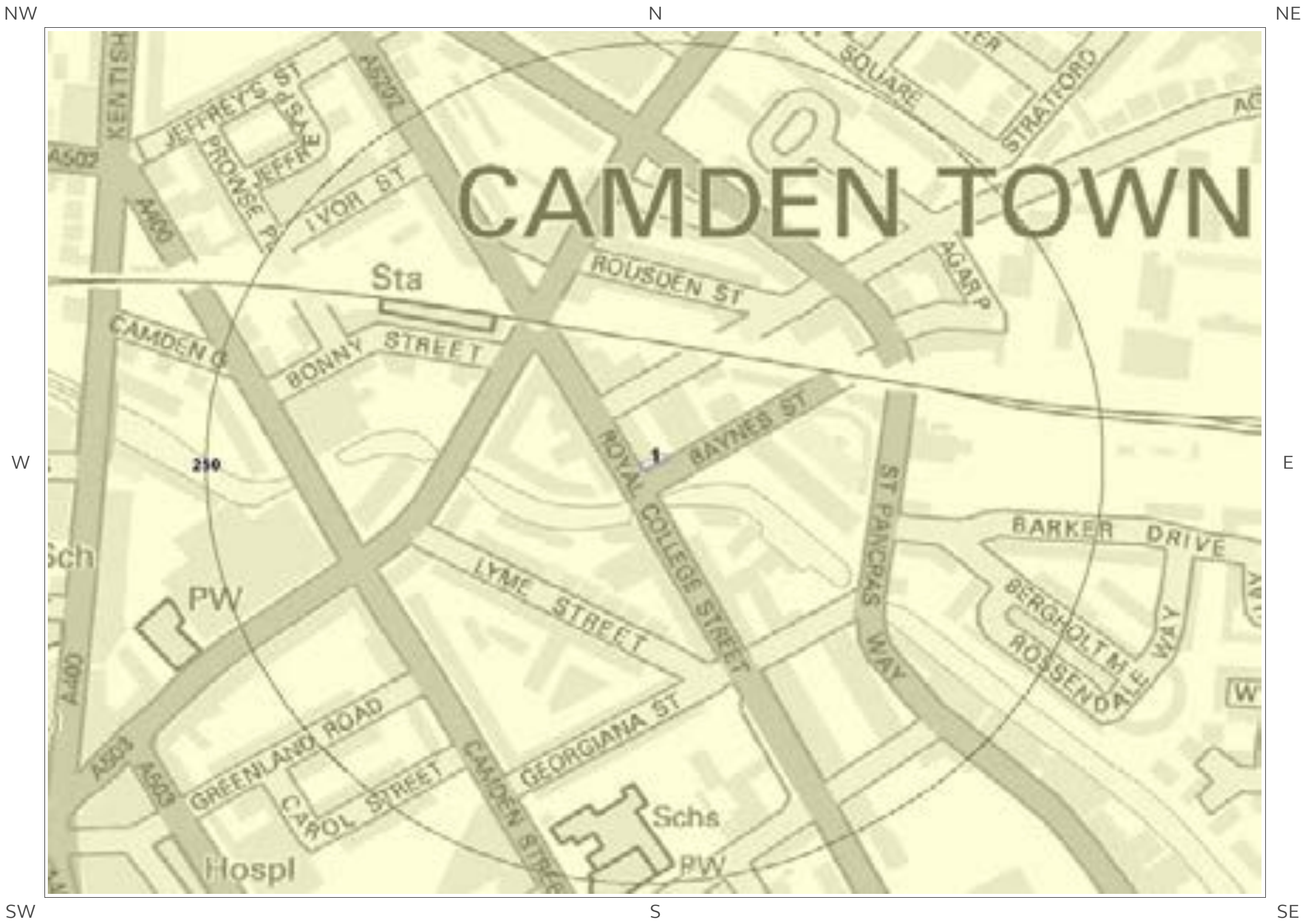
🟨 Very Low

🟧 Low

🟥 Moderate

🟫 High

4.3 Ground Dissolution Soluble Rocks Map



Ground Dissolution Soluble Rocks Legend

Mapping sourced from Ordnance Survey

Site Outline

125 / 250 Search Buffers (m)

☐ No Data / Null

🟨 Negligible

🟨 Very Low

🟧 Low

🟥 Moderate

🟥 High

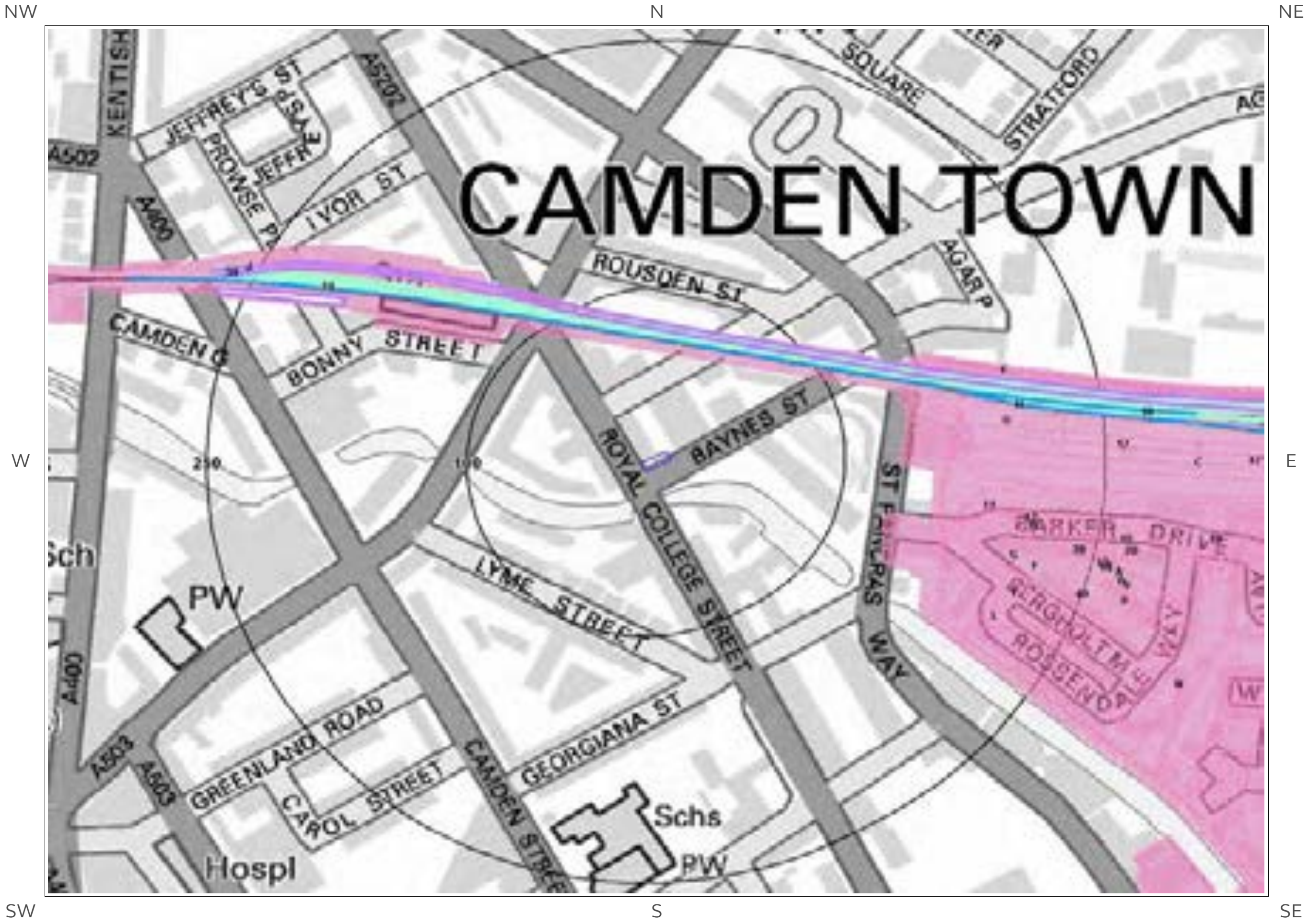
4.5 Collapsible Deposits Map

Collapsible Deposits Legend

Mapping sourced from Ordnance Survey

⬠	Site Outline	☐	No Data / Null	🟧	Low
		☐	Negligible	🟥	Moderate
125 250	Search Buffers (m)	🟨	Very Low	🟫	High

7 Railways and Tunnels Map



Railways and Tunnels Legend

Mapping sourced from Ordnance Survey

Appendix B – London Underground Letter

Transport for London
London Underground

UNDERGROUND

London Underground
Infrastructure Protection

3rd Floor
Albany House
55 Broadway
London SW1H 0BD

www.tfl.gov.uk/tube

Your ref: 15055-06o-150602
Our ref: 20878-SI-13-050615

Robert Dean
Michael Hadi Associates
robert.dean@mha-consult.co.uk

05 June 2015

Dear Robert,

152 Royal College Street London NW1 0TA

Thank you for your communication of 2nd June 2015.

I can confirm that London Underground has no assets within 50 metres of your site as shown on the plan you provided.

If I can be of further assistance, please contact me.

Yours sincerely

Shahina Inayathusein
Information Manager
Email: locationenquiries@tube.tfl.gov.uk
Direct line: 020 7918 0016

London Underground Limited
trading as London Underground
whose registered office is
55 Broadway
London SW1H 0BD

