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August 2016

Basement Impact Assessment (Hydrogeological and Structural)

At

Ornan Court, 2 Ornan Road, London, NW3 4PT

For

Ornan Court Limited

VOLUME 1 of 8

CONTENTS

1.1 Basement Impact Assessment

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Your Ref:

Our Ref: **14/22662-1**
January 2015

ORNAN COURT, 2 ORNAN ROAD

LONDON, NW3 4PT

BASEMENT IMPACT ASSESSMENT

Prepared for

Ornan Court Limited

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Accredited Contractor

constructionline

ISO 9002
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Contents

1.0 INTRODUCTION

1.1 Project Objectives

The purpose of this assessment is to consider the effects of a proposed basement construction on the local groundwater regime at the residential properties at Ornan Court, London NW3. For this assessment a representative of SAS Limited visited the property on 14th November 2014.

The recommendations and comments given in this report are based on the information contained from the sources cited and may include information provided by the Client and other parties, including anecdotal information. It must be noted that there may be special conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

1.2 Planning Policy Context

Camden Planning Guidance for Basements and Lightwells has recently been revised (CPG4, September 2013) and requires proposed developments to mitigate against the effects of ground and surface water flooding and to include drainage systems that do not impact neighbouring property of the site or the water environment by way of changing the groundwater regime.

Camden Guidance CPG4 sets out 5 Stages:

1. Screening
2. Scoping
3. Site Investigation
4. Impact Assessment
5. Review and decision making

This report is intended to address the scoping process set out in CPG4 and the Camden Geological, Hydrogeological and Hydrological Study (CGHHS). It will review existing site investigation data and provide a preliminary assessment of the issues identified by the Site Analytical Services Limited screening process. This report also provides an impact assessment (4) of the geo-environmental impacts on adjacent structures and the surrounding area based on available site investigation data.

As part of this guidance a subterranean (groundwater) flow, slope stability and surface water and flooding screening chart is provided (CPG 4, Figures 1, 2 and 3 respectively). The completed charts in relation to this development are provided as Table 1, to this report.

1.3 Qualifications

The report has been prepared by the Mr Andrew Smith, a Fellow of the Geological Society (FGS) and Member of the Chartered Institute of Water and Environmental Management (MCIWEM) in coordination with Mr Mike Brice of Applied Geotechnical Engineering, a Chartered Geologist (CGEOL), Neil Smith of Applied Geotechnical Engineering, a Chartered Civil Engineer (CEng) and Mr Martin Redston of Martin Redston Associates, a Chartered Structural Engineer (CEng).

2.0 SITE CONTEXT

(National Grid Reference: TQ 271 852)

2.1 Site Location

The site of the proposed development is situated on the south-west side of Haverstock Hill and on the north-west side of Ornan Road in the Belsize Park area of London, NW3 4PT. The site consists of an existing five-storey building on the corner of Haverstock Hill and Ornan Road with grassed landscaped areas to the south and east. Further details of the layout are shown on the topographical plan of the site (Figure 2).

The site lies on ground sloping down towards the south-east away from Hampstead Heath and there are a number of mature trees along the north-east boundary within the grassed area above a retaining wall next to Haverstock Hill.

2.2 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 1 to 50,000 Series, 'North London') indicates the site to be underlain by the London Clay Formation, although a surface cover of Made Ground may be expected in an established urban environment. The geology is summarised on Figure 1 of this report.

There is one BGS borehole within 100m of the site; TQ28NE38 located at the junction between Rosslyn Hill and Belsize Avenue approximately 95m south of the site. The geology in this borehole indicates a surface cover of Made Ground up to 1.2m in thickness overlying the London Clay Formation.

2.3 Hydrogeology and Hydrology

The Bedrock geology underlying the site (London Clay) has been classified as Unproductive Strata; rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

According to the Phase 1 Risk Assessment there are no surface water features or detailed river information recorded within 250m of the site. The nearest surface water feature from mapping evidence is Hampstead pond 1 located 412m north. There are no fluvial or tidal floodplains located within one kilometre of the site.

2.4 Previous Reports

The results from a Phase 1 Preliminary Risk Assessment and Phase 2 Intrusive Investigation are presented under separate cover in Site Analytical Services Limited reports (Project No's. 11/17802 and 14/22662) dated April 2011 and January 2015. The findings from these reports are described in this basement impact assessment.

2.5 Site Layout

The site was attended on 11th November 2014 for the purposes of conducting the site walkover. A topographical survey has been carried out at the site and this is included as Figure 2 of this report.

The existing development comprises a semi-detached six-storey building surrounded by a grass covered garden area. The site is cut into two levels with the pavement level surrounding the site (at a level of approximately 76.18mOD) approximately 1.95m lower than the ground floor of the building (at a level of approximately 78.13mOD). Consequently there is an embankment between Ornan Road and the front door to the building requiring stepped access up from the pavement. Around the building the garden is relatively flat and slopes down to the retaining wall at angles of between 1-2 degrees.

The property is situated at the junction of Ornan Road and Haverstock Hill. Information obtained from the site walkover, topographical survey and ordnance survey indicates that Ornan Road rises up north eastwards towards Haverstock Hill at shallow angles of around 3 degrees, whilst Haverstock Hill slopes towards the south-east away from the site down towards Belize Avenue at angles of up to 5 degrees. There is also a general slope in the wider hillside setting from north-west to south-east down towards the Thames Basin up to approximately 7-10 degrees.

The property was originally a five storey building constructed at the end of the nineteenth century as a nurses home. A new extended mansard roof structure has been installed to provide additional accommodation at high level thus converting the building into a six storey structure.

2.6 Proposed Development and Structural Context

Structural drawings and details have been prepared indicating the full methodology of underpinning and construction of reinforced concrete retaining walls below the building and around the site to levels of approximately 3.2m below ground level (approximately 74.8mOD assuming an overall ground level of 78.0mOD). As indicated above, the slope of the site towards Ornan Road ensures that the lower ground floor is constrained along the rear elevation and on each side by reinforced concrete, whilst the front elevation is almost entirely above pavement level. Lightwells at the front are bounded by retaining walls which restrain the remaining embankment between the building and the road.

The proposed lower ground floor level scheme will follow the footprint of the existing building with the exception of a large open lightwell to the rear. The proposed lower ground floor level will be situated approximately 1m below pavement level.

