16A LYNDHURST GARDENS GARDENS, NW3

REPORT: HYDROLOGY

CONSULTANT: SLR CONSULTING

VABEL

7th November 2011

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Our Ref: 401-03684-00001

Dear Daniel

RE: 16A LYNDHURST GARDENS – BASEMENT IMPACT ASSESSMENT FOR GROUNDWATER AND SURFACE WATER

SLR Consulting has been appointed by Lyndhurst Gardens LLP to carry out the groundwater and surface water components of a Basement Impact Assessment (BIA) for the proposed basement development at 16a Lyndhurst Gardens, as required by Camden Planning Guidance CPG4 'Basements and Lightwells'. A previous version of this letter was issued in June 2011 with a previous planning application which was subsequently withdrawn. Comments received from interested parties in connection with the previous planning application have been addressed in this letter, as detailed in section 4.0 below.

The SLR staff involved in the preparation of this letter include two hydrogeologists with the Chartered Geologist qualification and one hydrologist with the Chartered Water and Environmental Manager qualification, as required by section 2.10 of CPG4.

1.0 PROJECT INFORMATION FOR SCREENING PROCESS

CPG4 states that the BIA should start with a Screening Process, and that where the answers to any of the questions in the flowcharts are 'YES' OR 'UNKNOWN', these matters will need further investigation. Paragraph 233 of 'Guidance for Subterranean Development', LBC, 2010, indicates that the following summary information should be included in the BIA Screening Process.

1.1 Brief Description of the Proposed Development

As detailed in the planning application, the proposal is for demolition of the existing dwelling and construction of a new-build single private dwelling including a full basement with courtyard and a partial sub-basement. The proposed footprint of the basement with courtyard is shown in Drawing 1. The proposed partial sub-basement will be beneath the northern half of the basement, as shown in Drawing 1.

The excavations required for the partial sub-basement are estimated (based on the structural report accompanying the planning application) as having a basal elevation of approximately 69maOD. The excavations for the full basement are estimated in the structural report as being 2m higher than for the sub-basement i.e. approximately 71 maOD. The current site layout and topography are shown in Drawing 1069.01.02.

1.2 Proposed Construction Programme

As detailed within the Construction Management Plan in the planning application, the key phases of construction will be:

- a mini piling rig will pile the perimeter of the proposed development;
- soil will be excavated and moved immediately by an awaiting dumper truck; then
- the building structure will be built with reinforced concrete.

2.0 GROUNDWATER FLOW

2.1 Subterranean (Groundwater) Flow Screening Flowchart Questions

Q1a: Is the site located directly above an aquifer?

SLR Response: **NO.** The available published information[1] indicates that the application site is located on London Clay, which is not an aquifer. This has been confirmed by the excavation of three trialpits in June 2011 and the drilling in July 2011 of three 15m deep boreholes at the site (locations indicated in Drawing 1 and logs appended to this letter) which indicated site geology as summarised in Table 1 below.

Table 1 – Site Geology based on Site Investigation

Horizon (m below ground)	BH1/TPB	BH2	BH3/TPC[a]	TPA
Topsoil	0 – 0.5 m	0 – 0.3 m	0 – 0.3 m	0 – 0.5 m
Silty/Clayey Made Ground	0.5 – 2.3 m	0.3 – 1.7 m	0.3 – 1.7 m	0.5 – >1.8m
Stiff Weathered London Clay	2.3 – 3.0 m	1.7 – 3.0 m	1.7 – 3.0m	-
Very Stiff In Situ London Clay	3.0 – 15.0 m	3.0 – 15.0 m	3.0 – 15.0 m	-

[a] – TPC encountered concrete at 0 – 0.3m and 0.6 – 1.0m

Q1b: Will the proposed basement extend beneath the water table surface?

SLR Response: **NO**. As stated in the response to Q1a, the geological map indicates that the application site is located on London Clay, which does not contain an effective water table due to its low permeability. No groundwater was encountered during site investigation. Boreholes BH1 to BH3 were installed from 0.8m below ground to the base of the weathered London Clay, however no water was found in subsequent monitoring up to November 2011.

Q2: Is the site within 100m of a watercourse, well (used/disused) or potential springline?

SLR Response: **UNKNOWN.** As discussed in Q1a above, the available published information indicates that the potential springline at the south-eastern boundary of the Claygate Member is somewhere[2] between 40 – 150m north-west of the application site. It is

[1] Based on Figure 8 of 'Guidance for Subterranean Development' showing the areas of aquifer, the south-eastern edge of the Claygate Member aquifer is approximately 150m north-west of the site. However, based on the 1994 British Geological Survey geological map (Sheet 256 North London, reproduced as Figure 4 of 'Guidance for Subterranean Development', LBC, 2010) the outcrop of the Claygate Member is only approximately 40m to the north-west of the north-western corner of the proposed basement. The discrepancy between the two maps may be due to the variability of the Claygate Member, and it is possible that the south-eastern margins of the Claygate Member are considered too clayey to comprise an aquifer.

[2] Historical maps do not indicate any springs nearby, however the 1871 1:1056 London town plan (http://www.old-maps.co.uk/maps.html) indicates a pond approximately 80m west-north-west of the site at a time when the area was no yet residential, and this could be related to the springline.

noted that, as stated in the notes in the Groundwater Flow Screening Chart in CPG4, boundaries on the geological map should be considered to accurate to ±50m. However, site investigation at the site as detailed above has confirmed that the site itself is located on London Clay, hence the potential springline lies to the north-west of the site.

The available information indicates that there are no watercourses within 100m, (including culverted underground watercourses) as indicated by Figure 11 of ‘Guidance for Subterranean Development’. Furthermore, Figure 2 of ‘Guidance for Subterranean Development’ indicates that no wells were present within 100m in 1920, as do historical maps from 1871 to the present, and the British Geological Survey Geoindex http://maps.bgs.ac.uk/GeoIndex/default.aspx confirms that this remains the case.

Q3: Is the site within the catchment of the pond chains on Hampstead Heath?

SLR Response: **NO,** as indicated in Figure 14 of ‘Guidance for Subterranean Development’ (LBC, 2010).

Q4: Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?

SLR Response: **NO.** Currently the whole of the 380m^2 application site is hard surfaced/paved apart from the following small areas as shown in Drawing 1069.01.02:

- approximately 30m^2 of bushes on soil along the northern edge of the driveway – it is not proposed to change this as part of the proposed basement development; and
- approximately 63m^2 of flowerbeds and soil between the current building and the southern and eastern site perimeters.

The basement development will involve the loss of approximately 53m^2 area of soil and flowerbeds to the east and south of the current building. However, this will be offset by the fact that an area of approximately 167m^2 of the roof of the proposed development will be constructed as a ‘green roof’, as shown in Drawing 1. Furthermore, much of the remaining roof and basement courtyard surfaces will drain into a rainwater storage reservoir. The loss of rainfall infiltration into the approximately 53m^2 area of soil and flowerbeds will result in a reduction of any seepage through Made Ground and into adjoining gardens to the south and east.