Registered in England and Wales
Company number 1900907

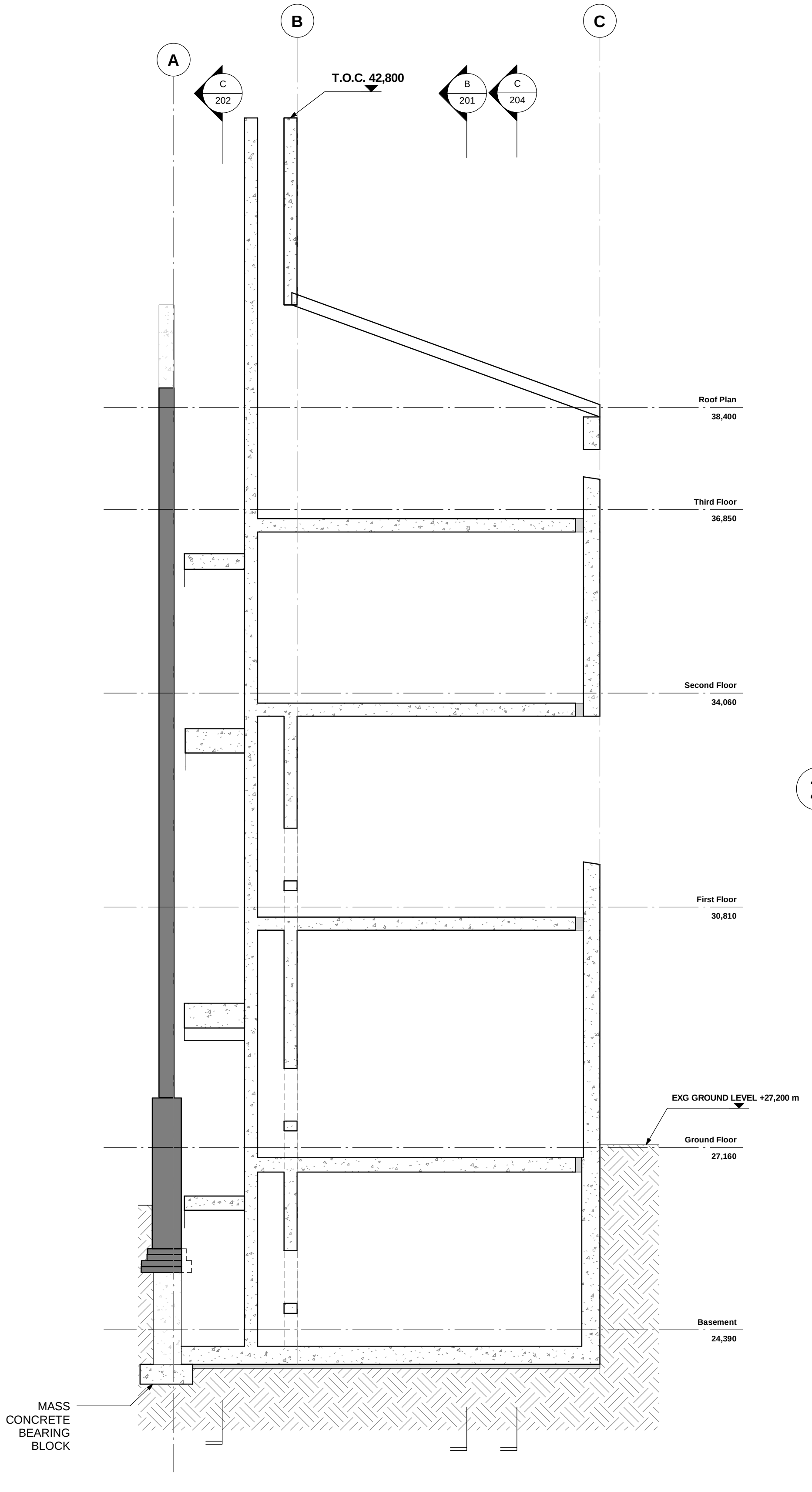
VAT number 238 7244 46

London Underground Limited is a company controlled by a local authority within the meaning of Part V Local Government and Housing Act 1989. The controlling authority is Transport for London.

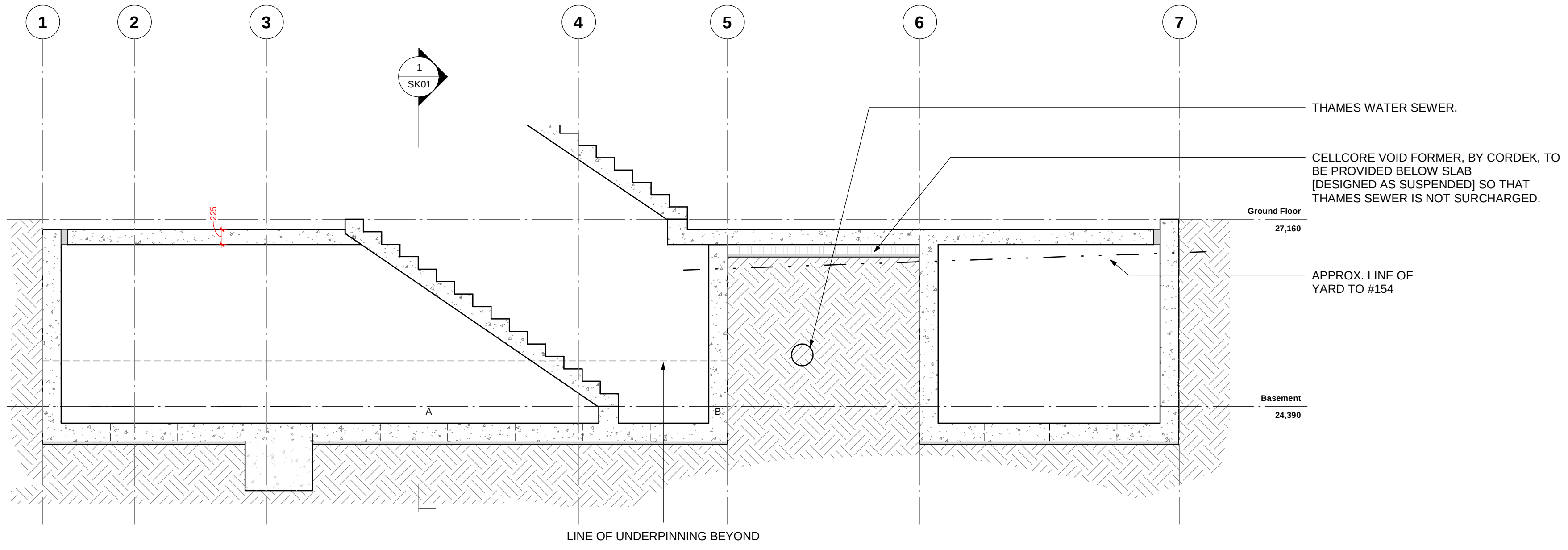
Appendix C – Revised Basement Drawings

NOTES

1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, employer's requirements, bills of quantities and specifications.
2. Do not scale off this drawing.
3. All dimensions are to be confirmed on site by the contractor.



1 Section A-A BIA
-



2 Section B2-B2 BIA
-

Rev	Date	Made by	Amendments
-	31.07.2017	GM	Issued For Information

Status
PRELIMINARY

Michael Hadi Associates Ltd.
Consulting Structural Engineers

14-18 Old Street,
London, EC1V 9BH.
0207 375 6340
all@mha-consult.co.uk
www.mha-consult.co.uk

Job Title
152 Royal College Street

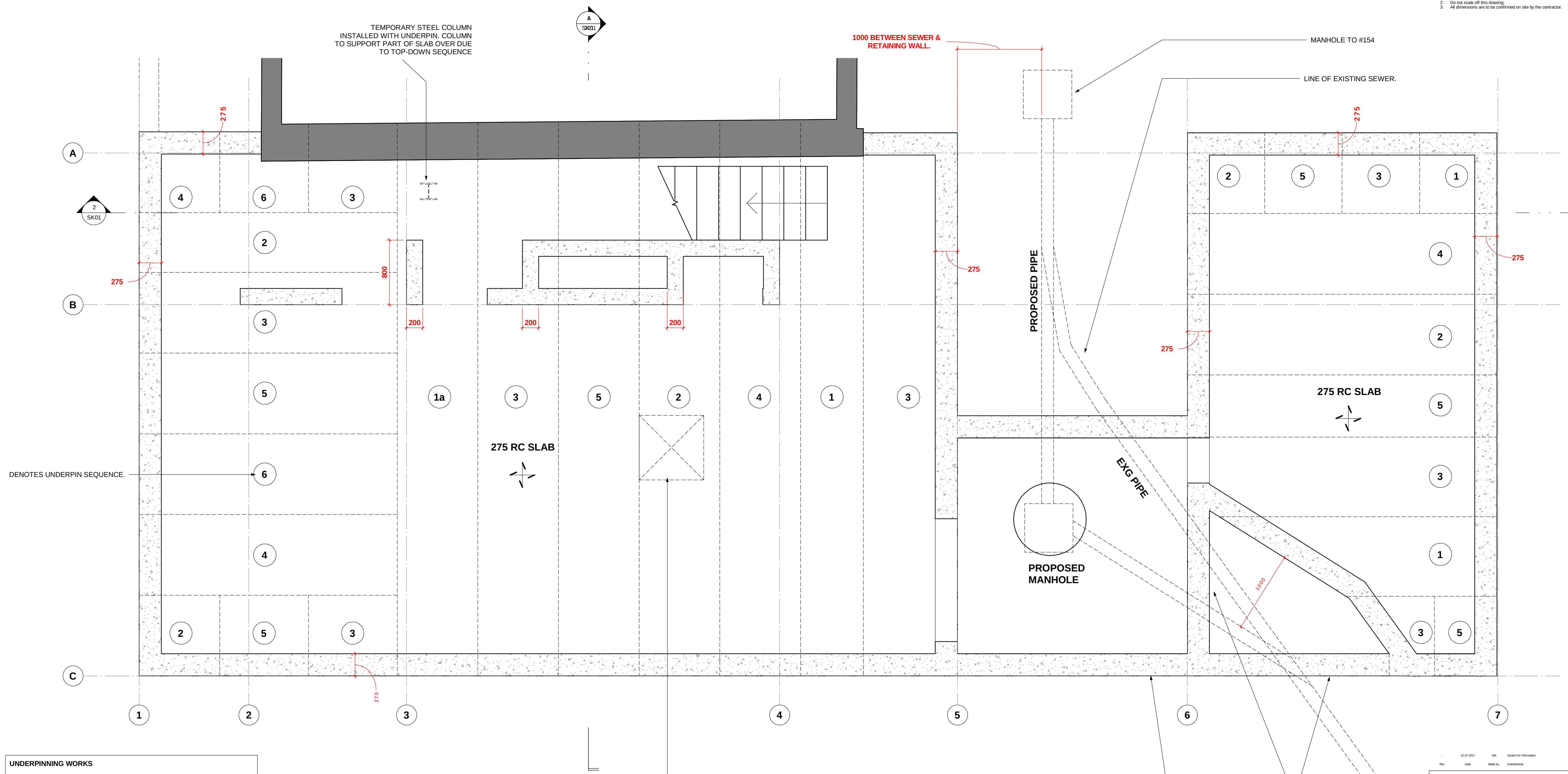
Drawing Title
Basement Indicative Sections

Scales **1:100 @ A3**

Drawn **GM**	Date **07/31/17**	Checked **CK**
Job No **15055**	Drawing No **SK01**	Revision **-**

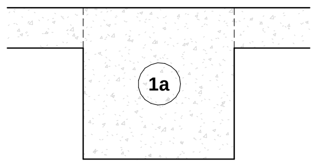
NOTES

1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, employer's requirements, bills of quantities and specifications.
2. Do not scale off this drawing.
3. All dimensions are to be confirmed on site by the contractor.



UNDERPINNING WORKS

1. BEFORE STARTING THE WORK, THE CONTRACTOR IS TO CHECK FOR ANY SERVICES THAT COULD BE DAMAGED BY THE UNDERPINNING WORK.
2. UNDERPINNING IS TO BE CARRIED OUT IN SHORT SECTIONS OF ABOUT 1M IN LENGTH. THE BOTTOMS OF THE FOUNDATIONS SHALL BE INSPECTED AND APPROVED BY THE BUILDING INSPECTOR BEFORE CONCRETE IS POURED. THE UNDERSIDES OF EXISTING FOOTINGS ARE TO BE CLEAN AND FREE OF DIRT, SOIL OR LOOSE MATERIAL BEFORE UNDERPINNING. REINFORCEMENT BARS ARE TO BE PUSHED INTO THE SOIL ON BOTH FACES & BOTH SIDES OF THE RC SECTION.
3. THE EXCAVATION AND CONCRETING OF ANY SECTION OF UNDERPINNING SHALL BE CARRIED OUT ON THE SAME DAY.
4. THE MAIN CONCRETE IS TO BE STOPPED OFF 75MM BELOW THE UNDERSIDE OF THE EXISTING FOOTINGS AND FINAL PINNING UP OVER THE WHOLE FOOTING IS TO BE CARRIED OUT WITH A 1:3 CEMENT TO SHARP SAND DRY PACKED MORTR, WELL RAMMED IN, 36 HOURS AFTER THE MAIN CONCRETE HAS BEEN POURED.
5. THERE SHALL BE AT LEAST FIVE COMPLETED OR UNEXCAVATED BAYS BETWEEN SIMULTANEOUS EXCAVATIONS. A BAY SHALL BE REGARDED AS COMPLETE 24 HOURS AFTER DRY PACKING.
6. THE SIDE OF PREVIOUS UNDERPINNING BAYS ARE TO BE ROUGHENED OR KEYED TO THE SATISFACTION OF THE BUILDING INSPECTOR & PROTRUDING DOWEL BARS CLEANED.