2.7 Results of Basement Impact Assessment Screening

A screening process has been undertaken for the site in accordance with CPG4 and the results are summarised in Table 1 below:

Table 1: Summary of screening results

Item	Description	Response	Comment
Sub-terranean (Ground water Flow)	1a. Is the site located directly above an aquifer.	No	The Bedrock geology underlying the site (solid permeable formations) associated with the London Clay Formation has been classified as Unproductive Strata; rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
	1b. Will the proposed basement extend beneath the water table surface.	Yes - refer to Section 4.2 for scoping	The proposed basement floor level of 3.2m (approx. 74.80mOD) will be at or around the historical water level at the site measured between 74.80mOD to 76.65mOD.
	2. Is the site within 100m of a watercourse, well (used/disused) or potential spring line.	No	The nearest existing surface water feature is recorded as a pond at Hampstead Heath, 1km north of the site. Also according to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is not within 100m of an ancient river.
	3. Is the site within the catchment of the pond chains on Hampstead Heath.	No	The site is away from this area.
	4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas.	Yes – refer to Section 4.3 for scoping	The amount of hardstanding on-site is expected to increase as the proposed front and rear lightwells are in areas of soft landscaping.
	5. As part of 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	Soakaways or SUDs are not proposed as part of the development
	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 nearest existing surface water feature is recorded as a pond at Hampstead Heath, 1km north of the site. Also according to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is not within 100m of an ancient river.
Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 1 in 8.	No	The site is cut into two levels with the pavement level surrounding the site (at a level of approximately 78.18mOD) approximately 1.95m lower than the ground floor of the building (at a level of approximately 78.13mOD). However, the areas between these two levels the site is essentially flat.

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	2. Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 1 in 8.	No	There are no proposed alterations of slope angles across the site.
	3. Does the development neighbor land, including railway cuttings and the like, with a slope greater than 1 in 8.	No	There is an embankment and retaining wall between Oman Road and the front door to the building requiring stepped access up from the pavement, but there is no large slope.
	4. Is the site within a wider hillside setting in which the general slope is greater than 1 in 8.	Yes - refer to Section 5.2 for scoping	There is a general slope in the wider hillside setting from north-west to south-east down towards the Thames Basin up to approximately 7-10 degrees.
	5. Is the London Clay the shallowest strata at the site.	No	The site is underlain by Made Ground overlying the London Clay Formation; the London Clay is the shallowest natural strata below the site.
	6. Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained.	No	It is understood that no trees are to be felled or added as part of the development.
	7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.	Yes - refer to Section 5.3 for scoping	The site lies above the London Clay Formation know to have a high tendency to shrink and swell.
	8. Is the site within 100m of a watercourse or a potential spring line.	No	The nearest existing surface water feature is recorded as a pond at Hampstead Heath, 1km north of the site. The lost rivers of London map shows a tributary flowing away from this pond at a point about 500m west of the site.
	9. Is the site within an area of previously worked ground.	Yes - refer to Section 5.4 for scoping	Made Ground has been encountered at the site.
	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 Bedrock geology underlying the site (solid permeable formations) associated with the London Clay Formation has been classified as Unproductive Strata.
	11. Is the site within 50m of the Hampstead Heath ponds.	No	The site is not located near Hampstead Heath.
	12. Is the site within 5m of a highway or pedestrian right of way.	Yes - refer to section 5.5 for scoping	The site lies adjacent to Oman Road.

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	13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Yes - refer to Section 5.6 for scoping	The development will increase the depths of foundation at the site, although the foundation depths of adjacent properties are not known.
	14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.	Yes – refer to Section 5.7 for scoping	According to the records supplied by LUL the nearest tube line (northern line) is located over approximately 5m from the site (see Appendix C).
Surface Water and Flooding	1. Is the site within the catchment of the pond chains on Hampstead Heath.	No	The site is not located near Hampstead Heath.
	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.	Yes - refer to Section 6.2 for scoping	The amount of hardstanding on-site is expected to increase as the proposed front and rear lightwells are in areas of soft landscaping.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	Yes - refer to Section 6.2 for scoping	The amount of hardstanding on-site is expected to increase.
	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.	Yes - refer to Section 6.3 for scoping	The amount of hardstanding on-site is expected to increase, therefore surface water may be impacted by the development.
	5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.	Yes - refer to Section 6.3 for scoping	As changes are occurring above the ground, surface water will be impacted by the development.
	6. Is the site in an area known to be at risk from surface water flooding.	Yes - refer to Section 6.3 for scoping	According to CPG4, October 2013, Ornan Road flooded in 2002.

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The Screening Exercise has indentified the following potential issues which will be carried forward to the Scoping Phase

Subterranean Groundwater Flow

- Is the site within 100m of a watercourse, well (used / disused) or potential spring line.
- Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.

Slope Stability

- Is there a history of seasonal shink-swell subsidence in the local area and/or evidence of such effects at the site.
- Is the site within an area of previously worked ground.
- Is the site within 5m of a highway or pedestrian right of way.
- Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.
- Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.

Surface Water and Flooding

- 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.
- Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.
- 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.
- Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.
- Is the site in an area known to be at risk from surface water flooding.

3.0 EXISTING SITE INVESTIGATION DATA AND ASSESSMENT

3.1 Records of site investigations

Ground conditions at the site were investigated by Site Analytical Services Limited in March 2011 (SAS Report Reference 11/17802) and again in November 2014 and comprised of a series of continuous flight auger and window sample boreholes (Boreholes 1 to 5ninclusive). Monitoring standpipes were installed in all boreholes to approximately 5m below ground level.

The locations and levels (mOD) of these boreholes are shown on Figure 2 of this report whilst the ground conditions revealed by the investigations are summarised in the following table. For detailed information on the ground conditions encountered in the boreholes, reference should be made to the exploratory hole records presented in Appendix A.

Strata	Depth to top, mbgl	Level (mOD)	Description
Made Ground	0.00	0.00	Topsoil and clayey silty sand overlying firm and stiff silty clay with fine gravel and brick fragments.
London Clay Formation	0.70 to 1.10	76.99 to 77.38	Stiff becoming very stiff medium strength becoming high strength clay with occasional partings of silty fine sand and scattered gypsum crystals

During the investigations, groundwater was not encountered during boring and the material remained essentially dry throughout. Groundwater levels of between 74.80mOD to 76.65mOD have been measured in the standpipe piezometers installed in the boreholes following completion of the fieldwork. A summary of the groundwater readings carried out at the site is detailed in Appendix B.

Two hand excavated trial pits (Trial Pits 1 and 2) were undertaken by Martin Redston Associates in 2008 and the results indicate the existing footings of the external walls of the structure to lie at between 1.0m and 1.2m depth and consist of spread footings of approximately 930mm width. The locations and levels (mOD) of these holes are shown on Figure 2, whilst sections of the pits are detailed in Appendix A.

3.2 Hydrological Context

During the latest monitoring visit on the 27th November 2014 a rising head permeability test was carried out in Borehole 1. The groundwater in the borehole was measured at 2.32m below ground level (75.5mOD). Subsequently the well was purged and the water level reduced to 4.89m below ground level. During the subsequent 60 minute period the following recharge levels were recorded:

Time after purging well (minutes)	Water Level (mbgl)
0	4.89
5	4.74
10	4.71
15	4.65
30	4.59
60	4.52

These results indicate the apparent permeability of the materials at the site to be of the order of 6.24×10^{-8} m/sec. This value lies at the boundary between published data for fissured and weathered clays and / or silty sands and intact clays is classed as very low permeability material with poor to practically impervious drainage characteristics.

