Building Impact Assessment for a New Basement at 58A Redington Road, London, NW3

Elite Designers Ltd

2018 - 059

October 2018

58A Redington Road, NW3

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Appendices

Instructions:

Elite Designers Ltd are consulting structural engineers who have been appointed by the building owners to provide full structural services in support of the design and construction of the proposed enlarged house and new basement at 58A Redington Road, NW3.

General:

This Building Impact Assessment report has been compiled in support of the Planning Application for the new basement, following the requirements and guidelines of the planning department of the London Borough of Camden.

Particular studies have been commissioned from appropriately qualified specialists, as required and defined in the guidelines. These reports are appended.

The three key aspects of basement constructions that are of concern to the Borough of Camden are:

- the built and natural environments
- flooding, and
- ground instability

These are addressed in the following Stages and substantiated in the relevant appended Specialists' Reports.

Non-Technical Summary:

The property is located at 58A Redington Road, NW3. Location plans are included in the appended geotechnical reports.

The property currently comprises a semi-detached house with split-level floors and a small subterranean extension below the front garden. Plan and section drawings are appended.

A desk study, screening and scoping have been carried out, and are included in the following sections.

A site investigation, hydro-geological study (including a flood risk assessment), and ground movement assessment have been carried out, and are appended.

A surface water drainage strategy and SUDS assessment have been compiled and is included in the following sections.

An impact assessment has been carried out and is included in the following sections.

The sub-soils comprise Claygate Member with discrete water-bearing lens at varying depths, but no perched water-table *per se*.

A structural monitoring strategy to control the works and the impacts of the works on neighbouring properties will be put in hand. This will comprise condition surveys as part of the necessary Party Wall Awards; the appointment of a suitably experienced Principle Contractor to supervise the works of experienced specialist ground works, etc; building movement surveys carried out by an independent company, with agreed 'trigger values' commensurate with the anticipated ground movements (as per the appended study); review of construction sequences and ground support temporary works by the project Engineer as well as by the principle Contractor. Routine inspections of the works will be carried out by the project Engineer.

The BIA has assessed that there is no risk of land instability, and that the anticipated ground movements will not result in damage to adjoining or adjacent properties greater than category 1 on the Burland Scale. The specialist studies concluded that the basement will not have any significant detrimental effect on the existing hydrological environment.

No flood risk has been identified therefore no mitigation is required.

It is therefore concluded that the proposed basement can be constructed without detriment to the adjoining or adjacent properties or buried services; will not increase the risk of flooding; nor create a risk of ground instability.

This report was prepared by:

B Huxtable CEng MIStructE MICE MSt
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Stage 1: Screening.

Screening reviews three aspects, namely:

- ground-water flow
- land stability
- surface water flow and flooding

Ground-water Screening Flow Chart:

Q1a: Is the site directly above and aquifer?

A: Yes, therefore carry forward

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

A: No

Q2: Is the site within 100m of a water-course, well or potential spring line?

A: Yes, therefore carry forward.

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

A: No

Q4: Will the proposed development change the proportion of hard surfacing?

A: Yes, therefore carry forward.

Q5: As part of the site drainage, will more surface water than at present be discharged to the ground (eg via soak-aways or SUDS)?

A: No

Q6: Is the lowest part of the excavation close to or lower than the mean water level in any local pond or spring line?

A: No

Slope Stability Screening Chart:

Q1: Does the existing site include slopes steeper than 1 in 8?
A: No (approximately 1 in 15)

Q2: Will the proposed re-profiling change slopes at the boundaries to more than 1 in 8?
A: No.

Q3: Does the neighbouring land have slopes more than 1 in 8?
A: No (approximately 1 in 15)

Q4: Is the site within a wider hillside setting in which the general slope is greater than 1 in 8?
A: No (approximately 1 in 15)

Q5: Is London Clay the shallowest strata on site?
A: No (Claygate Member)

Q6: Will any trees be felled, or any works proposed within tree protection zones?
A: No.

Q7: Is there a history of seasonal shrink-swell subsidence in the local area, or on the site?
A: No.