Section Through Pin 1a
NTS

ALL FOUNDATIONS TO BE FOUNDED AT A MIN OF 2.5M BELOW EXISTING GROUND LEVEL

Rev	Date	Made by	Amendments
-	31.07.2017	GM	Issued For Information

Status
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Job Title
152 Royal College Street

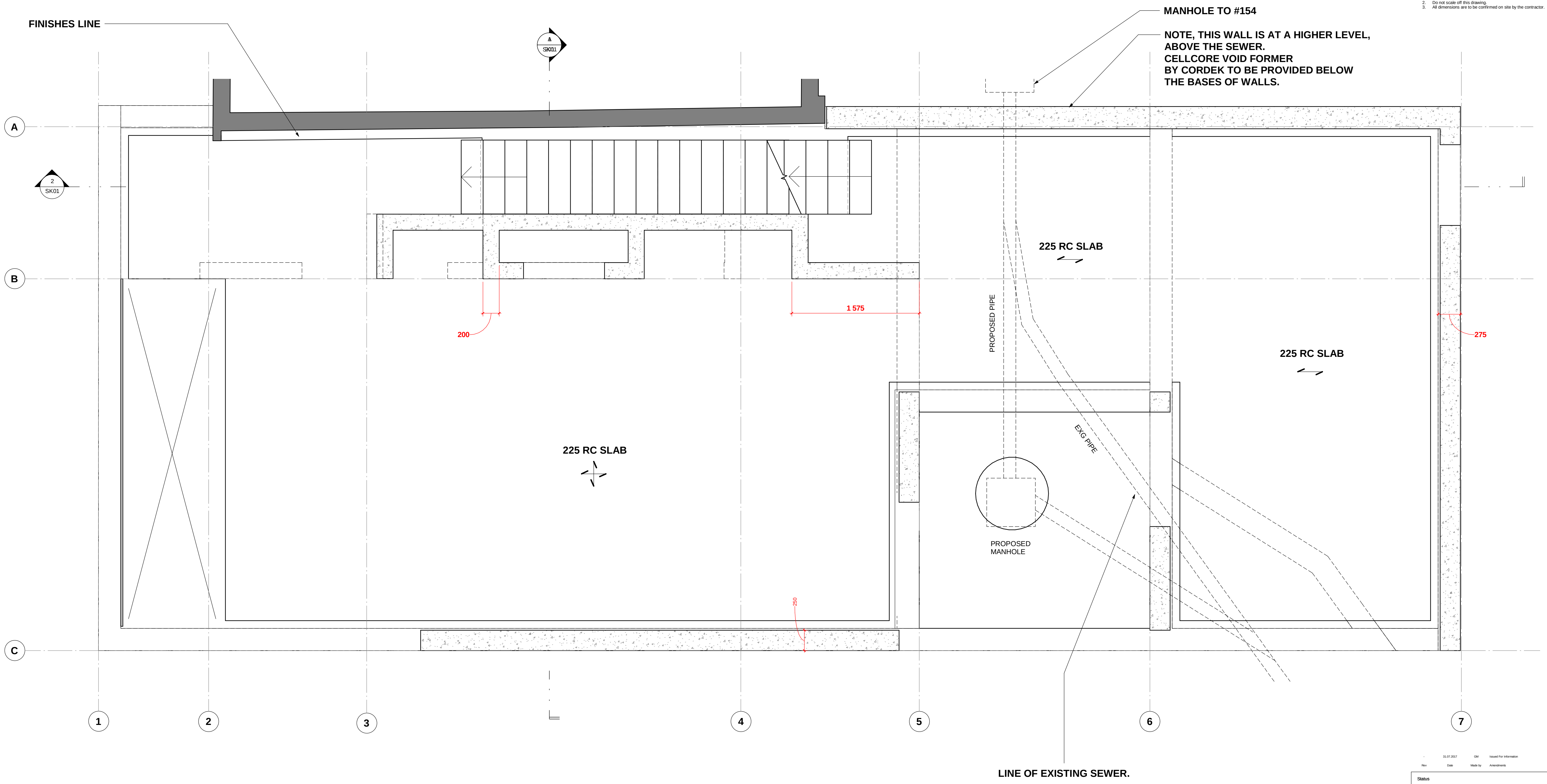
Drawing Title
Basement GA

Scales **1:50 @ A3**

Drawn **GM**	Date **07/31/17**	Checked **CK**
Job No **15055**	Drawing No **SK10**	Revision **-**

NOTES

1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, employer's requirements, bills of quantities and specifications.
2. Do not scale off this drawing.
3. All dimensions are to be confirmed on site by the contractor.



Rev	Date	Made by	Amendments
-	31.07.2017	GM	Issued For Information

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Job Title
152 Royal College Street

Drawing Title
Ground Floor GA

Scales **1:50 @ A3**

Drawn **GM**
Date **07/31/17**
Checked **CK**
Job No **15055**
Drawing No **SK11**
Revision **-**

Appendix D – Basement Heave Analysis

ROYAL COLLEGE STREET

CALCULATION OF HEAVE AT CENTRE OF SIMPLE RECTANGULAR AREA

1 Calculation of Stress Relief

Reduction of stress = 60 kN/m^2 (or use the following calculation)

Soil Type	Density	H (m)	Unload	Units
	20.0	3.0	60	Density = kN/m^3
				H = Thickness
	Totals =	3	60	kN/m^2

The stress relief used in calculation of heave = **60** kN/m^2

Excavation width = 7 length = 17 m

2 Soil Data

Strength relationship	Depth/OD	Cohesion	Strength increase	
Top of zone	3	60	Increasing at	kN/m^2
Base of zone	17	200	10.00 per m	

Factor to calculate Eu from Cu value 500

Factor to calculate E' from Cu value 250

Poisson's Ratio (undrained) 0.5

Poisson's Ratio (drained) 0.15

3 Calculation of Heave

Based on 10 layers 1.4 thickness

Layer	DEPTH	Cu	E	E'	I factor	VS	Incremental immediate	Cumulative immediate	Incremental Long term	Cumulative Long term	Cumulative Total Heave
1	3.7	67	33.5	16.8	0.997	59.8	1.9	**7.1**	3.0	**11.4**	**18**
2	5.1	81	40.5	20.3	0.934	56.1	1.5	5.2	2.3	8.4	14
3	6.5	95	47.5	23.8	0.808	48.5	1.1	3.8	1.7	6.0	10
4	7.9	109	54.5	27.3	0.674	40.4	0.8	2.7	1.3	4.3	7
5	9.3	123	61.5	30.8	0.557	33.4	0.6	1.9	0.9	3.1	5
6	10.7	137	68.5	34.3	0.461	27.6	0.4	1.3	0.7	2.1	3
7	12.1	151	75.5	37.8	0.384	23.0	0.3	0.9	0.5	1.5	2
8	13.5	165	82.5	41.3	0.322	19.3	0.2	0.6	0.4	0.9	2
9	14.9	179	89.5	44.8	0.272	16.3	0.2	0.3	0.3	0.6	1
10	16.3	193	96.5	48.3	0.232	13.9	0.2	0.2	0.2	0.2	0
	m	kN/m^2	MN/m^2	MN/m^2		kN/m^2	mm	mm	mm	mm	mm

Note, the above analysis (Boussinesq) is conservative as a basement was historically present on the site before being infilled.

The above long-term values do not consider the re-loading of the soil due to the building construction. The proposed superstructure loading is similar to the initial load relief due to the soil excavation and therefore the long-term heave movement values can be discounted.

Appendix E – Retaining Wall Movement Analysis

JOB 15035 / 152 Royal College St
TITLE Basement Movement & Damage

DATE July 17 PAGE 1
BY CK CHECKED MM

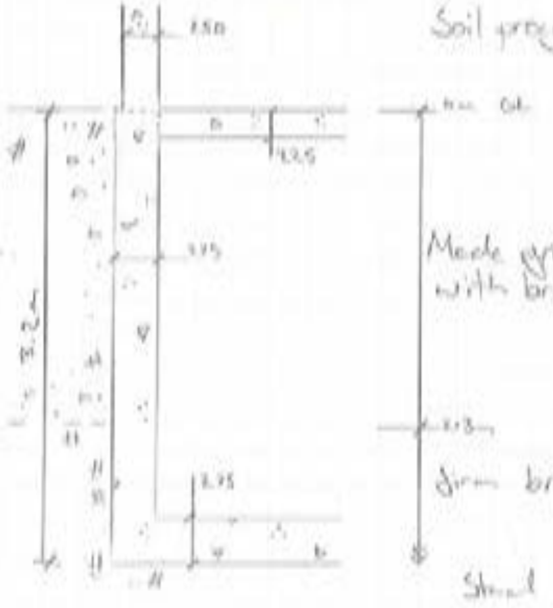
Two locations are to be assessed:

i) Full height retaining wall.
ii) Under pinning to party wall with No. 154 Royal College St

All movement assessments undertaken with reference to figure 2.12 CIRIA C580 & IStructE 'Soil Structure Interactions'.

1) Full Height Retaining Wall

Soil progression based on specialist SI



Made ground: brown mottled silty clay with brick fragments

firm brown fissured CLAY

Stand pipe to 6m depth : Dry

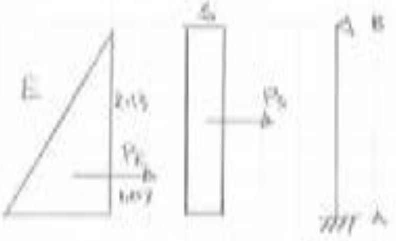
All retained material assumed to have:

Effective angle of friction	ϕ'	=	23°
Bulk density	γ	=	18kN/m³
	K_a	=	0.44

Consider the wall head to be effectively propped by the slab, props will be installed for the temporary case & thus the head of the wall will be considered as pinned.