4.0 SUBTERRANEAN (GROUNDWATER FLOW) - SCOPING ASSESSMENT

4.1 Introduction

This section addresses outstanding issues raised by the screening process regarding the presence of an ancient watercourse within 100m of the site and the fact that groundwater was encountered in the ground investigation above the level of the proposed basement depth.

4.2 Groundwater Flow and Depth to Groundwater

The ground floor level of the proposed development is at a maximum depth of approximately 3.2m below ground level (approximately 74.80mOD). This is at or around the historical water level at the site measured between 74.80mOD to 76.65mOD over the monitoring period.

Given the presence of a non-aquifer below the site it is likely that groundwater within these soils is recharged via intermittent seepages from surface water and infiltration associated with weather conditions rather than any large scale subterranean groundwater flow. This situation would explain the differences in the head of water level over the monitoring period between approximately 74.8mOD to 76.65mOD as the water changes with varying seasons and weather patterns.

This theory also seems to be validated by the results of the rising head permeability test (See Section 3.2) which shows the soils below the site are of very low permeability with poor to practically impervious drainage characteristics and therefore incapable of supporting groundwater flow.

Taking these results into consideration the impact from the basement development on the local groundwater flow is likely to be minimal. However, it may still be necessary to control this perched water during the construction period and consideration could be given to conventional internal pumping methods from open sumps. Further groundwater monitoring prior to, during and after construction is recommended.

4.3 Hardstanding

It is understood that the amount of hardstanding on-site is expected to increase as the proposed front and rear lightwells are in areas of soft partial landscaping. As a result the proposals may potentially affect the overall volume of surface water generated by the site unless mitigation is provided.

However, it is also understood that formal drainage is proposed for new hardstanding areas with attenuation provided as required by detailed design and therefore it is unlikely that any increase in surface water generated will cause an increase in peak run-off from the site.

In addition, in relation to groundwater given that the site is underlain by the London Clay Formation and therefore any increase in impermeable area is unlikely to change the amount of recharge occurring over the site area.

5.0 SLOPE STABILITY

5.1 Introduction

This section addresses outstanding issues raised by the screening process land stability (see Table 1).

5.2 Slope Stability

The 1:50,000 scale geological map for the area indicates that the site does not lie within an 'Area of Significant Landslide Potential'. No mapped areas of landslips are present in the vicinity of the site and the natural ground stability hazards dataset supplied by the BGS (present in the desk study report for the site (SAS Report Reference 14/22662) gives the hazard rating for landslides in the site area as 'very low'.

Information obtained from the site walkover, topographical survey and ordnance survey indicates that Ornan Road rises up north eastwards towards Haverstock Hill at shallow angles of around 3 degrees, whilst Haverstock Hill slopes towards the south-east away from the site down towards Belize Avenue at angles of up to 5 degrees. There is also a general slope in the wider hillside setting from north-west to south-east down towards the Thames Basin up to approximately 7-10 degrees, although it should be noted that the immediate site area is heavily urbanised and slopes at the site and in the close vicinity may have been altered historically or as part of developments and landscaping.

As part of the development it is proposed to excavate below the site by at least 3.20m below ground level (approximately 74.80mOD), although excavation may locally be to a greater depth to facilitate floor slab and foundation construction. It is anticipated that the natural London Clay Soils would be encountered at this depth and therefore 'running sand' conditions and ground instability is unlikely.

It is therefore considered that slope stability can be maintained through the proper design and construction of mitigation measures, similar to those outlined above.

All risks related to the stability of the slopes must be identified and managed in accordance with CDM legislation.

5.3 Shrinking / Swelling Clays

Atterberg Limit tests were conducted on three selected samples taken from the essentially cohesive natural soils encountered in the boreholes and showed the samples tested to have a medium to high susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2.

The depth of foundation required to avoid the zone likely to be affected by the root systems of trees is shown in the recommendations given in NHBC Standards, Chapter 4.2, April 2010, "Building near Trees" and it is considered that this document is relevant in this situation.

5.4 Made Ground

In the boreholes drilled at the site, Made Ground was found to extend down to depths of between 0.80m and 1.10m below ground level and consisted of a surface layer of grassed topsoil and clayey silty sand with gravel and brick fragments underlain by a mixture of firm becoming firm to stiff silty clay, fine gravel and brick fragments.

A result of the inherent variability of uncontrolled fill, (Made Ground) is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should therefore, be taken through any made ground and either into, or onto suitable underlying natural strata of adequate bearing characteristics.

The bearing capacity of the made ground should therefore be assumed to be less than 50kN/m^2 because of the likelihood of extreme variability within the material.

5.5 Location of public highway

The proposed basement is not to be extended below Ornan Road and therefore it is suggested that the impact on this local access road is likely to be minimal.

There is nothing unusual in the proposed development that would give rise to any concerns with regard to the stability of public highways.

5.6 Ground Movement

5.6.1 Structural Stability of Adjacent Properties

The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground if not properly managed. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures during the works. This will require close collaboration with the appointed contractor's temporary works coordinator.

The Party Wall Act (1996) will apply to this development because neighbouring houses lie within a defined space around the proposed building works. The party wall process should be followed and adhered to during this development.

A ground movement assessment was carried out at the site by Applied Geotechnical Engineering under the instruction of Site Analytical Services Limited (Report Reference P4086). The report is provided as Appendix D to this report and concludes that given good workmanship given good workmanship, the basement to Ornan Court can be constructed without imposing more than very slight damage on the adjoining properties.

The report does state that although the development is not likely to disrupt any existing local groundwater flows further groundwater monitoring should be undertaken in order to better understand the likely water inflows during construction and the implications of those inflows in terms of construction methods and impacts on neighbouring structures. This is in accordance with recommendations given in Section 4.2 of this report.

5.6.2 Heave/Swell

The upward movement of the base of an excavation occurs as a result of unloading and may be considered as consisting of two parts:

1. A short term movement called heave which occurs as a result of elastic rebound and may typically occur during the construction period

2. A long term movement called swell which occurs as a result of the absorption of water into the pores of the soils as the ground adjusts to new stress conditions.

Heave and its magnitude depends on soil properties and the degree of load that is removed. At this site is understood that a suspended concrete slab over a compressible material (claymaster or similar) will be constructed at basement level and therefore heave is unlikely to be an issue.

5.7 Structural Stability of Underground Railways/Tunnels

According to records from London Underground Limited (LUL), the site lies within 5m of the Northern Line which runs along Haverstock Hill. These records are included as Appendix C to this report. The site does not lie below any Network Rail owned tunnels (for example Thameslink).

The drawings show a tunnel head of approximately 37mOD. This is approximately 37.20m below the deepest part of the proposed basement at 74.80mOD and therefore unlikely to be impacted by the works. A detailed cross section and a loading calculation below the existing building has been undertaken by Martin Redston Associates to show the proposed basement will not impact the structural stability of the tunnel. These documents are included in Appendix C to this report.

