Basement Impact Assessment: 10a Oakhill Avenue.

(Surface Water and Groundwater)

Basement impact assessment: hydrology and hydrogeology. 10a Oakhill Avenue.

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Surface Water

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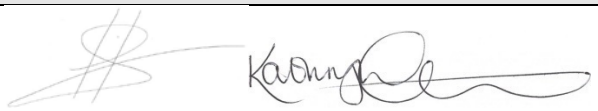
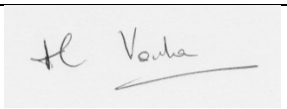
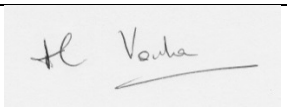
Author	Kathryn Mair Henry Kelly	
Checked by	Helen Vonka (M.CIWEM)	
Reviewed by	Helen Vonka (M.CIWEM)	

Groundwater

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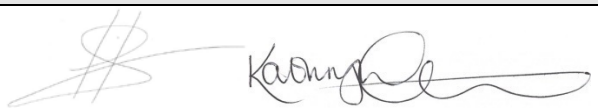
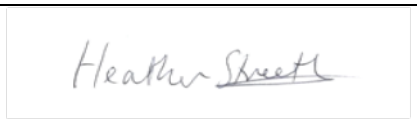
Author	Kathryn Mair Henry Kelly	
Checked by	Heather Streetly (C.Geol)	
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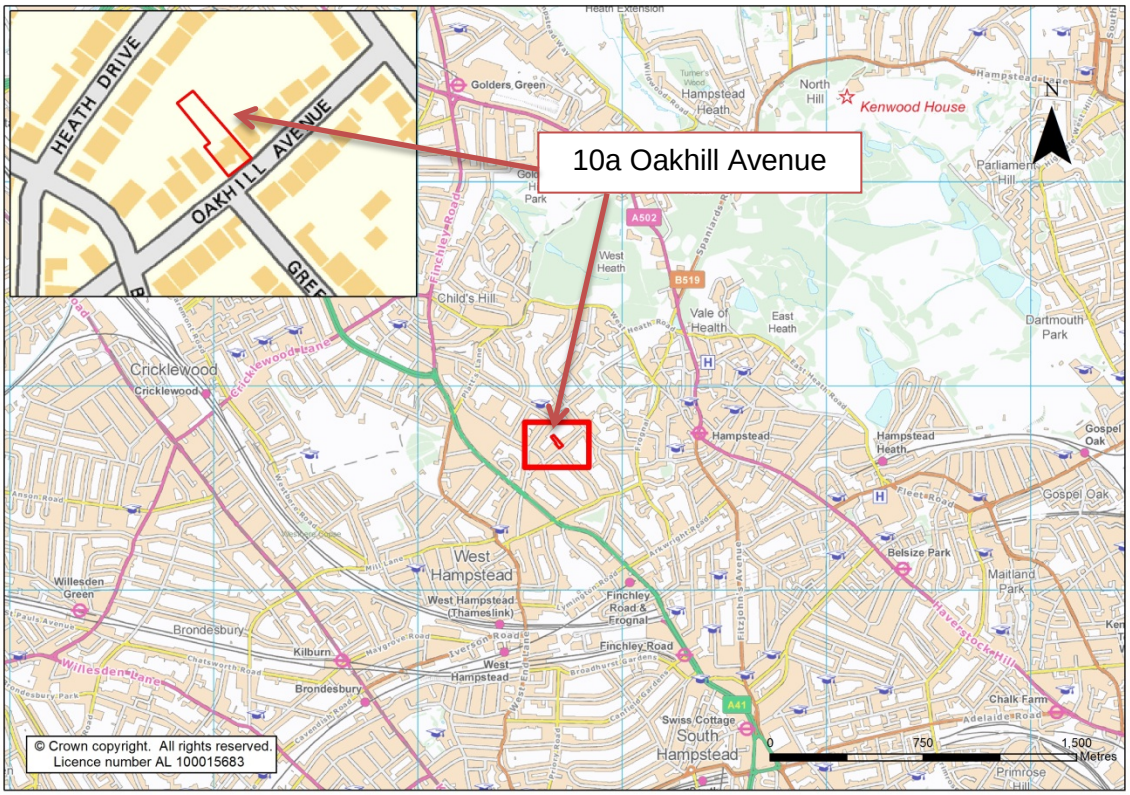
1 INTRODUCTION

1.1 This Document

ESI Ltd (ESI) was commissioned by AD Design Concepts Ltd in February 2015 to revise an existing Basement Impact Assessment for a proposed development at 10a Oakhill Avenue NW3 7RE, (at approximate grid reference TQ 256 857) in the Frognal and Fitzjohns Ward of the London Borough of Camden (Figure 1.1). The original Basement Impact Assessment (Report Ref: 61458R1Rev3) was commissioned by Martin Evans Architects in April 2013.

A revision of the proposed basement design has been undertaken by AD Design Concepts Ltd and subsequently the Basement Impact Assessment has been revised to reflect the new design.

Figure 1.1 Site location



This document is a desk study which considers the potential impact relating to the proposed basement development in terms of surface water and groundwater flow and flooding.

1.2 Scope of Works

The following scope of works was requested: an assessment of the impacts of the proposed development on surface water and groundwater flow, levels and drainage. This report outlines the hydrogeological conditions with relevance to construction of the basement at the property. The assessment conforms to the requirements of guidance set out by the London Borough of Camden, which provides comprehensive guidance on planning applications for basement extensions. These guidelines for basement impact assessments (ARUP (2010), Camden Borough Council, (2011)) have been consulted in order to complete a screening analysis of key hydrological and hydrogeological issues that will satisfy the relevant planning requirements.

The Site is also the subject of further reports conducted by Soil Consultants Limited: A Factual Ground Investigation (Soil Consultants Ltd, 2015), a Land Stability Report (Soil

Consultants Ltd, 2015) and a report conducted by KeyGS: Slope Stability and Ground Movement Assessment (Key GS, 2015).

1.3 Proposed Basement Works

The proposed development is for the excavation of a new, single storey basement for a residential property. The basement is to be developed below the proposed lower ground floor with the underside of the basement slab completed to a final depth of approximately 88.65 meters Above Ordnance Datum (mAOD) where the basement slab has an assumed thickness of 0.5 m.

The vertical depth of the basement below ground level varies across Site due to the variation in ground level. The basement lies approximately 7.45 meters below ground level (mbgl) to the north-western extent of the proposed development and 3.58 mbgl at the south-eastern extent of the proposed development.

The proposed development on Site is for the demolition of existing buildings and the construction of a new development incorporating a lower ground floor and basement. Plans are included at Appendix A and show that the proposed lower ground floor development has an external area of 545.0 m^2. The underlying proposed basement development has an external area of 627.0 m^2.

The majority (87%) of the proposed basement (545.0 m^2) will lie beneath the footprint of the lower ground floor of the proposed development, with the exception of 82m^2.

2 SCREENING AND SCOPING

The screening and scoping stage for Impact Assessment has been considered as set out in CPG4 (Camden Council, 2011) as follows.

2.1 SURFACE WATER (Surface flow and flooding screening flowchart (Figure 3, CPG4 (Camden Council, 2011))			
Impact question	**Answer**	**Justification**	**Reference**
1) Is the Site within the catchment of the pond chains on Hampstead Heath?	**No**	The Site is not located within the catchment for any of the Hampstead Heath ponds.	Arup, 2008.
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**	The proposed development, (inclusive of the basement) is larger than the current development on Site. A detailed drainage design will be incorporated at detailed design stage to adjust drainage routes to deal with the excess volume of rain fall and peak run-off generated on-Site.	Site Plans.
3) Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	**Yes**	The majority (87%) of the proposed basement will be located beneath the footprint of the proposed development. However as the entire development, inclusive of the basement, will extend beyond the current development on Site, there will be a reduction in permeable surface on Site. The total Site area is 1240.45 m^2. Prior to development, the Site consisted of and impermeable surface area amounting to 645.75 m^2 which will increase to 715.0 m^2. This is an increase in impermeable surface at the Site of 69.25 m^2 from pre-development conditions.	Site plans.
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**	A culverted tributary of the "lost" river Westbourne exists approximately 105 m to the north of the proposed basement (at their closest point) and flows in a southwest direction. No other surface water bodies are known to exist within 500 m of the Site. Despite a change in the proportion of impermeable surfaces on the Site, there is not expected to be any significant change in profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties given their distance and direction from Site and subject to the incorporation of a suitable drainage scheme into the development design.	Ordnance Survey Mapping. Barton, 1992.
5) Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	**No**	The "lost" river Westbourne runs approximately to the north of the Site as stated above. It is possible that the Site falls within the catchment of this underground river; however, the size and position of the proposed development mean it is highly unlikely to impact on the quality of this water course or the receiving waters of adjacent properties.	Ordnance Survey Mapping. Barton, 1992.

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**	Oakhill Avenue is not a road which has previously experienced surface water flooding nor is it at risk from surface water flooding according to Arup (2008). The area is not at risk from flooding from rivers or reservoirs as defined by the Environment Agency (2015). The Site has no history of sewer flooding (Appendix C).	Arup, 2008. Environment Agency, 2015.

2.2 GROUND WATER (Subterranean (ground water) flow screening chart (Figure 1, CPG4 (Camden Council, 2011))			
Impact question	**Answer**	**Justification**	**Reference**
1a) Is the Site located directly above an aquifer?	**Yes**	The Site is located upon the Claygate Member; a sedimentary bedrock comprising chiefly low permeability clay, with pockets of silt and sand. This may contain permeable horizons within the generally low permeability material and is classified as a Secondary A aquifer by the Environment Agency. Beneath the Claygate Member lies the London Clay (classed as unproductive strata) at a depth of around 5 mbgl according to on-Site window sample logs (Appendix B). There are no superficial deposits recorded at the Site.	British Geological Survey, 2013 (A). Environment Agency, 2012.
1b) Will the proposed basement extend beneath the water table surface?	**Yes**	Monitoring of boreholes installed 02/05/13 was conducted on 16/05/13 and 24/05/13; this established stabilised ground water levels to be between 91.3 mAOD and 92.53 mAOD); the groundwater gradient across Site reflects the topographic gradient, descending towards the south. The proposed basement will extend down below these water table elevations by approximately 3.9 m (calculated from the difference between the maximum recorded stabilised water level (92.53 mAOD) and the maximum proposed depth of the basement (88.65 mAOD)). As stated previously, the groundwater will be confined to thin localised layers of higher permeability sediment.	British Geological Survey, 2013 (A). British Geological Survey, 2013 (B). Soil Consultants Ltd, 2015.
2) Is the Site within 100m of a watercourse, well (used/disused) or potential spring line?	**No**	As stated above, a culverted tributary of the river Westbourne runs 105 m to the north of the proposed basement. The nearest surface watercourse is 800 m to the north; this is a small stream originating from the Leg of Mutton Pond. This watercourse is up gradient from the Site and will not be affected by the development. There are no wells within 100 m of the Site. The change in geological strata from Claygate to London Clay occurs to the west of the Site and has the potential to produce springs; the distance of this is thought to be greater than 100m. The Claygate Member does have the potential to produce springs where permeable horizons crop out. No springs were identified at the Site	British Geological Survey, 2013 (A). British Geological Survey, 2013 (B). Barton, 1992. Soil Consultants Ltd, 2015

		during the Site investigation.	
3) Is the Site within the catchment of the pond chains on Hampstead Heath?	**No**	The Site is not located within the catchment for any of the Hampstead Heath ponds.	Arup, 2008.
4) Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	**Yes**	The majority (87%) of the proposed basement will be located beneath the footprint of the proposed development. However as the entire development, inclusive of basement, will extend beyond the current development on Site, the net result will be a reduction in permeable surface on Site. The total Site area is 1240.45 m^2. Prior to development, the Site consisted of an impermeable surface area amounting to 645.75 m^2, which will increase to 715.0 m^2. This is an increase in impermeable surface at the Site of 69.25 m^2 from pre-development conditions.	Site Plans.
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)?	**Yes**	Due to the increase in impermeable surface at the Site which will result from the proposed development, inclusive of the basement development, more surface water run-off is anticipated.	Site Plans.
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 or spring line.	**No**	There are no known ponds or spring lines within close proximity of the Site.	Ordnance Survey Mapping.

3 SITE CONCEPTUAL MODEL

3.1 CONCEPTUAL UNDERSTANDING		
Geology	Superficials	No superficial deposits are known to exist at the Site.
	Bedrock	The Site is located directly upon the Claygate Member; a sedimentary bedrock comprising clay, silt and sand. The depth of the Member beneath the Site is around 5 m according to a Site investigation carried out in 02/05/2013 (Appendix B & D)). This is supported by historical boreholes 280 m to the west of the Site gave depth of between 4.15 m – 4.45 m (appendix B). On-site window sample logs show that the Claygate Member extends to approximately 5 mbgl and state that the strata comprise chiefly sandy silty clay, with partings of silty sand. The Site investigation determined that the partings were no thicker than a few millimetres and no discrete water bearing horizons were encountered. Beneath the Claygate Member lies the London Clay aquiclude, proven to a thickness of at least 22.27 by borehole TQ28NE103 approximately 500 m to the north east (Appendix B) and to a thickness of around 50 m by other boreholes within 1.5 km of the Site (TQ28SW73, TQ28SE1490, TQ28NE48). This is a hydrogeologically unproductive layer overlying the principal Chalk aquifer beneath.
Aquifers	The Claygate Member is classified as a Secondary A aquifer by the Environment Agency. The definition of this is as follows: "Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers." The generally low permeability Claygate member is known to contain horizons of higher permeability material capable of transmitting water. Borehole logs from the Site included in Appendix B indicate that the Claygate at this location comprised homogenous material containing numerous thin (several mm) partings of silty sand. The pockets and partings of sand that are present do not form continuous horizons of permeable material. Based upon the changes in groundwater elevation recorded over the observed period, migration of groundwater through the Site appears to be occurring. The Claygate member was proven to a thickness of around 5 m during the Site investigation and shown to be underlain by London Clay.	

Groundwater levels	The presence of groundwater beneath the Site was confirmed during Site investigation at a maximum stabilised level of 92.53 mAOD. This is based on the minimum dip measurements from three separate locations during May 2013 (the details of all recorded water levels for each dip location are presented in Appendix B). The water levels will be subject to seasonal variation beyond what has been observed, in response to rainfall recharge. It is therefore likely that they will rise above the recorded levels during particularly wet periods. *Note; the levels recorded during the Site investigation have not been considered as they do not represent stabilised water levels.* This indicates that the basement (underside of the basement slab) would extend up to approximately 3.9 m below the water table. Dewatering of the Site will need to be conducted during construction to lower the water table beyond the final elevation of the underside of the basement slab. The highest groundwater elevations were found to the northeast of the Site (WS1) with WS2 to the northwest and WS3 to the southwest both having similar values on both days signifying a preferential flow direction of approximately northeast to southwest across the Site. As the proposed basement is likely to protrude below the recorded groundwater elevations, there will likely be some interference to groundwater flow, and this has been modelled in section 4. As stated previously, the Claygate Member comprises chiefly low permeability clay. This means the overall magnitude of groundwater flow passing through the Site is likely to be relatively low (as stated in section 3.1). Using Darcy's law an estimate of the flow passing beneath the Site has been made assuming that the permeable horizons make up a total of 1 % of the Claygate Member thickness, and using a hydraulic conductivity of 10 m/day for the more permeable horizons (within the range commonly ascribed to fluvial deposits (Hiscock 2009)). This yielded an estimate of 0.75 m^3/day (0.009 l/s), assuming the presence of a continuous aquifer. Due to the proposed depth of the development, the Claygate Member will be removed across up to two thirds of the footprint of the basement development (figure 3.1). This means that the groundwater flow would be diverted around the proposed basement. This is likely to cause a slight increase in groundwater levels on the up-gradient side of the property and a corresponding decrease on the down-gradient side. Groundwater modelling has been undertaken to clarify the impact of the basement development on the groundwater levels (see section 4).

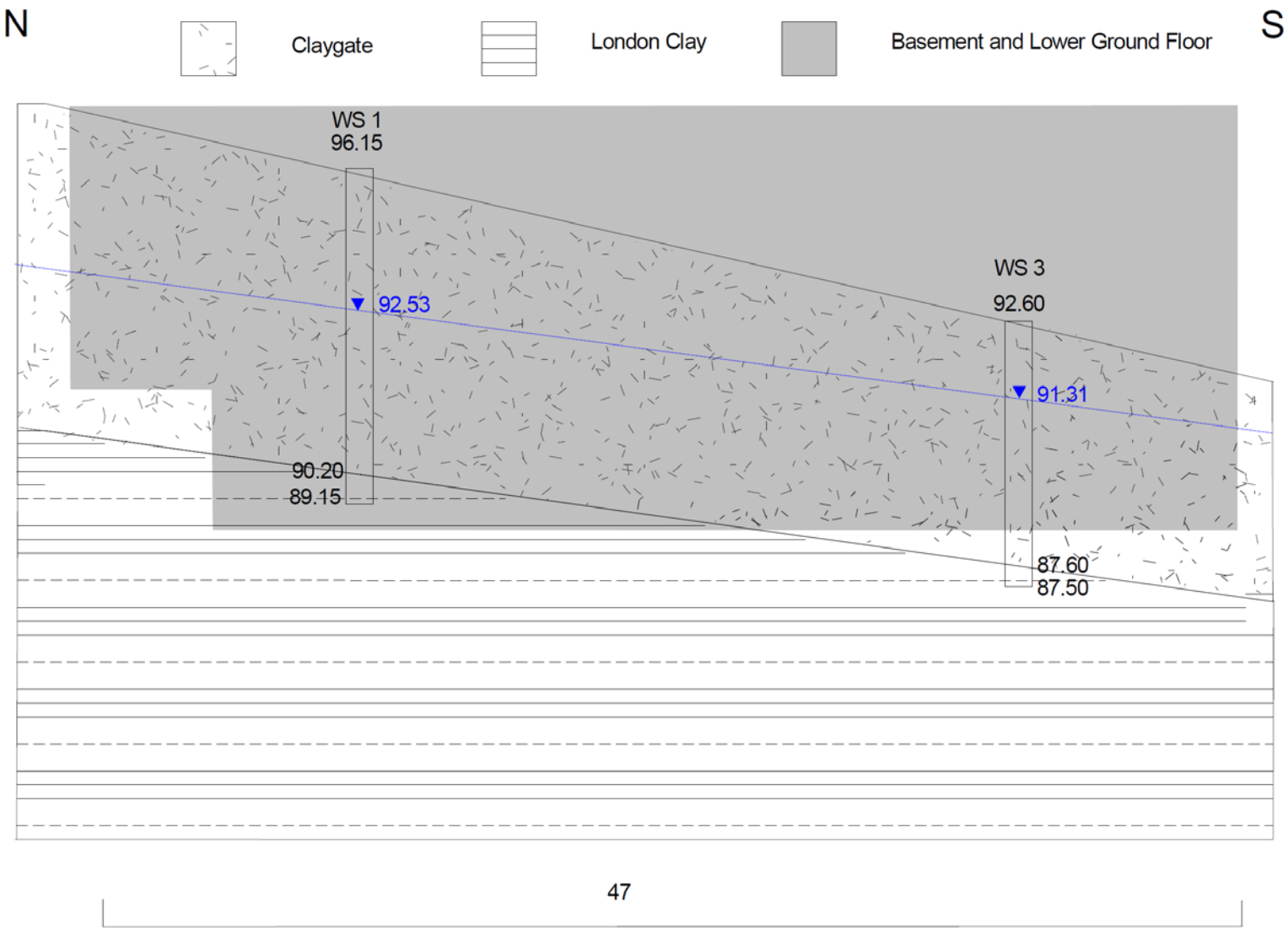


Figure 3.1 Cross section A – Generalised cross section from north to south across the Site
Figure not to scale (units in metres). Water levels shown were recorded on the 24/05/2013.