Q5: As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)

SLR Response: **NO.** As detailed in Q4 response, there will not be an increase in the impermeable area of the application site and therefore there will be no increase in runoff generated by the site. Given the site setting on a steep hillside on low permeability London Clay, with the adjoining property at an elevation several metres lower, it is not considered appropriate to discharge more surface water to the ground.

Q6: Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or springline.

SLR Response: **UNKNOWN.** As discussed in Q2, based on the local geology any nearby potential springline would be between 40 – 150m north-west of the application site, at an elevation of approximately 77maOD. As the lowest point of the proposed excavation will be approximately 69maOD, this would be significantly lower than the water level at any nearby springline that may exist. There are no ponds or other surface water features in close proximity to the site.

2.2 Subterranean (Groundwater) Flow Scoping and Impact Assessment

2.2.1 Introduction

As some of the responses in the Subterranean (Groundwater) Flow Screening were UNKNOWN, it is necessary to proceed to further stages of the BIA. As detailed in CPG4 and chapter 6 of ‘Guidance for Subterranean Development’, these further stages involve presentation of a conceptual ground model, site investigation and including identification of potential impacts. To facilitate the development of the conceptual ground model and impact assessment, site investigation was carried out in June – July 2011 as summarised in section 2.1 above.

2.2.2 Conceptual Ground Model and Potential Impacts

Geology

The available published information indicates that the application site is located on London Clay, as detailed in Q1a above. Site investigations confirmed that this is the case as detailed in section 2.1 above. Available published information also indicates that the geological boundary with the silty clays and sandy silt of the Claygate Member is approximately 40m north-west of the site.

Site investigations indicated that the natural geology at the application site is covered by silty Made Ground up to ca. 1.7m thickness of at the front of the property and up to ca. 2.3m thickness at the rear. This may have been used to create the flat terrace on which the current building is constructed - the landform prior to residential development of this area is likely to have been a slope of approximately 1 in 12. The basal Made Ground above the London Clay is generally silt with some concrete and silty sand encountered at TPA and TPC.

Hydrogeology

Rainfall is likely to be able to infiltrate into the Claygate Member through gardens on the hillside to the north-west of the site. This process is only likely to be significant in the winter, as from April to September most incident rainfall can be expected to be lost to evapotranspiration or surface runoff. Water which has infiltrated is then likely to flow downgradient to the south-east through the Claygate Member until it reaches the boundary with the London Clay, where it may emerge as seepages at the ground surface (or into any Made Ground overlying this geological boundary).

Drawing 1 indicates that any such seepages would emerge in gardens to the north of 20 Lyndhurst Gardens and at the hospice across the road (assuming that the geological boundary is as shown on the geological map). The only possible underground pathway for this water to flow towards the proposed basement would be if there is a significant thickness of permeable Made Ground between the geological boundary and the application site. There are no known basements beneath 18 or 20 Lyndhurst Gardens which would block this potential pathway, however building foundations may partially block the pathway. As any seepages beneath the application site are likely to be restricted to the Made Ground rather than in natural in situ geology, these are referred to below as underground water rather than groundwater.

No underground water was observed during site investigation or subsequent monitoring up to November 2011s. Borehole BH3 and trialpits TPC and TPA suggest that along the southern boundary of the site, any potential underground water seepages flowing from the north-west are likely to be restricted by clayey Made Ground and concrete. More permeable silty fine sand Made Ground is only present within approximately 1m of the ground surface.

At the north-western corner of the application site, borehole BH2 indicated that the Made Ground is clayey silt, which is not likely to allow significant underground water flows. At the north-eastern corner of the application site, the silt or silty fine sand Made Ground identified within borehole BH1 and trialpit TPB could currently allow any potential underground seepages in this area to flow downhill to the east.

Potential Impacts of Basement on Subterranean (Groundwater) Flow

It is noted that no underground water was encountered during site investigations, however there is a theoretical possibility that underground seepages from the springline offsite to the north-east could currently reach the site during winter and spring months.

Beneath the application site towards the south, as discussed above, based on the available site investigation information it is considered very unlikely that there could currently be significant shallow[3] underground water flow, owing to the presence of clayey Made Ground and concrete below approximately 1m below ground level. Hence, under these conditions it is considered that the proposed basement is unlikely to make a significant difference to underground water flow to the south. However, it is considered that any potential seepages that may be present following the proposed basement development could be blocked and back up in between the basement of no.16 and the proposed basement of no.16a, unless a groundwater pathway is available between the two basements.

Beneath the north-eastern corner of the application site, it is possible that minor underground seepages of water could currently occur through the Made Ground during the winter and spring months. The proposed basement development could block any such seepages beneath the site, resulting in seepages being diverted around the perimeter of the basement towards the north-eastern corner of the site. Any such impact is likely to be offset by the loss of rainfall infiltration into the soil and flowerbeds to the east of the current building. Furthermore, any additional underground water seepage near the north-eastern corner of the site could be intercepted by root systems of the two nearby trees. However, in order to minimise any such impact the proposed basement development has been offset away from the north-eastern corner of the application site. The construction of a drainage corridor, eg French drain or similar, along the eastern site boundary would also minimise any potential slight increase in seepages near the north-eastern corner of the site.

The potential localised slight rise in levels of underground water along the northern side of the basement which might be caused by any diversion of seepages in winter and spring months could (without mitigation measures) affect the moisture content in clays beneath the south-eastern corner of 18 Lyndhurst Gardens, with resultant potential structural impacts. To avoid this risk, it may be necessary to construct a drainage corridor e.g. French drain or similar, along the northern side of the proposed basement.

[3] Shallow groundwater is distinguished from deep groundwater flow in the Chalk deep beneath the London Clay

Proposed Mitigation Measures

The following mitigation measures are proposed to address the above noted potential underground water seepage issues:

- construction of a drainage corridor (e.g. French drain, geocomposite or similar) around the perimeter of the proposed basement;
- offsetting of the proposed basement development from the southern site boundary (near 16 Lyndhurst Gardens) to allow an underground drainage pathway between the two properties; and
- offsetting of the proposed development from the north-eastern corner of the site boundary to allow any underground seepages to continue as at present.

3.0 SURFACE FLOW AND FLOODING

3.1 Surface Flow and Flooding Screening Flowchart Questions

Q1: Is the site within the catchment of the pond chains on Hampstead Heath?

SLR Response: **NO,** as indicated in Figure 14 of 'Guidance for Subterranean Development' (LBC, 2010).

Q2: As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?

SLR Response: **NO.** Currently, surface water drainage from the application site enters Thames Water combined sewers under Lyndhurst Gardens road. As detailed in Q3 below, the proportion of hard surfaced/paved areas will not be increased, due to the incorporation of a 'green roof'. Furthermore, excess rainwater falling on most of the remainder of the roof and on the basement courtyard will reach the rainwater storage reservoir, and harvested rainwater will be used for plant irrigation and toilet flushing. Any overflow from the rainwater storage reservoir will be released to the site drain which feeds into the Thames Water combined sewer.

Q3: Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?

SLR Response: **NO.** As detailed in the response to Q4 of the Groundwater Flow Screening above, the proposed development will not increase the total area of hard surfaced / paved areas at the application site.

Q4: Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?

SLR Response: **NO.** As discussed in Q3 above, the net runoff from the application site will not be significantly increased by the proposed basement development. The rainwater harvesting tank is likely to slightly reduce the peak flow and total volume of surface water discharged from the site.