6.0 SURFACE WATER AND FLOODING - SCOPING ASSESSMENT

6.1 Introduction

This section addresses outstanding issues raised by the screening process regarding surface water and flooding (see Table 1).

6.2 Surface Water Drainage

It is understood that the proposed basement development may result in a small change in the proportion of hard surfaced external areas and therefore the proposals may potentially affect the overall volume of surface water generated by the site unless mitigation is provided.

Based on the information available for the site, the London Clay Formation has a measured permeability of 6.81×10^{-9} m/s and a likely mass permeability several orders of magnitude higher. On this basis, infiltration drainage is not feasible as a drainage solution for the proposed basement.

Formal drainage is therefore recommended for the proposed new lightwell with attenuation provided as required by detailed design. It is unlikely that any increase in surface water generated will cause an increase in peak runoff from the site.

An appropriately qualified engineer should be engaged to ensure mandatory requirements are met.

6.3 Flood Risk

Information from the desk study and Environment Agency website indicates that the site does not lie within 250m of any Zone 2 or Zone 3 Environment Agency Flood Zones. Additionally, there are no Environment Agency floodplains, flood defenses, or areas benefitting from flood defences within 250m of the site. Reference to the Environment Agency website also indicates that the site does not lie within an area shown as being at risk from flooding from reservoirs and is not at risk from surface water flooding.

However, with respect to potential flooding from surface water run-off, the site lies within an area known to have historically flooded in 2002 according to Figure 15 of the ARUP report (i.e. a primary area). In addition, CPG4 provides a list (p. 29) of streets in the London Borough of Camden that have historically been affected by surface water flooding and Ornan Road appears in this list.

The flooding of the London Borough of Camden in 2002 was attributed to overland flow and sewer flooding. Although Ornan Road flooded in 2002 the site itself is raised above surrounding road levels of Ornan Road. Therefore the risk of surface water and sewer flooding to the site are considered to be low.

British Standard (BS) 8102 (Code of Practice for Protection of Below Ground Structures Against Water from the Ground) recommends that basements with a depth greater than 4m below ground level (bgl) as in the case of this site should be designed to allow for fluctuations in the water table of up to 1m. It also offers guidance for the design and waterproofing of basements and defines 3 grades as follows.

- Grade 1: Basic Utility. Car parking, plant rooms (excluding electrical equipment), workshops. Some seepages and damp patches tolerable;
- Grade 2. Better Utility. Workshops and plant rooms that require drier environments. No water penetration but moisture vapor tolerable.
- Grade 3. Habitable. Ventilated residential and working areas including offices. Dry environment. Active measures to control internal humidity may be necessary

The proposed basement excavation should be designed to the appropriate grade therefore reducing the risk posed to the basement from groundwater flow.

In addition, it is understood from the structural engineer that the below ground structures will be made watertight by the inclusion of water resisting concrete and by the addition of a proprietary waterproofing system (Sika or similar). This waterproofing system will be specified as a series of inert water resisting cement render layers applied directly to the concrete surfaces to ensure that moisture remains outside the curtilage of the new structure.

7.0 CONCLUSIONS

1. It is proposed to extend the existing lower ground floor level at the site. The proposed lower ground floor level will follow the footprint of the existing building with the exception of a large open lightwell to the rear.

2. Ground conditions at the site were investigated by Site Analytical Services Limited in April to August 2011 (Report Reference 11/17802) and again as part of this Basement Impact Assessment in November 2014. The exploratory holes revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised between up to 1.10m thickness of Made Ground overlying materials typical of the London Clay Formation.

3. Water levels in the immediate vicinity of the property have been recorded above floor level of the proposed basement. However, given the presence of a non-aquifer below the site it is likely that groundwater within these soils is recharged via intermittent seepages from surface water associated with weather conditions rather than any large scale subterranean groundwater flow. As a result the impact from the basement development on the local groundwater regime is likely to be minimal.

4. According to records from London Underground Limited (LUL), the site lies within 5m of the Northern Line which runs along Haverstock Hill. Available drawings show a tunnel head of approximately 37mOD. This is approximately 37.20m below the deepest part of the proposed basement at 74.80mOD and therefore unlikely to be impacted by the works.

5. Formal drainage is recommended for the proposed new lightwell with attenuation provided as required by detailed design. It is unlikely that any increase in surface water generated will cause an increase in peak runoff from the site.

6. Although Ornan Road flooded in 2002 the site itself is raised above surrounding road levels of Ornan Road. Therefore the risk of surface water and sewer flooding to the site are considered to be low.

7. The site lies within 5m of the existing Northern Line which runs below Haverstock Road. Discussions with London Underground Limited will be necessary to ensure the proposed basement does not impact the structural stability of this tunnel.

A P Smith BSc (Hons) FGS MCIWEM
Senior Geologist

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524000 526000 528000

186000

Approximate Location of Site

Data Source: BGS Mapping - Scale 1:10,000

N

Scale at A3: 1:15,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.25 0.5 1 1.5
Kilometers

Legend

- London Borough of Camden
- Railway Lines
- A Roads

BGS 1:10K Artificial Ground

- MADE GROUND
- WORKED GROUND

BGS 1:10K Drift Geology

- ALLUVIUM
- HACKNEY GRAVEL FORMATION
- LANGLEY SILT FORMATION
- LYNCH HILL GRAVEL FORMATION
- STANMORE GRAVEL FORMATION

BGS 1:10K Solid Geology

- BAGSHOT FORMATION
- CLAYGATE MEMBER
- LAMBETH GROUP
- LONDON CLAY FORMATION

NB. Geological boundaries are largely indicative based on available geological mapping data