4 GROUNDWATER MODELLING

4.1 Model Design

A two-dimensional scoping model has been developed of the area around the Site, to estimate the magnitude of groundwater level change in the vicinity of the proposed basements at the Site. The details of the model are as follows:

The basement is represented in the model as a block of impermeable cells (it is reasonable to assume that it is sealed as it penetrates the whole aquifer and therefore must be constructed to limit groundwater ingress). The neighbouring property (to the northeast) was included into the model in the same manner.

Model results are compared between two scenarios, with and without a basement, where the model with a basement fully penetrates the superficial aquifer across approximately two thirds of area covered by the proposed basement.

The conceptual model is of a thin aquifer (Claygate Member) overlying an essentially impermeable base (London Clay). The model has not been calibrated to groundwater level except to match approximately the observed hydraulic gradient and saturated thickness at the Site.

A sample output from the model, showing geometry, boundary conditions and groundwater heads (0.04 m contours) is presented in Figure 4.1 below.

4.2 Model Parameters

- The model was developed using Groundwater Vistas, running MODFLOW in steady state mode.
- The model is made up from 22,500 cells arranged in a 150 x 150 cell grid; cell size is 1 m x 1 m.
- The aquifer is constructed of two homogenous layers; layer 1 thickness is 3.5 m and layer 2 thickness is 1.5 m, giving a total of 5 m. Two layers were modelled to represent the different footprints of the lower ground floor and the basement.
- The hydraulic conductivity is set to 0.1 m/day (within the range commonly ascribed to fluvial deposits (Hiscock 2009) multiplied by 0.01 given that only around 1% is estimated to be alluvial deposits, and the rest low permeability clay).
- The hydraulic gradient utilised was 0.03 (average gradient in the London Clay established using up-gradient and down-gradient boreholes at a distance of approximately 500 m from the Site: borehole IDs NE102, NE104, NE21, NE32, NE129, NE130).

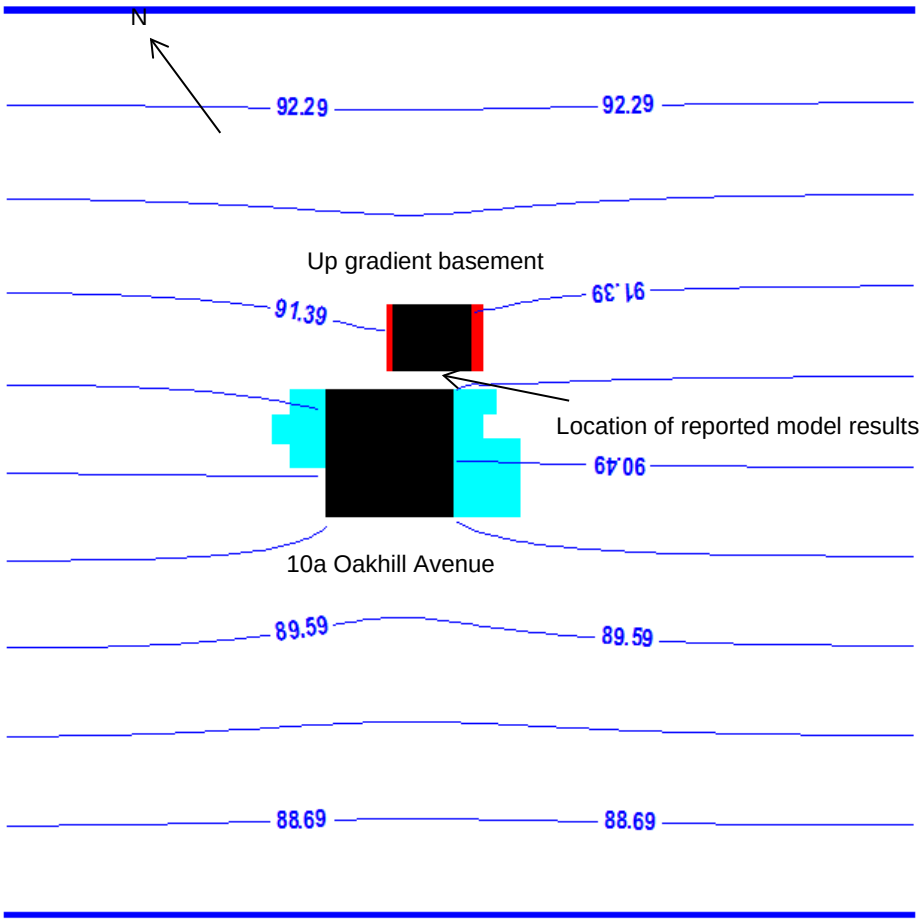


Figure 4.1 Scoping model grid and results

4.3 Model results

Without the proposed basement in the model, simulated groundwater level in the cell immediately to the northeast of the basement (marked in Figure 4.1) was 90.70 m above an arbitrary datum. When the proposed basement was added to the model, the simulated groundwater level in the same cell rose to 91.09 m above datum: an increase in water table elevation of 0.39 m.

4.4 Sensitivity analysis

There are few parameters that lend themselves to sensitivity analysis in this simple, steady state model but hydraulic gradient has been varied to assess the range of likely outcomes. The range of sensitivity values used was 0.02 to 0.04; this was conducted by raising or lowering the general head boundary to the northeast and southwest of the model domain. These are not based upon observed values but used to check that the model is operating as expected, i.e. to see how perturbation of parameters alters model output and increases in the hydraulic gradient causes an increase in the groundwater flow leading to an increase in up-gradient groundwater level rise. Hydraulic conductivity was not selected for the sensitivity analysis as this is not a sensitive parameter when the hydraulic gradient is fixed as is the case in this scenario.

Under these parameters, the likely range of increase in groundwater level in the cell immediately to the southwest of the up gradient property are as follows:

Table 4.1 Simulated rise in water table elevation post construction

Hydraulic gradient:	Change in head
0.02	0.28 m
0.03	0.39 m
0.04	0.15 m

These results indicate the model was sensitive to changes hydraulic gradient. The modelled water level rise is 0.39 m in the model cell adjacent to the neighbouring basements.

Furthermore, the hydraulic conductivity used in the model represents interconnected higher permeability horizons rather than isolated lenses which are typical of the Claygate Member. This represents a conservative modelling approach. However, when modelled hydraulic conductivities were reduced (to 0.01), there was little if no variation in the modelled change in head.

4.5 Cumulative Impact Assessment

In order to understand the impact the basement may have when taking into account potential neighbouring basements, further modelling was conducted. Similar to the model described in section 4.2 this new model incorporated two layers, both homogeneous, with the same properties mentioned above; the main difference being that the resolution was reduced by increasing the cell size to 2 m by 2 m grid cells to allow for the increase in overall model extent whilst maintaining a reasonable model size and run time. The size of the model domain was increased so that more basements could be assessed whilst maintaining a reasonable distance from the constant head boundaries (over 170 m) to ensuring that the boundaries of the model were not influencing the groundwater levels surrounding the basements modelled on Oakhill Avenue. The model was 500 m by 500 m overall.

The model was oriented northeast to southwest to allow for a northeast-southwest flow of groundwater as expected from the hydraulic gradient established from site data, and the regional gradient of the top of the London Clay formation below which generally controls the groundwater flow direction in this area (based upon previous studies by ESI in this region).

It should be noted that no information on other existing basements in Oakhill Avenue is possessed by ESI Ltd. This modelling process represents a conservative “worst case” scenario in which all neighbouring properties within the vicinity of the Site (marked as black in Figure 4.2) are assumed to possess a basement which encompasses the majority of the above-ground construction footprint and fully penetrates the superficial aquifer.

4.5.1 Cumulative Impact Assessment Results

Following the introduction of the proposed basement into the cumulative impact assessment model, the simulated groundwater level in the cell immediately to the southwest of the up gradient basement (marked in Figure 4.2) rose to an additional 0.40 m above an arbitrary datum. Compared to the first model (basements at 10a Oakhill and up gradient property) this represents an additional 0.01 m rise in the groundwater level adjacent to 10a Oakhill Avenue if every property highlighted black in Figure 4.2 constructed a basement that fully penetrated the London Clay. In this run it was also noted that the cell immediately adjacent the property on the opposite side of the road to Oakhill Avenue saw a 0.07 m rise in simulated groundwater level; this is within the normal range of fluctuations expected due to variations in recharge. It should be noted that if the groundwater flow direction were to be perpendicular to the row of basements modelled, the rise in groundwater level may be greater; we are confident that this is not the case based upon water level at the site and the gradient of the top of the London Clay in the area.

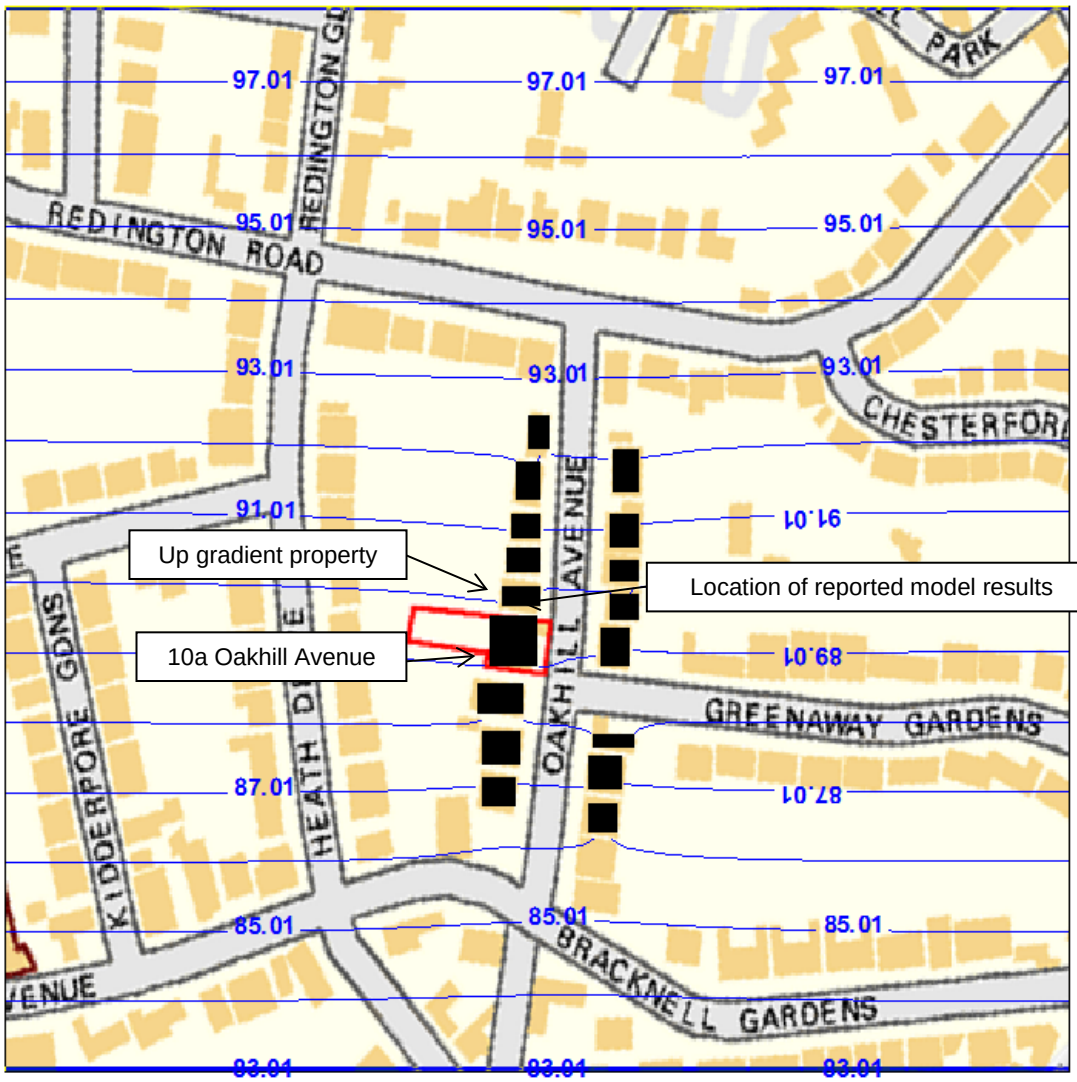


Figure 4.2 Cumulative Impact Assessment Model predictions
(Contours are in m above an arbitrary datum).

5 IMPACT ASSESSMENT

5.2 IMPACTS ON GROUNDWATER FLOWS

The up-gradient adjacent property (to the northeast) is 5 m away from the proposed basement and the lowest point is approximately 2.5 m above the estimated lowest point of the proposed basement. Given that the adjacent property exists up-gradient of the Site it is probable that transmissive horizons of permeable material would be intersected by the adjacent property up-gradient of the proposed development. In this case the volume of water currently transmitted through this body would be reduced and the estimate of 0.75 m^3/day could, in reality, be much smaller, which would reduce any potential impact.

The Claygate Member will be mostly removed beneath the proposed development (figure 3.1). This means that the groundwater flow will be diverted around the proposed basement where the basement penetrates the London Clay

The development is expected to cause a relatively minor obstruction of groundwater flow leading to slightly increased flows around the proposed basement and a negligible increase in groundwater elevation on the up-gradient side of the Site. Groundwater modelling was used determine the likely scale of the impact (see section 4).

Groundwater modelling shows that the proposed development would likely cause a 0.39 m rise in water levels adjacent to the neighbouring basement. As stabilised water levels are shown to between 3.62 and 4.14 m below ground level up-gradient of the proposed development, the 0.39 m rise is within the observed fluctuation range recorded at Site in May 2013. The groundwater level up-gradient of the site at BH1, where the 0.4 m rise is predicted, was between 3.55 and 4.14 m below ground level (mbgl) in May 2013. There is no data to determine the natural fluctuation range and thus winter groundwater levels are uncertain, however the predicted rise is not expected to cause groundwater levels to exceed the ground level at the upgradient side of the site. At the down-gradient side of the site (BH3) the groundwater level is shallower due to the lower ground level (minimum observed 1.07 mbgl), however the groundwater levels are not predicted to rise on the downgradient side of the site.

Down-gradient properties are also not expected to be affected by the development, because of their distance from the development and the small predicted changes to groundwater levels.

Cumulative Impact on Groundwater Flows

The cumulative impact of the proposed basement was assessed under a scenario in which every house in Oakhill Avenue (see Figure 4.2) constructed a basement that fully penetrated the London Clay, intercepting the groundwater flow. This was assessed by further groundwater modelling. The results of this indicated an additional rise of 0.01 m above that established for the previous modelling for the same location (0.40 m in total). Additionally, the groundwater adjacent to the property on the opposite side of 10A Oakhill Avenue saw a 0.07 m rise in groundwater levels following the implementation of the proposed basement into the model. The predicted rise is lower than the observed fluctuation range of groundwater levels recorded at Site in May 2013 and represents a potential maximum rise, with any average long term increase most likely to be less.

5.3 IMPACTS ON SURFACE WATER FLOWS AND FLOODING

The majority (87%) of the proposed basement will be located beneath the footprint of the proposed development. However as the entire development, inclusive of basement will extend beyond the current development on Site, resulting in reduction in permeable surface on-Site.

The total Site area is 1240.45 m^2. Prior to development, the Site consisted of and impermeable surface area amounting to 645.75 m^2 which will increase to 715.0 m^2 as result of the proposed development. This is an increase in impermeable surface at the Site of 69.25 m^2 from pre-development conditions.

Due to the increase in impermeable surface at the Site as a result of the proposed development, inclusive of the basement development, additional surface water (e.g. rainfall and run-off) is expected at the Site. Subsequently measures will have to be taken to attenuate this additional surface water following the competition of a sustainable drainage system assessment and detailed drainage design.

Cumulative Assessment on Surface Water Flows and Flooding

The cumulative impact of the proposed basement under a highly conservative scenario in which every house in Oakhill Avenue (see Figure 4.2) constructed a basement was considered. Given that the area is not known to have any history of surface water flooding and assuming that the other basements on Oakhill Avenue do not increase the impermeable area to a significant degree, and incorporate appropriate drainage systems, there will be no additional cumulative impact compared to the individual impact of this development on surface water flows and related flooding.

6 CONCLUSIONS

Potential impacts of the proposed basement development at 10a Oakhill Avenue have been considered as set out in the scope of works. The following summary conclusions are drawn.

6.1 Surface Water

- The Site does not fall within the catchment of the pond chain on Hampstead Heath and will therefore not impact on the water supply to the pond chain.
- The majority (87%) of the basement development will be located beneath the footprint of the proposed lower ground floor development on-Site with the exception of 82m^2.
- Given that the proposed development on-Site, inclusive of the basement development, will result in an increase in impermeable surface on Site, additional surface water (e.g. rainfall run-off) is expected at the Site.
- There are no known watercourses within 100 m of the Site; thus the change in permeable/impermeable surface at the Site is unlikely to cause any detrimental impact to surrounding surface water courses.
- The Site is at low risk from surface water flooding. There is no documented historical surface water flooding at the Site and the Site falls outside of identified flood risk zones. Furthermore, the Site is not at risk of flooding from rivers or reservoirs
- The “lost river” Westbourne is located approximately 105 m north of the proposed basement (at its closest point) and flows in a south-westerly direction. However, given the distance from the proposed basement, it is unlikely that there will be any influence on the proposed development.
- The overall risk from the proposed development, inclusive of basement, is considered to be **low to medium** in terms of impact to surface water, subject to a Sustainable Drainage System assessment and detailed drainage design.
- Given that the area is not known to have any history of surface water flooding and assuming that the other basements on Oakhill Avenue do not increase the impermeable area to a significant degree, there will be no additional cumulative impact compared to the individual impact of this development.

6.2 Groundwater

- The proposed basement will be constructed to an elevation of 88.65 mAOD into the underlying Claygate Member (approximately 5m thick) and London Clay Formation. The Claygate Member is a Secondary A Aquifer, and is of generally low permeability with horizons of higher permeability material. Groundwater flow within the Claygate member will preferentially occur along these horizons at an estimated hydraulic conductivity of 10 m/d.
- The underlying London Clay is classed as unproductive Strata and is unlikely to permit significant groundwater flow. No superficial deposits are anticipated on Site.
- Groundwater modelling used to assess the impact of the basement development on groundwater suggests that the proposed development would likely cause a 0.39 m rise in water levels adjacent to the neighbouring basement. This rise is lower than the observed fluctuation range recorded at Site during May 2013 and the natural variation is likely to be much higher than this, so the rise is not considered to be significant compared to the natural fluctuation range.
- There is no data to determine the natural fluctuation range in groundwater level and thus winter groundwater levels are uncertain, however the predicted rise is not expected to cause groundwater levels to exceed the ground level at the up-gradient side of the site.