Q8: Is the site within 100m of a water-course or a potential spring line?
A: Yes (culverted 'lost river'), therefore carry forward.

Q9: Is the site in an area of previously-worked land?
A: No.

Q10: Is the site within an aquifer, if so, will de-watering be required during construction?
A: No.

Q11: Is the site within 50m of the Hampstead Heath ponds?
A: No.

Q12: Is the site within 5m of a highway or public right of way?
A: Yes, therefore carry forward.

Q13: Will the proposed development increase the differential depth of foundations relative to neighbouring properties?
A: Yes, therefore carry forward.

Surface Flow and Flooding Screening Chart.

Q1: Is the site within the catchment of the pond chains on Hampstead Heath?
A: No.

Q2: As part of the proposed site drainage, will surface water flows be materially changed from the existing route?
A: No.

Q3: Will the proposed basement development result in a change in the proportion of hard surfaced external areas?
A: Yes, therefore carry forward.

Q4: Will the proposed basement result in changes to the profile of the inflows of surface water being received by adjacent properties or downstream water-course?
A: No.

Q5: Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream water-courses?
A: No.

Q6: Is the site in an area of known risk, for example because the proposed basement is below the static water level of a nearby surface water feature?
A: No.

Stage 2: Scoping.

Potential concerns raised during Phase 1 screening are:

Ground-water flow:

Located above an aquifer

Within 100m of a water-course

Increased area of hard surfacing

Slope Stability:

Within 100m of a water-course

Within 5m of a highway

Increased differential of foundation levels

Surface Flows and Flooding:

Increased proportion of hard landscaping

Potential Impacts:

It is proposed to retain the current level of rain-water discharge into the public sewers as at present. Increased areas of roofs and hard landscaping will result in greater run-off in a shorter period than at present, but it is proposed to mitigate this by retaining the current level of rain-water discharge in the ground as at present. A SUDS system will therefore be required in order to achieve this, and avoid all risks associated with increased areas of hard surfacing.

The published map of London's known water-courses (Ref: The Lost Rivers of London), shows a culverted tributary aligned with Redington Road, with the start of the tributary being close to the property (approximately 100m to the west), probably below the public highway. The proposed basement and building works will therefore be some distance from the culvert and will not have a detrimental effect of the culvert's integrity. No additional flow would be caused by the development, nor any existing flow be intercepted from it.

The public footpath and highway at the front of the property are currently supported by the reinforced concrete subterranean extension below the front garden. This extension will not be altered by the proposed works. The new basement will be no closer than 6m from the back of the public footpath, and approximately 8m from the highway's kerb line. Therefore, the

basement will be more than 5m from the highway, and thus there will be no risk to the integrity or support of the footpath and highway.

It is proposed to construct the new basement in reinforced concrete, in 1m bays in a 1-in-5 underpin sequence, in accordance with best practice. The bearing pressures of the new construction on the soil strata at the depth of the excavation, will be kept to within limits such that consolidation settlements will be within acceptable limits. Supporting scheme calculations are appended.

A ground movement analysis and a (potential) damage assessment have been carried out, and the conclusion is that the net vertical and lateral movements would be unlikely to cause cracking in the adjoining or adjacent properties greater than Category 1. Therefore, the risk of damage to adjacent and adjoining properties has been reduced to acceptable limits.

The construction of the proposed basement will be carried out by a specialist ground-works contractor who will be supervised by a suitably experienced Principle Contractor. Temporary works lateral ground supports will be designed by the Principle Contractor and will be executed strictly in accordance with an agreed sequence of works.

Movement monitoring will be carried out during the under-pinning, the excavation and the basement construction phases, to confirm the soil-structure behavior. Systems will be in place to deal with un-expected movements should they occur.

Stage 3: Site Investigations and Study.

The investigations carried out comprised the following:

- Desk Study and Walk-over inspection
- Site Investigation, including boreholes and trial pits
- Monitoring of ground-water levels
- Factual and Interpretive Reports, as appended.
- Interpretation by qualified geo-technical engineer.