Ornan Court, NW3

Geological Setting

213923 **FIGURE** **1**

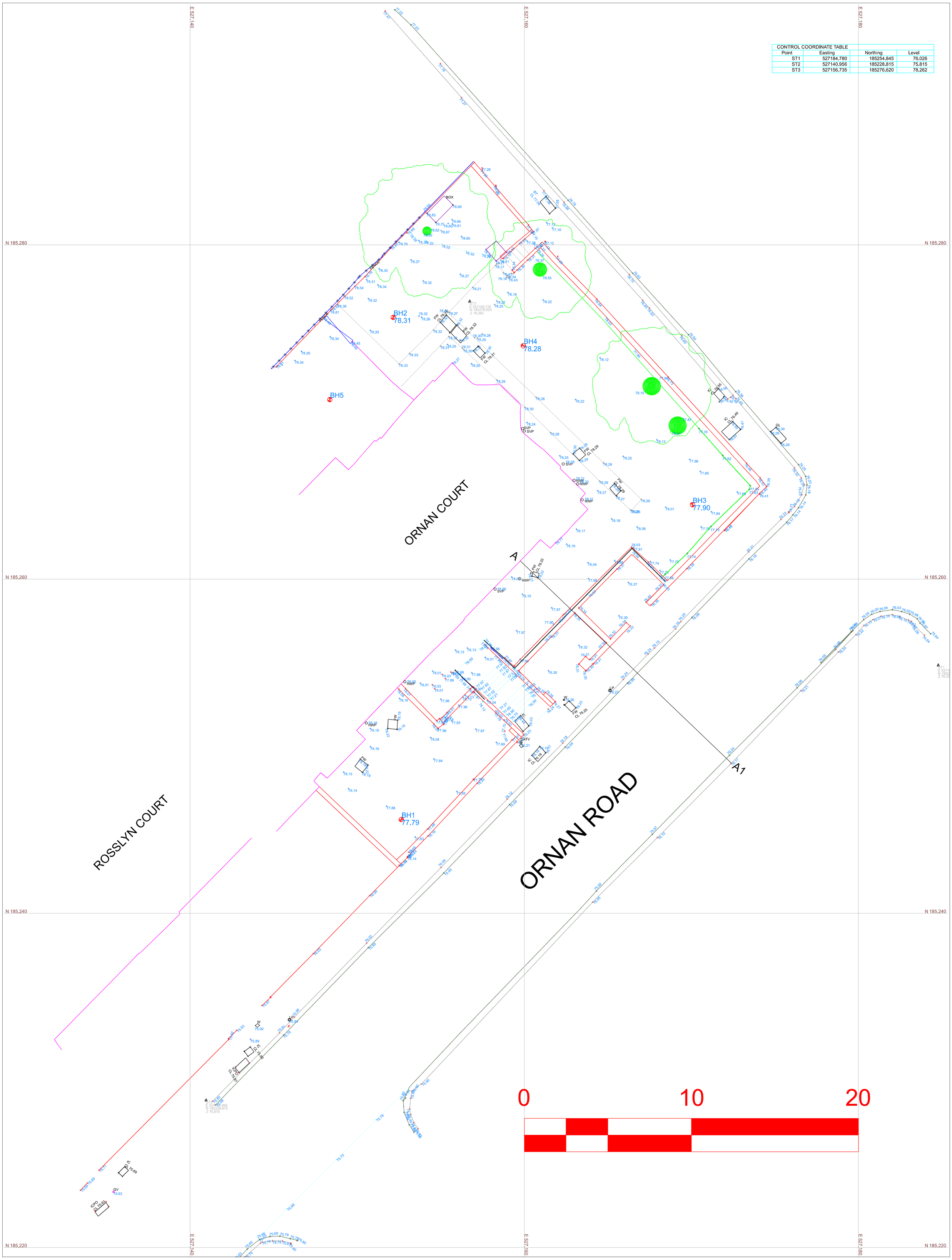

FIGURE 2

NOTES

CLIENT

SITE ANALYTICAL LIMITED

Units 14 - 15 River Road Business Park
33 River Road
Barking
Essex IG11 0EA

ORNAN COURT

SITE SURVEY

PROJECT NO.	SRS/14/1192
DWG. NO.	1192/001
SCALE	1:100 @ A1; 1:200@A3
DRAWN	MM-T
CHECKED	JSW
DATE	DECEMBER 2014
SHEET NO.	1 OF 1
REV	A
REV DATE	07/01/2015
REF.	

Site Remedial Services Ltd
Unit 13 River Road Business Park
33 River Road
Barking
Essex IG11 0EA
Tel: 020 8594 8134
Fax 020 8594 8072
Email: info@siteremedialservices.com
Web: www.siteremedialservices.com

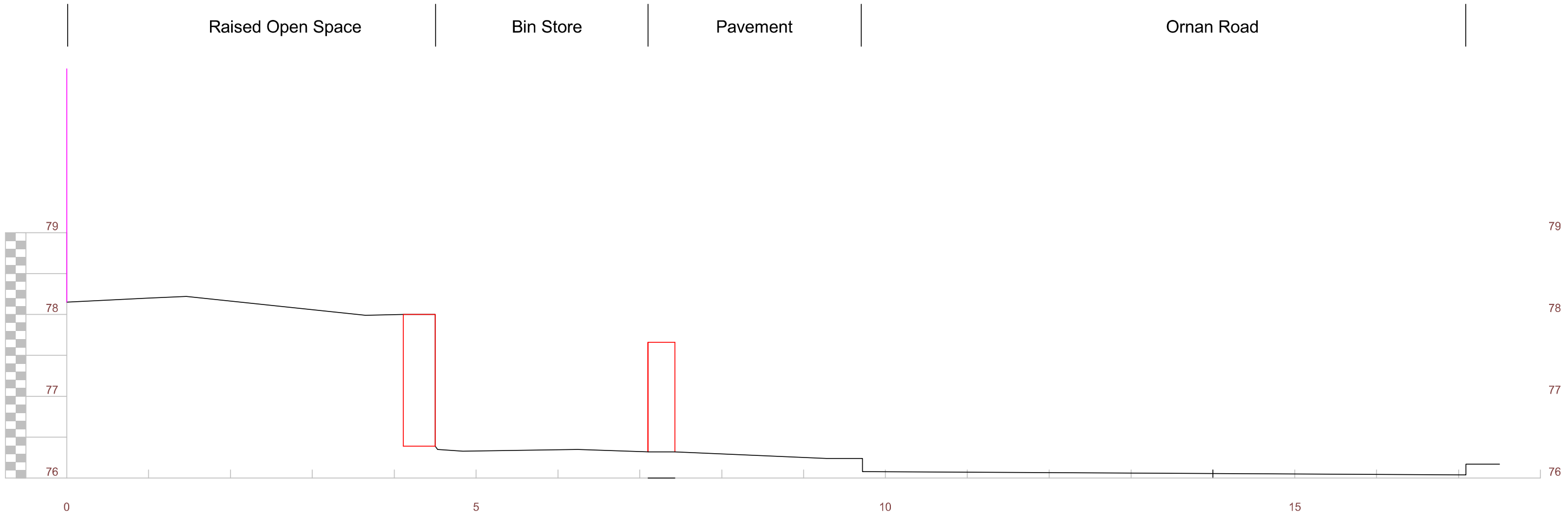

FIGURE 2A

NOTES

CLIENT

SITE ANALYTICAL LIMITED

Units 14 - 15 River Road Business Park
33 River Road
Barking
Essex IG11 0EA

ORNAN COURT

CROSS SECTION

PROJECT NO.	SRS/14/1192
DWG. NO.	1192/002
SCALE	1:50 @ A3
DRAWN	MM-T
CHECKED	JSW
DATE	JANUARY 2015
SHEET NO.	1 OF 1
REV.	
REV DATE	
REF.	

Site Remedial Services Ltd
Unit 13 River Road Business Park
33 River Road
Barking
Essex IG11 0EA
Tel: 020 8594 8134
Fax 020 8594 6972
Email: info@siteremedialservices.com
Web: www.siteremedialservices.com

1.2 Exploratory Hole Records

Site Analytical Services Ltd.