- At the down-gradient side of the site the groundwater levels are not predicted to rise.
- There are no known watercourses, wells (used/disused), ponds or potential spring lines within 100 m of the Site.
- Given the evidence to date, the overall risk from the proposed development is considered to be **low** in terms of impact to groundwater.
- The cumulative impact of the proposed basement under a highly conservative scenario was assessed using further groundwater modelling. The results of this indicated an additional rise of 0.04 m above that established for the previous modelling for the same location (0.40 m in total). Additionally, the groundwater adjacent to the property on the opposite side of 10A Oakhill Avenue saw a 0.07 m rise in groundwater levels following the implementation of the proposed basement into the model. These rises are very small compared to the natural fluctuation range of groundwater levels at this location.

6.3 Recommendations

- A Sustainable Drainage System Assessment and detailed drainage design is recommended as part of the detailed development design to assess and manage the additional surface water/run-off that will need to be attenuated on Site and/or discharged appropriately.
- Dewatering should be undertaken during development and a watching brief should be maintained throughout construction. Any change in groundwater conditions from those anticipated (e.g. significant changes in groundwater levels or flows) should be alerted to the Local Authority.

7 REFERENCES

Arup, 2008. Royal Borough of Kensington & Chelsea Town Planning Policy on Subterranean Development Phase 1 - Scoping Study DRAFT, June 2008.

Barton, N., 1992. The Lost Rivers of London, revised edition. Historical Publications Ltd. London.

British Geological Survey, 2013 (A). Received 23/04/13 from http://mapapps.bgs.ac.uk/geologyofbritain/home.html.

British Geological Survey, 2013 (B). Geoindex. Received 23/04/13 from http://mapapps2.bgs.ac.uk/geoindex/home.html

Camden Council, 2011. Camden Planning Guidance: Basements and lightwells. London Borough of Camden, CPG4.

Environment Agency, 2015. What's in your backyard website. Last accessed February 2015.

Hiscock, 2009. Hydrogeology: principles and practice. Blackwell Science Ltd. Oxford.

KeyGS, 2015. Slope Stability and Ground Movement Assessment Report. Ref 15-061-R-001

Soil Consultants Ltd, 2015. Factual Ground Investigation. Ref 9374/MC/AW [Rev 1].

Soil Consultants Ltd, 2015. Land Stability Report. Ref 9374D/MC/AW [Rev 0].

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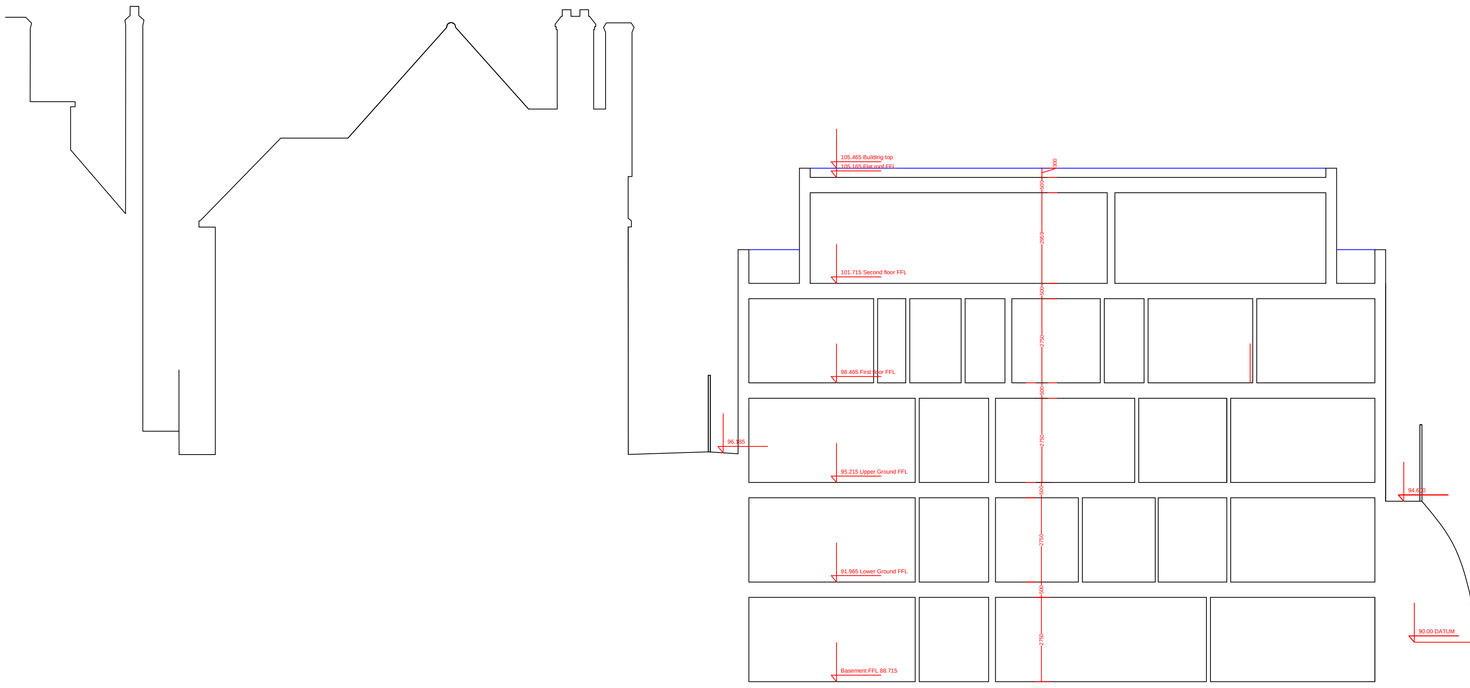
APPENDICES

APPENDIX A

Site Plans



Section B-B

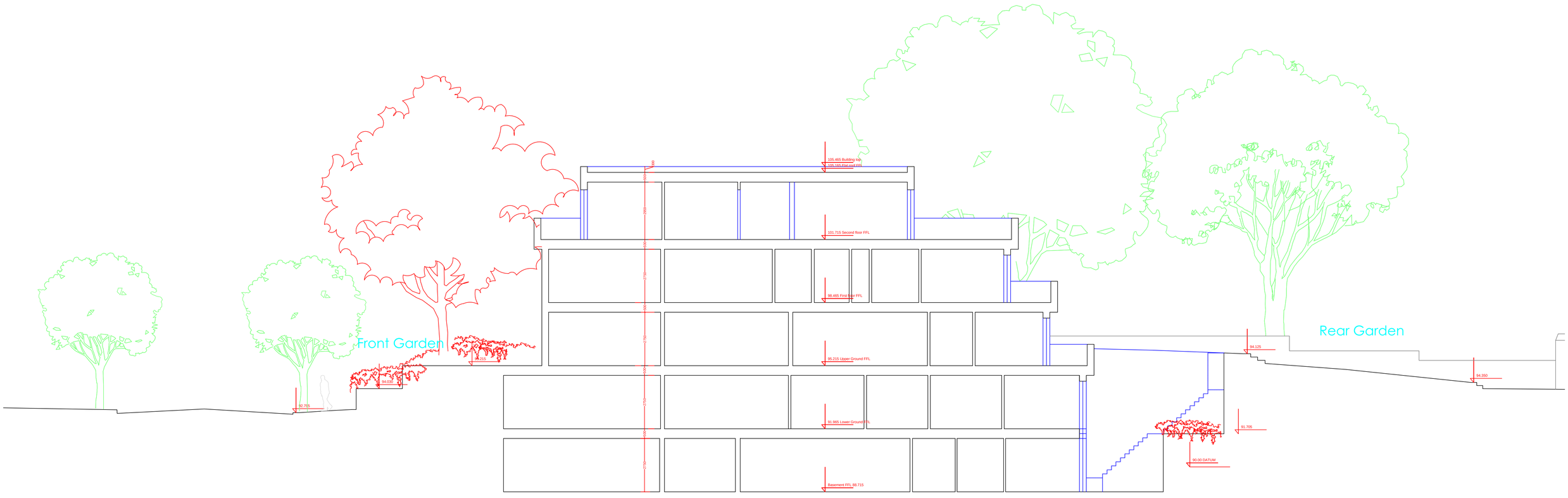
Section B-B

-		
Revision	Date	Comment
Issue		For comment

ad design concepts planning - architecture - interiors

Project	10a Oakhill Avenue, London NW3
Drawing Title:	Proposed section B-B
Drawing Number:	99-201
Revision:	
Date:	January 2014
Scale:	1:100@A1; 1:200@A3

AD Design Concepts Ltd - 25 Gainsboro Gardens London NW3 1AL - www.adconcepts.co.uk - tel 02082983143 - fax 02084551424 - email: info@adconcepts.co.uk



Section A-A

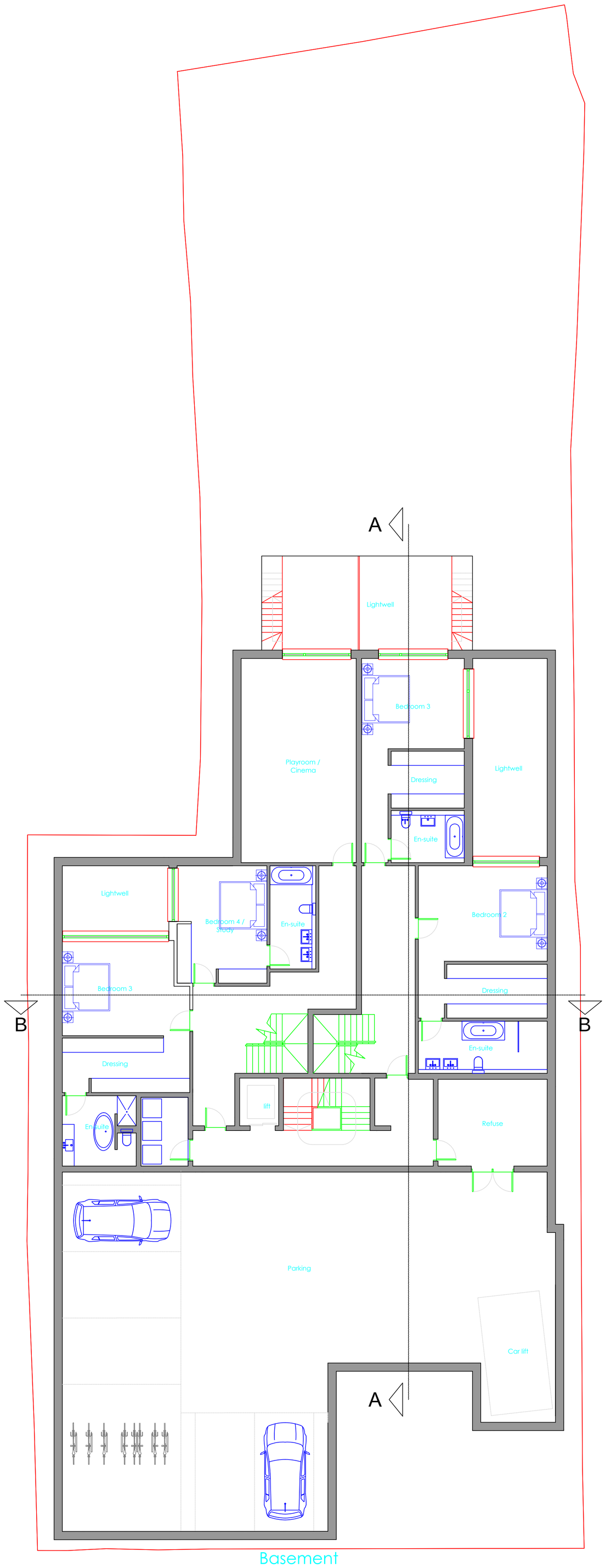
Section A-A

-		
Revision	Date	Comment
Issue		For comment

ad design concepts planning - architecture - interiors

Project	10a Oakhill Avenue, London NW3
Drawing Title:	Proposed section A-A
Drawing Number:	99-200
Revision:	
Date:	January 2014
Scale:	1:100@A1; 1:200@A3

AD Design Concepts Ltd • 25 Gerrards Gardens, London NW2 1JH • www.addconcepts.co.uk • tel: 02089089343 • fax: 02084551494 • e-mail: info@addconcepts.co.uk



Basement floor

-		
Revision	Date	Comment
Issue		For comment

ad design concepts planning - architecture - interiors

Project	10a Oakhill Avenue, London NW3
Drawing Title:	Proposed basement plan
Drawing Number:	99-010
Revision:	
Date:	November 2014
Scale:	1:100@A1; 1:200@A3

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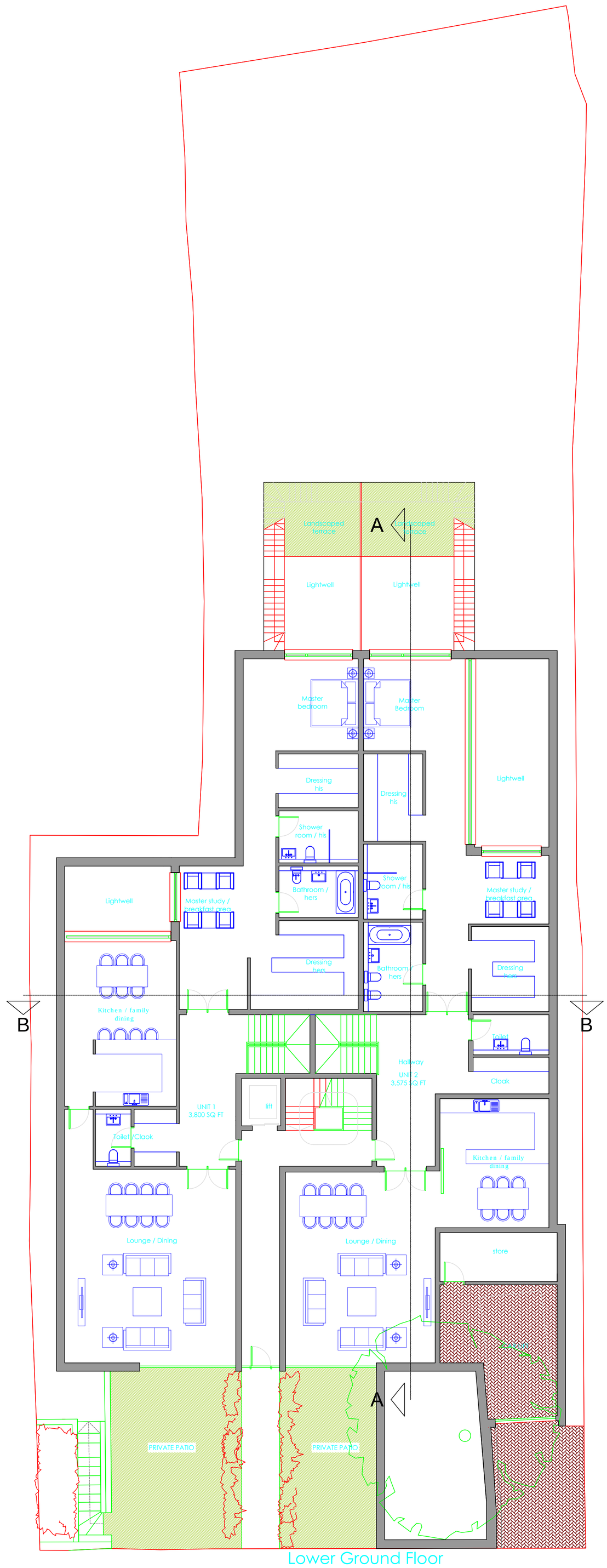

Lower Ground Floor

Lower ground floor

-		
Revision	Date	Comment
Issue		For comment

ad design concepts planning - architecture - interiors

Project	10a Oakhill Avenue, London NW3
Drawing Title:	Proposed lower ground floor plan
Drawing Number:	99-011
Revision:	
Date:	November 2014
Scale:	1:100@A1; 1:200@A3

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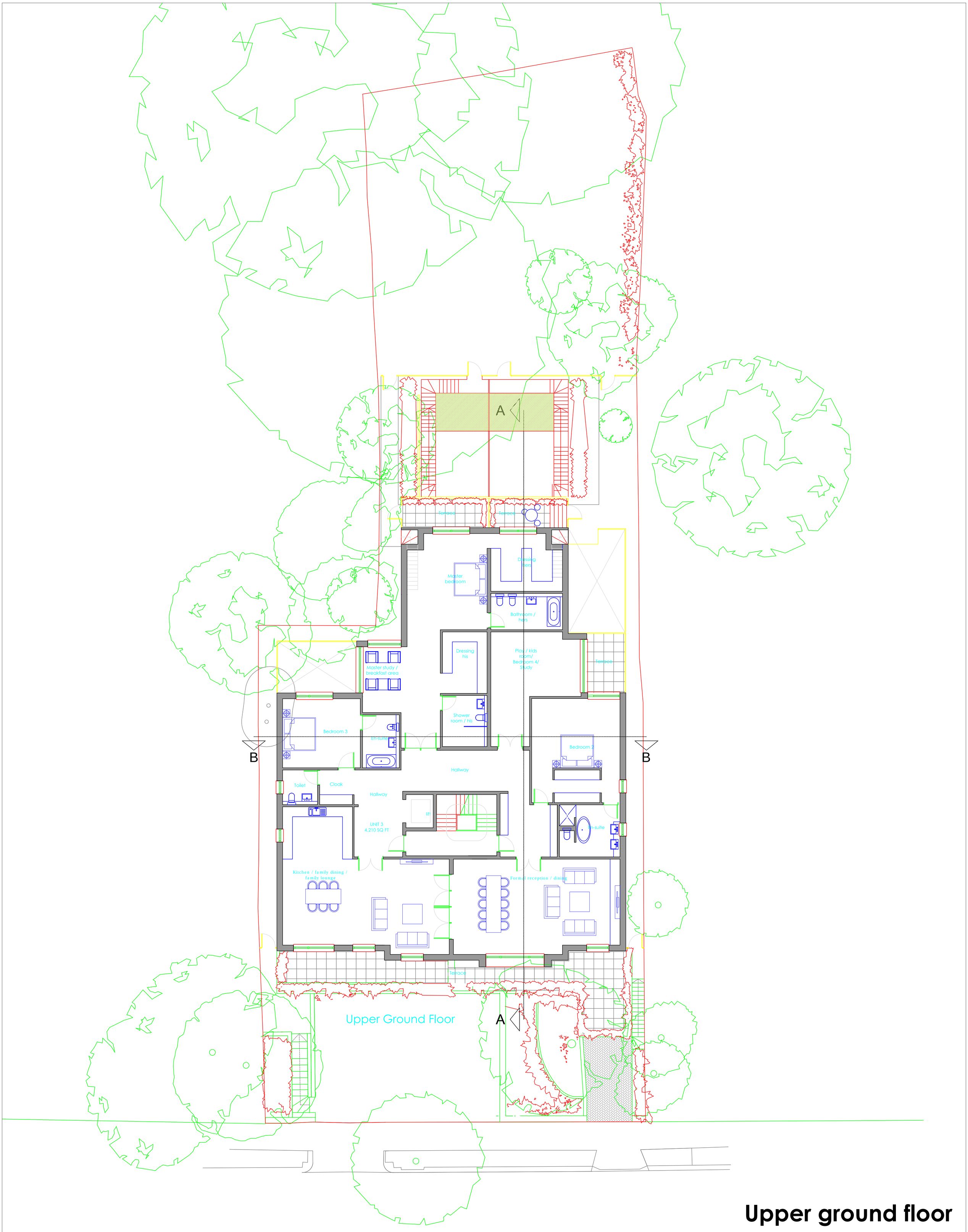

Upper ground floor

-		
Revision	Date	Comment
Issue		For comment

ad design concepts planning - architecture - interiors

Project	10a Oakhill Avenue, London NW3
Drawing Title:	Proposed upper ground floor plan
Drawing Number:	99-012
Revision:	
Date:	November 2014
Scale:	1:100@A1; 1:200@A3