Highway surcharge Ps = 10kN/m²

Water table below structural level so not considered for retaining wall design



$P_E = \frac{1}{2} \times 3.2^2 \times 18 \times 0.44$ = 40.4 kN
$x_E = 3.2 / 3$ = 1.07 m

$P_S = 3.2 \times 10 \times 0.44$ = 14.1 kN
$x_S = 3.2 / 2$ = 1.6 m

Formulas from 'Steel Designers Manual' 6ED p1094-95

Total Load = $40.4 \times 1.4 + 14.1 \times 1.6$ = 79.1 kN
Moment @ base $M_A = \frac{(14.1 \times 1.6) \times 3.2}{8} + \frac{2(40.4 \times 1.4) \times 3.2}{15}$ = 32 kNm

Bending reinforcement B16 @ 150 Fy 500
concrete C35 50mm cover

$d = \overset{\text{depth}}{275} - \overset{\text{cover}}{50} - \frac{16}{2}$ = 217 mm
$K = \frac{32 \times 10^6}{35 \times 1000 \times 215^2}$ = 0.019 < 0.156
$z = 0.95\,d$ = 206 mm

$A_{s\,req} = \frac{32 \times 10^6}{0.87 \times 500 \times 206}$ = 357 mm²
$A_{s\,prov}$ = 1340 /m

Consider deflection using uncracked short term stiffness

E = 28×10^3

Conservatively (simply supported) $\delta_{st} = \frac{5(40.4 + 14.1) \times 10^3 \times 3200^3}{384 \times 28 \times 10^3 \times \left(\frac{1000 \times 275^3}{12}\right)}$ = 0.48 mm

To account for cracked section stiffness & long term creep × 2.8

$\delta_{long} = 0.48 \times 2.8$ = 1.3 mm

Distance to negligible movement (from CIRIA C580 Table 2.4) = 3.5 × 3.2m = 11.2m.

Distance to negligible installation movements (Table 2.2) = 2 × 3.2m = 6.4m.

Since the nearest structure behind the wall is 39m away, installation movements neglected.

ii) RC underpinning No 154 Party wall

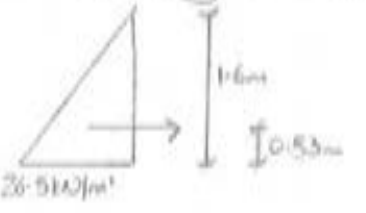
Taking soil parameters as ic), 5kN/m² surcharge from existing buildings & conservatively take ground water acting at top of retaining wall.

Retained height = 1.6m (due to existing adjacent basement).

Peak pressures are as follows:

$$\text{At rest earth} = (20-10) \times \overset{K_o}{0.5} \times \overset{h}{1.6m} = 8\,kN/m^2$$
$$\text{Hydrostatic} = 10 \times 1.6m = 16\,kN/m^2$$
$$\text{Surcharge} = 5 \times 0.5 = \underline{2.5\,kN/m^2}$$
$$26.5\,kN/m^2$$

Simplify to Δ distribution,



Considering 1m length of wall, resultant load:

$$F = 0.5 \times 26.5 \times 1.6 = 21.2\,kN$$
$$M = 21.2 \times 0.53 = 11.2\,kNm$$

Considering 350thk wall (to match existing)

$$K = \frac{\overset{\gamma_f}{1.2} \times 11.2 \times 10^6}{\underset{b}{1000} \times \underset{d}{288^2} \times \underset{f_{cu}}{40}} = 0.004$$

$$\therefore z = 0.95d = 274\,mm$$

$$A_{s\,reqd} = \frac{1.2 \times 11.2 \times 10^6}{0.87 \times 500 \times 274} = 113\,mm^2/m$$

provide
B12's @ 200
$A_s = 565mm^2/m$

By inspection shear ok.

Consider deflection of wall acting as a cantilever, using uncracked short term stiffness in the first instance.

$$\delta_{inst,h} = \frac{21.2\times10^6 \times 530^2}{3\times28000\times\frac{1000\times350^3}{12}} \times \left(1600 + \frac{1070}{2}\right) = 0.04\text{mm}$$

Increase by factor of 2.8 to account for cracked section stiffness reductions & long term creep effects

$\therefore \delta_{long\ term,h} = 0.1$ mm.

Neglect vertical installation movements as they produce a linear settlement profile, which doesn't contribute to deflection ratio. Estimate horizontal movements from C580 T7.2 = 0.05% of 1.6m = 0.8mm

$\delta_{TOTAL} = 0.1 + 0.8 = 0.9$mm

Negligible movement @ 3.5 × 1.6m = 5.6m

Damage Assessment

With reference to marked up site plan, showing zone of maximum movement (blue hatch) & line at which movement negligible (dashed line).

i) Full height retaining wall

With reference to pg 3. maximum settlement of ground = 1.3mm within 6.4m of excavation.
Settlements negligible within 11.2m of excavation.

Closest structure is canal retaining wall, 9m from excavation & positioned parallel to excavation.

By inspection the anticipated ground movement at the canal retaining wall will be minimal & due to orientation of wall relative to excavation, differential movements (which result in cracking) will be even less

Therefore it can be judged that risk of cracking to canal wall is negligible.

ii) Underpinning to No.154 Party wall.

The existing masonry basement wall to No 154 will have a slight horizontal movement as the soil behind it is excavated & the earth pressure removed. Based on CIRIA C680 table 2.4 this has been taken as 0.15% of the masonry wall's height 1.6m

$\delta_{hor} = 0.15\% \times 1.6m =$ 2.4 mm

Total horizontal movement including pin deflection

$\delta h = 2.4mm + 0.8 mm =$ 3.3mm

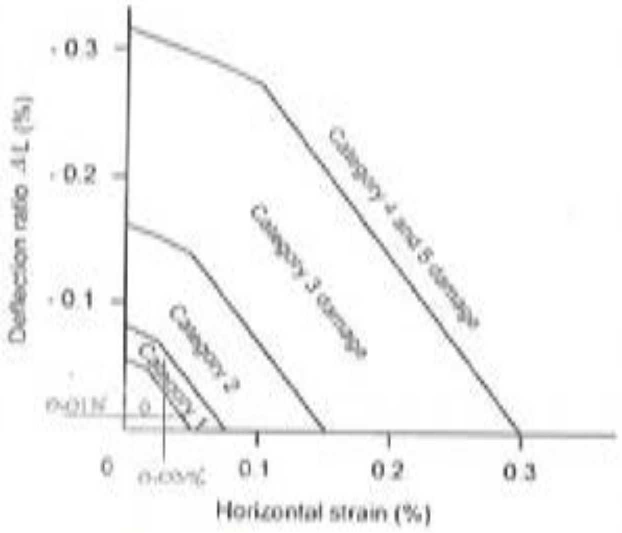
Damage Category assessment, ref Fig. 2.18 & Box 2.5 CIRIA C580.

$L = 11.2m, \; H = 11m \Rightarrow L/H = 1.0$

Deflection ratio $\delta\Delta / L = 0.9 / 11.2E3 =$ 0.01%

Horizontal strain $\varepsilon_H = \delta h / L = 3.3 / 11.2E3 =$ 0.03%

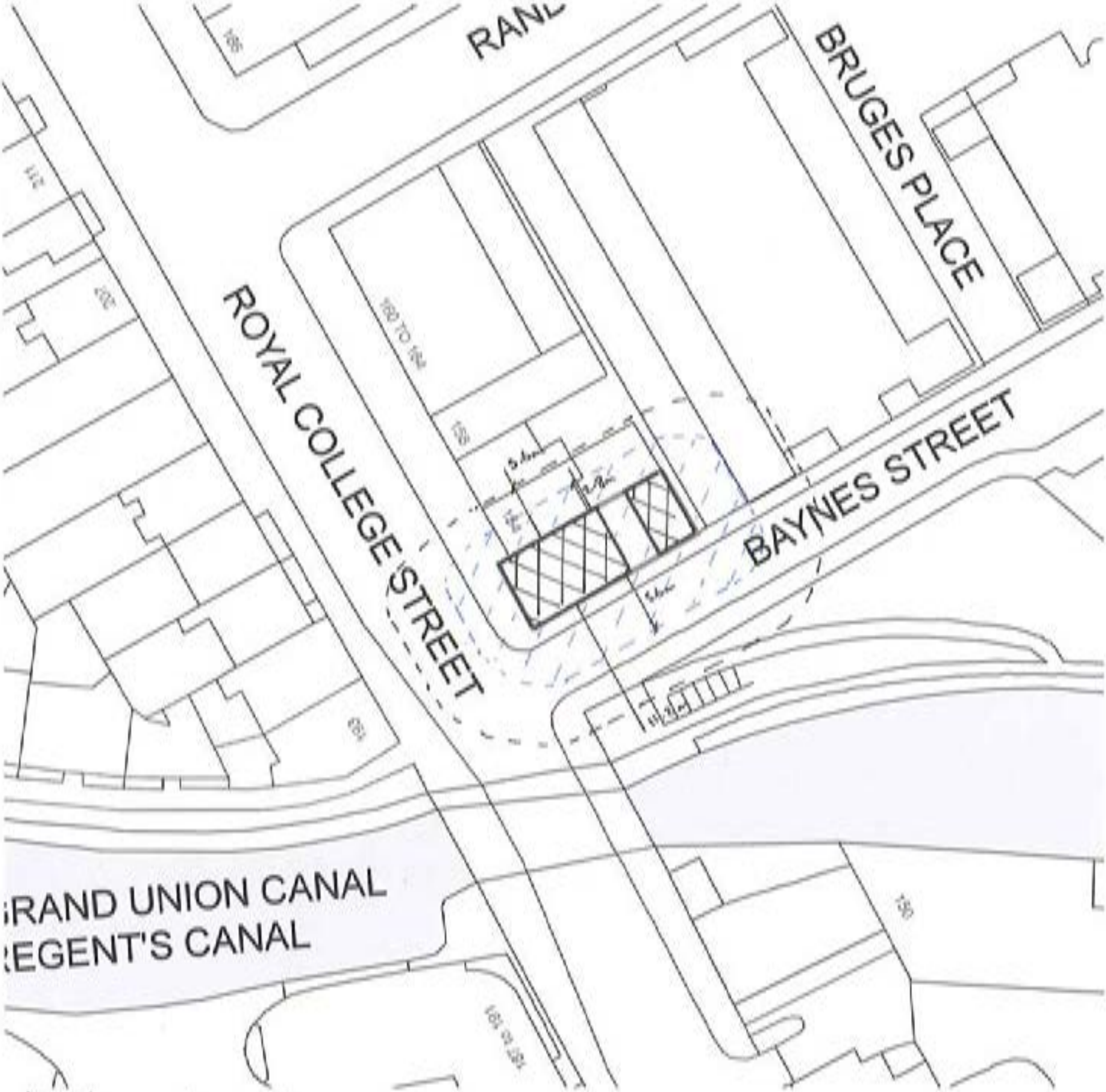
Predicted damage = Cat 0



(c) Relationship between damage category and deflection ratio and honzontal tensile strain for hogging for (L/H) = 1.0 (after Burland, 2001)

The magnitude of movements depends on the quality of workmanship as noted in CIRIA C580. If the eventual contractor is able to exert greater over movements during pin installation & underpinning, the movements will reduce further.