Site: ORNAN COURT, 2 ORNAN ROAD, LONDON, NW3 4PT				Borehole Number: BH1
Boring Method: CONTINUOUS FLIGHT AUGER	Casing Diameter: 100mm cased to 0.00m	Ground Level (mOD): 77.79	Client: PRIME CENTRAL	Job Number: 1117802
	Location: TQ 271 852	Dates: 31/03/2011	Engineer: MARTIN REDSTON ASSOCIATES	Sheet: 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.40)	MADE GROUND : grass over dark brown clayey silty sand with flint gravel and brick fragments		
0.25	D1				77.39	0.40			
0.50	D2					(0.40)	MADE GROUND : firm to stiff dark brown and orange brown silty clay with occasional flint gravel and brick fragments		
0.50	V1 60								
0.75	D3				76.99	0.80	Stiff becoming stiff to very stiff brown and mottled orange brown and veined blue grey silty CLAY with occasional partings of light brown silty fine sand, scattered small gypsum crystals, roots up to 2mm diameter above 1.30m depth and rootlets above 1.90m depth		
0.75-1.05	M1 40/300								
1.00	D4								
1.00	V2 8!								
1.50	D5								
1.50	V3 140+								
2.00	D6								
2.00	V4 140								
2.50	D7								
2.50	V5 140+								
3.00	D8					(4.20)			
3.00	V6 140+								
3.50	D9								
3.50	V7 140+								
4.00	D10								
4.00	V8 140+								
4.50	D11								
4.50	V9 140+								
5.00	D12			31/03/2011:DRY	72.79	5.00	Complete at 5.00m		
5.00	V10 140+								

Remarks
V = Vane Test - Result in kPa
M = Mackintosh Probe - Blows/Penetration (mm)
D = Disturbed Sample
Groundwater was not encountered during boring

Scale (approx)	Logged By
1:40	AHS

Figure No.
1117802.BH1

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Site Analytical Services Ltd.

Site: ORNAN COURT, 2 ORNAN ROAD LONDON, NW3 4PT			Borehole Number: BH1
Installation Type: MONITORING STANDPIPE	Dimensions: Internal Diameter of Tube (A) = 50 mm; Diameter of Filter Zone = 150 mm	Client: PRIME CENTRAL	Job Number: 11/7902
Location: TQ 271 852	Ground Level (mOD): 77.79	Engineer: MARTIN REDSTON ASSOCIATES	Sheet: 1/1

Legend	Instr (A)	Level (mOD)	Depth (m)	Description
				Bentonite Seal
		76.79	1.00	
				Slotted Standpipe
		72.79	6.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings: 5 min	10 min	15 min	20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift: Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift: Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
31/03/11				DRY			6.00		DRY	

Instrument Groundwater Observations

Inst. [A] Type : SINGLE STANDPIPE

Date	Instrument [A]: Time	Depth (m)	Level (mOD)	Remarks
08/04/11		2.35	75.44	Gas readings taken
12/04/11		2.39	75.40	Gas readings taken
20/04/11		2.31	75.48	Gas readings taken

Remarks
Lockable cover set in concrete
Gas valve fitted

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Site Analytical Services Ltd.

Site: ORNAN COURT, 2 ORNAN ROAD, LONDON, NW3 4PT			Borehole Number: BH2
Boring Method: CONTINUOUS FLIGHT AUGER	Casing Diameter: 102mm cased to 0.00m	Ground Level (mOD): 78.31	Client: PRIME CENTRAL	Job Number: 1117802
	Location: TQ 271 862	Dates: 31/03/2011	Engineer: MARTIN REDSTON ASSOCIATES	Sheet: 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							MADE GROUND : grass over dark brown silty sand with flint gravel and brick fragments		
0.25	D1					(0.80)			
0.50	D2				77.71	0.60			
0.50-0.50	M1 36/300						MADE GROUND : firm becoming firm to stiff dark brown and mottled orange brown and grey silty clay with occasional flint gravel, brick and concrete fragments		
0.75	D3					(0.40)			
1.00	D4				77.31	1.00			
1.00	V1 62						Stiff becoming stiff to very stiff brown and mottled orange brown and very occasional blue grey silty CLAY with occasional partings of light brown silty fine sand, scattered small gypsum crystals and roots up to 1mm diameter above 1.10m depth		
1.50	D5								
1.50	V3 140+								
2.00	D6								
2.00	V4 130								
2.50	D7								
2.50	V5 140+								
3.00	D8					(4.00)			
3.00	V6 140+								
3.50	D9								
3.50	V7 140+								
4.00	D10								
4.00	V8 140+								
4.50	D11								
4.50	V9 140+								
5.00	D12			31/03/2011 DRY	73.31	5.00	Complete at 5.00m		
5.00	V10 140+								

Remarks
Groundwater was not encountered during boring
D = Disturbed Sample
M = Mackintosh Probe - Blows/Penetration (mm)
V = Vane Test - Result in kPa

Scale (approx)	Logged By
1:40	APS

Figure No. 1117802.BH2

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Site Analytical Services Ltd.

Site	Borehole Number
ORNAN COURT, 2 ORNAN ROAD, LONDON, NW3 4PT	BH2

Installation Type	Dimensions	Client	Job Number
MONITORING STANDPIPE	Internal Diameter of Tube [A] = 50 mm Diameter of Filter Zone = 100 mm	PRIME CENTRAL	17802

Location	Ground Level (mOD)	Engineer	Sheet
TQ 271 852	78.31	MARTIN REDSTON ASSOCIATES	1/1

Legend	Water	Instr [A]	Level (mOD)	Depth (m)	Description
					Bentonite Seal
			77.31	1.00	
					Slotted Standpipe
			73.31	5.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
21/03/11				DRY			5.00		DRY	

Instrument Groundwater Observations

Inst. [A] Type : SINGLE STANDPIPE

Date	Instrument [A] Time	Depth (m)	Level (mOD)	Remarks
08/04/11		3.49	74.82	Gas readings taken
12/04/11		3.40	74.91	Gas readings taken
22/04/11		3.49	74.82	Gas readings taken

Remarks
Lockable cover set in concrete
Gas valve fitted

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Site Analytical Services Ltd.

Site: ORNAN COURT, 2 ORNAN ROAD LONDON, NW3 4PT			Borehole Number: BH3
Boring Method: W NDOW SAMPLER	Casing Diameter: 100mm cased to 0.00m	Ground Level (mOD): 77.90	Client: ORNAN COURT LIMITED
	Location: TQ 271 852	Dates: 05/11/2014	Engineer: MARTIN REDSTON ASSOCIATES
			Job Number: 1422602
			Sheet: 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.25	D1					(0.70)	MADE GROUND: Grass surface over soft sandy slightly gravelly clay with small brick fragments.		
0.50	D2				77.20	0.70	Still medium strength becoming high strength light brown silty sandy CLAY		
0.75	D3								
1.00-1.45	SPT N=14		DRY	2,2/3,3,4,4					
1.00	D4								
1.50	D5								
2.00-2.45	SPT N=17		DRY	3,3/4,5,4,4		(2.50)			
2.00	D6								
2.50	D7								
3.00-3.45	SPT N=17		DRY	5,4/4,4,5,4					
3.00	D8				74.70	3.20	Very stiff high strength brown slightly silty sandy CLAY		
3.50	D9								
4.00-4.45	SPT N=18		DRY	4,4/4,4,4,6		(1.80)			
4.00	D10								
4.50	D11								
5.00	D12				72.90	5.00	Complete at 5.00m		

Remarks
Groundwater was not encountered during boring.
S = Standard Penetration Test
D = Disturbed sample

Scale (approx)	Logged By
1:50	

Figure No. 1422602.BH3

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Site Analytical Services Ltd.