Q5: Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?

SLR Response: **NO.** After the proposed development, there will be less runoff from paved garden areas, but more runoff from the increased roof area and basement courtyard, but the latter will be collected in a rainwater storage system. There is unlikely to be any significant change in the quality of surface water being received by the drainage system as a result of this change. There will be no change to the car parking area, hence no changes in surface water quality for this reason.

Q6: Is the site in an area known to be at risk from surface water flooding?

SLR Response: **YES,** as the table on page 29 of CPG4 indicates that Lyndhurst Gardens flooded in 1975.

3.2 Surface Flow and Flooding Scoping

As the responses to questions Q1 to Q5 above were all NO, no further surface flow scoping is required apart from the Flood Risk Assessment required in relation to Q6.

3.3 Flood Risk Assessment

It is recognised that developments that are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. Current guidance on development and flood risk[4][5] identifies several key aims for a development to ensure that it is sustainable in flood risk terms. These aims are as follows:

- the development should not be at a significant risk of flooding and should not be susceptible to damage due to flooding;
- the development should not be exposed to flood risk such that the health, safety and welfare of the users of the development, or the population elsewhere, are threatened;
- normal operation of the development should not be susceptible to disruption as a result of flooding;
- safe access to and from the development should be possible during flood events;
- the development should not increase flood risk elsewhere;
- the development should not prevent safe maintenance of watercourses or maintenance and operation of flood defences;
- the development should not be associated with an onerous or difficult operation and maintenance regime to manage flood risk. The responsibility for any operation and maintenance required should be clearly defined;
- future users of the development should be made aware of any flood risk issues relating to the development;
- the development should not lead to degradation of the environment; and
- the development should meet all of the above criteria for its entire lifetime, including consideration of the potential effects of climate change.

In order to achieve the aims outlined above, a staged approach has been adopted in undertaking this Flood Risk Assessment (FRA), in accordance with current best-practice guidance. A screening study has initially been undertaken to identify whether there are any

[4] CIRIA, 2004, Funders Report CP/102 Development and Flood Risk – Guidance for the Construction Industry
[5] Planning Policy Statement 25: Development and Flood Risk Practice Guide (CLG, Dec 2009)

potential sources of flooding at the application site which may warrant further consideration. Any potential flooding issues identified in the screening study have subsequently been considered in a scoping study. The aim of the scoping study is to define the input data requirements and study methodologies required to technically assess each of the flood risks and produce a site layout which addresses each of the issues appropriately.

The FRA has been undertaken with due regard to the EA's National Standing Advice on Development and Flood Risk[6].

3.3.1 Site Location

The application site is approximately 0.4ha in size and is located on a densely built-up hillside sloping to the south-east with an average slope of approximately 1 in 12. As shown in Drawing 1069.01.02, the site is bounded to the north and south by dwellings with gardens, and to the east by a school garden and playground. To the west is the corner of Lyndhurst Gardens as shown in Drawing 1069.01.02 – the road slopes steeply down from the north, but is almost flat to the west. The site is set on a terrace at approximately 76 maOD which appears to have been built up with Made Ground, and the sites immediately to the south and east are several metres lower. The site currently comprises a single dwelling, with gardens composed of approximately 90 m^2 of soil beds and approximately 170m^2 of paved driveway and garden terraces.

The nearest watercourses, as indicated by Figure 11 of 'Guidance for Subterranean Development', are culverted underground watercourses approximately 300m to the south-east and 400m to the west. There are no EA flood zones[7] associated with these culverted underground watercourses, and the site is in a Flood Zone 1. As the site is less than 1ha and in a Flood Zone 1, it would not normally require a FRA. However, Camden Planning Guidance CPG4 'Basements and Lightwells' requires in section 2.41 that all applications for basement developments in streets where there was surface water flooding in 1975 or 2002 (as listed on page 29 of CPG4) should include a FRA.

3.3.2 Proposed Development

As detailed in the planning application, the proposal is for demolition of the existing dwelling and construction of a new-build single private dwelling including a full basement with courtyard and a partial sub-basement. The proposed footprint of the basement with courtyard is shown in Drawing 1. The proposed partial sub-basement will be beneath the northern half of the basement, as shown in Drawing 1.

3.3.3 Screening Study of Potential Flood Risk

All potential sources of flooding must be considered for any proposed development. A summary of the potential sources of flooding and a review of the potential risk posed by each source at the application site is presented in Table 1.

[6] Environment Agency, January 2011, National Standing Advice to Local Planning Authorities for Planning Applications – Development and Flood Risk (Version 3.0).
[7] EA website http://maps.environment-agency.gov.uk/ reviewed on 10th June 2011

Table 2 - Potential Risk Posed by Flooding Sources

Potential Source	Potential Flood Risk at Site?	Justification
Fluvial flooding	No	EA Flood Mapping shows Flood Zone 1 Distance from nearest surface watercourse 750m
Tidal flooding	No	Site location is ‘inland’ and topography > 75mAOD.
Flooding from rising / high groundwater	Yes	Potential springline may exist 40m uphill from site.
Surface water (pluvial) flooding	Yes	Recorded in Lyndhurst Gardens in 1975.
Flooding from artificial drainage systems	Yes	Nearby drainage in Lyndhurst Gardens could potentially overflow
Flooding due to infrastructure failure	Yes	The site does not rely on flood protection infrastructure. However, drainage of the basement courtyard relies on pumping up to the rainwater storage reservoir.

3.3.4 Scoping Study

Following the screening study additional information has been gathered in order for an experienced SLR hydrologist to scope the studies required to further assess the flood risk at site. A site visit was undertaken on 8th June 2011.

3.3.5 Groundwater Flooding

As discussed in Q1a of the Groundwater Flow Screening above, the available published information indicates that there is a potential springline somewhere between 40 – 150m north-west of the site. As discussed in the Conceptual Ground Model in section 2.2.2 above, there may be a pathway for seepages from this springline through Made Ground beneath the application site. No underground water was observed during site investigation or subsequent monitoring up to November 2011. However, there is a possibility that minor seepages may currently occur in winter and spring months -, any such seepages flowing beneath the site would be likely to appear close to ground level at St Christopher’s School (to the east) which has ground elevations several metres lower than ground levels on the application site.

The construction of the proposed basement would be likely to divert any underground water seepage along the northern side of the proposed basement, potentially increasing seepages into the grounds of St Christopher’s School near the north-eastern corner of the application site. As the rate and volume of any underground water seepages are likely to be minimal, any such impact is likely to be offset by the loss of rainfall infiltration into the soil and flowerbeds to the east of the current building (which would reduce seepage into the school garden), and furthermore additional seepages could be intercepted by the root systems of the two nearby trees. However, the impacts of this would be minimised by the offsetting of the proposed basement development from the north-eastern corner of the site, and the construction of a drainage pathway along the eastern site boundary.

It is considered unlikely that groundwater runoff would cause significant flooding at the site and it is considered unlikely that the development would increase the risk of groundwater flooding in the local area.