The site investigation confirmed the property to be founded on Claygate Member, and underlain at depth by London Clay

Ground water was encountered in discrete layers at various depths across the property. It was ***not*** encountered as a single perched water table. The shallowest recorded water level was at a level of 103m AOD i.e. approximately 0.7m above the excavated depth but only at one end of the site; the lowest at 99mAOD i.e. approximately 3m below the proposed excavation depth for the majority of the planned excavation.

The water level was found to fluctuate only by approximately 0.4m after a period of heavy rainfall. Records are included in the appended soils investigation report.

The soil properties and water level have been used to ascertain the proposed soil bearing capacity, and thus also the parameters of the ground movement analysis, concluding that movements would be within acceptable limits.

The soils identified in the zone of the proposed excavation were found to be suitable for the proposed method of construction.

Desk-top Study.

A dimensional survey of the existing property and curtilage has been carried out and is appended. This provided ground levels and thus ground slopes. The OS 1: 1250 scale map also provides level information. Slopes are calculated to be 1 in 15 from front to rear, and approximately 1 in 27 across the width of the property. The highway to the front slopes at approximately 1 in 27.

The OS map shows the property to be located approximately 100m from the crest of a hill, with the culverted tributary located downhill the front of the property and separated from the hill

beyond by the highway. It is therefore likely that rain-water run-off from this small hill is currently intercepted by the highway drainage, and thus by the tributary.

The 1: 50,000 geological drift map shows the property to lay close to the boundary of the Bagshot Formation (sands) and the area to be under-lain by Claygate Member (silt and fine-grained sand, approximately 16m thick), over London Clay at depth. No discontinuities of faults are located with 1000m of the property. These materials are over-consolidated, and not fluvial deposits. Therefore, they are likely to be stable during excavations, such that normal ground support systems and techniques would be suitable. The strata could be expected to have a perched water table above the London Clay, some 16m below ground level, which may fluctuate seasonally, and after period of high rainfall, or periods without rain.

The site investigation carried out by Messrs GEA confirmed that the area has been residential since it was first developed.

The published maps of WW2 bomb damage show the nearest bomb damage to be 125m to the west, and another also 125m distant to the south. Therefore, the soils within the rear garden are not expected to be 'disturbed'.

The Lost Rivers of London indicates a small culverted tributary to be located below the line to the highway to the west of the property, further along Redington Road approximately 100m distant.

The closest Hampstead Heath ponds are approximately 500m to the north, and 1000m to the east. The chains of ponds are more distant. The Golders Hill Chain catchment area of the ponds to the north, is beyond (on the far side of) the small hill in front of the house. The catchment area of the Hampstead Heath Extension Chain lies approximately 600m to the east. Therefore, the house is not within any of the defined catchment areas serving the ponds.

No Tube tunnels or exclusion zones lay below the property. The Northern line tunnel lies approximately 500m to the north-east, at depth.

The published list of streets known to suffer from surface water flooding does not include Redington Road. The London Borough of Camden’s data indicates that the site is not within a ground-water source protection zone.

Record drawings for the 1970's house alterations and extensions to the front and rear have been made available, and these include information on the foundations.

Walk-over Survey.

Number 58A is a semi-detached house, with a party wall shared with number 58. Number 58B is set beyond number 58, but we understand may extend over the latter in the upper floor(s), so may also share the party wall with number 58A.

The house has a large rear garden downhill of the house, with mature trees at the furthest end of the garden. The garden is laid to lawn with some shrubs in the half nearest to the rear of the house.

The houses to the north side of Redington Road are set in large gardens with mature trees. Those on the south side tend to be semi-detached and set much closer together, with fewer trees. The rear garden of this property has shrubs but no mature trees. It is expected that summer rain fall will be taken up by vegetation, but winter rain will tend to percolate down to a perched water table.

The property is set on the south side of a road that slopes downhill in a generally south-westerly direction. The road subsequently runs downhill in a southerly direction. The land on the north side of the road, opposite the property, is at a slightly higher level, with a low hill beyond. There is therefore only a limited catchment area uphill from the property, and underground flows are likely to be intercepted by the 'cut' of the road across and into the slope of the lay of the land.