Site: ORNAN COURT, 2 ORNAN ROAD, CAMDEN, NW3 4PT		Borehole Number: BH3
Installation Type: Single Installation	Dimensions: Internal Diameter of Tube [A] = 100 mm	Client: ORNAN COURT LIMITED
Job Number: 14229BZ		
Location: TQ 271 862	Ground Level (mOD): 77.90	Engineer: MARTIN REDSTON ASSOCIATES
Sheet: 1/1		

Legend	Water	Instr [A]	Level (mOD)	Depth (m)	Description
					Bentonite Seal
			76.90	1.00	
					Slotted Standpipe
			72.90	5.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings: 5 min	10 min	15 min	20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift: Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift: Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A]: Time	Depth (m)	Level (mOD)	Remarks

Remarks
Lockable cover set in concrete.

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Site Analytical Services Ltd.

Site: ORNAN COURT, 2 ORNAN ROAD, LONDON, NW3 4PT

Borehole Number: BH4

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
WINDOW SAMPLER	100mm cased to 0.60m	78.28	ORNAN COURT LIMITED	1422662

Location	Dates	Engineer	Sheet
TQ 271 862	05/11/2014	MARTIN REDSTON ASSOCIATES	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.25	D1					(0.90)	MADE GROUND: Soft sandy slightly gravelly clay with brick and concrete fragments.		
0.50	D2								
0.75	D3				77.38	0.90			
1.00-1.45	SPT N=14			2,2/3,3,4,4			Very stiff medium strength becoming high strength light brown silty sandy CLAY		
1.00	D4								
1.50	D5								
2.00-2.45	SPT N=15			2,3/5,4,4,3					
2.00	D6								
2.50	D7								
3.00-3.45	SPT N=16			4,4/6,3,3,4		(4.10)			
3.00	D8								
3.50	D9								
4.00-4.45	SPT N=19			4,5/6,6,4,4					
4.00	D10								
4.50	D11								
5.00	D12				73.28	5.00	Complete at 5.00m		

Remarks
Groundwater was not encountered during boring.
S = Standard Penetration Test
D = Disturbed sample

Scale (approx)	Logged By
1:50	

Figure No.
1422662.BH4

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Site Analytical Services Ltd.

Site: ORNAN COURT, 2 ORNAN ROAD, LONDON, NW3 4PT		Borehole Number: BH4
Installation Type: Single Installation	Dimensions: Internal Diameter of Tube [A] = 100 mm	Job Number: 1422562
Location: TQ 271 852	Ground Level (mOD): 78.28	Sheet: 1/1
Client: ORNAN COURT LIMITED	Engineer: MARTIN REDSTON ASSOCIATES	

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
					Bentonite Seal
			77.28	1.00	
					Slotted Standpipe
			73.28	5.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift: Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift: Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A] Time	Depth (m)	Level (mOD)	Remarks

Remarks
Lockable cover set in concrete.

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Site Analytical Services Ltd.

Site: ORNAN COURT, 2 ORNAN ROAD, LONDON, NW3 4PT			Borehole Number: BH5
Boring Method: WINDOW SAMPLER	Casing Diameter: 100mm cased to 0.00m	Ground Level (mOD): 78.29	Client: ORNAN COURT LIMITED	Job Number: 1422662
Location: TQ 271 852	Dates: 05/11/2014	Engineer: MARTIN REDSTON ASSOCIATES	Sheet: 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					78.19	0.10	MADE GROUND. Grass surface over a layer of soft yellow sand.		
0.25	D1						MADE GROUND: Clayey slightly gravelly sand with roots and small brick and concrete fragments		
0.50	D2					(1.00)			
0.75	D3								
1.00-1.45 1.00	SPT N=9 D4			2,2/2,2,2,3	77.19	1.10	Very medium strength becoming high strength brown silty sandy CLAY. Sand is fine to coarse and found in pockets.		
1.50	D5								
2.00-2.45 2.00	SPT N=17 D6			3,4/5 3,4,5					
2.50	D7								
3.00-3.45 3.00	SPT N=10 D8			3,5/5 5,5,5		(3.90)			
3.50	D9								
4.00-4.45 4.00	SPT N=22 D10			4,4/5,6,6,5					
4.50	D11								
5.00	D12				73.29	5.00	Complete at 5.00m		

Remarks
Groundwater was not encountered during boring.
S = Standard Penetration Test
D = Disturbed sample

Scale (approx)	Logged By
1:50	

Figure No.
1422662.BH5

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Site Analytical Services Ltd.

Site: ORNAN COURT, 2 ORNAN ROAD, LONDON, NW3 4PT	Borehole Number: BH5	
Installation Type: Single Installation	Dimensions: Internal Diameter of Tube [A] = 100.0mm	Client: ORNAN COURT LIMITED
Job Number: 1422662		
Location: TQ 271 852	Ground Level (mOD): 78.29	Engineer: MARTIN REDSTON ASSOCIATES
Sheet: 1/1		

Legend	Water	Instr [A]	Level (mOD)	Depth (m)	Description
					Bentonite Seal
			77.29	1.00	
					Slotted Standpipe
			73.29	5.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings: 5 min	10 min	15 min	20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift: Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift: Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Instr. [A] Type : Standpipe

Instrument [A] Date	Time	Depth (m)	Level (mOD)	Remarks

Remarks
Lockable cover set in concrete.

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Site Analytical Services Ltd.