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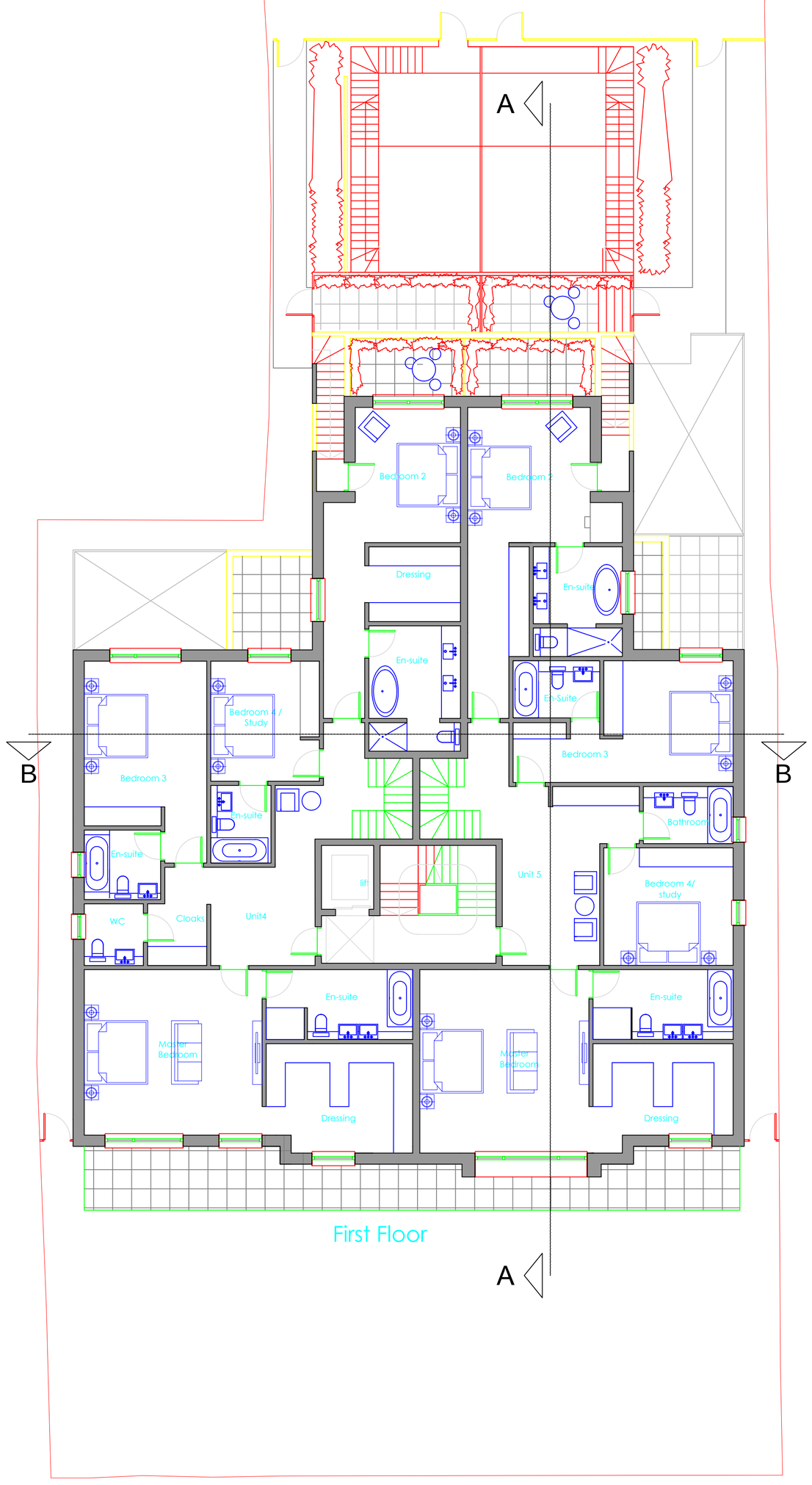

First floor

-		
Revision	Date	Comment
Issue		For comment

ad design concepts planning - architecture - interiors

Project	10a Oakhill Avenue, London NW3
Drawing Title:	Proposed first floor plan
Drawing Number:	99-013
Revision:	
Date:	November 2014
Scale:	1:100@A1; 1:200@A3

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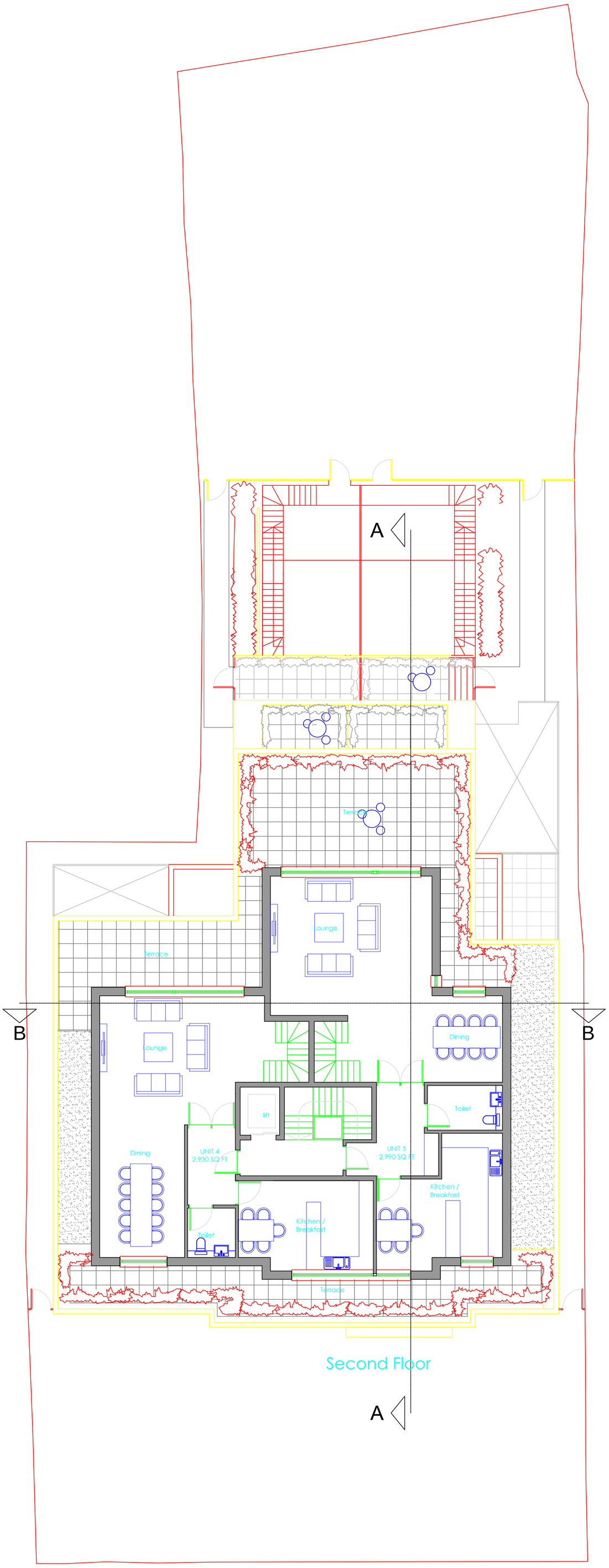

Second floor

-		
Revision	Date	Comment
Issue		For comment

ad design concepts planning - architecture - interiors

Project	10a Oakhill Avenue, London NW3
Drawing Title:	Proposed second floor plan
Drawing Number:	99-014
Revision:	
Date:	November 2014
Scale:	1:100@A1; 1:200@A3

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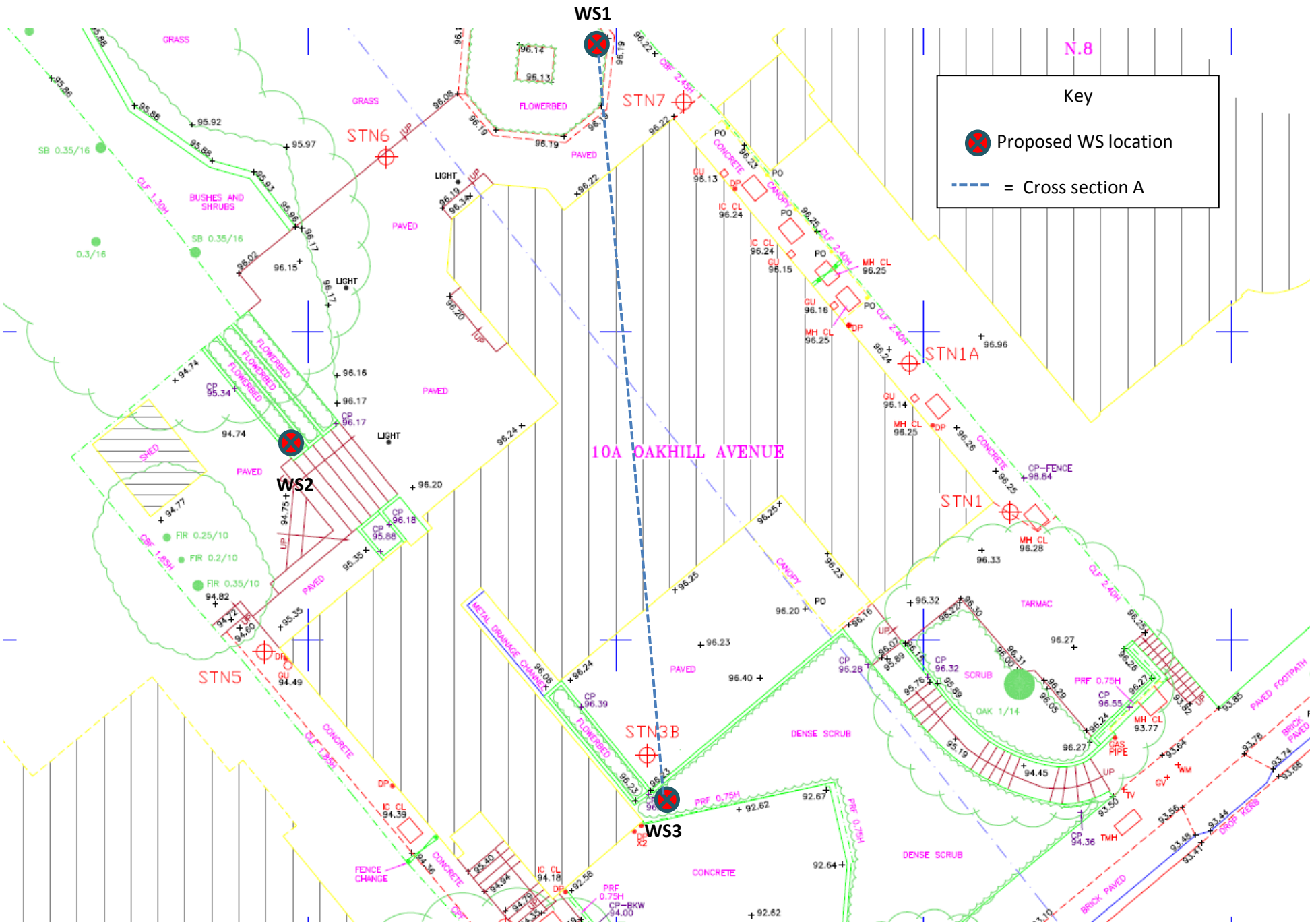
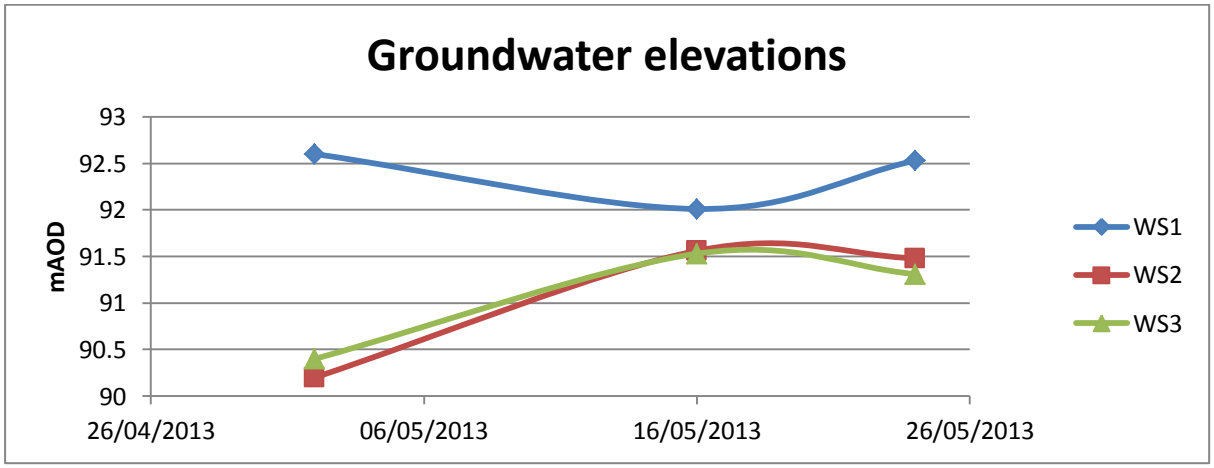
APPENDIX B

BGS Borehole log data


WS1
WS2
WS3
Key
Proposed WS location
= Cross section A
10A OAKHILL AVENUE
N.8
STN1
STN1A
STN3B
STN5
STN6
STN7
GRASS
PAVED
FLOWERBED
CONCRETE
TARMAC
DENSE SCRUB
SCRUB
BUSHES AND SHRUBS
METAL DRAINAGE CHANNEL
PAVED FOOTPATH
BRICK PAVED
DROP KERB
CANOPY
SHED
FENCE CHANGE
GAS PIPE
OAK 1/14
FIR 0.25/10
FIR 0.2/10
FIR 0.35/10
SB 0.35/16
0.3/16
CLF 1.20H
CLF 1.95H
CLF 2.40H
CRF 2.45H
PRF 0.75H
CRF 1.95H
CP-FENCE
CP-BKW

Groundwater data						
	02/05/2013		16/05/2013		24/05/2013	
	GW Strike (mAOD)	Rest water Level (mAOD)	Rest water Level (mAOD)	Change (m)	Rest water Level (mAOD)	Change (m)
WS1	91.75	92.6	92.01	-0.59	92.53	0.52
WS2		90.2	91.56	1.36	91.48	-0.08
WS3		90.4	91.53	1.13	91.31	-0.22



Site	**10a Oakhill Avenue**	Borehole No: **WS1**
Location	**London NW3 7RE**	
Client:		Sheet **1 of 3**
Engineer:	**ESI Ltd**	Report No: **9374/MC**

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]	Strata Level[mOD]	Strata Description
Borehole conducted: 02 May 2013				0.00	+96.15	Grey stone dressing over TOPSOIL: Soft, very dark grey-brown, slightly sandy and gravelly, organic silt. Gravel is of ash, glass and slate.
	D	0.20		0.30	+95.85	Soft, locally firm, becoming stiff, locally soft and firm, below 2.7m, orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.
	D	0.50				
	D	0.90				
	D	1.20				
	D	1.50				
	D	1.80				
	D	2.10				
	D	2.40				
	D	2.70				
	D	3.00				
	D	3.30				
Groundwater depth 3.55m [60 minutes after completion].						
	D	3.80				
	D	4.30				
Groundwater strike around 4.4m depth						
	D	4.80				

Legend: 0, 1, 2, 3, 4, 5

Constructed using tracked rig with cased percussive sampling system [plastic liner]

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

Remarks :- Groundwater monitoring well installed on completion - see Sheet 3 for details

Ground level interpolated from Kings Land and Architectural Surveyors' survey drawing (ref. 95274.0001)

Borehole No: **WS1**

[* = extrapolated SPT 'N' value]

Soil Consultants

Site	10a Oakhill Avenue	Borehole No:	WS1
Location	London NW3 7RE		
Client:		Sheet	2 of 3
Engineer:	ESI Ltd	Report No:	9374/MC

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]	Strata Level[mOD]	Strata Description	Legend
	D	5.30				*...continued from previous* Stiff, locally soft and firm, orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	
	D	5.80					
				5.95	+90.20	Stiff, fissured, dark grey-brown, slightly sandy silty CLAY, with occasional pockets and partings of silty sand.	
	D	6.30					
	D	6.80					
				7.00	+89.15	End of borehole at 7.00m.	

Constructed using tracked rig with cased percussive sampling system [plastic liner]

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

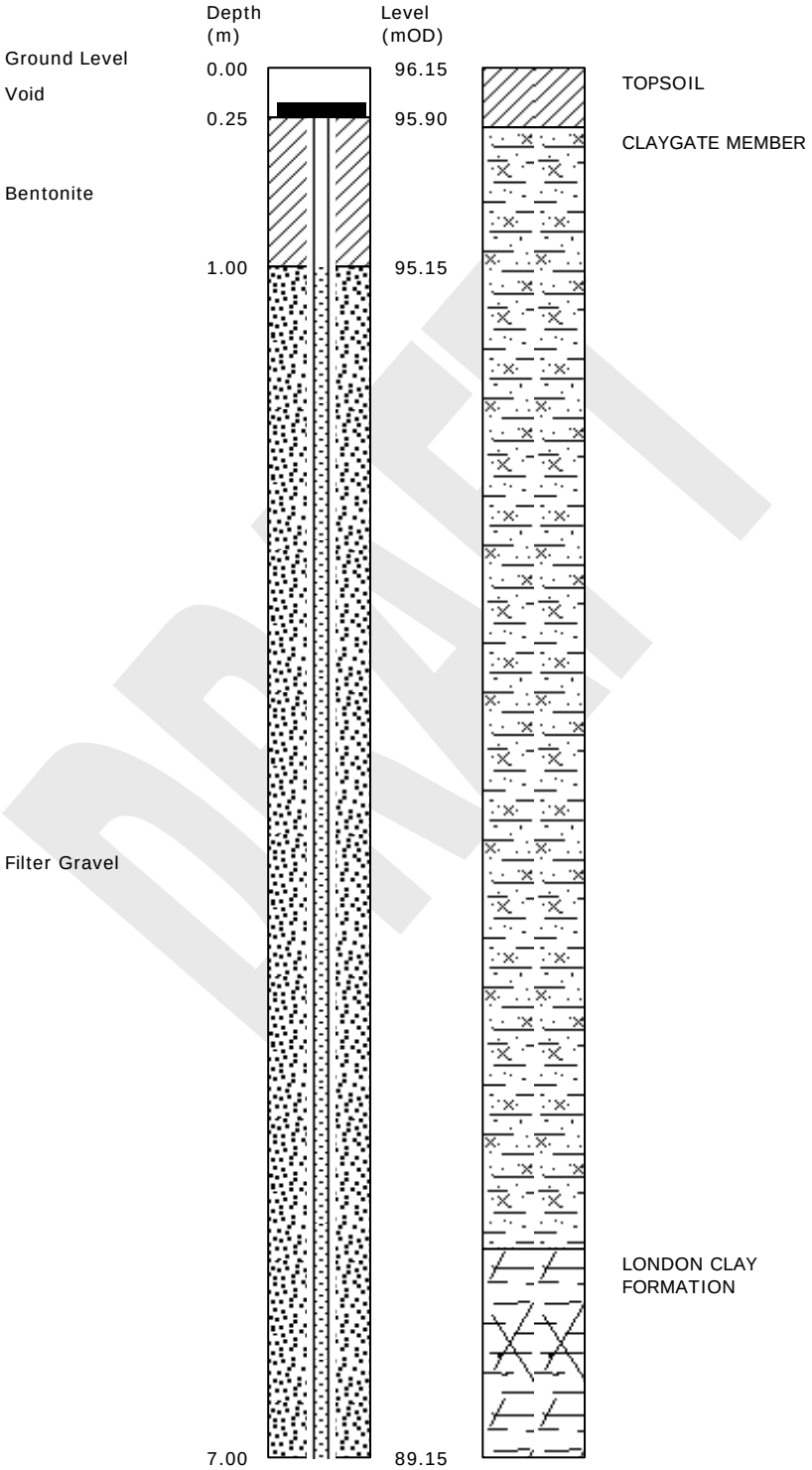
Remarks :-

Borehole No: WS1

[* = extrapolated SPT 'N' value]