3.3.6 Surface Water (Pluvial) Flooding

Potential Surface Water Flooding affecting the Application Site

Any surface water runoff generated along the length of Lyndhurst Gardens north of the site, as well as some flows from Wedderburn Road (which crosses Lyndhurst Gardens approximately 100m north of the site), could cause overland flow to occur down Lyndhurst Gardens to the low point at the corner outside 12 Lyndhurst Gardens, at an estimated elevation of approximately 75.5 maOD. The low point is drained by a gulley pot as shown in Figures 1 and 2 below.

Figure 1
Lowest Point in Road looking looking towards 16a Driveway

Figure 2
Lowest Point in Road with 12 Lyndhurst Gardens

It is recorded in CPG4 that Lyndhurst Gardens suffered surface water flooding in August 1975, although there are no records as to which part of the road was affected (apart from information provided by Stephen Stark[9] that the lower ground floor of no.16 suffered significant flood damage in 1975 and flash flooding in 2002). It is possible that the low point of Lyndhurst Gardens near no.12 was affected during the 1975 surface water flooding recorded in CPG4. Thames Water has informed[10] SLR that surface water on Lyndhurst Gardens currently drains into a combined trunk sewer of cross-section 940mm by 610mm. This trunk sewer runs down Lyndhurst Gardens from the northern end to the western end, then continues downgradient with the same cross-section into Belsize Crescent and on into Belsize Lane. As the total catchment drained by this trunk sewer above the corner of Lyndhurst Gardens is estimated at less than 4ha, the trunk sewer cross-section is considered adequate to remove rainfall from the area.

If the drain is blocked or the capacity of the drainage is exceeded, the following sequence of events is likely to occur[12]:

[9] As mentioned in the letter from Stephen Stark dated 5 July 2011 entitled '16a Lyndhurst Gardens LONDON NW3 5NR – Planning Application Reference 2011/2456/P'

[10] Telephone call between Phil Slater (SLR) and Imran Hussain (Operations Team, Thames Water), 10/6/2011

[12] It should be noted that the elevations referenced in these bullet points are approximate and have not been surveyed except at 16a Lyndhurst Gardens and the immediate vicinity.

- water levels at the lowest point would rise by 17cm, when they would spill on to the pavement outside 12 Lyndhurst Gardens;
- water levels on the pavement would rise by approximately a further 30cm until they spill on to the steps leading down to the basement at 12 Lyndhurst Gardens;
- as the no. 12 basement steps only provide limited storage, water levels could then rise by approximately a further 10cm along the pavement to the east until they spill on to the steps leading down to the western basement at 14 Lyndhurst Gardens;
- as the no.14 basement has limited storage, water levels could rise by a further 10cm to flow down the steps to the east of no.14; and
- as the threshold of 16 Lyndhurst Gardens is at an approximately similar level to the threshold of no.14, water could also enter the lower ground level of no.16 (as is understood[13] to have happened in 1975 and 2002).

The topographic information on Drawing 1069.01.02 and site inspection indicate that the threshold for water to flow down the no.14 basement steps is likely to be similar to the surveyed elevation for the threshold of no.16 i.e. 76.26 maOD. As the surveyed threshold elevation for water to flow onto the driveway of no.16a is 76.58 maOD, it is not considered likely that overland flow down Lyndhurst Gardens would affect the proposed basement development

As for other surface water which could reach the site, the rear garden of 18 Lyndhurst Gardens slopes gently towards the site, but it is vegetated (as shown in Figure 3) and hence unlikely to generate significant runoff. However, runoff from the side terrace of no. 18 (shown in Figure 4, approximately 50m^2) could flow beneath the existing fence and on to the no.16a site. Furthermore, additional runoff could develop if there was a blockage at the base of the two downpipes (draining a roof area of approximately 40m^2) which feed into drains beneath the side terrace of no.18.

Figure 3
Rear Garden of No.18

Figure 4
Side Terrace of No. 18 with Downpipe

This small potential amount of runoff from no.18 is likely at present to flow beneath the fence and infiltrate into the soil along the northern side of the driveway of no.16a. As it is proposed to replace this fence with a brick wall, and the soil along the northern side of the driveway will be retained, this potential runoff is unlikely to reach the proposed basement development.

[13] As mentioned in the letter from Stephen Stark dated 5 July 2011 entitled '16a Lyndhurst Gardens LONDON NW3 5NR – Planning Application Reference 2011/2456/P'

Potential Surface Water Flooding caused by Proposed Development

The proposed basement development is unlikely to cause increased surface water flooding at adjoining properties. As discussed in Q3 of section 3.1 of the Surface Water Flow Screening above, the net runoff from the site will not be significantly increased by the proposed basement development. All new hard surfaces will drain into a rainwater storage reservoir, any overflow from which will be released to enter the site drain which feeds into the Thames Water combined sewers.

It is considered unlikely that surface water runoff would cause significant flooding at the site and it is considered unlikely that the development would increase the risk of surface water flooding in the local area.

3.3.7 Flooding from Artificial Drainage Systems

In the event of a blockage or capacity exceedance in the trunk sewer mentioned in section 3.3.6 above, the sewer would surcharge spilling onto the road and any flow would be as described above. It is considered unlikely that artificial drainage systems could cause significant flooding at the site and it is considered unlikely that the development would increase the risk of flooding from artificial drainage systems within the local area.

3.3.8 Flooding due to Infrastructure Failure

Rainfall falling on the basement courtyard area (approximately 40 m^2) will be collected in a sump and pumped up to the rainwater storage reservoir. However, if this pumping system failed, then it is possible that rainfall falling in the basement courtyard could cause limited flooding to the basement and sub-basement. The depth of flooding would increase slowly and water would not be flowing, therefore the risk to life would be minimal however the risk to the property may be considerable.

It is recommended that the following flood resilience measures be considered around the basement courtyard:

- a dual pumping system from the basement courtyard sump, to ensure that pumping can continue when necessary, even if one pump breaks down;
- the levels of all thresholds into the property should be set at least 300mm above the exterior ground levels to offer protection against floodwater ponding outside the building;
- all electrical and communications services to be routed from ceiling down rather than floor up; and
- tiles are recommended rather than carpets for flooring in the basement rooms.

It is proposed to check and service the pumping system on a regular basis. As the basement courtyard is not likely to flood quickly to significant depth, regular checking of the pumping system should be adequate to avoid the risk of flooding the basement.

3.4 Management of Off-Site Impacts

As detailed in sections 3.3.5 to 3.3.7 above, it is considered unlikely that the development would increase the risk of flooding within the local area.

4.0 RESPONSE TO OBJECTIONS

Three reports with relevant objections were received in response to the June 2011 withdrawn planning application, and the relevant objections in each report are summarised and addressed below.

4.1 Objections by Stark (on behalf of 16 Lyndhurst Gardens)

The report submitted by Stark[9] in July 2011 raised five objections relevant to this report as reproduce in italics below.

4.1.1 Requirements of Camden Development Policy DP27

Stark 6.4: *'DP27 requires an assessment of the scheme for drainage, flooding, groundwater conditions and structural stability. This has not been done'.*

SLR Response: The Basement Impact Assessment prepared by SLR has followed the requirements of Camden Planning Guidance CPG4, which states in section 2.5 that it contains further detail as to how to implement the generalised requirements mentioned by DP27.