15055/152 Royal College Street
Site Plan 1:500@ A4

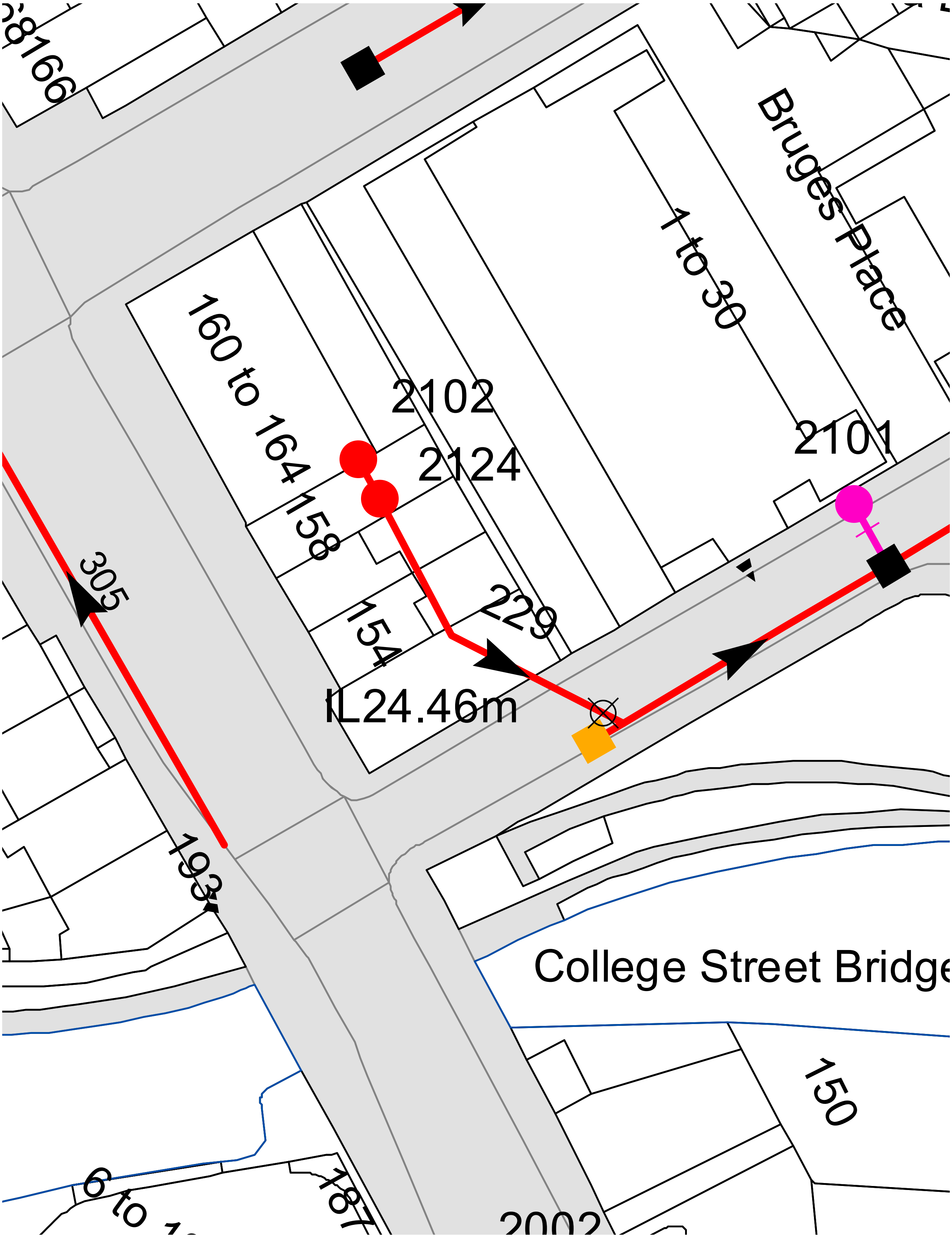


☒ Basement excavation

▨ Zone of max movement

---- Line of negligible movements

Appendix F – Thames Water Sewer Plan Extract



68166
Bruges Place
1 to 30
160 to 164
2102
2124
2101
158
154
229
305
IL24.46m
193
College Street Bridge
150
6 to 1
187
2002

Appendix G – Construction Management Plan

15055 / 152 Royal College Street, NW1 0TA

August 2017 / Outline Construction Management Plan (CMP)

Rev	Date	Description
-	08 April 2016	Submission for inclusion in planning application
A	2 August 2017	Foundations Proposal Amended

Prepared by: Christian Knight *MEng (Hons)*

Authorised by: Robert Dean *BEng (Hons) CEng MIStructE*

Issued by: Christian Knight *MEng (Hons)*

Summary

This note provides an outline Construction Management Plan (CMP) for the proposed basement at 152 Royal College Street to assist with the planning submission.

As is normal the CMP will be developed by the contractor appointed to carry out the works and will be subject to review and amendment during the course of the works. The CMP will be reformatted by the main contractor to be in accordance with Camden Council's CMP pro-forma (v2.0).

The construction of the property is feasible, without significantly disturbing local residents or local traffic flows.

Michael Hadi Associates Ltd

Consulting Structural Engineers

First Floor
14-18 Old Street
London EC1V 9BH
t 020 7375 6340
www.mha-consult.co.uk

Registered in England & Wales
Company No. 04718155

Contents

A Management Arrangements, Communication and Neighbour Liaison

The key contact will be the Site Manager: their name and address will be provided. 24 hour emergency contact details will be displayed at the site.

Adjoining occupiers likely to be affected by proposals and any local amenity society or residents group will be kept informed about the programme of works and any significant changes to the programme or changes to the key contact details.

A complaints process and log will be in place on site.

The Site Manager will be made aware of and take all reasonable measures to comply with any conditions attached to the planning permission and notify the relevant council officers of any changes during the course of works. The Site Manager will be made aware of the relevant contacts in the council's Building Control, Environmental Health and Highways teams.

B Party Wall Awards & Best Practice

Party Wall Awards will be agreed with all neighbours who are required to be notified under the act.

Under the construction contract the site manager will take responsibility for managing the site according to best practice, the contract documents and Camden guidelines.

In the tender appraisal process priority will be given to contractors who are members of the Considerate Constructors Scheme. The works will be appointed to a specialist contractor, experienced in basement works in central London sites.

C Timetable and Programming of Works

The target start for construction is in the January 2018 and the works are estimated to take around 1 year to complete. An outline construction programme is appended to this CMP.

The formation of the basement will be the first activity after site set up and is anticipated to take around 18 weeks.

The appointed contractor will develop their detailed programme for the works and before commencement will communicate the programme with the neighbours. Prior to this the contractor will liaise with any nearby construction sites to establish their proposed construction programmes and to see how works maybe coordinated to minimise/mitigate disruption to neighbours.

D Working Hours

Working hours will comply with Camden Council's standard requirements, i.e. Monday to Friday 8am – 6pm and Saturdays 8am – 1pm.

The site manager will maintain a dialogue with adjoining occupiers in relation to working hours and where practicable seek to avoid any particularly noisy operations at any sensitive times.

E Storage of Materials and Equipment and Use of the Highway

The proposed new #152 Royal College Street building will occupy the full perimeter of the site. Space will therefore be limited and the appended outline construction sequence (primarily SK05 & SK06) has been prepared considering the site restraints and provides outline details for the potential locations of site facilities, site deliveries and site skips. This outline proposal will be developed by the chosen main contractor and will be submitted to Camden Council prior to the commencement of the works.

Due to the limited space on site it is intended to close Baynes Street and use the adjacent space for site storage, site facilities, site deliveries and site skips. This would be undertaken in accordance with Camden Council's requirements and a license would be obtained before hand.

F Access, Parking, Traffic Management

Local parking is limited and therefore site operatives will be encouraged to use the many nearby public transport connections and access the site on foot. Metered on street car parking bays are located nearby and site visitors not utilising public transport can use these facilities.

Vehicular access to the site is from Baynes Street or from Royal College Street. Both are one-way streets and the access route from Baynes Street has a 15ft (4.57m) height restriction and Royal College Street 15' 9" (4.8m), due to railway bridges. Most deliveries will be made via Royal College Street, as it is the wider of the two access roads, and vehicles will park within the closed off section of Baynes St.

In conjunction with the main contractor a suitable risk assessed vehicle route to the site will be determined and will be communicated to all contractors and drivers prior to the commencement of deliveries. Barring any unavoidable diversions this vehicle route is to be adhered to.

All deliveries will be made on a just-in-time basis with calls made to the site foreman with an expected time of arrival so the parking can be made clear ahead of arrival. The stacking of vehicles or parking within residents' parking bays will not be allowed. Vehicles will mainly be skip lorries and concrete trucks during the basement works, concrete trucks for the superstructure works and then reducing to smaller vehicles for the later construction phases.

A traffic marshal or banksman will be positioned in the street to ensure the safe and timely passage of pedestrians, cyclists and other traffic.

For the basement spoil removal approximately 42 number of '12-yard skip' ($9.2m^3$) removals will be necessary, considering a basement volume of approximately $285m^3$ and clay bulking factor of say 1.35. Skip drops and removal can be safety undertaken, in conjunction with the traffic marshal, in a matter of a few minutes.

All efforts will be made for construction contracts to be award to companies with delivery vehicles complying with CLOCS (Construction Logistics and Cyclist Safety) standards to minimise road risk, especially to vulnerable road users.

Deliveries and collections from the site will be limited to between 9.30am and 3.30pm. Where possible vehicle dwell time will be limited to 15 minutes.

G Handling Materials and Waste

All waste substances from the site will be disposed of offsite, under the appropriate Duty of Care and subject to approvals or consents from the relevant statutory bodies

Recycling is to be undertaken wherever appropriate.

H Managing Environmental Impacts, Noise, Vibration and Dust

The Contractor will adhere to, and respect any restrictions on working hours or the enforcement of silent periods throughout the day, which may be imposed by the Local Authority, Contract Documents or the Party Wall requirements.

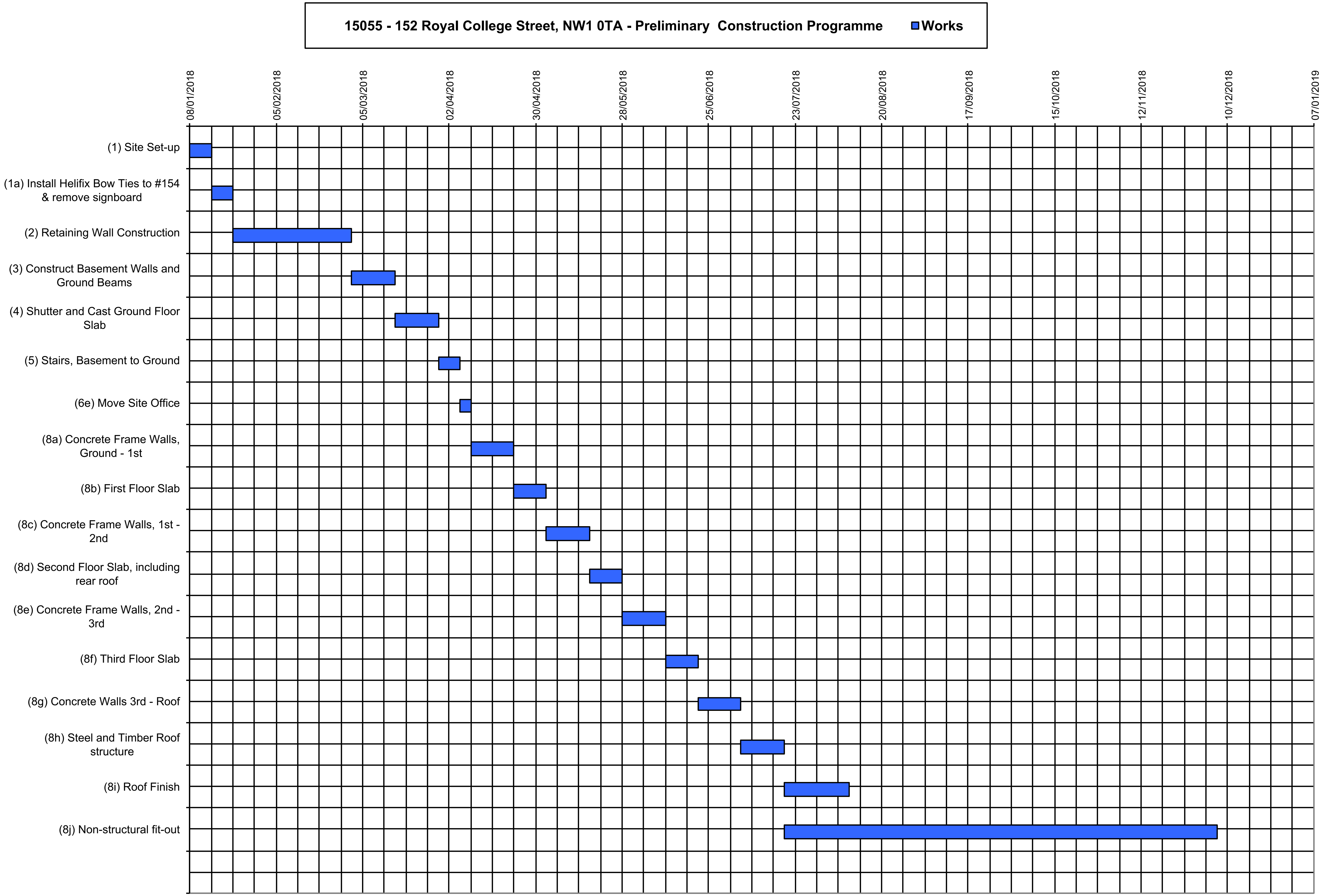
All site activities will be placed behind hoarding to limit the effect of the works on the public.