There are gardens on the uphill side of the road, and on the downhill side of each property. The front extension occupies the full width of the plot, so its depth relative to any perched water-table should be (and has been) ascertained.

No signs of building movement were noted in this property or those to either side. No significant defects were noted in boundary walls close to mature deciduous trees. This suggests that the sub-soils are not subject to seasonal moisture movements.

No signs of ground instability were noted within 500m of the property.

The main house is of similar construction to those on the same side of the road, dating from the late 19th century. It has undergone internal re-modelling and extensions in the 1970's. the extensions are of reinforced concrete. The extensions occupy the full width of the plot, both at the front and at the rear. The rear garden has lawns, shrubs and small trees only. The front garden is fully paved.

Stage 4: Impact Assessment.

The concerns identified during the stage 1 screening were:

Ground-water flow:

Located above an aquifer

Within 100m of a water-course

Increased area of hard surfacing

Slope Stability:

Within 100m of a water-course

Within 5m of a highway

Increased differential of foundation levels

Surface Flows and Flooding:

Increased proportion of hard landscaping

Current Situation:

The house currently has a subterranean extension below the front garden, extending across the full width of the property, to the rear of the public footpath, to a depth of approximately 2.8m below ground level. It is understood that this was constructed in the 1970's without detrimental effects of adjoining properties, the highway or the culverted tributary (some 100m distant).

Rain water from the house roofs and from hard landscaped areas to the front, currently drain to the public sewer. The rear gardens currently take run off from rear facade canopies and also a small area of hard paving.

The original house (and adjacent properties) is understood to have been constructed off stepped foundations following the general front to rear slope of the landscape. The 1970's rear extension was built off concrete strip footings deeper than adjacent existing foundations, without detriment to adjacent properties.

Proposed Situation:

It is proposed to construct a new basement in reinforced concrete with retaining walls fully supporting the ground on all sides, and thus also the foundations of adjoining and adjacent properties, the highway, and the culverted tributary (some 100m distant). The existing front garden subterranean room separates the public footpath and highway from the new basement, and thus there would be no change to the support of these.

It is proposed to control rain water discharge to the public sewer such that there is no increase in either volume or rate of flow. A SUDS system will also be used to limit the quantity and rate of flow of rain-water discharged into the ground down-hill (i.e. to the rear) of the property, to that presently discharged.

Although it is proposed to extend existing Party Wall foundations downwards by underpinning, the assessed vertical and lateral movement are sufficiently small that it has been assessed that the adjoining property could tolerate these movements with only cosmetic cracking likely to occur, no more than Category 1.

The properties are currently founded on soils that do not shrink or expand seasonally and therefore to introduce discontinuities in the depths of the foundations is considered not to significantly increase the risk of differential settlement after the construction phase has been completed.

The ground water levels monitored in the four stand-pipes show that the majority of the basement will be founded significantly higher than 1m higher that the highest recorded level. Therefore, settlement should predominantly occur during construction, and would not be subject to changes in soil behavior during periods of increased rain-fall. Where the water level was encountered higher than the basement level, a reduced bearing capacity will be used in the detailed design, so that this small are will also not be subject to fluctuating soil parameters.

The Conceptual Site Model is described and defined in detail in the reports by Messrs GCG, which are appended.

Land Stability / Slope Stability.

The site is underlain by Claygate Member, which is confirmed as a suitable bearing stratum in the site investigation report by Messrs GEA, which is appended. This material is not considered as ‘highly shrinkable’, and there are no indications of seasonal volume changes effecting existing properties, including garden walls.

The ground movement assessment has concluded that the order of magnitude of lateral and vertical movements will be such that adjoining and adjacent structures would not exhibit more than Category 1 damage, as define in the Burland Scale, i.e. very slight.

The BIA concluded that there will not be a risk or stability impact to the development or adjacent structures due to slopes.

Hydrogeology and Groundwater Flooding.

The BIA concluded that there is a very low risk of ground water flooding, and therefore no mitigation measures other than the SUDS soak-away are required. It was also concluded that there was no impacts to the wider hydrogeological environment.

Hydrology, Surface Water Flooding and Sewer Flooding.