4.1.2 Assessment of Groundwater Flow

Stark 6.5: *'The construction of a basement will alter the ground water flow which may increase the risk of flooding to adjacent properties not just the neighbouring properties. A full assessment of this has not been submitted by the applicant. No modelling of the effects that a basement development will have on water flow adjacent to the works has been carried out'.*

SLR Response: Section 2.2.2 of this SLR letter is entitled 'Conceptual Ground Model and Potential Impacts' and is considered to provide an adequate assessment of the potential alterations of any underground water seepages which might occur in winter and spring months. It is noted that the site is located on London Clay overlain by silty Made Ground, and no underground water was encountered during site investigation or subsequent monitoring up to November 2011, hence the potential for any significant underground seepages is very limited.

4.1.3 *Flood Risk Assessment*

Stark 6.5 and 6.11: *'The applicant has not provided a flood risk assessment for the local area'.*

SLR Response: Section 3.3 of this SLR letter presents a Flood Risk Assessment which assesses the potential for groundwater or surface water flooding to affect the application site itself, and also for any exacerbation of groundwater or surface water flooding potentially caused by the proposed basement development to affect adjoining properties or the local area.

4.1.4 Site Investigation

Stark 6.5: *'The soil report issued with the planning application is woefully inadequate. The investigations are limited to just 3 trial holes .. only excavated to a depth of 1.8m whereas .. the excavation required for this double basement will be in excess of 6m. The site* *investigations are manifestly inadequate and no meaningful reporting or analysis has been prepared.'*

SLR Response: Section 2.1 of this SLR letter includes details of site geology based on three boreholes drilled to depths of 15m in July 2011. The 'Conceptual Ground Model and Potential Impacts' presented in section 2.2.2 of this letter provides analysis based on the drilling results.

4.1.5 Ground Water Levels

Stark 6.11: *'No details of ground water levels have been recorded'.*

SLR Response: No water was encountered during site investigation or subsequent monitoring up to November 2011.

4.2 Objections[14] by Belsize Residents Association

Comment 2**:** *'No Basement Impact Assessment or hydrogeological report is presented'.*

SLR Response: This SLR letter is a Basement Impact Assessment including a hydrogeological assessment of the potential impacts of the proposed basement.

4.3 Objections[15] by Signet Planning (on behalf of St Christopher's School)

Proposed Basement and Hydrological Impact on St Christopher's School: '*The Basement Impact Assessment prepared by SLR Consulting confirms that there could be ground water seepages beneath the application site to the east particularly during the winter and spring months. It is confirmed that the proposed basement could block any such seepages beneath the site resulting in ground water seepages being diverted around the perimeter of the basement and emerging into the ground of St Christopher's School. It is then suggested that such an impact may be offset by the loss of rain for infiltration for soil and flowerbeds into the east of the current building.. On the basis of the information submitted by the applicant, it is not considered that there is any guarantee that such [groundwater] flooding would be unlikely to occur.'*

SLR Response: This revised application includes mitigation measures to minimise any potential diversion of potential winter underground water seepages towards St Christopher's School. As the basement footprint is now proposed to extend only to within 6m of the north-western corner of the application site, any underground seepages diverted along the northern edge of the basement development would be able to revert to near their current pathways before reaching the school grounds, avoiding any concentration of additional seepages at the north-eastern corner of the application site. The construction of a drainage corridor, eg French drain or similar, along the eastern site boundary would also minimise any potential slight increase in seepages near the north-eastern corner of the site.

5.0 SUMMARY AND CONCLUSIONS

This letter report has presented the Basement Impact Assessment screening responses for groundwater flow and for surface flow / flooding.

[14] Memo dated 27 June 2011 from Belsize Residents Association entitled 'Comment on Planning Application in Belsize Park'

[15] Letter from Julian Sutton (Signet Planning) to Charles Thuaire (London Borough of Camden) entitled 'Re: The Gateway, 16a Lyndhurst Gardens, London NW3 5NR, Planning Applications Ref: 2011/2456/P and 2011/2459/C'

As the responses to Q2 and Q6 of the groundwater flow screening (regarding a possible nearby springline) were UNKNOWN, it was considered appropriate to carry out site investigation to assist with the development of a conceptual ground model and an assessment of potential impacts. Although the site investigation and subsequent monitoring did not encounter any underground water, the conceptual ground model found that it is possible (but not likely) that there could currently during winter and spring months potentially be some underground water seepage to the east in silty Made Ground beneath the application site. This could (in the absence of mitigation) be diverted towards the east by the proposed basement development. Also it is possible that any potential seepages that may be present following the proposed basement development, could be blocked and back up in between the basement of no.16 and the proposed basement of no.16a, unless a groundwater pathway is available between the two basements.

Recommended mitigation measures to address these potential issues involve the construction of a drainage corridor (e.g. French drain, geocomposite or similar) around the perimeter of the proposed basement, with offsetting of the proposed basement from the site boundary at both the south-west and north-east corners, to allow adequate drainage pathways.

As the responses to Q1 to Q5 of the surface flow screening were NO, it was not necessary to proceed to develop a surface flow scoping. However, as the response to Q6 was YES due to previous surface water flooding in Lyndhurst Gardens in 1975, it was considered appropriate to undertake a Flood Risk Assessment.

The Flood Risk Assessment examined four potential risks. The potential risk from surface water flooding and flooding from artificial drainage systems was found to be negligible. The rate and volume of flows caused by potential groundwater flooding or by flooding due to infrastructure failure were found to be negligible in terms of off-site impacts. Regular checking and servicing of the overflow pumps for the basement courtyard sump is recommended as a mitigation measure to avoid the possibility of basement courtyard overflow after heavy rains causing flooding of the basement.

Compared to the pre-development site condition, the proposed basement development is very unlikely to increase the rate or volume of surface water discharged from the application site.

The Flood Risk Assessment therefore demonstrates that the proposed basement development can be deemed sustainable and 'safe' in flood risk terms, and in compliance with the requirement of PPS25, assuming the proposed mitigation measures are incorporated into the design of the property.

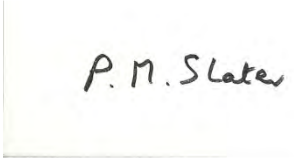
6.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Lyndhurst Gardens LLP; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