Wheel washing and the like should not be required as vehicles making deliveries to site and removing spoil will be parked on the street and not be driving onto a muddy site. Due to the nature of construction traffic the roads adjacent to the site will be monitored and washed periodically should dust and spoil build up.

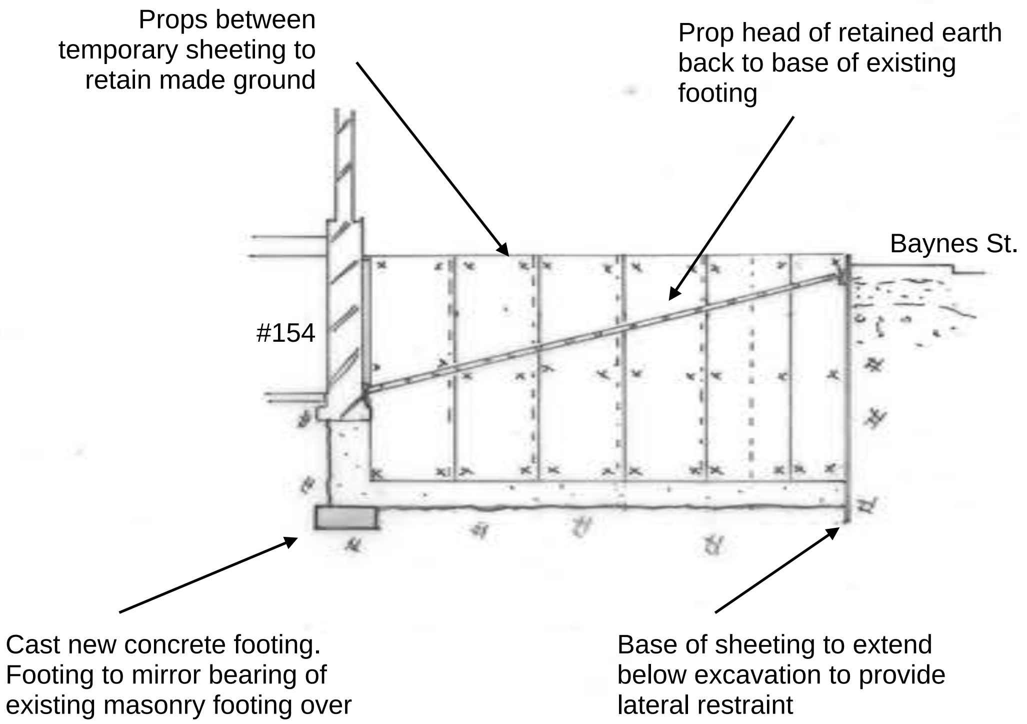
Demolition and excavation dust on site will be controlled by watering. Inlets to the drainage system will be protected with filters bunded with sandbags to prevent slurry runoff entering the system.

All vehicles leaving site carrying potentially dust-generating demolition or construction waste will be completely sheeted with tarpaulin or netting. The sheeting will be in good condition.

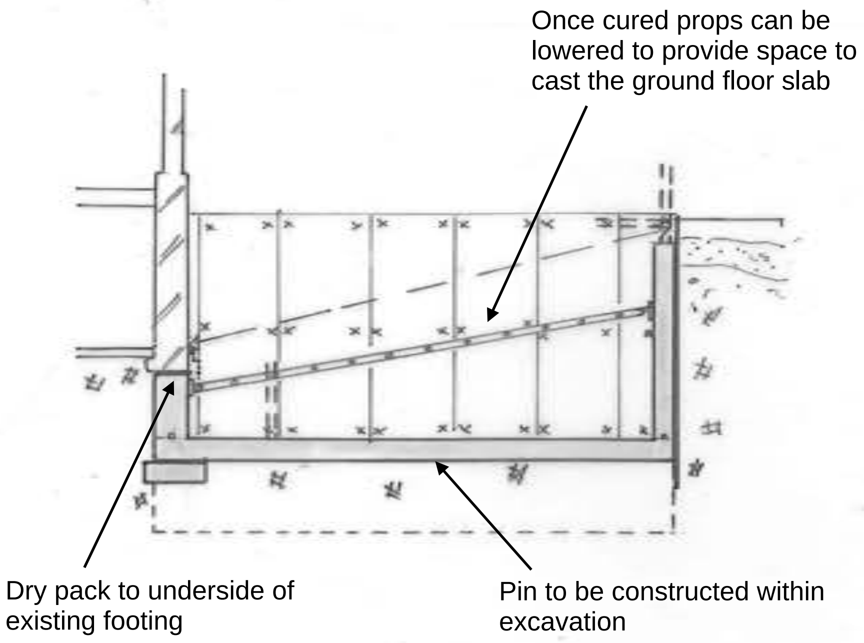
Appendices to CMP



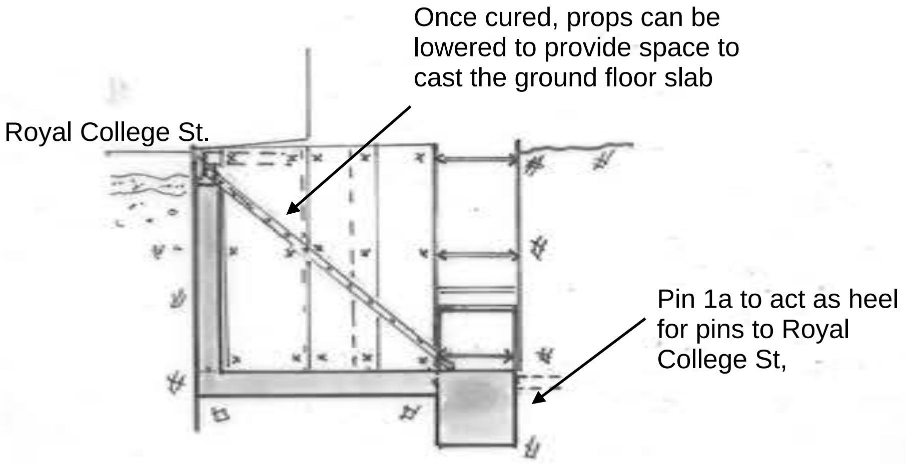
15055 - 152 Royal College Street, NW1 0TA - Preliminary Construction Programme



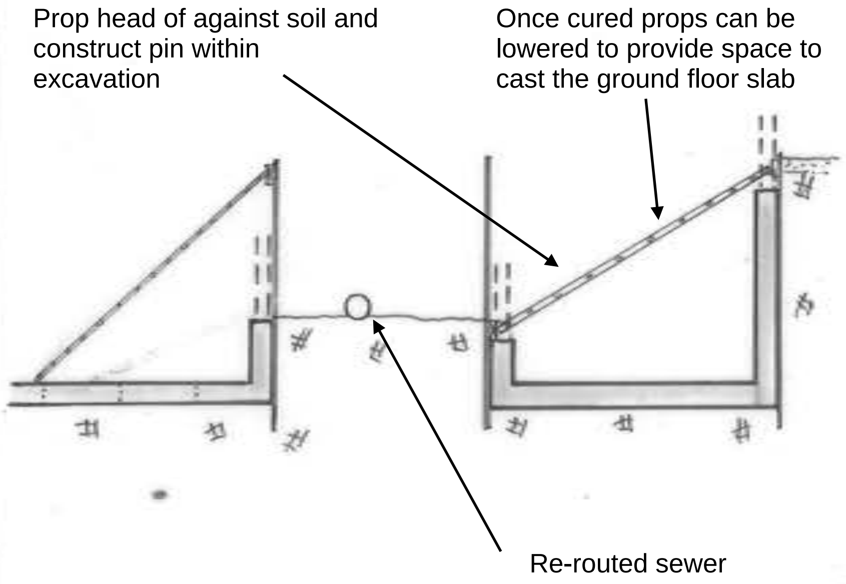
Stage 2a - Typical U Pin Excavation



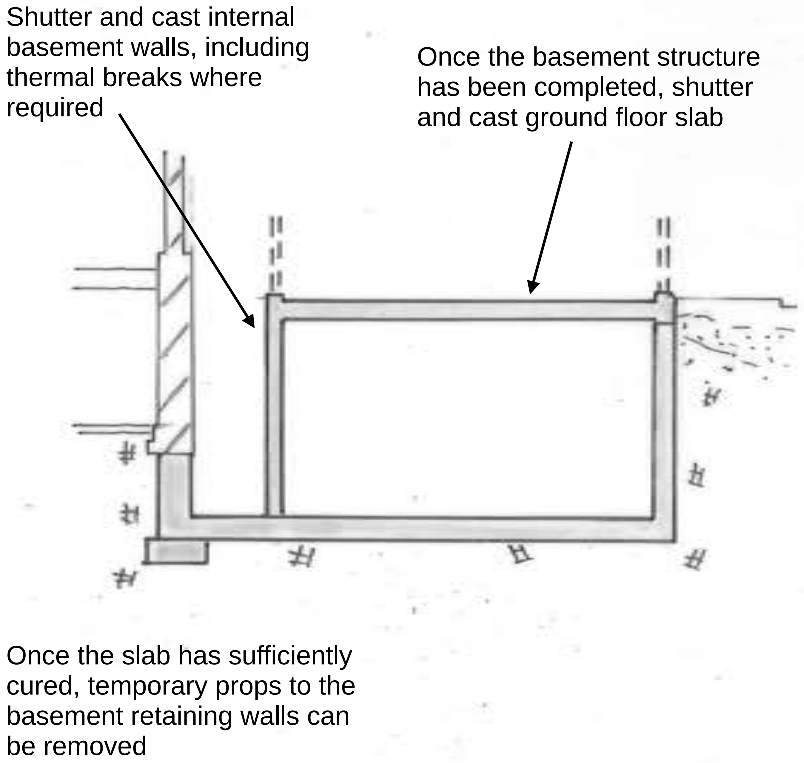
Stage 2b, 2c & 2g - Typical U Pin Construction