Site	**10a Oakhill Avenue**	Borehole No:	**WS1**
Location	**London NW3 7RE**		
Client:		Sheet	**3 of 3**
Engineer:	**ESI Ltd**	Report No:	**9374/MC**

Borehole Installation and Backfill Details



Constructed using tracked rig with cased percussive sampling system [plastic liner]

Remarks :- [i] Pipe diameter: 19mm
[ii] Tip at 7m depth [89.15m OD approx]
[iii] Bung fitted

Borehole No: **WS1**

Site	**10a Oakhill Avenue**	Borehole No: **WS2**
Location	**London NW3 7RE**	
Client:		Sheet **1 of 2**
Engineer:	**ESI Ltd**	Report No: **9374/MC**

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]		Strata Level[mOD]	Strata Description	Legend
Borehole conducted: 02 May 2013				0.00	0	+94.75	MADE GROUND: Paving slab over light orange-brown, slightly silty sand.	0
				0.10		+94.65	TOPSOIL: Soft, very dark grey-brown, slightly sandy and gravelly, organic silt. Gravel is of brick and flint.	
	D	0.25						
	D	0.50						
				0.70		+94.05	Soft, locally firm, becoming stiff, locally soft and firm, below 3.4m, orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	
	D	0.80			1			1
	D	1.10						
	D	1.40						
	D	1.70			2			2
	D	2.00						
	D	2.30						
Rootlets at 2.5m depth.	D	2.60						
	D	2.90			3			3
	D	3.40						
	D	3.90			4			4
	D	4.40						
Groundwater depth 4.55m [10 minutes after completion].								
Borehole dry throughout boring	D	4.90						
				5.00	5	+89.75	End of borehole at 5.00m.	5

Constructed using tracked rig with cased percussive sampling system [plastic liner]

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

Remarks :- Groundwater monitoring well installed on completion - see Sheet 2 for details

Ground level interpolated from Kings Land and Architectural Surveyors' survey drawing (ref. 95274.0001)

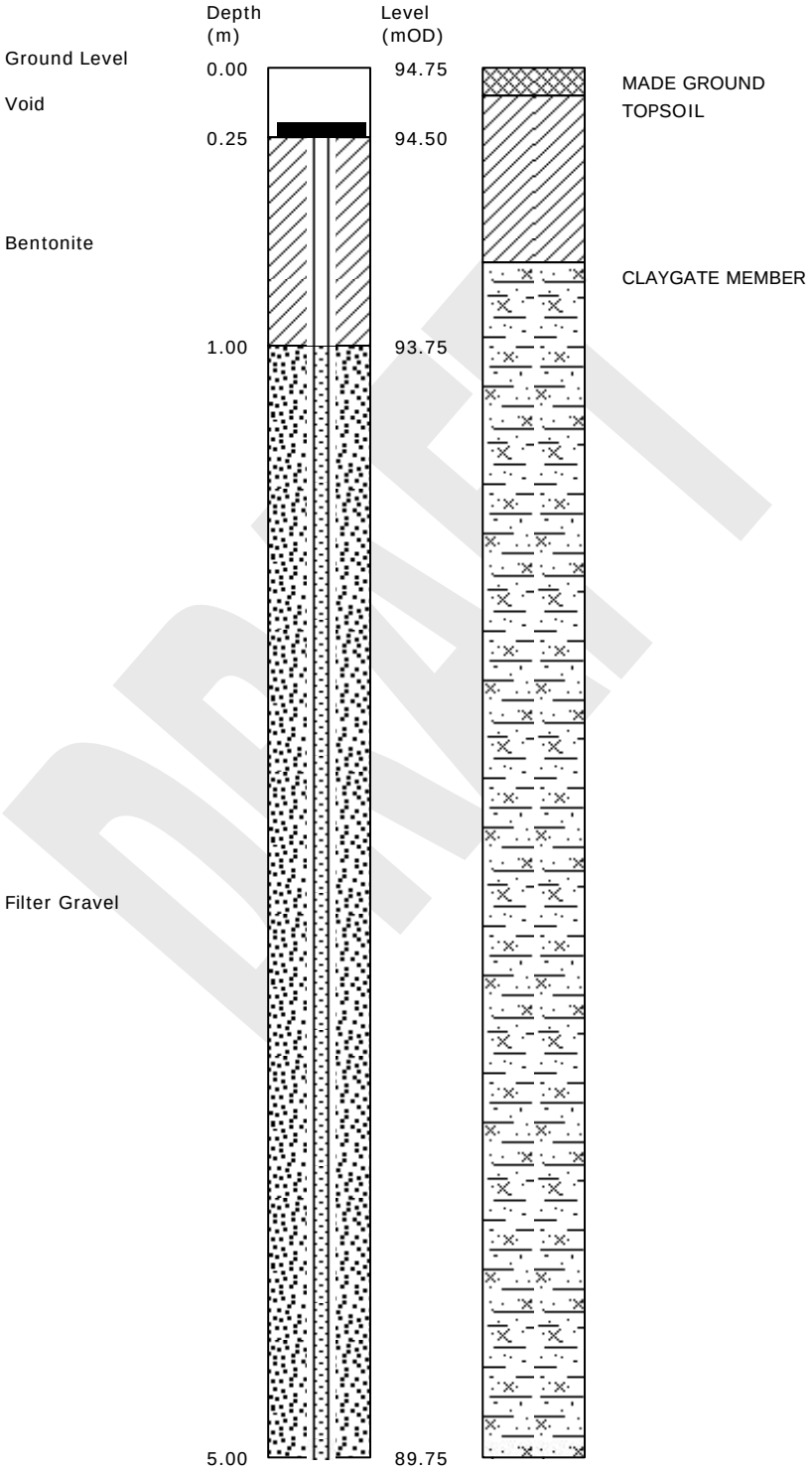
Borehole No: **WS2**

[* = extrapolated SPT 'N' value]

Soil Consultants

Site	**10a Oakhill Avenue**	Borehole No:	**WS2**
Location	**London NW3 7RE**		
Client:		Sheet	**2 of 2**
Engineer:	**ESI Ltd**	Report No:	**9374/MC**

Borehole Installation and Backfill Details



Constructed using tracked rig with cased percussive sampling system [plastic liner]

Remarks :- [i] Pipe diameter: 35mm
[ii] Tip at 5m depth [89.75m OD approx]
[iii] Bung fitted

Borehole No: **WS2**

Site	**10a Oakhill Avenue**	Borehole No: **WS3**
Location	**London NW3 7RE**	
Client:		Sheet **1 of 2**
Engineer:	**ESI Ltd**	Report No: **9374/MC**

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]		Strata Level[mOD]	Strata Description	Legend
Borehole conducted: 02 May 2013				0.00	0	+92.60	MADE GROUND: Reinforced concrete slab.	0
				0.15		+92.45	Firm, becoming stiff, locally firm, below 1.8m, orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	
	D	0.25						
	D	0.50						
	D	0.70						
	D	1.00			1			1
	D	1.30						
	D	1.60						
	D	1.90						
					2			2
Groundwater depth 2.20m [10 minutes after completion].	D	2.20						
	D	2.70						
	D	3.00			3			3
	D	3.50						
	D	4.00			4			4
	D	4.50						
				4.90		+87.70	Stiff, fissured, dark grey-brown, slightly sandy silty CLAY, with occasional pockets and partings of silty sand.	
				5.00	5	+87.60	End of borehole at 5.00m.	5

Constructed using tracked rig with cased percussive sampling system [plastic liner]

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

Remarks :- Groundwater monitoring well installed on completion - see Sheet 2 for details

Ground level interpolated from Kings Land and Architectural Surveyors' survey drawing (ref. 95274.0001)

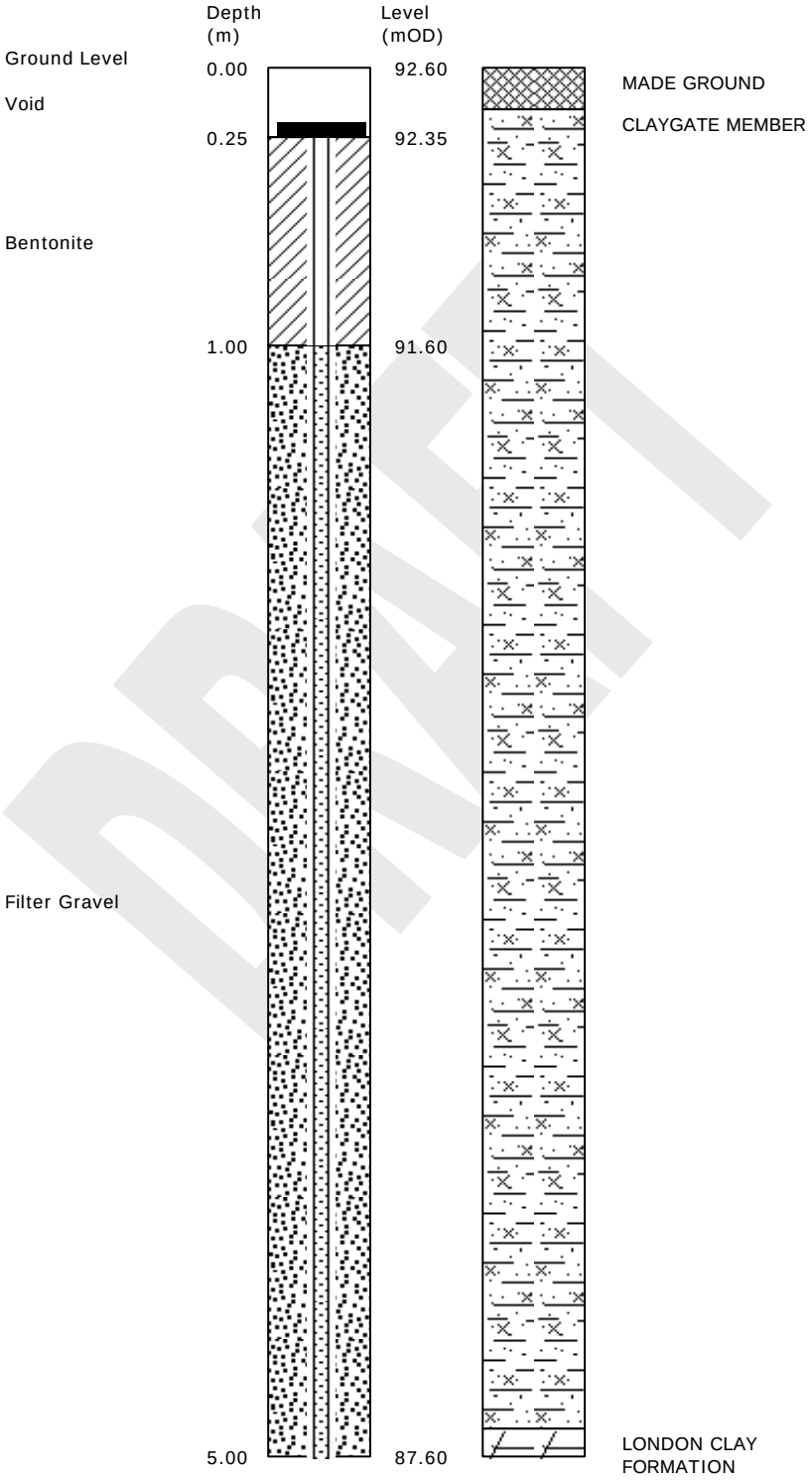
Borehole No: **WS3**

[* = extrapolated SPT 'N' value]

Soil Consultants

Site	**10a Oakhill Avenue**	Borehole No:	**WS3**
Location	**London NW3 7RE**		
Client:		Sheet	**2 of 2**
Engineer:	**ESI Ltd**	Report No:	**9374/MC**

Borehole Installation and Backfill Details



Constructed using tracked rig with cased percussive sampling system [plastic liner]

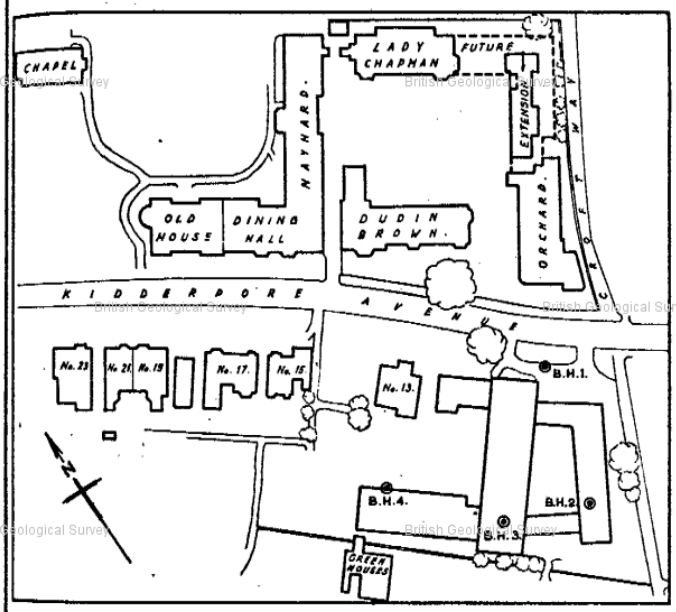
Remarks :- [i] Pipe diameter: 35mm
[ii] Tip at 5m depth [87.6m OD approx]
[iii] Bung fitted

Borehole No: **WS3**

TQ/28NE/119

1" : 256

Fig. 6.



SCALE:- 1:1000

BOREHOLE	DEPTH FT.	GROUND LEVEL Ft.	LONDON CLAY Ft.	WATER LEVEL Ft.	TRIAXIAL TEST RESULTS: SAMPLE DEPTH Ft.	SHEAR STRENGTH OR COHESION (C) lb/sq ft.	ANGLE OF SHEARING RESISTANCE (φ)°
1	50·5	71·7	32·7	51·3	5	(1) 2230	0
					16	(2) 2580	
					21	(3) 2090	0
					41	(4) 2598	
2	35·0	62·0	48·0	37·5	-	-	-
3	50·0	62·3	47·3	55·6	7	(1) 790	0
					16	(2) 1080	
					26	(3) 1800	0
4	35·0	69·1	51·1	62·9	16	(1) 1730	0
					30	2230	

NOTE: ALL LEVELS REFERRED TO CLIENT'S DATUM WHICH IS 326·44 ft. ABOVE N.D.

LOC. 3117. WESTFIELD COLLEGE, HAMPSTEAD N.W.3.
PLAN SHOWING BOREHOLES POSITIONS ON SITE OF NEW SCIENCE BUILDING.

SOIL MECHANICS LTD.
63, OLD CHURCH STREET, LONDON, S.W.3

3119

TQ28NE/119

2587 8575

Fig. 1

BOREHOLE LOG

LOCATION NO. 3117 Westfield College, Hampstead, N.W.3.

CARRIED OUT FOR Council of Westfield College.

BOREHOLE NO. 1 DIAMETER: 8 Inch

GROUND LEVEL: 71.7 above Clients arbitrary datum DATE: 14th to 16th March, 1959

Description	Reduced Level	Legend	Sample	Depth	Thickness	M/c %
	+71.7			0'0"		
Rubble, clinker and gravel MADE GROUND	+69.9		1	1'9"	1'9"	
			2			26
Firm mottled grey and brown sandy clayey SILT becoming brown and more sandy below 7 ft. (CLAYGATE BEDS)			3			24
			4			25
			5		12'9"	24
			6			25
	+57.2		7	14'6"		24
Firm becoming stiff light grey-brown sandy clayey SILT, more clayey below 17 ft. (Probably Claygate Beds)			8		4'6"	30
	+52.7		9	19'0"		26
Stiff dark grey silty CLAY fissured and very stiff below 40 ft. Fine gypsum throughout. (LONDON CLAY)			10			29
			11			25
			12			29
			13			27
			14		31'6"	26
			15			25
			16			25
			17			24
			18			25
			19			25
			20			25
			22 21			29
	+21.2			50'6"		

END OF BOREHOLE

Water Level Observations

Date	Time	Depth of Borehole	Depth of Casing	Depth to Water
16 3 59	0730	14'6"	14'6"	7'4"
17 3 59	0730	50'6"	-	20'6"

Scale: 1 in. = 5 ft. • Disturbed Sample ▮ Core Sample △ Water Sample

SOIL MECHANICS LTD., 65 OLD CHURCH ST., S.W.3

3119 3120 3121 3122 31

TQ28NE/119

2587. 8575

Fig. 2

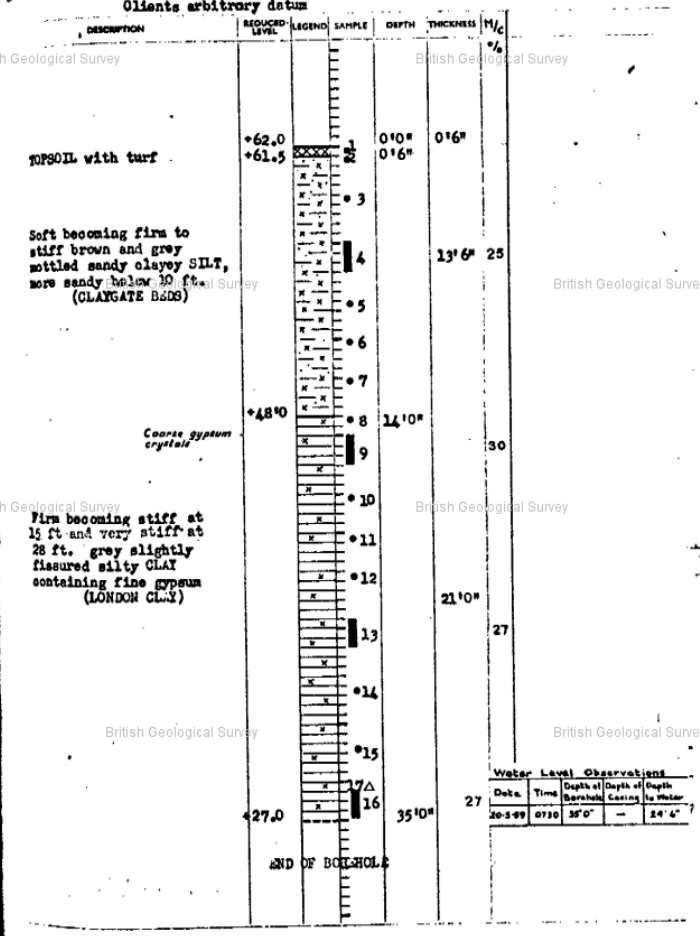
BOREHOLE LOG

LOCATION NO. 3117 Westfield College, Hampstead

CARRIED OUT FOR Council of Westfield College.