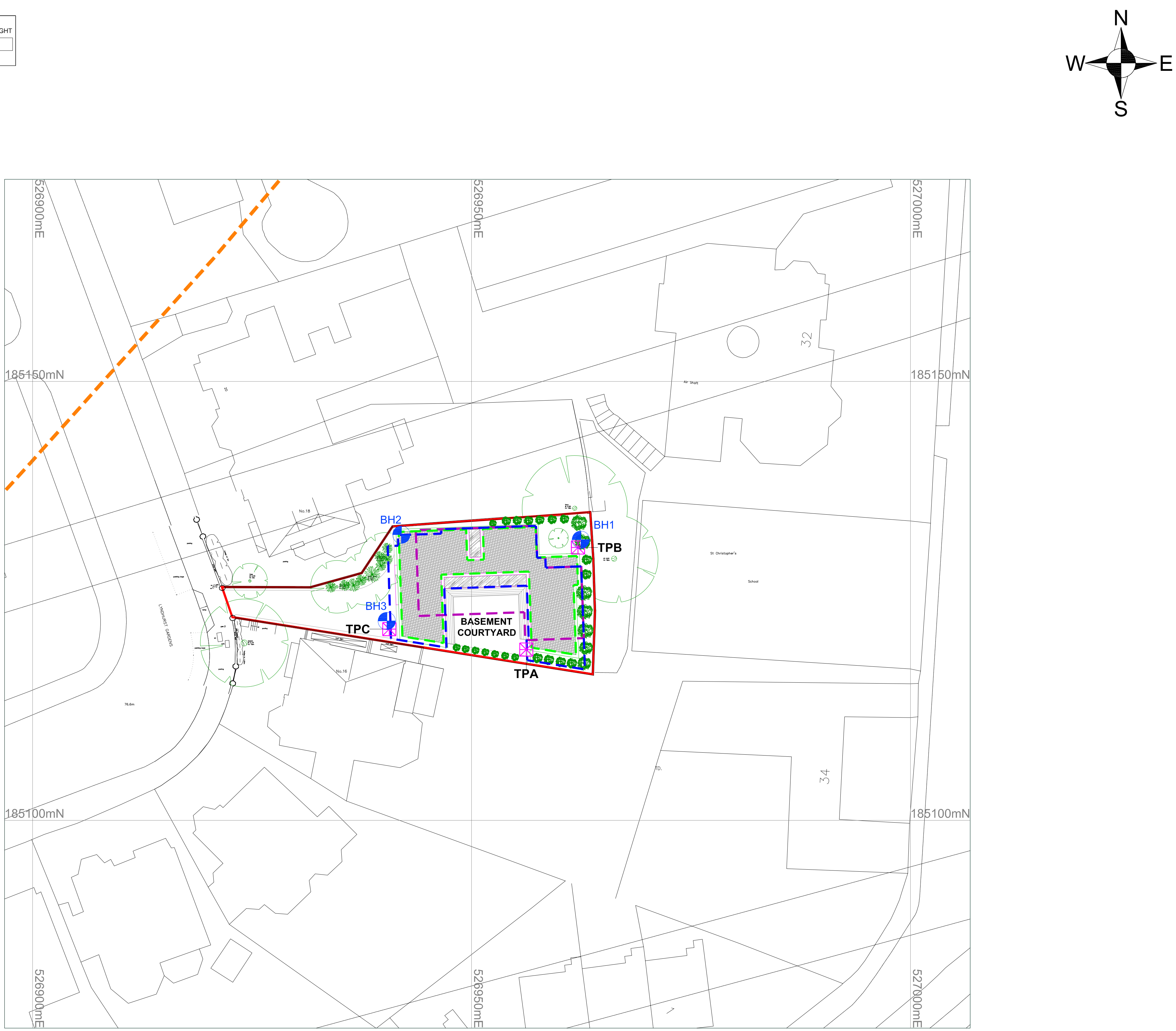
SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

Yours sincerely
SLR Consulting Limited



for **Phil Slater CGeol** **Paul Klimczak C.WEM**
Associate Hydrogeologist Senior Hydrologist

cc Richard Webb, Webb Architects
Enc Drawing 1 – Proposed Development and Site Geology
Drawing 1069.01.02 - Existing Site Plan
Borehole Logs
Trialpit Logs



NOTES

1. DRAWING INFORMATION SUPPLIED BY WEBB ARCHITECTS LTD, REF: 1069-PRPSD PLNS-A1.DWG, DATE RECEIVED: 07.06.2011.

2. ADDITIONAL INFORMATION SUPPLIED BY WEBB ARCHITECTS LTD, REF: FIGURE 4 TAKEN FROM CAMDEN GEOLOGICAL, HYDROGEOLOGICAL & HDROLOGICAL STUDY (LONDON BOROUGH OF CAMDEN, 2010), DATE RECEIVED: 07.06.2011.

LEGEND

- SOUTHERN EXTENT OF CLAYGATE BEDS TAKEN FROM BGS SHEET 256 (NORTH LONDON)
- SITE BOUNDARY
- OUTLINE OF BASEMENT FOOTPRINT
- OUTLINE OF SUB-BASEMENT FOOTPRINT
- OUTLINE OF GREEN FLAT ROOF FOOTPRINT
- TPA — TRIAL PIT LOCATION & REFERENCE
- BH1 — BOREHOLE LOCATION & REFERENCE

Revision	By	Chk'd By	Date	Comments
0	KW	PS	06/11	

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MENMARSH ROAD
WORMINGHALL, AYLESBURY
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Site
16a LYNDHURST GARDENS

Project
BASEMENT IMPACT ASSESSMENT

Drawing Title
PROPOSED DEVELOPMENT & SITE GEOLOGY

Scale: 1:500 @ A3
Date: JUNE 2011

0 5 10 15 20m 30 40 50
Metres
1:500

Drawing Number: 001
Revision: 0

03684.00001.11.001.0D Proposed Development.dwg

t 020 89680279
m 077 98854810
richard@webb-architects.co.uk

WEBB ARCHITECTS LIMITED

Drawing to be read in conjunction with consultants information.
Do not scale from drawing.
All dimensions to be checked on site.
Drawing only to be used for purposes indicated.
Notify Architect of any discrepencies.

REV

16A LYNDHURST GARDENS

EXISTING SITE PLAN

1:100 / A1, 1:200 / A3 | FOR INFORMATION

1069.01.02(-)

TRIAL PIT LOG

TRIAL PIT No
TPA - North side

Client:
LYNDHURST GARDENS LLP

Project:
BASEMENT IMPACT ASSESSMENT 16A LYNDHURST GARDENS

Project No:	Date:	Ground Level:	Co-ordinates:	Sheet:
401.03684.00001	16/06/11			1 of 1

SAMPLES & TESTS				Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Type	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	
							(0.50) 0.50	Brown clayey silt TOPSOIL with frequent rootlets. Part of north side of trial pit overlain by 20cm of concrete.	
							(0.40) 0.90	Brown slightly clayey silty fine SAND with frequent rootlets and angular cobble sized brick fragments (MADE GROUND)	
1							(0.90) 1.80	Firm to stiff brown CLAY with occasional gravel sized brick fragments and occasional lenses of clayey silt (MADE GROUND)	
2								Trial Pit complete at 1.80m	
3									

GENERAL REMARKS:
No groundwater seepages

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space Measurement

Trial Pit Dimensions:
1.7
0.7

Shoring/Support:
Stability:

All dimensions in metres Scale 1:25	Contractor : Plant:	Method: Trial Pit/trench	Logged By: P Slater	Approved By: D Morgan

SLR Consulting Ltd, Treenwood House, Bradford on Avon, BA14 8GH, Tel: 01225 309400, Fax: 01225 309401

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930

TRIAL PIT LOG

TRIAL PIT No **TPA - South side**

Client: **LYNDHURST GARDENS LLP**

Project: **BASEMENT IMPACT ASSESSMENT 16A LYNDHURST GARDENS**

Project No:	Date:	Ground Level:	Co-ordinates:	Sheet:
401.03684.00001	16/06/11			1 of 1