The BIA concludes that there is a very low risk of surface water flooding at present, and the proposed development will maintain the *status quo*. It also concludes that there are no impacts to the wider hydrological environment, due to the use of a SUDS system in the rear garden.

Stage 5: Review and Decision Making

Detailed Engineering Study.

This study comprises the structural aspects reviewed by Elite Designers Ltd; a hydro-geological study carried out by the Geotechnical Consulting Group (GCG); ground movement and slope stability analyses, and a building damage assessment, also carried out by GCG. These were informed by the factual and interpretive site investigation reports provided by Messrs GEA.

These reports are appended.

Ground water levels were established during the site investigation, and have been monitored since. They will continue to be monitored until the works commence. Variations in water level have been established, with readings being taken after heavy rainfall events. The highest levels have been used in the scheme design, and will also be used in the final detailed design. The measured water levels were between 100.5m AOD and 104.7m AOD, i.e. approximately 3m below the proposed basement generally, and locally to one end approximately 0.7m above the excavation for the proposed basement slab.

Record drawings of the extensions and alterations carried out in the 1970's have been reviewed, and these provided information on the original house (including Party Wall) foundations, and also those of the extensions, particularly alongside the boundaries.

The basement will comprise a single level only, and will not extend into the garden areas by more than 50% (approximately 12% only). This is approximately 1.3 times the plan area of the host building, so less than 1.5 times that area.

A scheme design has been carried out for the main structural elements of the proposed basement, including retaining walls, and foundation loadings. Plans and sections are appended, together with supporting scheme calculations.

A Demolition Report has been compiled by Elite Designers Ltd, which concluded that the proposed works are appropriate, and in compliance with the required guidelines produced by both ICE and the Borough of Camden. This report is appended.

The slope stability study concluded that the proposed works will not increase the risk of local ground instability.

The site investigation report concluded that normal under-pinning techniques are suitable in these soils, and that ground bearing pressures are sufficient for the order of magnitude that the proposed new basement and house would exert on the soils at depth.

The building damage assessment concluded that the anticipated ground movement may cause damage to properties adjoining and adjacent, to Level 1 as per the Burland Scale definitions, i.e. minor cracks easily repaired using normal methods.

The detailed design of the permanent works will be completed by Elite Designers Ltd, and will take into account the need for temporary works lateral propping of the basement underpins that will make up the basement walls. Propping loads will be provided to the Principle Contractor.

Schematic temporary works for ground support during construction have been compiled, and are also appended. The final detailed design for all temporary works will be the responsibility of the Principle Contractor, but will be reviewed in principle by Elite Designers Ltd.

The proposed construction techniques and sequence of works will comprise:

- Fix monitoring points to adjoining and adjacent buildings (Nos 58 and 60), and carry out surveys to establish reliable base readings.

- Dismantle the existing superstructure, with recovery of materials for recycling being carried out off-site.

- Fix additional monitoring points to the Party Wall with Nos 58 and 58B, and establish base readings.

- Underpin the perimeter of the new basement with reinforced concrete underpins, constructed in a 1-in-5 sequence, with all pins laterally propped in the temporary condition.

- Insert full-width propping to allow the central mass of soils to be excavated to full basement depth.

- Construct sump chambers and below-slab drainage.

- Construct the reinforced concrete (r.c.) basement slab, integral with the bases of the underpins.

- Construct reinforced concrete suspended floor slab 9transfer slab), as permanent lateral propping to the basement walls.

- Remove temporary propping.

- Construct superstructure off the r.c. transfer slab structure.

The construction programme will be compiled by the Principle Contractor, but it is anticipated that the demolition of the house could require 4 to 6 weeks, the underpinning and basement r.c. works a further 12 to 16 weeks; and the superstructure 12 to 16 weeks.

Hydrology, Drainage and Flood Risk.

The site is approximately 100m from a culverted water course, as identified in the 'lost rivers of London'. No surface water features were identified within 500m of the site.

The site is not within the catchment areas of the Hampstead Heath Pond Chain, which is located to the east.