BOREHOLE NO. 2 DIAMETER: 8 inches

GROUND LEVEL: 62.0 ft. above Clients arbitrary datum DATE: 19th March, 1959



SOIL MECHANICS LTD., 65, OLD CHURCH ST., S.W.3.

TQ/28NE/119
2537.8575

Fig. 3

BOREHOLE LOG

LOCATION NO. 3117 Westfield College

CARRIED OUT FOR Council of Westfield College

BOREHOLE NO. 3 DIAMETER : 8 inches

GROUND LEVEL : 62.3 ft. above clients arbitrary datum DATE : 20th and 21st March, 1959

Description	Reduced Level	Legend	Sample	Depth	Thickness	%
SOIL with turf	+62.3 +61.3		1 2	0'0" 1'0" 0.31	1'0"	
Firm becoming stiff brown and grey mottled sandy silty CLAY. Very sandy at 5 ft. 6 in. (CLAYGATE BEDS)			3 4 5 6		14'0"	28
Stiff grey slightly fissured silty CLAY with fine gypsum (LONDON CLAY)	+47.3		7 8 9 10 11 12 13 14 15	15'0" 4.57		29 20
Each find gypsum 39 ft. and 1 large septarian nodule.			16 17 18 19 20		35'0"	29
	+12.3		21	50'0" 15.24		

END OF BOREHOLE

Water Level Observations				
Date	Time	Depth of Borehole	Depth of Casing	Depth to Water
21-3-59	0730	41'0"	20' 0"	6' 6"

Scale: 1 in. = 5 ft. • Disturbed Sample ▮ Core Sample △ Water Sample

SOIL MECHANICS LTD, 65 OLD CHURCH ST, S.W.3.

3119 3120 3123 3124 3125

TQ/28NE/119

2537.8575

Fig. 4

BOREHOLE LOG

LOCATION NO. 3117 Westfield College, Hampstead

CARRIED OUT FOR Council of Westfield College.

BOREHOLE NO. 4 DIAMETER: 8 inches

GROUND LEVEL: 69.1 ft. above clients arbitrary datum DATE: 17th and 18th March, 1959

DESCRIPTION	REDUCED LEVEL	LEGEND	SAMPLE	DEPTH	THICKNESS	M/c %
TOPSOIL with turf.	+69.1 +68.6	XXXX	1 2	0'0" 0'6"	0'6"	
Soft becoming firm (below 5 ft.) grey and brown mottled sandy silty CLAY (CLAYGATE BEDS)			3 4		14'6"	30
More Sandy			5 6 7			
	+54.1		8	15'0"	3'0"	28
Firm brown and grey mottled sandy clayey SILT (Probably Claygate Beds)	+51.1		9	18'0"		
Firm to stiff grey sandy silty CLAY with shell fragments and fine gypsum. (LONDON CLAY)			10 11 12 13 14		12'0"	26
	+39.1		15	30'0"		24
Stiff grey slightly fissured silty CLAY with fine silt laminations and shell fragments (LONDON CLAY)			16		5'0"	
	+34.1		17	35'0"		26
END OF BOREHOLE						

Water Level Observations				
Date	Time	Depth of Borehole	Depth of Casing	Depth to Water
19-3-59	0730	35' 0"	-	6' 2"

Scale 1 in. = 5 ft. • Disturbed Sample | Core Sample △ Water Sample

SOIL MECHANICS LTD., 65, OLD CHURCH ST., S.W.3.

B/1 (1965)

Height 405.08 O.D.

TQ/28NE/103

2608. 8603.

	Thickness (ft)	Depth (ft)
Top Soil	¼	
Brown sand with stones	4½	¼
Brown sandy mottled clay	4¼	4½
Firm brown clay with layers of sand	32	9
Very sandy brown clay	8½	41
Silt with layers of silty clay	11	49½
Soft brown mottled silty clay	2½	60½
Silt with layers of silty clay	8	63
Firm silty blue clay	11	71
Hard blue clay with layers of sand	37½	82
	119½	

? 81 ft Wash

DB

CB

B/HL (1968)

TQ/28NE/104 c. 370'+OD

2603. 8603.

	Thickness (ft)	Depth (ft)
Dirty sand	4	
Silty clayey sand	38	4
Silty grey clay	2	42
Silty sand	6	44
Grey silt (liquid)	10	50
Grey clay	10	60
	70	

BB

CB

KEY PLAN AT BACK OF REPORT.

APPENDIX C

Thames Water Sewer Flooding History Enquiry

Sewer Flooding

History Enquiry

Thames Water Property Searches
12
Vastern Road
Reading
RG1 8DB

Search address supplied 10 A
Oakhill Avenue
London
NW3 7RE

Your reference N/A

Our reference SFH_SFH_Standard_2013_2460512

Search date **29 April 2013**

Thames Water Utilities Ltd

Property Searches
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
F 0118 923 6655/57
E searches@thameswater.co.uk
I www.thameswater-propertysearches.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Sewer Flooding

History Enquiry

Search address supplied: 10 A, Oakhill Avenue, London, NW3 7RE

This search is recommended to check for any sewer flooding in a specific address or area

TWUL, trading as Property Searches, are responsible in respect of the following:-

(i) any negligent or incorrect entry in the records searched;

(ii) any negligent or incorrect interpretation of the records searched;

(iii) and any negligent or incorrect recording of that interpretation in the search report

(iv) compensation payments

Thames Water Utilities Ltd

Property Searches
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
F 0118 923 6655/57
E searches@thameswater.co.uk
I www.thameswater-propertysearches.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Sewer Flooding

History Enquiry

History of Sewer Flooding

Is the requested address or area at risk of flooding due to overloaded public sewers?

The flooding records held by Thames Water indicate that there have been no incidents of flooding in the requested area as a result of surcharging public sewers.

Although Thames Water does not have records of public sewer flooding within the vicinity, please be aware that property owners are not legally obliged to report this flooding to Thames Water. In addition flooding from private sewers, watercourses and highways drains are not the responsibility of Thames Water, and such incidents may not be noted in our records. We therefore strongly advise you to contact the current owners and occupiers of the premises and inquire about sewer flooding.

For your guidance:

- A sewer is "overloaded" when the flow from a storm is unable to pass through it due to a permanent problem (e.g. flat gradient, small diameter). Flooding as a result of temporary problems such as blockages, siltation, collapses and equipment or operational failures are excluded.
- "Internal flooding" from public sewers is defined as flooding, which enters a building or passes below a suspended floor. For reporting purposes, buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.
- "At Risk" properties are those that the water company is required to include in the Regulatory Register that is presented annually to the Director General of Water Services. These are defined as properties that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system more frequently than the relevant reference period (either once or twice in ten years) as determined by the Company's reporting procedure.
- Flooding as a result of storm events proven to be exceptional and beyond the reference period of one in ten years are not included on the At Risk Register.
- Properties may be at risk of flooding but not included on the Register where flooding incidents have not been reported to the Company.
- Public Sewers are defined as those for which the Company holds statutory responsibility under the Water Industry Act 1991.
- It should be noted that flooding can occur from private sewers and drains which are not the responsibility of the Company. This report excludes flooding from private sewers and drains and the Company makes no comment upon this matter.
- For further information please contact Thames Water on Tel: 0845 9200 800 or website www.thameswater.co.uk

Thames Water Utilities Ltd

Property Searches
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
F 0118 923 6655/57
E searches@thameswater.co.uk
I www.thameswater-propertysearches.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

APPENDIX D

Site Investigation Report

Report Reference: 61458R1D1
Report Status: First Draft

Soil Consultants
Ground Investigation
Geotechnical Analysis
Contamination Assessment

FACTUAL REPORT ON GROUND INVESTIGATION

PROPOSED REDEVELOPMENT:

10a OAKHILL AVENUE, LONDON NW3 7RE

Client:	**ESI Ltd** **New Zealand House** **160 Abbey Foregate** **Shrewsbury** **SY2 6FD**
Report ref:	**9374/MC/AW**
Date:	**27th February 2015 [Rev 1]**

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Haven House, Albemarle Street
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CF5 1FH
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Registered in England No 1814762 – 36 Harefield Road, Uxbridge, Middlesex UB8 1PH
VAT No 491 8249 15

FACTUAL REPORT ON GROUND INVESTIGATION

PROPOSED REDEVELOPMENT:

10a OAKHILL AVENUE, LONDON NW3 7RE

DOCUMENT ISSUE STATUS:

Issue	Date	Description	Author	Checked / approved
Rev 0	24 May 2013	First issue	Matthew Clarke	Alan Watson
Rev 1	27 February 2015	Revised Client details	Matthew Clarke BSc(Hons) MSc(Dipl) CGeol FGS	Alan Watson BSc (Eng) CEnv CEng MICE

TABLE OF CONTENTS

APPENDIX

1.0 INTRODUCTION

It is proposed to demolish the existing buildings of No. 10a Oakhill Avenue, London NW3 7RE, and to construct a new residential building with four storeys above ground. The design will extend the existing front-aspect lower ground floor level to become a rear-aspect basement and, across some of the existing footprint, extend down for an additional basement level and a swimming pool.

This report presents the findings of a geotechnical ground investigation.

The site is also the subject of a further report: Soil Consultants Limited's, 'Land Stability Report' [Ref 9374D/MC/AW, dated February 2015].

This Report has been prepared for the benefit of the Client and associated parties directly involved with the design and construction of the project under direction of the Client. No reliance can be assumed by others without written agreement from Soil Consultants Limited.

2.0 SITE DESCRIPTION

The site of our investigation comprises the existing residential buildings, at number 10a Oakhill Avenue, in the Frognal and Fitzjohns district of the London Borough of Camden, at postcode NW3 7RE and approximate National Grid Reference 525690E, 185715N.

The site, which is approximately rectangular on plan, extends for some 23m along the northern side of Oakhill Avenue and 60m towards the north-west - covering an area of around 1135m². The existing buildings have a maximum of four above-ground storeys, including the front-aspect lower ground floor and are set amidst hardstanding with peripheral soft landscaping to the front and a garden to the rear. The site is bounded by further residential properties along Oakhill Avenue to the front and side and also to the rear, on Heath Drive.

The general topography slopes gently down, from Parliament Hill 500m to the NE, towards the River Westbourne, some 2.9km to the SW. The site is at an approximate elevation of +93mOD, although there are various elevation changes across the site: from a maximum of +96.25mOD near to the northern corner of the existing building, to +92.20mOD at the southern street boundary. Oakhill Avenue descends the hill along the steepest gradient and there is a fall across the length of the property of around 2.0m. The property is partially cut into the hillside and the southern half has been cut [by some 2.5m] to form an area of level hardstanding, providing access to lower ground floor garages, that are at street level at that end of the site. The northern half of the property is fronted by a terrace garden, which is accessed by stairway; rising from street level to the general 'ground floor' level of +96.2mOD. This general level extends, apart from a western corner of the rear garden which is at a lower elevation, to a point approximately mid-way along the property's length. From here the site slopes down by around 2.0m to the northern boundary.

There are rows of mature trees within the pavement on both sides of Oakhill Avenue and several mature trees, including oaks, within the gardens of the property and neighbouring properties. It is understood that the site has been the subject of an arboricultural survey and it is recommended that this be consulted with regard to tree locations, conditions, height and species.

The current site features are shown on the Site Plan which is included in the Appendix.

3.0 EXPLORATORY WORK

The ground investigation was carried out in May 2013 and the property was in residential occupancy. Potential locations for exploratory holes were therefore limited to those deemed suitable to avoid impeding site usage.

Our investigation comprised the following elements.

Window sample boreholes

Three window sample boreholes [WS1 to WS3] were completed using hand held/operated equipment under the supervision of an experienced geotechnical engineer. This technique involves driving hollow tubes of gradually reducing diameter into the ground using a hydraulically driven jackhammer. After each tube reaches the desired depth, it is removed using hydraulic jacks and the next tube is then driven. This method provides a near-continuous profile of the soil. Pocket penetrometer shear strength testing was performed at various depths and representative samples were taken for geotechnical and environmental testing. Monitoring pipes were installed in each borehole.

Groundwater monitoring

Water monitoring was carried out on two occasions following completion of the site works on 16th May and 24th May 2013.

Geotechnical laboratory testing

The following geotechnical laboratory testing was completed:

- moisture content profiling
- index properties tests [Atterberg Limits]
- pH and water-soluble sulphate tests [by QTS Environmental]

The engineering logs of the exploratory holes and the laboratory testing results to-date are included in the Appendix. The pH and sulphate results are pending and will be appended.

4.0 GROUND CONDITIONS

The geological survey map of the area indicates that the site is underlain by horizons of the London Clay Formation, with the uppermost unit, the Claygate Member at surface. Our investigation confirmed this sequence, beneath a thin cover of topsoil and made ground.

4.1 Made ground

Boreholes WS2 and WS3 were located in areas of existing hard-standing, which was 0.10m and 0.15m thick and comprised paving slabs and tarmac hardstanding, respectively.

4.2 Topsoil

Beneath the paving slab in WS2 and from surface in WS1 was soft, very dark grey-brown, slightly sandy and gravelly, organic silt topsoil. This extended to 0.30m in WS1 and included gravel-size pieces of ash, glass and slate; and in WS2 it extended to 0.70m and included gravel of brick and flint.

4.3 Claygate Member

The Claygate Member was met beneath the made ground and topsoil and, where proven, extended to depths of between 5.95m [+90.20mOD] and 4.90m [+87.70mOD]. This deposit comprised orange-brown and light orange-brown, sandy, silty clay, with pockets and partings of silty sand.

The Claygate Member was of soft, locally firm, becoming stiff consistency, but was locally soft and firm amidst the stiff. Atterberg Limits tests show these to be of low to intermediate plasticity in the Casagrande classification and, in the NHBC definition, to be soils of low volume-change potential.

Live rootlets were observed only within WS2, at a depth of 2.5m.

4.4 London Clay

The London Clay comprised fissured, dark grey-brown, slightly sandy, silty clay, with occasional pockets and partings of silty sand. The proportion of sand was lower than in the Claygate Member and the sandy pockets less frequent. Where proven the upper surface was present at depths of 4.90m and 5.95m. The London Clay was of stiff consistency.

This formation extended to the base of boreholes WS1 and WS3, at depths of 7.00m [89.15mOD] and 5.00m [87.60mOD].

4.5 Ground-water

Ground-water was encountered within the Claygate Member and rest levels of between 1.07m and 4.14m were measured during monitoring of the standpipes. The range in depths reflects the topographical variation across the site.

Water data are summarised in the table below:

BH WS	Inflows [depth & level]	Monitoring results [depth and level] 2 May 2013	16 May 2013	24 May 2013
1	Around 4.4m [+91.75mOD]	3.55m [+92.60mOD]	4.14m [+92.01mOD]	3.62m [+92.53mOD]
2	Dry	4.55m [+90.20mOD]	3.19m [+91.56mOD]	3.27m [+91.48mOD]
3	Around 3.6m [+89.00mOD]	2.20m [+90.40mOD]	1.07m [+91.53mOD]	1.29m [+91.31mOD]

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

Fieldwork, in-situ testing and monitoring

- Window sample borehole records
- Pocket Penetrometer Test results
- Ground-water monitoring results

Laboratory testing

- Index property testing
- Plasticity chart
- Volume-change potential chart

Plans and drawings

- Site Plan
- Location Maps

Site	**10a Oakhill Avenue**	Borehole No:	**WS1**
Location	**London NW3 7RE**		
Client:	**ESI Ltd**	Sheet	**1 of 3**
Engineer:		Report No:	**9374/MC**

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]		Strata Level[mOD]	Strata Description	Legend
Borehole conducted: 02 May 2013				0.00	0	+96.15	Grey stone dressing over TOPSOIL: Soft, very dark grey-brown, slightly sandy and gravelly, organic silt. Gravel is of ash, glass and slate.	0
	D	0.20		0.30		+95.85	Soft, locally firm, becoming stiff, locally soft and firm, below 2.7m, orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	
	D	0.50						
	D	0.90			1			1
	D	1.20						
	D	1.50						
	D	1.80			2			2
	D	2.10						
	D	2.40						
	D	2.70			3			3
	D	3.00						
	D	3.30						
Groundwater depth 3.55m [60 minutes after completion].								
	D	3.80			4			4
	D	4.30						
Groundwater strike around 4.4m depth								
	D	4.80						
					5			5

Constructed using tracked rig with cased percussive sampling system [plastic liner]

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

Remarks :- Groundwater monitoring well installed on completion - see Sheet 3 for details

Ground level interpolated from Kings Land and Architectural Surveyors' survey drawing (ref. 95274.0001)

Borehole No: **WS1**

[* = extrapolated SPT 'N' value]

Soil Consultants

Site	**10a Oakhill Avenue**	Borehole No: **WS1**
Location	**London NW3 7RE**	
Client:	**ESI Ltd**	Sheet **2 of 3**
Engineer:		Report No: **9374/MC**

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]		Strata Level[mOD]	Strata Description	Legend
					5		*...continued from previous*	5
	D	5.30					Stiff, locally soft and firm, orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	
	D	5.80		5.95		+90.20	Stiff, fissured, dark grey-brown, slightly sandy silty CLAY, with occasional pockets and partings of silty sand.	
					6			6
	D	6.30						
	D	6.80						
				7.00	7	+89.15	End of borehole at 7.00m.	7
					8			8
					9			9
					10			10

Constructed using tracked rig with cased percussive sampling system [plastic liner]

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

Remarks :-

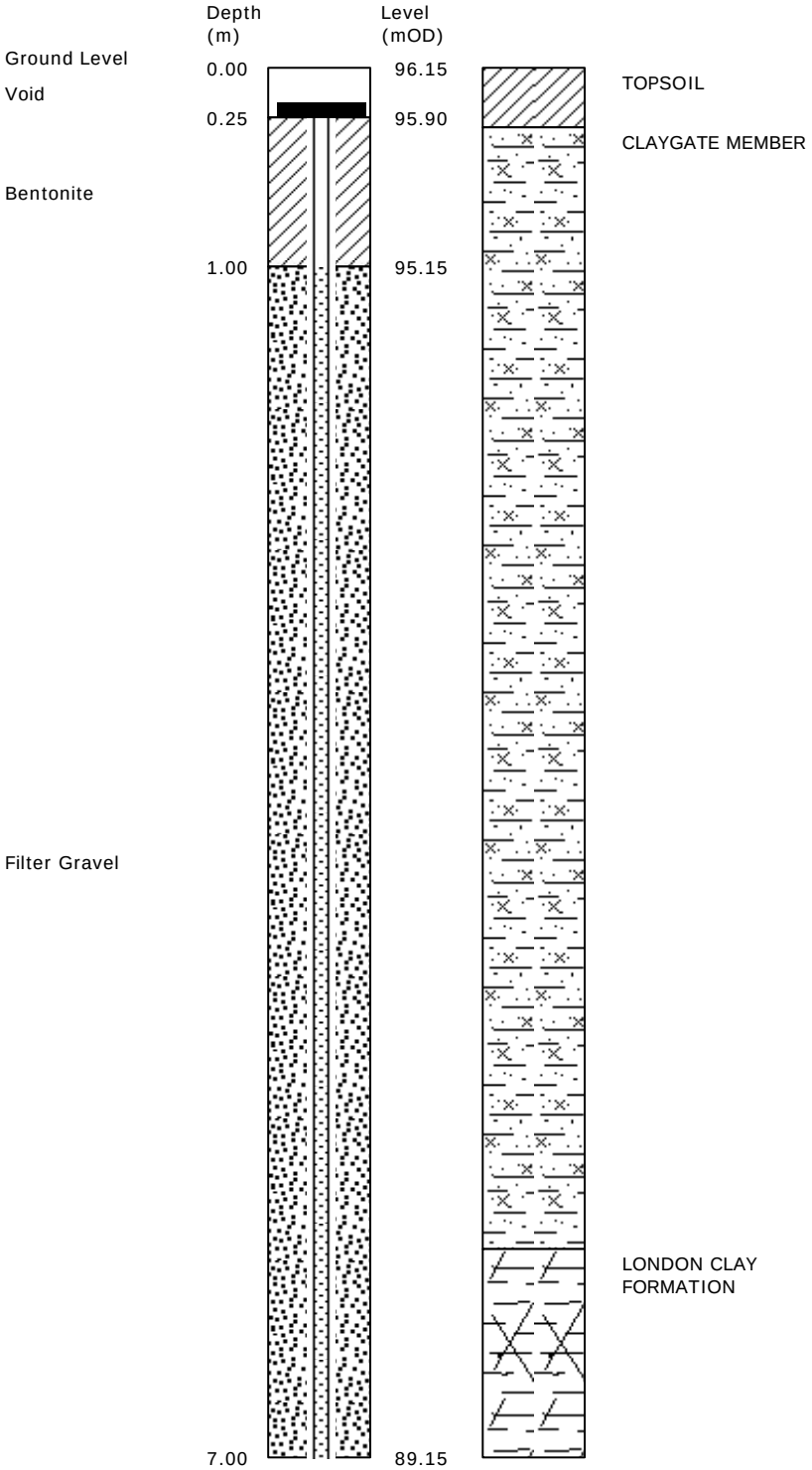
Borehole No: **WS1**

[* = extrapolated SPT 'N' value]