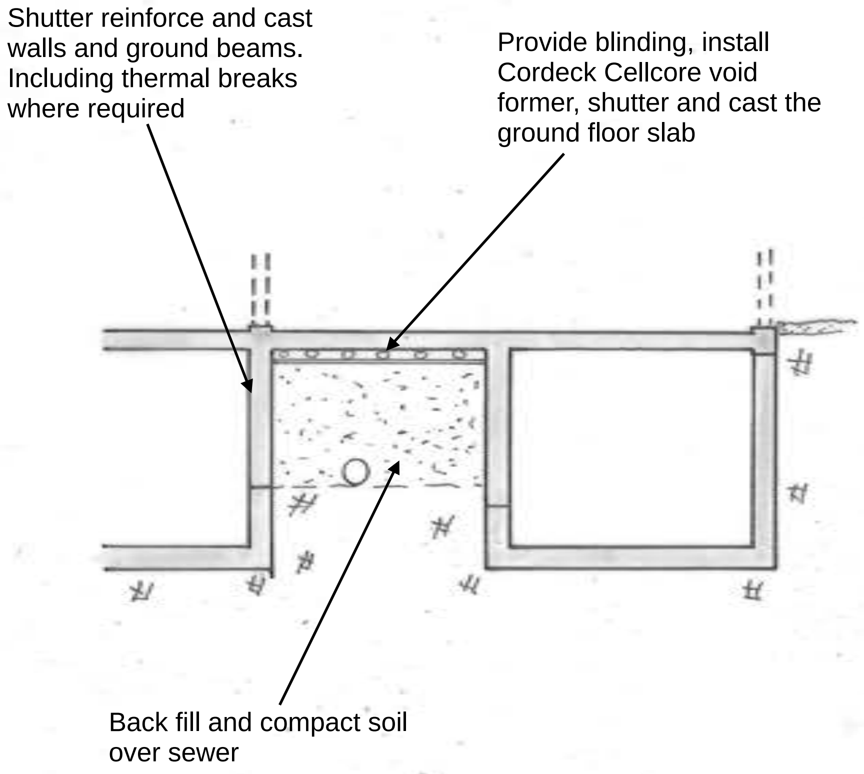
Stage 2e - Pins to Royal College Street



Stage 2f - Pins to the Rear of the Property



Stage 3a, 3b & 4c - Internal Walls and Ground Floor Slab



Stage 3c, 4a, 4b & 4c - Ground Beams and Ground floor Slab

NOTES

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS

2 DO NOT SCALE THIS DRAWING. ALL DIMENSIONS AND LEVELS TO BE CONFIRMED ON SITE

Rev.	Date	Made by	Amendments
A	13/07/17	CK	Change from pilled retaining all to u-pin

Status
Preliminary

mha

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Job Title: **152 Royal College Street, NW1**
Job No: **15055**
Drawing Title: **Indicative Basement Construction Sequence**
Drg. No: **SK02**
Scale @ A3: **1:100**
Date: **31/07/17**
Drawn: **CK**
Checked: **MS**
Rev: **A**

Outline Sequence and Construction Methodology

As is normal, the sequence of construction will be developed by the contractor appointed to carry out the works and will be subject to review during the course of the works.

This is to be read in conjunction with the construction sequence shown on SK02 and all other drawings. This document provides additional information (not conflicting) with regards to site set-up as part of the proposed Construction Management Plan (CMP).

Deliveries will be made during off-peak hours (between 9.30am and 3.30pm) on a just-in-time basis with calls made to the site foreman with an expected time of arrival so the parking can be made clear in advance.

Alterations of existing sewer route to be completed by an approved contractor before commencement of basement construction.

Stage 1 - Site Setup

1a - Place temporary heras fencing to close off the section of Baynes Rd adjacent the site and install welfare cabins. Demolish the existing garden walls and temporary shed and remove fencing currently around the site.

1b – Subject to Party Wall agreement, install Helifix Bow-Ties externally through the Party Wall to #154 and into the mid-depth of the floor joists at 1m centres at all main floor levels. Confirmation of floor levels and location of services to be carried out beforehand.

Remove and cart-away steelwork used for advertising signboard.

Stage 2 - Retaining Wall Construction

Underpinning works to be undertaken carefullyand strictly in accordance with the sequence indicated on SK10 and in accordance with good practice. Underpins are to have projecting reinforcement bars driven into the soil to provide full-continuity with subsequent pins and slabs.

Ready-mix concrete trucks delivering for the underpins are to park briefly outside the site on Baynes Street and the concrete moved manually into place using wheel barrows. Deliveries are to be made during off-peak hours (see definition above) and a banks-person is to be present to oversee the wheel barrows crossing the pavement.

2a Typical U Pin Excavation - Excavate pins starting with pin 1, soil sides to be supported with ply sheeting and regular props. Excavations to end walls are to be supported with slim profile metal sheet piles partly embeded below the depth of the excavation. Racking props to be provided from the head of the wall to Grid C to the base of the existing masonry retaining wall on Grid A. Pin 1a has been designed to include a heel to prop the adjacent pins of Royal College Street. Spoil is to be placed into licensed skips on Baynes Street.

2b - Immediately blind the base of the excavation with 50mm cement/sand mix. Construct the pin. Maintaining the props to the head of the excavation throughout. Where required, cast mass concrete footing to mirror bearing of existing masonry over.

2c - Install rebar, shutter and pour pin base followed by walls (install waterstops where required). Once cured, and where required, ram drypack between the soffit of existing foundations and the top of new underpins. Void to be completely filled. Allow dry pack to cure for a minimum of 24 hours.

2d - The side of completed underpins are to be roughened or keyed prior to the installation of adjacent pins.

2e Pins Grid 1to3 - Excavate and construct pins starting with pin 2. The excavations of end walls are to be supported with slim profile metal sheet piles as above. Racking props are to be provided from the head of the wall at Grid 1, to the completed pin 1a.

2f Pins Grid 6to7 - Excavate and construct pins starting with pin 1. Props are to be provided from the head of the wall at Grid 7 to 300mm from the top of the excavated wall on Grid 6.

2g - Once the retaining structure has sufficiently cured, relocate props to prop the head of the RC wall back to the RC slab, locating props so as to avoid clashes with future internal walls.

Stage 3 - Cast Internal Basement Walls and Ground Beams

3a - Install thermal breaks and, where required, resin fix starter bars into the base of the slab. Thermal breaks to be predrilled.

3b - Internal basement walls and columns to be shuttered, reinforced and cast.

3c - Excavate and construct reinforced concrete ground beams between Grids 5 and 6. Cordeck Celcore void former to be used where beams pass over the mains sewer. Shutter reinforce and cast remaining sections of walls along grid 5 and 6.

Stage 4 - Ground Floor Slab

4a - Back fill to the required level between grids 5 and 6. Back fill to be compacted gradually and carefully to avoid damage to the mains sewer.

4b - Blind with 50mm of sand/cement mix and install Cordeck Cellcore void former beneath areas of ground floor slab that will pass over the mains sewer.

4c - Shutter and cast the ground floor slab. Install thermal breaks and kickers where required.

4d - Once the slab has cured, construct the basement staircase.

Once the ground floor slab has been struck, the props to the basement retaining walls can be removed.