Standard Penetration Test Results

Site : ORNAN COURT, 2 ORNAN ROAD, LONDON, NW3 4PT

Client : ORNAN COURT LIMITED

Engineer: MARTIN REDSTON ASSOCIATES

Job Number: 1422662

Sheet: 1 / 1

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH3	1.00	1.15	1.45	SPT	2	2	3	3	4	4	N=14	
BH3	2.00	2.15	2.45	SPT	3	3	4	5	4	4	N=17	
BH3	3.00	3.15	3.45	SPT	5	4	4	4	5	4	N=17	
BH3	4.00	4.15	4.45	SPT	4	4	4	4	4	6	N=18	
BH4	1.00	1.15	1.45	SPT	2	2	3	3	4	4	N=14	
BH4	2.00	2.15	2.45	SPT	2	3	5	4	4	3	N=16	
BH4	3.00	3.15	3.45	SPT	4	4	6	6	6	4	N=16	
BH4	4.00	4.15	4.45	SPT	4	5	5	6	4	4	N=19	
BH5	1.00	1.15	1.45	SPT	2	2	2	2	2	3	N=8	
BH5	2.00	2.15	2.45	SPT	3	4	5	6	4	6	N=17	
BH5	3.00	3.15	3.45	SPT	3	5	6	5	5	5	N=18	
BH5	4.00	4.15	4.45	SPT	4	4	5	6	6	5	N=22	

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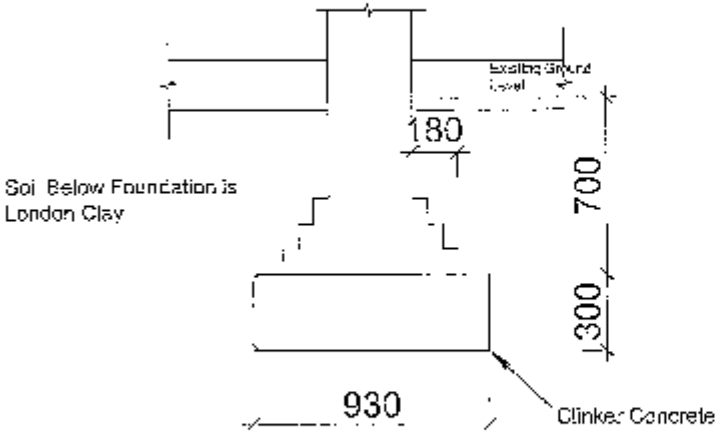
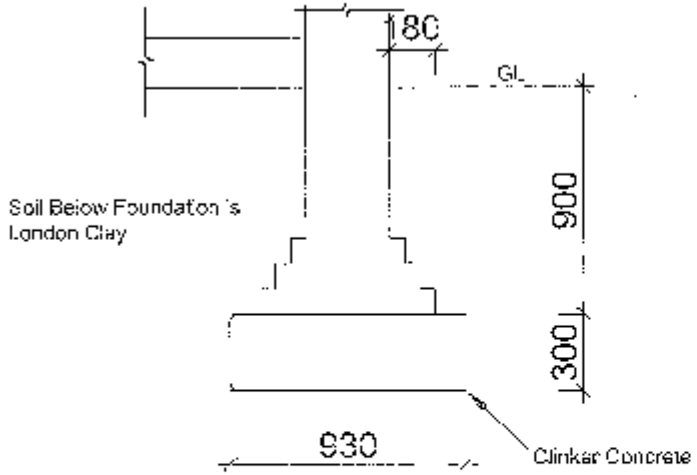
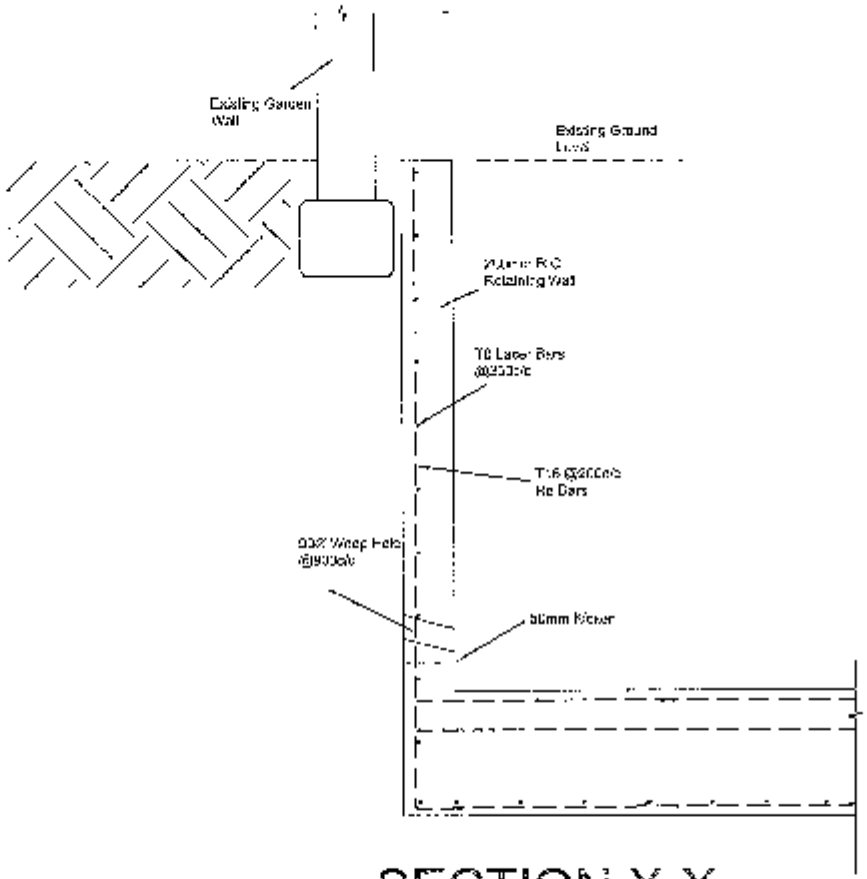


Existing Foundations Of Party Wall



Existing Foundations Of Flank Wall



SECTION X-X

Foundations For The Front And Rear Walls Are The Same As For The Party Wall

Rev	Date	Description	App

Title: Trial Pit Information Section XX

Martin Redston Associates
Consulting Civil & Structural Engineers
3 Edward Square, London N1 0SP
Tel: 020-7837 5377 Fax: 020-7837 3211
5 Hale Lane, London NW7 3NX
Tel: 020-8959 1666 Fax: 020-8906 8503

Date 10.04.08		Sheet No. Rev
Dng. GD	Scale 1:50	20 A
Job No. 07/69		

Project: Oman Court, Edgware Park, NW9

Appendix B – Groundwater Monitoring Results

Borehole	Ground Level	Installation Depth	Installation Date	Date and groundwater level (mbgl)													
				06/04/2011		12/04/2011		20/04/2011		17/08/2011		25/09/2014		11/11/2014		27/11/2014	
				mBGL	mOD	mBGL	mOD	mBGL	mOD	mBGL	mOD	mBGL	mOD	mBGL	mOD	mBGL	mOD
BH1	77.79	Jan-00	Mar-11	2.35	75.44	2.39	75.4	2.31	75.48	2.76	75	2.64	75.15	2.2	75.6	2.32	75.5
BH2	78.31	Jan-00	Mar-11	3.49	74.82	3.5	74.81	3.49	74.82	3.51	74.8	3.08	75.23	2.25	76.1	2.31	76
BH3	77.9	Jan-00	Nov-14											2.5	75.4	2.64	75.3
BH4	78.28	Jan-00	Nov-14											2.75	75.5	2.87	75.4
BH5	78.29	Jan-00	Nov-14											1.64	76.7	1.73	76.6

Site Analytical Services Ltd.