Soil Consultants

Site	**10a Oakhill Avenue**	Borehole No:	**WS1**
Location	**London NW3 7RE**		
Client:	**ESI Ltd**	Sheet	**3 of 3**
Engineer:		Report No:	**9374/MC**

Borehole Installation and Backfill Details



Constructed using tracked rig with cased percussive sampling system [plastic liner]

Remarks :- [i] Pipe diameter: 19mm
[ii] Tip at 7m depth [89.15m OD approx]
[iii] Bung fitted

Borehole No: **WS1**

Site	**10a Oakhill Avenue**	Borehole No:	**WS2**
Location	**London NW3 7RE**		
Client:	**ESI Ltd**	Sheet	**1 of 2**
Engineer:		Report No:	**9374/MC**

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]		Strata Level[mOD]	Strata Description	Legend
Borehole conducted: 02 May 2013				0.00	0	+94.75	MADE GROUND: Paving slab over light orange-brown, slightly silty sand.	0
				0.10		+94.65	TOPSOIL: Soft, very dark grey-brown, slightly sandy and gravelly, organic silt. Gravel is of brick and flint.	
	D	0.25						
	D	0.50						
				0.70		+94.05	Soft, locally firm, becoming stiff, locally soft and firm, below 3.4m, orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	
	D	0.80						
					1			1
	D	1.10						
	D	1.40						
	D	1.70						
	D	2.00			2			2
	D	2.30						
Rootlets at 2.5m depth.	D	2.60						
	D	2.90						
					3			3
	D	3.40						
	D	3.90						
					4			4
	D	4.40						
Groundwater depth 4.55m [10 minutes after completion].								
Borehole dry throughout boring	D	4.90						
				5.00	5	+89.75	End of borehole at 5.00m.	5

Constructed using tracked rig with cased percussive sampling system [plastic liner]

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

Remarks :- Groundwater monitoring well installed on completion - see Sheet 2 for details

Ground level interpolated from Kings Land and Architectural Surveyors' survey drawing (ref. 95274.0001)

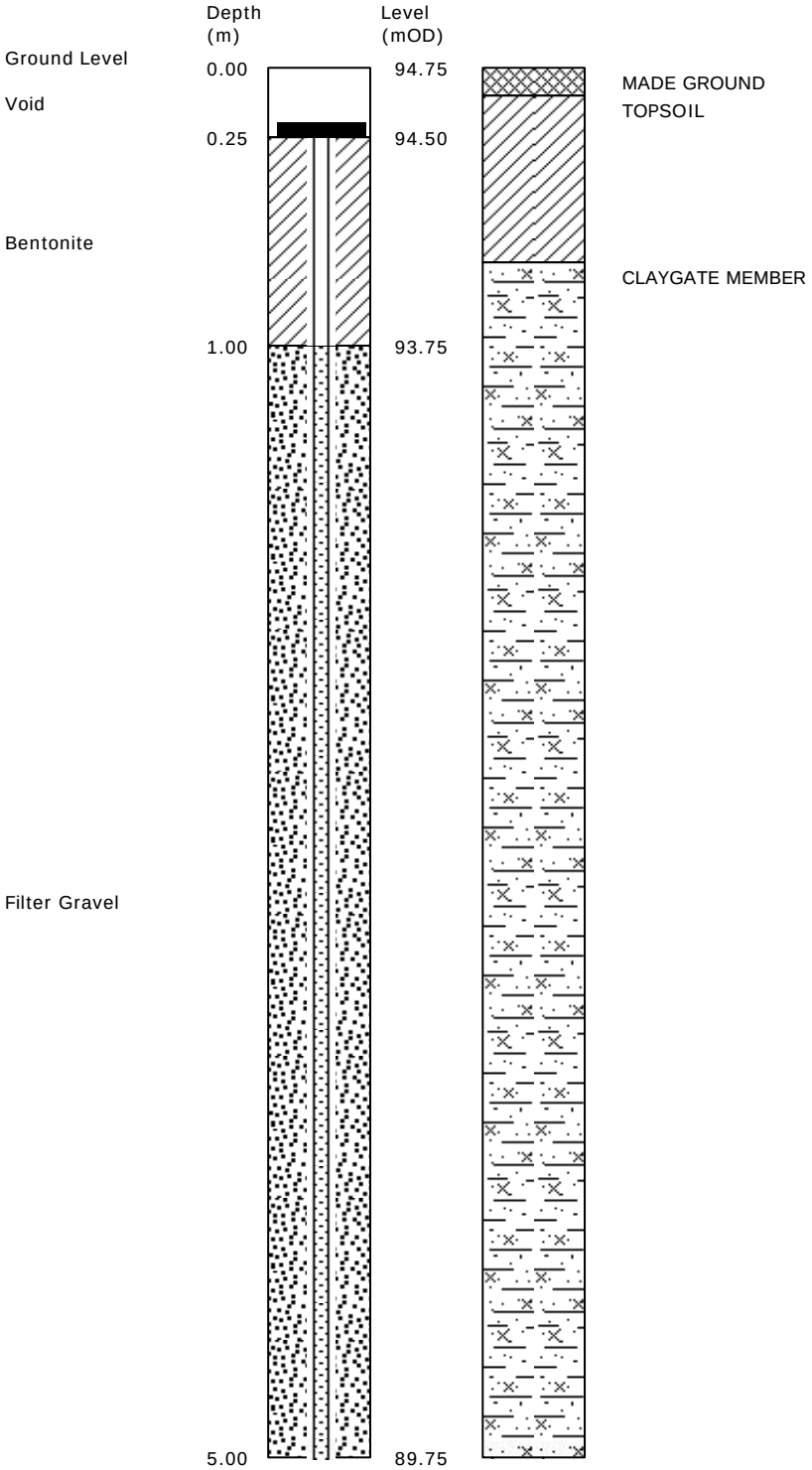
Borehole No: **WS2**

[* = extrapolated SPT 'N' value]

Soil Consultants

Site	**10a Oakhill Avenue**	Borehole No:	**WS2**
Location	**London NW3 7RE**		
Client:	**ESI Ltd**	Sheet	**2 of 2**
Engineer:		Report No:	**9374/MC**

Borehole Installation and Backfill Details



Constructed using tracked rig with cased percussive sampling system [plastic liner]

Remarks :- [i] Pipe diameter: 35mm
[ii] Tip at 5m depth [89.75m OD approx]
[iii] Bung fitted

Borehole No: **WS2**

Site	**10a Oakhill Avenue**	Borehole No:	**WS3**
Location	**London NW3 7RE**		
Client:	**ESI Ltd**	Sheet	**1 of 2**
Engineer:		Report No:	**9374/MC**

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]		Strata Level[mOD]	Strata Description	Legend
Borehole conducted: 02 May 2013				0.00	0	+92.60	MADE GROUND: Reinforced concrete slab.	0
				0.15		+92.45	Firm, becoming stiff, locally firm, below 1.8m, orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	
	D	0.25						
	D	0.50						
	D	0.70						
	D	1.00			1			1
	D	1.30						
	D	1.60						
	D	1.90						
					2			2
Groundwater depth 2.20m [10 minutes after completion].	D	2.20						
	D	2.70						
	D	3.00			3			3
	D	3.50						
Groundwater strike around 3.6m depth								
	D	4.00			4			4
	D	4.50						
							Stiff, fissured, dark grey-brown, slightly sandy silty CLAY, with occasional pockets and partings of silty sand.	
				4.90		+87.70		
				5.00	5	+87.60	End of borehole at 5.00m.	5

Constructed using tracked rig with cased percussive sampling system [plastic liner]

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

Remarks :- Groundwater monitoring well installed on completion - see Sheet 2 for details

Ground level interpolated from Kings Land and Architectural Surveyors' survey drawing (ref. 95274.0001)

Borehole No: **WS3**

[* = extrapolated SPT 'N' value]

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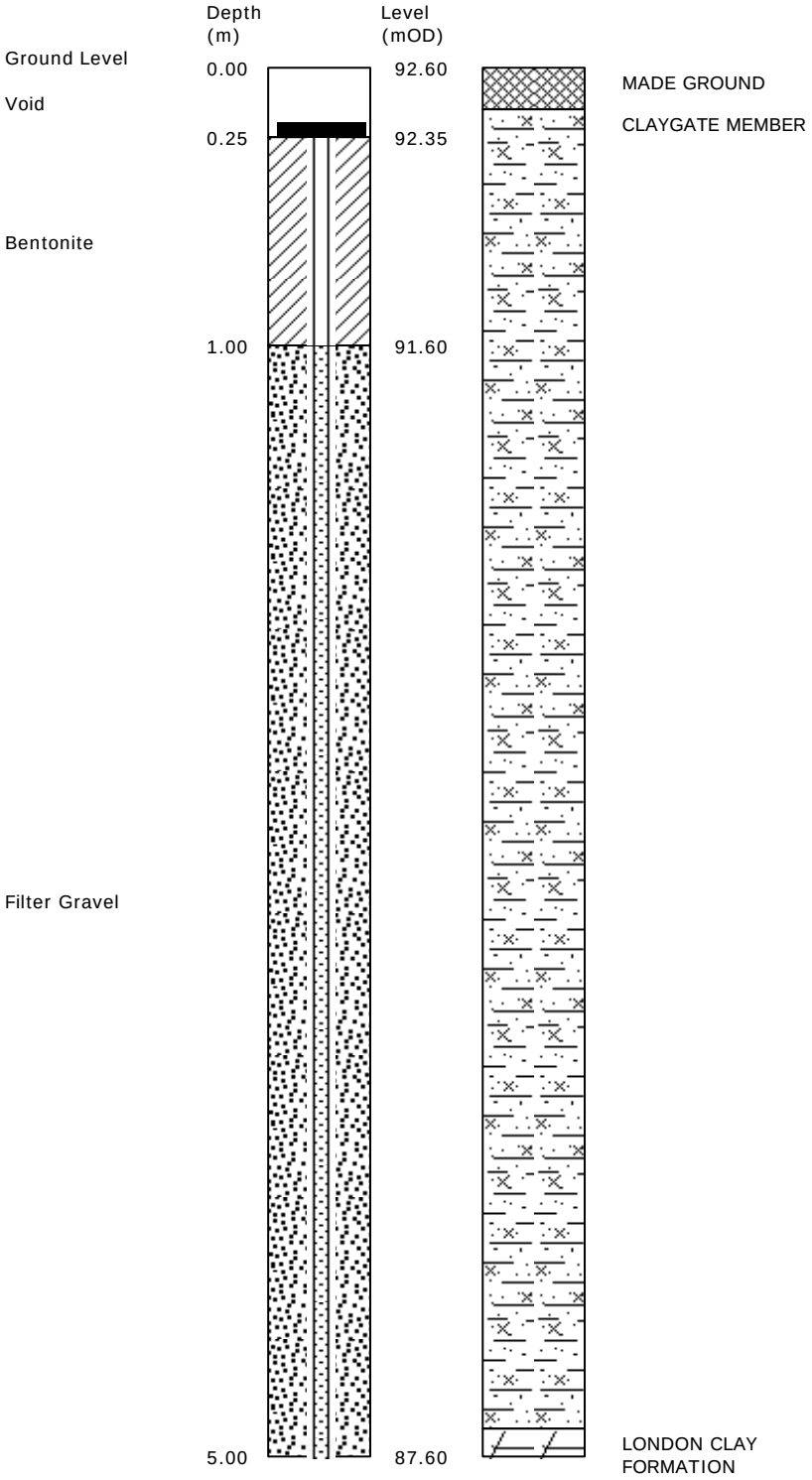
Site	**10a Oakhill Avenue**	Borehole No:	**WS3**
Location	**London NW3 7RE**		
Client:	**ESI Ltd**	Sheet	**2 of 2**
Engineer:		Report No:	**9374/MC**

Borehole Installation and Backfill Details



Constructed using tracked rig with cased percussive sampling system [plastic liner]

Remarks :-
[i] Pipe diameter: 35mm
[ii] Tip at 5m depth [87.6m OD approx]
[iii] Bung fitted

Borehole No: **WS3**

Site Location	**10a Oakhill Avenue London NW3 7RE**	Report No:	**9374/MC**

Pocket Penetrometer Test Results

WS1		WS2		WS3							
Depth [m]	Value [kg/cm²]	Depth [m]	Value [kg/cm²]	Depth [m]	Value [kg/cm²]	Depth [m]	Value [kg/cm²]	Depth [m]	Value [kg/cm²]	Depth [m]	Value [kg/cm²]
0.50	1.7	0.90	1.5	0.60	1.8						
0.75	1.2	1.20	1.3	0.90	1.6						
1.00	1.0	1.50	1.7	1.20	1.8						
1.25	0.7	1.80	1.8	1.50	1.3						
1.50	1.7	2.10	1.8	1.80	2.7						
1.75	1.7	2.40	2.0	2.10	1.9						
2.00	1.5	2.70	1.8	2.40	2.5						
2.25	1.1	3.00	1.8	2.70	2.9						
2.50	1.7	3.30	1.5	3.00	2.8						
2.75	1.9	3.60	2.2	3.30	2.4						
3.00	1.5	3.90	2.2	3.60	1.8						
3.25	1.4	4.20	2.7	3.90	2.2						
3.50	1.6	4.50	1.8	4.40	1.6						
3.75	1.4	4.80	3.4	4.90	1.6						
4.00	2.2	5.00	3.4								
4.25	2.0										
4.50	0.8										
4.75	1.2										
5.00	2.0										
5.25	2.9										
5.50	3.2										
5.75	2.6										
6.00	2.6										
6.25	1.7										
6.50	1.7										
6.75	1.6										
7.00	1.8										

Notes

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Site Location

10a Oakhill Avenue,
London NW3 7RE

Ref:

9374/MC

Record of groundwater monitoring

Date	Time	Well Ref	Groundwater depth from surface [m]	Depth of base of monitoring pipe from surface [m]	Comments	Recorded by
16/05/2013	10:45	WS1	4.14	6.15		AC
		WS2	3.19	4.95		
		WS3	1.07	3.40		
24/05/2013	12:00	WS1	3.62	-		MvR
		WS2	3.27	-		
		WS3	1.29	-		

Site Location	**10a Oakhill Avenue London NW3 7RE**	Report No:	**9374/MC**

Index Property Test Results

Sample Location	Depth (m)	Sample Description	Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	Percent Passing [%]	Remarks
WS1	0.90	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	25	33	17	16	100	
	1.20	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	26					
	1.50	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	28					
	1.80	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	28					
	2.10	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	29					
	2.40	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	26					
	2.70	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	29					
	3.00	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	29	33	19	14	100	
	3.30	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	30					
	3.80	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	30					
	4.30	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	27					
	4.80	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	30					
	5.30	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	29					

Notes

- Moisture content test: BS 1377:Part 2 [1990] Clause 3.2 [value in brackets = calculated matrix moisture content for comparison with LL and PL]
- Liquid and Plastic Limit: BS 1377:Part 2 [1990] Clauses 4.4, 5.2, 5.3, 5.4 is carried out on fine grained soil matrix
- Percent passing 425 micron sieve is by estimation, by hand* or by wet sieving**
- LOI = Loss on Ignition

Sample examined by MC (Engineer)

Results checked by MC (Engineer) Certificate date : 24/05/2013

Soil Consultants

Site Location	**10a Oakhill Avenue London NW3 7RE**	Report No:	**9374/MC**

Index Property Test Results

Sample Location	Depth (m)	Sample Description	Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	Percent Passing [%]	Remarks
WS1	5.80	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	31	39	20	19	100	
	6.30	Dark grey-brown, slightly sandy silty CLAY, with occasional pockets and partings of silty sand.	29					
	6.80	Dark grey-brown, slightly sandy silty CLAY, with occasional pockets and partings of silty sand.	26					
WS2	0.80	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	25					
	1.10	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	24					
	1.40	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	24					
	1.70	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	27					
	2.00	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	27					
	2.30	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	28					
	2.60	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	26					
	2.90	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	27					
	3.40	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	25					
	3.90	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	26					

Notes

- Moisture content test: BS 1377:Part 2 [1990] Clause 3.2 [value in brackets = calculated matrix moisture content for comparison with LL and PL]
- Liquid and Plastic Limit: BS 1377:Part 2 [1990] Clauses 4.4, 5.2, 5.3, 5.4 is carried out on fine grained soil matrix
- Percent passing 425 micron sieve is by estimation, by hand* or by wet sieving**
- LOI = Loss on Ignition

Sample examined by MC (Engineer)

Results checked by MC (Engineer) Certificate date : 24/05/2013

Soil Consultants

Site Location	**10a Oakhill Avenue London NW3 7RE**	Report No:	**9374/MC**

Index Property Test Results

Sample Location	Depth (m)	Sample Description	Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	Percent Passing [%]	Remarks
WS2	4.40	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	30					
	4.90	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	27					
WS3	0.70	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	28					
	1.00	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	24					
	1.30	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	27					
	1.60	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	27					
	1.90	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	27					
	2.20	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	30					
	2.70	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	26					
	3.00	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	25					
	3.50	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	31					
	4.00	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	29					
	4.50	Orange-brown and light orange-brown, sandy silty CLAY, with pockets and partings of silty sand.	27					

Notes

- Moisture content test: BS 1377:Part 2 [1990] Clause 3.2 [value in brackets = calculated matrix moisture content for comparison with LL and PL]
- Liquid and Plastic Limit: BS 1377:Part 2 [1990] Clauses 4.4, 5.2, 5.3, 5.4 is carried out on fine grained soil matrix
- Percent passing 425 micron sieve is by estimation, by hand* or by wet sieving**
- LOI = Loss on Ignition