Status
Preliminary

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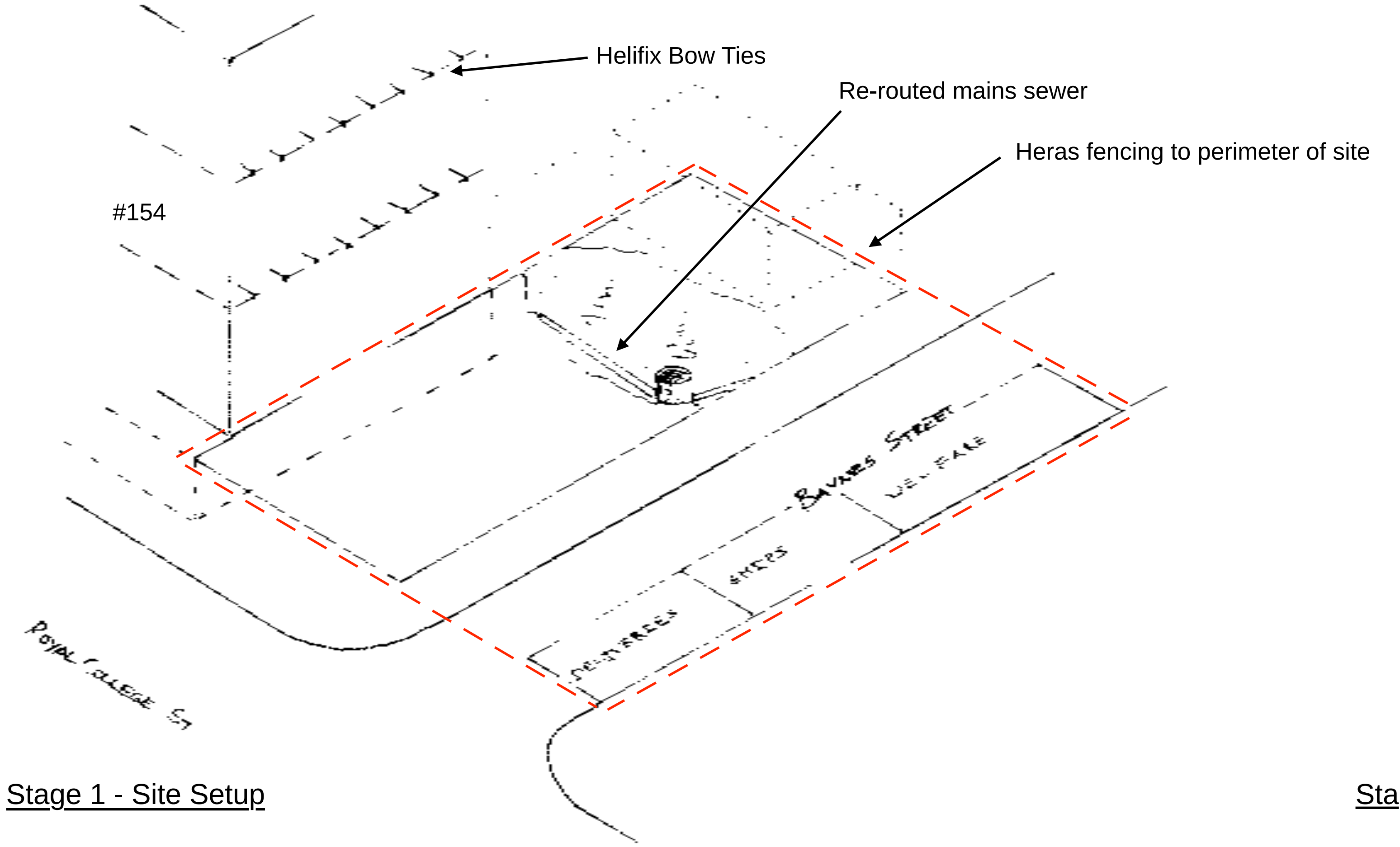
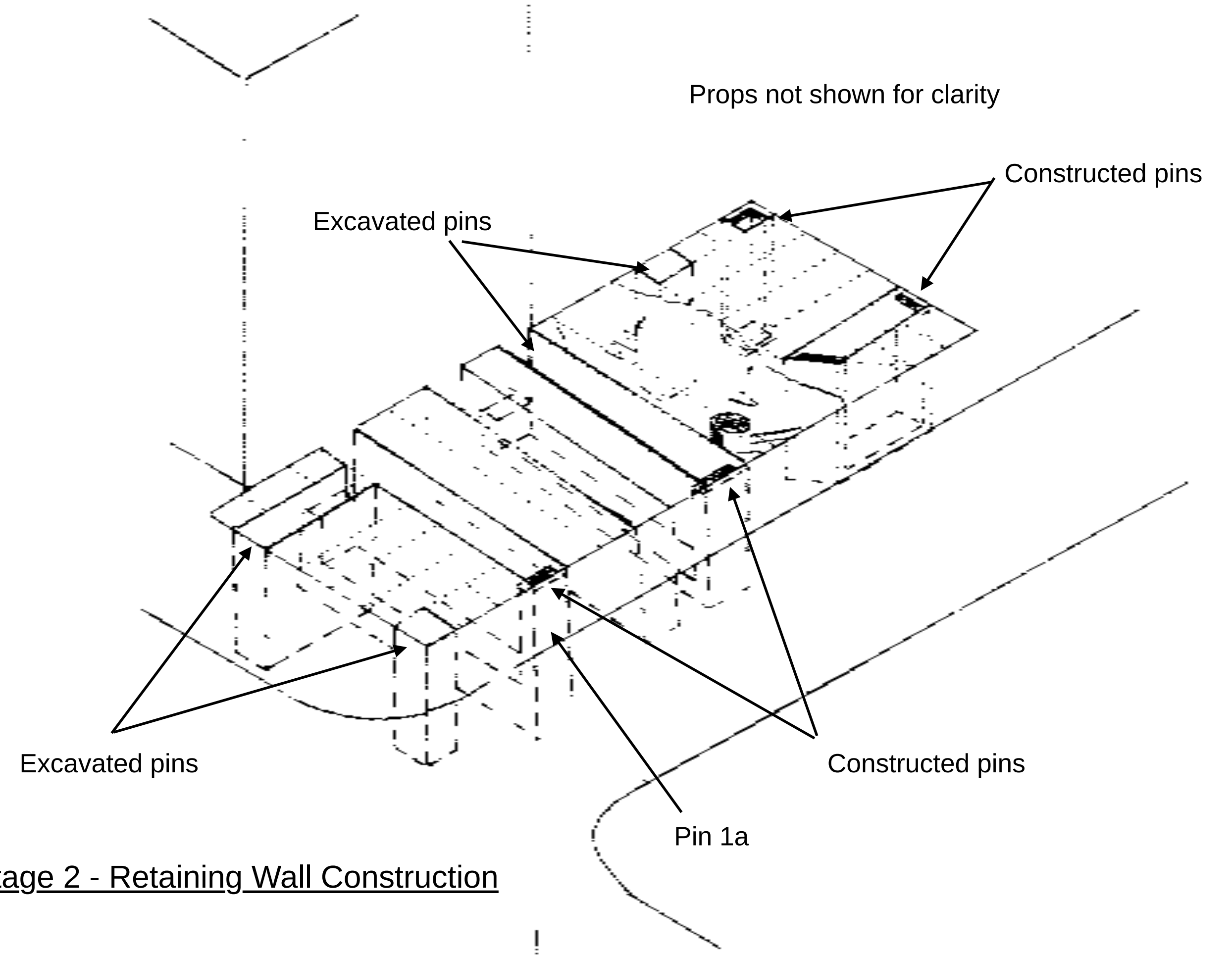
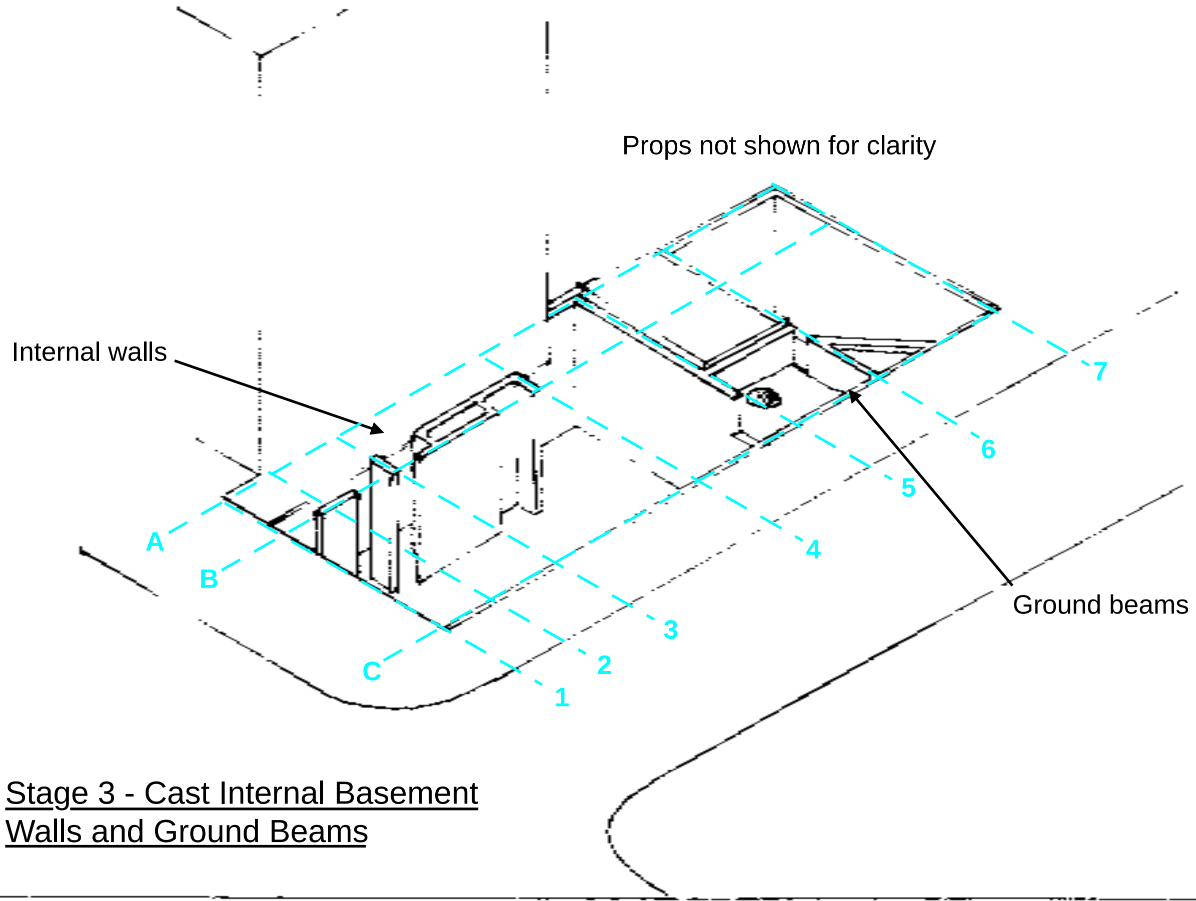
Job Title **152 Royal College Stree, NW1**				Job No. **15055**
Drawing Title **Additional Sequencing Information for CMP**				Drg. No. **SK05**
Scale @ A3 **-**	Date **31/07/17**	Drawn **CK**	Checked **MS**	Rev. **A**



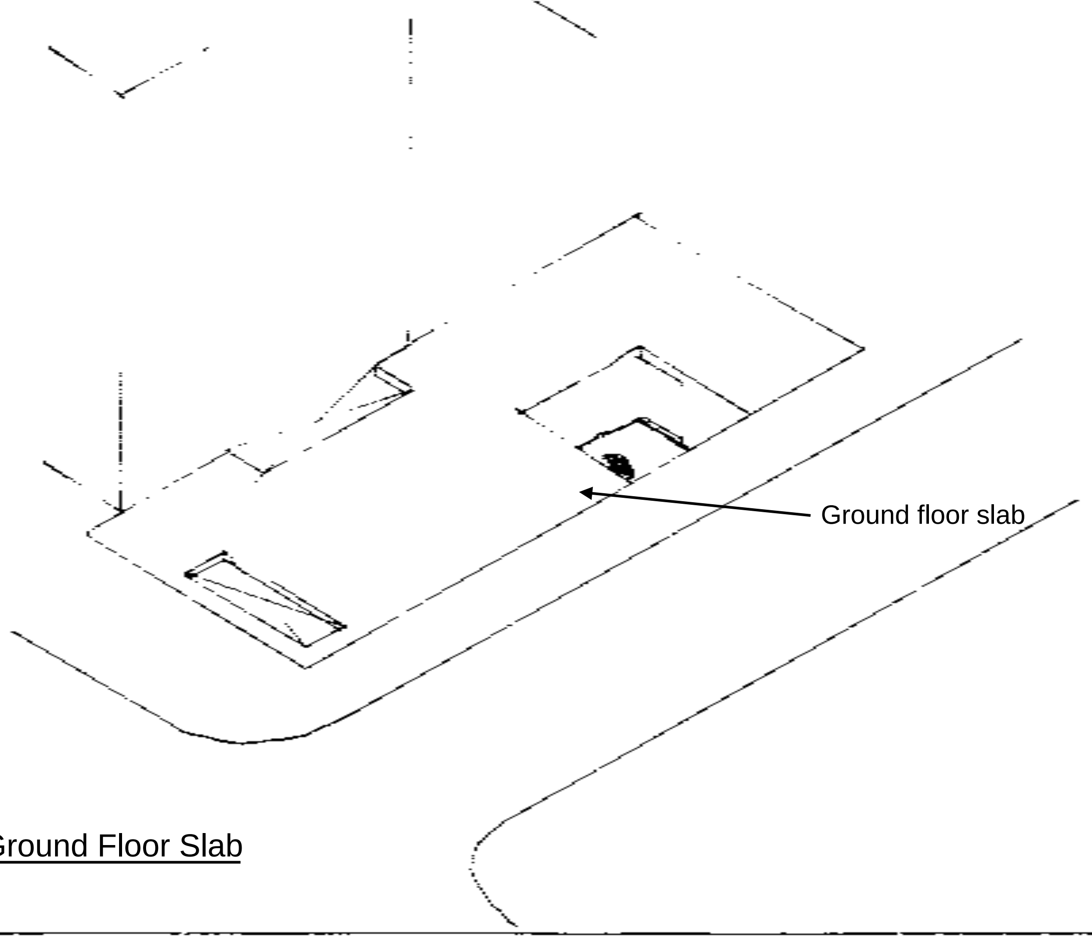
Stage 1 - Site Setup



Stage 2 - Retaining Wall Construction



Stage 3 - Cast Internal Basement Walls and Ground Beams



Stage 4 - Ground Floor Slab

A 13/07/17. CK Change from pilled retaining all to u-pin

Preliminary

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Consulting Structural Engineers

152 Royal College Street, NW1 **15055**

Additional Sequencing Information for CMP **SK06**

-	**31/07/17**	**CK**	**MS**	**A**