SAMPLES & TESTS / STRATA

Depth	Type No	Test Type	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument/ Backfill
							(0.50) 0.50	Brown clayey silt TOPSOIL with frequent rootlets	
							(0.40) 0.90	Brown silty fine SAND with frequent angular cobble sized brick fragments (MADE GROUND)	
							(0.60) 1.50	Grey coarse CONCRETE (MADE GROUND)	
							(0.30) 1.80	Stiff brown CLAY with occasional coarse gravel sized brick fragments (MADE GROUND)	
								Trial Pit complete at 1.80m	

Depth scale: 1, 2, 3

GENERAL REMARKS:
No groundwater seepages

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space Measurement

Trial Pit Dimensions:
1.7
0.7

Shoring/Support:
Stability:

All dimensions in metres Scale 1:25	Contractor : Plant:	Method: Trial Pit/trench	Logged By: P Slater	Approved By: D Morgan

Form SLR AGS3 UK TP File 110617_401-3684-00001_TRIALPITS.GPJ 20-06-11

TRIAL PIT LOG

TRIAL PIT No **TPB**

Client: **LYNDHURST GARDENS LLP**

Project: **BASEMENT IMPACT ASSESSMENT 16A LYNDHURST GARDENS**

Project No:	Date:	Ground Level:	Co-ordinates:	Sheet:
401.03684.00001	17/06/11			1 of 1

SAMPLES & TESTS				Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Type	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	
							(0.50) 0.50	Brown, clayey silt TOPSOIL with frequent rootlets	
							(0.30) 0.80	Brown, slightly clayey silty, fine SAND with frequent angular cobble sized brick fragments (MADE GROUND)	
							(0.50) 1.30	Silty CLAY with frequent brick fragments (MADE GROUND)	
							(0.50) 1.80	Brown slightly sandy SILT with frequent angular gravel sized brick fragments (MADE GROUND)	
								Trial Pit complete at 1.80m	

Depth scale: 1, 2, 3

GENERAL REMARKS:
No groundwater seepages

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space Measurement

Trial Pit Dimensions: 1.5 × 0.45

Shoring/Support:
Stability:

All dimensions in metres Scale 1:25	Contractor : Plant:	Method: Trial Pit/trench	Logged By: P Slater	Approved By: D Morgan

Form SLR AGS3 UK TP File 110617_401-3684-00001_TRIALPITS.GPJ 20-06-11

TRIAL PIT LOG

TRIAL PIT No **TPC - North side**

Client: **LYNDHURST GARDENS LLP**

Project: **BASEMENT IMPACT ASSESSMENT 16A LYNDHURST GARDENS**

Project No:	Date:	Ground Level:	Co-ordinates:	Sheet:
401.03684.00001	17/06/11			1 of 1

SAMPLES & TESTS: Depth	Type No	Test Type	Test Result	Water	STRATA: Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument/ Backfill
							(0.30) 0.30	Grey coarse CONCRETE (MADE GROUND)	
							(0.20) 0.50	Brown silty fine SAND with frequent rootlets and numerous bricks (MADE GROUND)	
							(0.50) 1.00	Brown silty fine SAND with frequent rootlets and occasional angular gravel sized brick fragments (MADE GROUND)	
							(0.30) 1.30	Brown slightly sandy SILT with occasional rootlets and rare pockets of sand sized brick fragments (MADE GROUND)	
							(0.30) 1.60	Firm to stiff brown CLAY with rare pockets of sand sized brick fragments (MADE GROUND)	
							(0.20) 1.80	Stiff to very stiff dark brown CLAY with occasional gravel sized angular brick fragments and rare rootlets (MADE GROUND)	
								Trial Pit complete at 1.80m	

Depth scale: 1, 2, 3

GENERAL REMARKS:
No groundwater seepages

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space Measurement

Trial Pit Dimensions: 1.35 × 0.6

Shoring/Support:
Stability:

All dimensions in metres Scale 1:25	Contractor : Plant:	Method: Trial Pit/trench	Logged By: P Slater	Approved By: D Morgan

SLR Consulting Ltd, Treenwood House, Bradford on Avon, BA14 8GH, Tel: 01225 309400, Fax: 01225 309401

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930

TRIAL PIT LOG

TRIAL PIT No
TPC - South side

Client: **LYNDHURST GARDENS LLP**

Project: **BASEMENT IMPACT ASSESSMENT 16A LYNDHURST GARDENS**

Project No:	Date:	Ground Level:	Co-ordinates:	Sheet:
401.03684.00001	17/06/11			1 of 1

Depth	Type No	Test Type	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument/ Backfill
							(0.30) 0.30	Grey coarse CONCRETE (MADE GROUND)	
							(0.30) 0.60	Brown silty fine SAND with frequent rootlets and occasional angular gravel sized brick fragments (MADE GROUND)	
							(0.40) 1.00	Grey coarse CONCRETE (MADE GROUND)	
							(0.25) 1.25	Brown slightly sandy SILT with occasional rootlets and rare pockets of sand sized brick fragments (MADE GROUND)	
							(0.35) 1.60	Firm to stiff brown CLAY with rare pockets of sand sized brick fragments (MADE GROUND)	
							(0.20) 1.80	Stiff to very stiff dark brown CLAY with occasional gravel sized angular brick fragments and rare rootlets (MADE GROUND)	
								Trial Pit complete at 1.80m	

Depth scale: 1, 2, 3

GENERAL REMARKS:
No groundwater seepages

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space Measurement

Trial Pit Dimensions: 1.35 × 0.6

Shoring/Support:
Stability:

All dimensions in metres Scale 1:25	Contractor : Plant:	Method: Trial Pit/trench	Logged By: P Slater	Approved By: D Morgan

Form SLR AGS3 UK TP File 110617_401-3684-00001_TRIALPITS.GPJ 20-06-11

Borehole No: 1		Sheet: 1 of 1 Job No:	**TerraSpec** Site:
Boring Method: C.F.A		Date: 22/07/2011	16a Lyndhurst Gdns, NW3
Diameter: 100mm	Coordinates:	Ground Level mOD:	Work Carried out for: Chesters

Depth (m)	Description of Strata	Thick-ness (m)	Sample	Test Type	Test Result	Depth (m)	Field Records/Comments	Depth to water (m)
GL	Topsoil						Roots of live appearance to 5mm to 1m	
0.50	Made ground, medium compact dark brown slightly gravelly SILT with fine pieces of brick rubble		D			0.50		
			D	SPT	N=6	1.00		
			D			1.50		
			D	SPT	N=7	2.00		
2.30	Stiff mid brown silty CLAY with partings of brown silt/fine sand							
			D			2.50		
3.00	Very stiff as above		D	SPT	N=11	3.00		
			D	SPT	N=12	4.00		
5.00	Very stiff dark brown silty CLAY with partings of brown silt/fine sand		D	SPT	N=14	5.00		
			D			6.00		

Remarks:

X(Y) = X blows for Ymm penetration.