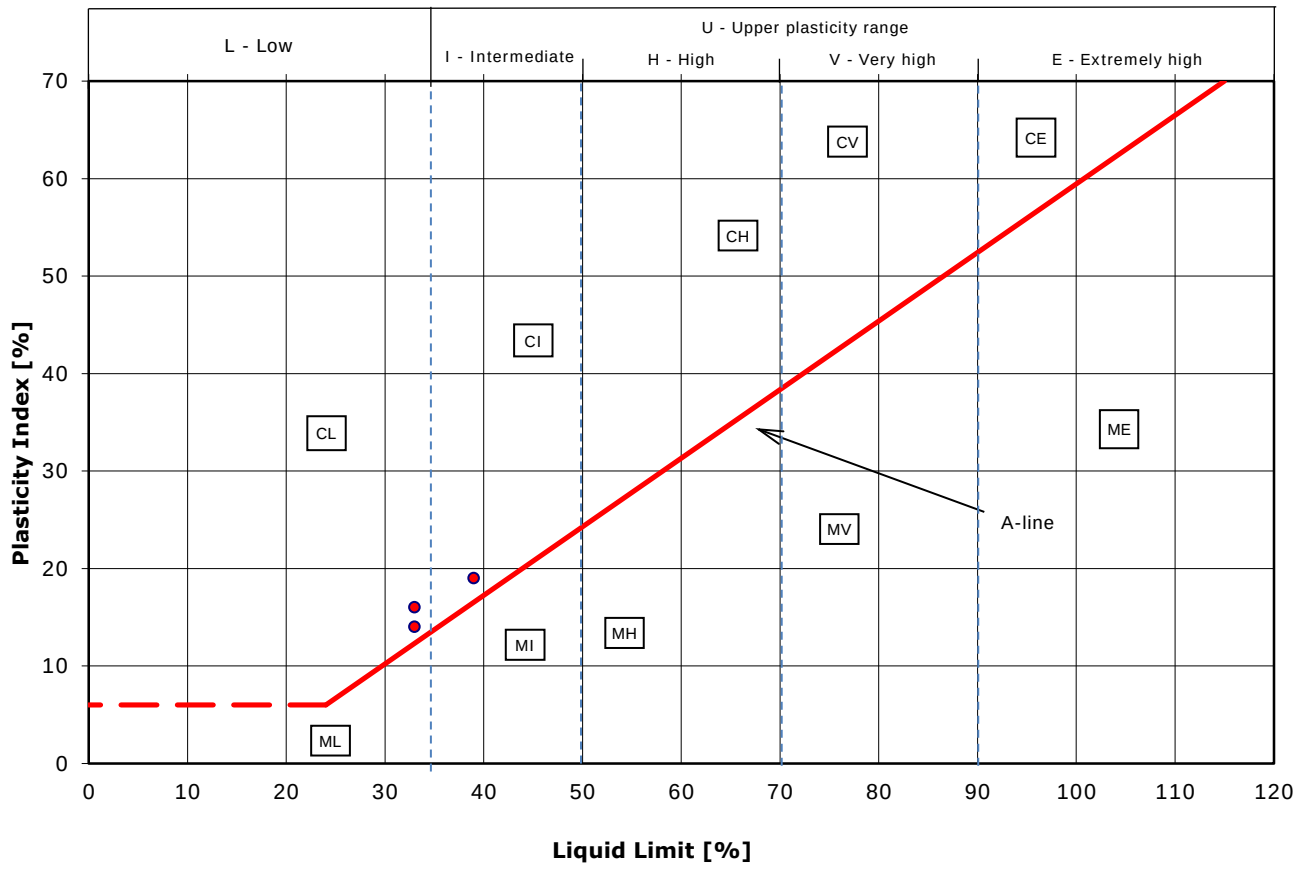
Sample examined by MC (Engineer)

Results checked by MC (Engineer) Certificate date : 24/05/2013

Soil Consultants

Site Location	**10a Oakhill Avenue London NW3 7RE**	Report No:	**9374/MC**

PLASTICITY CHART - BS5930 classification



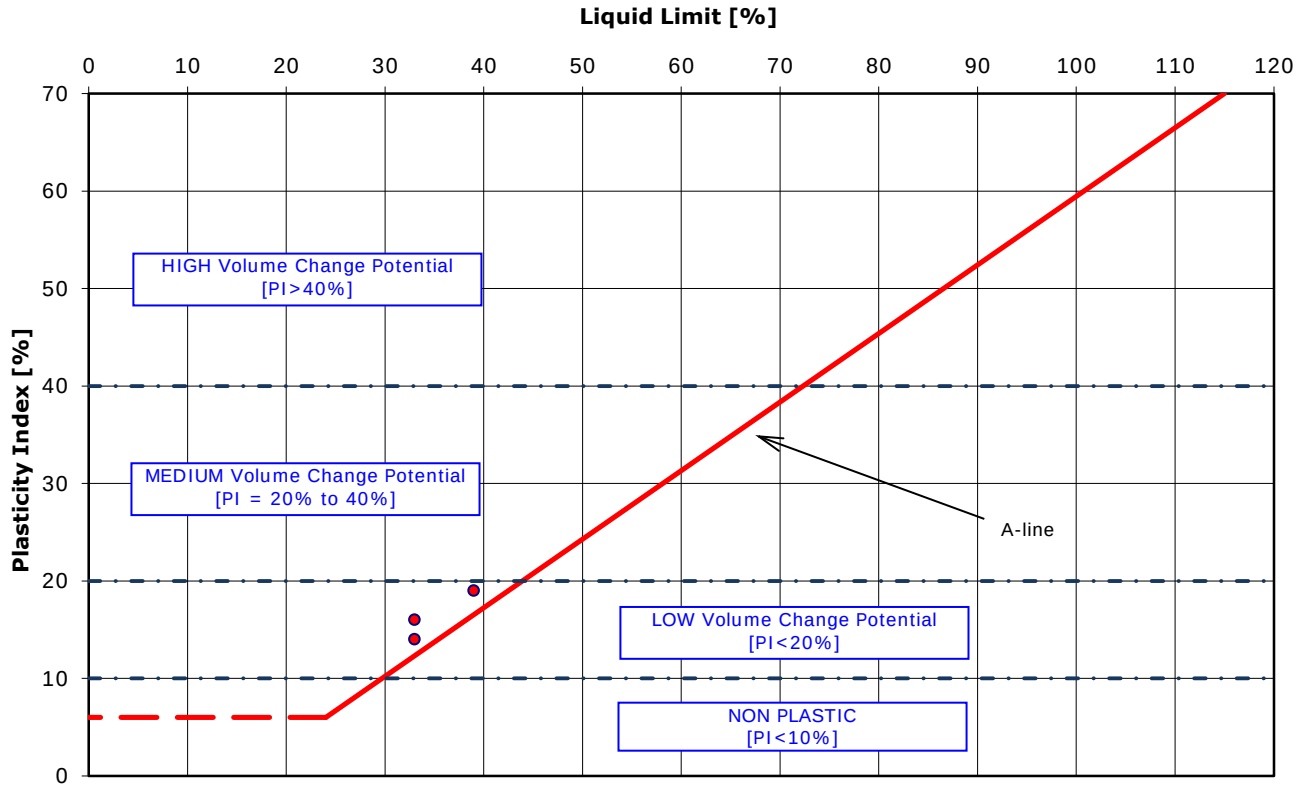
M - Silt [M-soil] plots below the A-line
C - Clay plots above the A-line

Notes:

Classification based upon BS5930:1999 'Code of practice for site investigations'

Site Location	**10a Oakhill Avenue London NW3 7RE**	Report No:	**9374/MC**

PLASTICITY CHART - NHBC classification



Notes:

Classification based upon NHBC Standards, Part 4 'Foundations', Chapter 4.2 'Building near trees'

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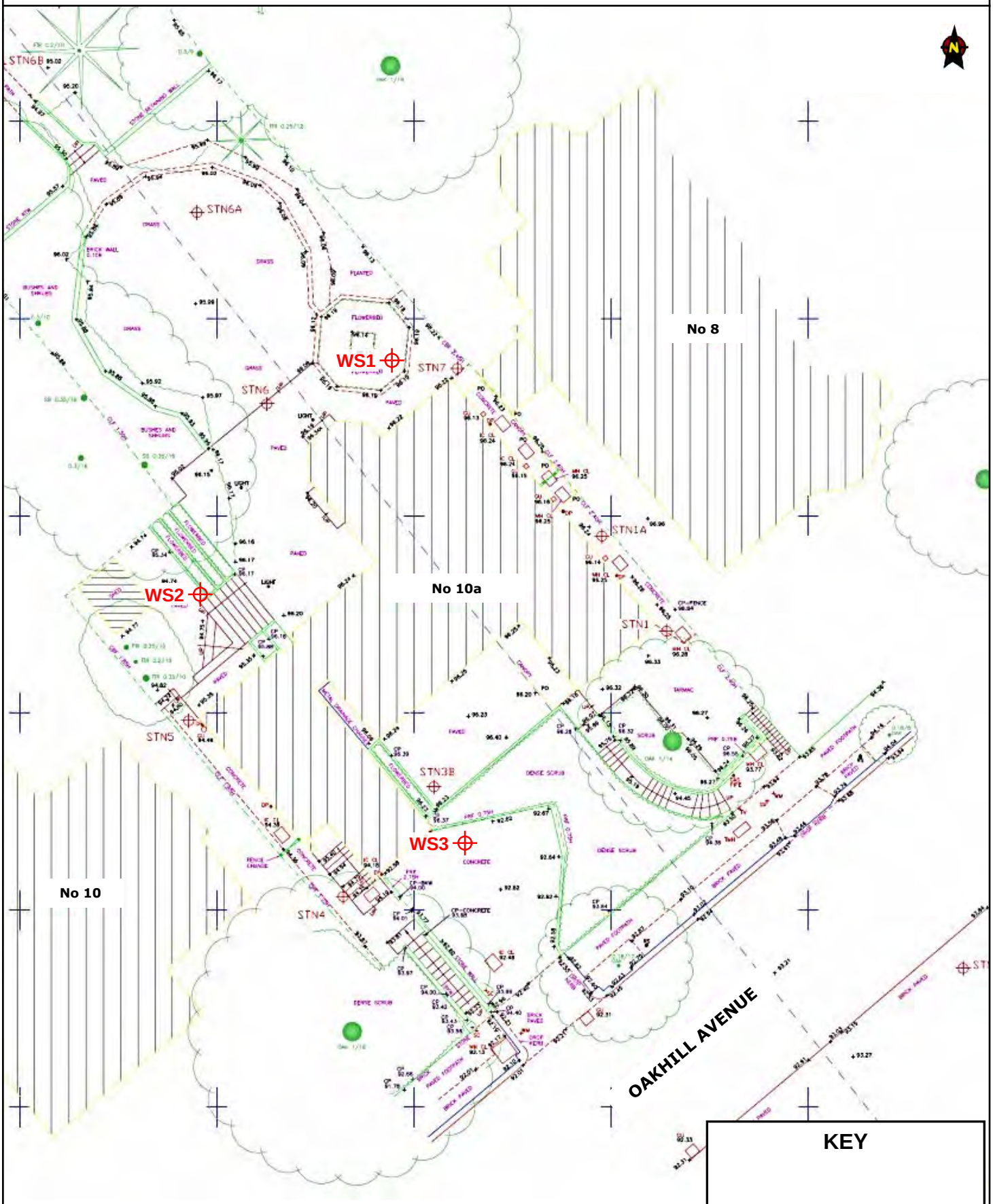
Site & Location	**10a Oakhill Avenue London NW3 7RE**	Report No: **9374/MC**

Site Plan – showing locations of exploratory holes



0 Scale: 1:250 @A4 25m

KEY

WS1 — WS borehole

Based on extract from Kings Land and Architectural Surveyors' drawing 95274.0001, dated April 2013

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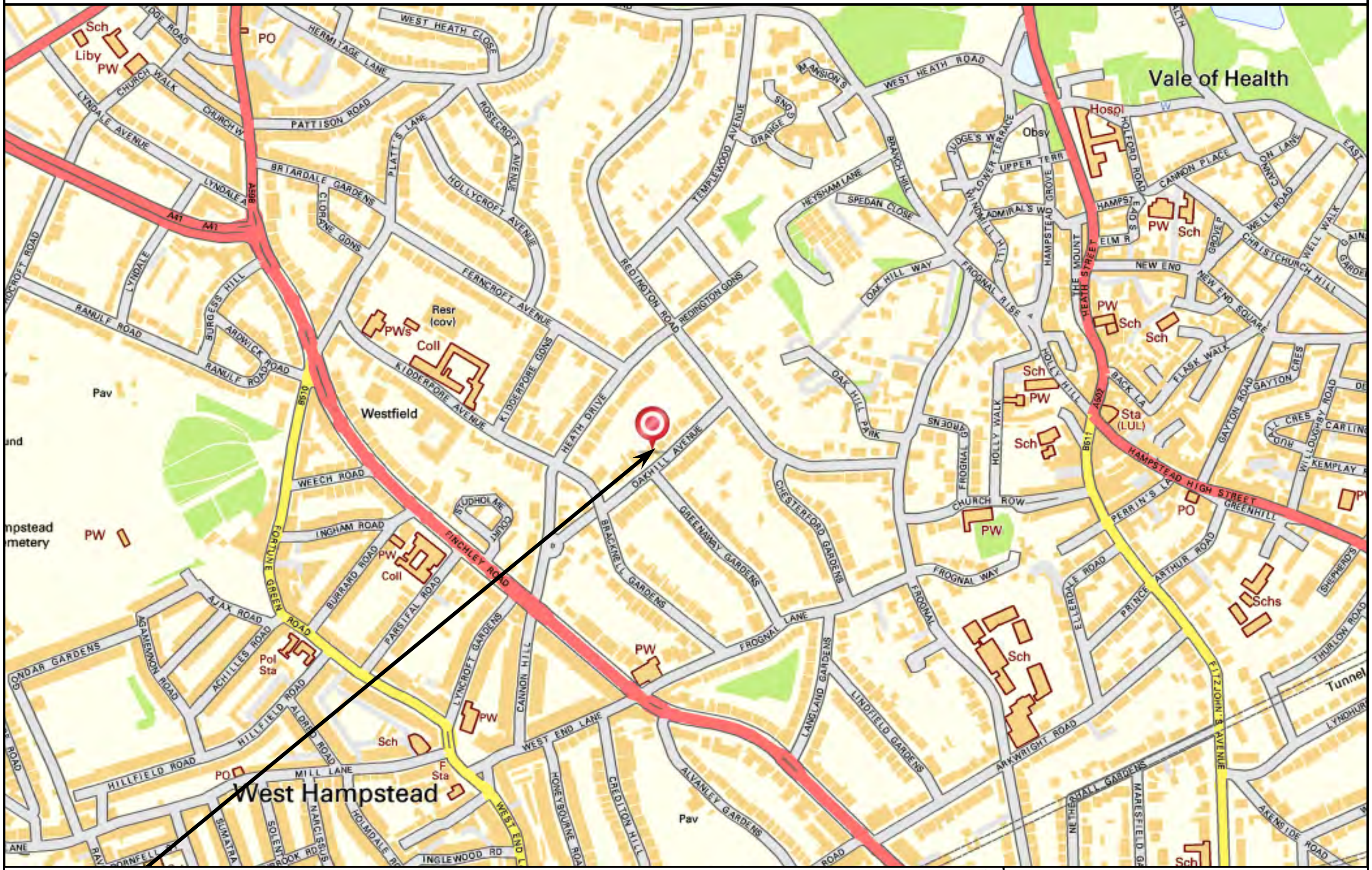
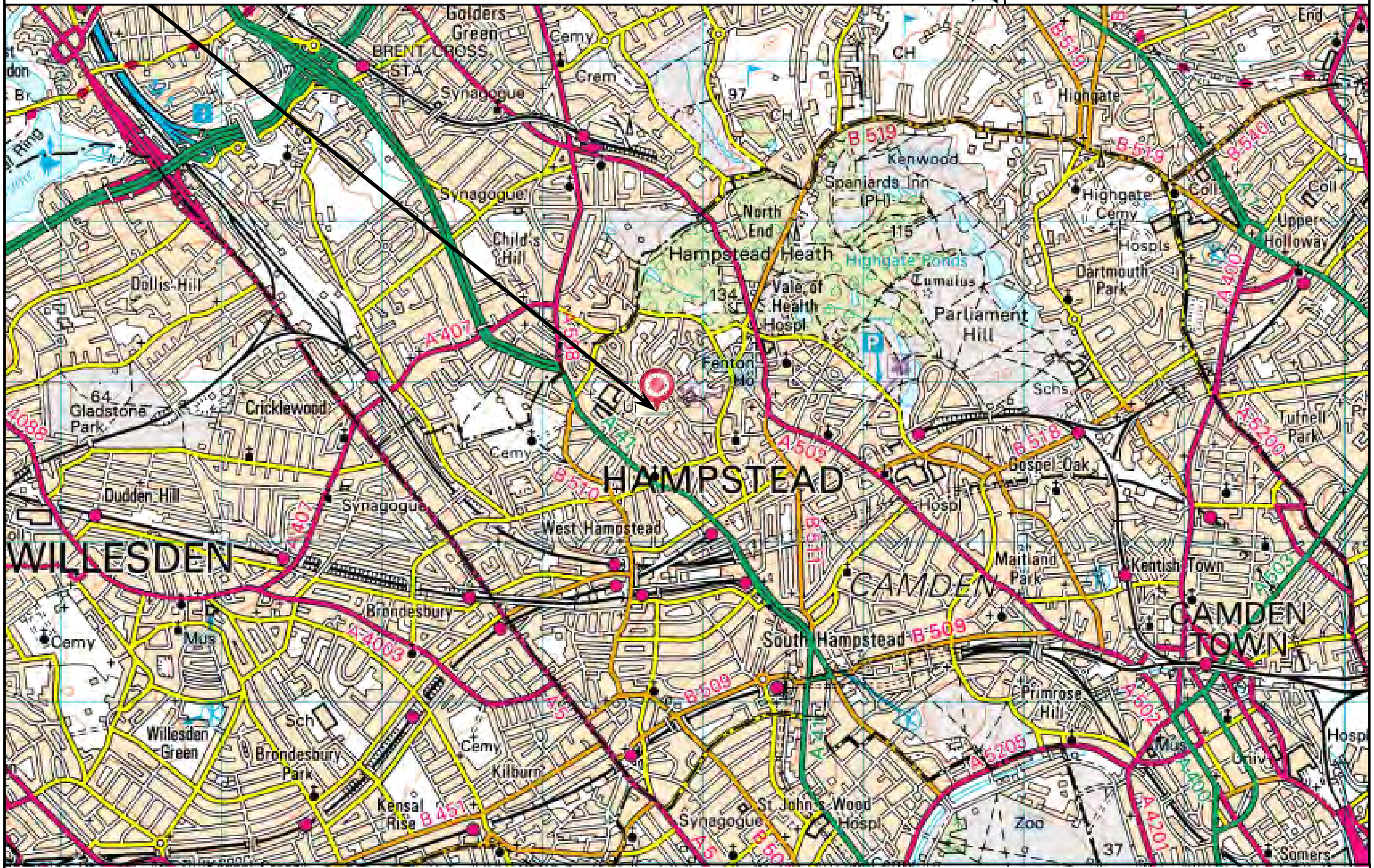
Site & Location	10a Oakhill Avenue London NW3 7RE	Report No: 9374/MC

Location Maps



SITE LOCATION: approximate NGR 525690E, 185715N

Contains Ordnance Survey data © Crown copyright and database right 2012



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