Key: T.D.T.D. Too Dense to Drive

D	Small disturbed sample	J	Jar sample
B	Bulk disturbed sample	V	Pilcon Vane (kPa)
W	Water sample	M	Mackintosh Probe

Logged: SC	Checked:	Approved:	Scale: NTS	Weather:

Borehole No: 1

Sheet:	1 of 1
Job No:	
Date:	22/07/2011
Site:	16a Lyndhurst Gdns, NW3
Boring Method:	C.F.A
Diameter:	100mm
Coordinates:	
Ground Level mOD:	
Work Carried out for:	Chesters

Depth (m)	Description of Strata	Thick-ness (m)	Sample	Test Type	Test Result	Depth (m)	Field Records/Comments	Depth to water (m)
			D	SPT	N=17	7.00		
7.30	Very stiff dark grey silty CLAY with partings of grey silt/fine sand							
			D			8.00		
			D	SPT	N=21	9.00		
			D			10.00		
			D	SPT	N=23	11.00		
			D			12.00		
			D	SPT	N=27	13.00		
			D			14.00		
	BH Ends 15.0m		D	SPT	N=28	15.00	BH dry and open on completion	

Remarks:
SP installed 1m plain + 2m slotted
Top 1m was bentonited
X(Y) = X blows for Y mm penetration.

Key: T.D.T.D. Too Dense to Drive
D Small disturbed sample
B Bulk disturbed sample
W Water sample
J Jar sample
V Pilcon Vane (kPa)
M Mackintosh Probe

Logged: SC	Checked:	Approved:	Scale: NTS	Weather:

Borehole No: 2		Sheet: 1 of 1 Job No:	Site: **TerraSpec**
Boring Method: C.F.A		Date: 22/07/2011	16a Lyndhurst Gdns, NW3
Diameter: 100mm	Coordinates:	Ground Level mOD:	Work Carried out for: Chesters

Depth (m)	Description of Strata	Thick-ness (m)	Sample	Test Type	Test Result	Depth (m)	Field Records/Comments	Depth to water (m)
GL	Topsoil	0.30					Roots of live appearance 6mm to 1.2m	
0.30	Made ground, medium compact dark brown slightly gravelly clayey SILT with pieces of brick rubble	1.40	D			0.50		
			D	SPT	N=8	1.00		
							Hair and fibrous roots observed to 2.4m	
			D			1.50		
1.70	Stiff mid brown silty CLAY with partings of brown silt/fine sand	1.30						
			D	SPT	N=12	2.00		
			D			2.50		
3.00	Very stiff as above	2.00	D	SPT	N=12	3.00		
			D	SPT	N=13	4.00		
5.00	Very stiff dark brown silty CLAY with partings of brown silt/fine sand	2.30	D	SPT	N=14	5.00		
			D			6.00		

Remarks:

X(Y) = X blows for Ymm penetration.

Key: T.D.T.D. Too Dense to Drive

D	Small disturbed sample	J	Jar sample
B	Bulk disturbed sample	V	Pilcon Vane (kPa)
W	Water sample	M	Mackintosh Probe

Logged: SC	Checked:	Approved:	Scale: NTS	Weather:

Borehole No: 2			**Sheet:** 1 of 1					
			Job No:		**Site:** 16a Lyndhurst Gdns, NW3			
Boring Method: C.F.A			**Date:** 22/07/2011					
Diameter: 100mm	**Coordinates:**		**Ground Level mOD:**		**Work Carried out for:** Chesters			

Depth (m)	Description of Strata	Thick-ness (m)	Sample	Test Type	Test Result	Depth (m)	Field Records/Comments	Depth to water (m)
			D	SPT	N=16	7.00		
7.30	Very stiff dark grey silty CLAY with partings of grey silt/fine sand	7.70						
			D			8.00		
			D	SPT	N=20	9.00		
			D			10.00		
			D	SPT	N=23	11.00		
			D			12.00		
			D	SPT	N=25	13.00		
			D			14.00		
	BH ENDS 15.0M		D	SPT	N=25	15.00	BH dry and open on completion	

Remarks: SP installed
0.8m plain 0.8-3.2m slotted
Top 1m bentonited
X(Y) = X blows for Ymm penetration.

Key: T.D.T.D. Too Dense to Drive
D Small disturbed sample — J Jar sample
B Bulk disturbed sample — V Pilcon Vane (kPa)
W Water sample — M Mackintosh Probe

Logged: SC	**Checked:**	**Approved:**	**Scale:** NTS	**Weather:**

Borehole No: 3	Sheet: 1 of 1 Job No:	Site:	**TerraSpec**
Boring Method: C.F.A	Date: 22/07/2011		16a Lyndhurst Gdns, NW3
Diameter: 100mm / Coordinates:	Ground Level mOD:	Work Carried out for:	Chesters

Depth (m)	Description of Strata	Thick-ness (m)	Sample	Test Type	Test Result	Depth (m)	Field Records/Comments	Depth to water (m)
GL	Topsoil	0.30					Roots of live appearance to 4mm to 1.2m	
0.30	Made ground, medium compact dark brown slightly gravelly SILT with fine pieces of brick rubble	0.70	D			0.50		
1.00	Made ground, medium compact mid brown gravelly silty CLAY with pieces of rubble	0.70	D	SPT	N=10	1.00		
			D			1.50		
1.70	Stiff mid brown silty CLAY with partings of brown silt/fine sand	1.30						
			D	SPT	N=12	2.00		
			D			2.50		
3.00	Very stiff as above	2.00	D	SPT	N=13	3.00		
			D	SPT	N=14	4.00		
5.00	Very stiff dark brown silty CLAY with partings of brown silt/fine sand	2.30	D	SPT	N=15	5.00		
			D			6.00		

Remarks:

X(Y) = X blows for Ymm penetration.

Key: T.D.T.D. Too Dense to Drive

D Small disturbed sample
B Bulk disturbed sample
W Water sample
J Jar sample
V Pilcon Vane (kPa)
M Mackintosh Probe

Logged: SC	Checked:	Approved:	Scale: NTS	Weather:

Borehole No: 3

Borehole No: 3	**Sheet:** 1 of 1	**Site:** 16a Lyndhurst Gdns, NW3	
	Job No:		
Boring Method: C.F.A	**Date:** 22/07/2011		
Diameter: 100mm **Coordinates:**	**Ground Level mOD:**	**Work Carried out for:** Chesters	

Depth (m)	Description of Strata	Thick-ness (m)	Sample	Test Type	Test Result	Depth (m)	Field Records/Comments	Depth to water (m)
			D	SPT	N=17	7.00		
7.30	Very stiff dark grey silty CLAY with partings of grey silt/fine sand	7.70						
			D			8.00		
			D	SPT	N=21	9.00		
			D			10.00		
			D	SPT	N=24	11.00		
			D			12.00		
			D	SPT	N=26	13.00		
			D			14.00		
	BH Ends 15.0m		D	SPT	N=27		BH dry and open on completion	

Remarks: SP installed
0.8m plain 0.8m-3.2m slotted
Top 0.8m bentonited
X(Y) = X blows for Ymm penetration.

Key: T.D.T.D. Too Dense to Drive

D	Small disturbed sample	J	Jar sample
B	Bulk disturbed sample	V	Pilcon Vane (kPa)
W	Water sample	M	Mackintosh Probe

Logged: SC	**Checked:**	**Approved:**	**Scale:** NTS	**Weather:**