The site surface area is approximately 26% impermeable and 76% permeable. Rain water from roofs generally flows into the combined drainage system in the public highway to the front of the house, in Redington Road. Rain water falling in the rear garden soaks into the top-soil and sub-soils. No run-off is received from adjoining properties, nor discharged onto them.

The proposed basement will increase the impermeable area by approximately 70m2, thus the percentage of impermeable will increase to 36%, and the impermeable area will decrease to approximately 64%. The rain water from this additional 70m2 will collected and fed into a soak-away located in the rear garden, and thus attenuated before discharging to the same ground as at present.

The site is not within a critical risk area and has a low risk of surface water flooding. The proposed scheme will maintain the *status quo*.

Construction Methodology.

Outline Geotechnical Parameters.

The soils investigations and testing have informed the interpretive site investigation report, which is appended. This has provided design parameters for the assessment of lateral soils pressures, and for permissible bearing pressures below new foundations at depth.

Soil density: 19kN/m3

Phi: 24 degrees

Permissible bearing pressure: 150kN/m2

These have been used in the appended scheme designs for key retaining wall elements, and thus informed the wall and slab thicknesses shown on the 'as proposed' plans and sections.

The soils test results have also been used in the ground movement study, carried out by Messrs GCG, appended. This should be referred to, for the appropriate data.

Outline Temporary and Permanent Works Proposals.

Lateral propping of excavations will be required in order to construct underpinning to the party wall, and to form the perimeter walls to all other sides. This will take the form of adjustable props supporting walings and poling boards, in traditional access pits for each pin in sequence. As pins are cast, the r.c. stems will require to be laterally propped off the mass of un-disturbed soil in the middle of the site. Once all pins are cast, narrow tranches will be formed from side to side, to allow full-width propping to be installed, just above the general excavation level. These props will support walings spanning across the faces of the pins, allowing the access pit props, walings and poling boards to be removed. A typical arrangement of walings and full-width props is shown on a schematic plan, appended.

As the general excavation is progressed, additional levels of propping may be required, subject to the detailed design by the ground-worker's Engineer. One the excavation is complete, below slab items (sump chamber, drains, etc) can be constructed, and then the basement slab can be constructed. Suspended r.c. slabs at Lower Ground floor level can then be constructed, which will provide lateral support to all sides, as well as support of superstructure gravity loads.

The basement slab will be designed for vestigial 'heave' pressures, as noted in the ground movement report by Messrs GCG, appended. Scheme design calculations for the basement slab are appended.

It is likely that locally, ground water may be encountered above the planned excavation depth, at the end of the site nearest to the front garden. Local sumps may be required in order to keep the soils below the r.c. underpin bases clear of water whilst concrete is poured. As water was found in discrete lens during the site investigation, it is not anticipated that large quantities of water will need to be pumped. Small submersible pumps should therefore suffice, with water being discharged to a soak-away in the rear garden. De-watering of the site would not be permitted.

The majority of rain, grey and foul water produced in the completed house will drain by gravity to the existing combined drainage system in the public highway, in Redington Road. Grey and foul produced in the basement will be discharged via sump pumps, to the same gravity drainage system. The total flow from the new house to the public sewer will be no more than from the current house.

Rain water from the rear terrace and from a flat roof at the rear, will be kept separate, and not add to the flow to the public sewer. It will be taken to a SUDS system in the rear garden, comprising a soak-away with sufficient capacity to deal with a design storm event, and will then allow the contents to percolate into the sub-soils. The terrace and flat roof are located in areas that are currently part of the rear garden. Therefore, the rain which falls onto these would currently fall on the garden. The total rain water that is discharged into the rear garden would not increase. Therefore the proposals would not create a flood risk to the properties downhill from the rear garden.

Ground Movement and Damage Impact Assessment.

These studies have been carried out by Messrs GCG, whose report is appended. The report concluded that movement would be un-likely to cause damage greater than category 1 on the Burland Scale, so could be made good using normal decorative techniques.

The methods required to minimise ground movements are associated with the installation and maintenance of properly designed lateral supports during the construction of the under-pins, general excavation, and basement slab. These will be the responsibility of the Principle Contractor. Therefore, it is fundamental to appoint a suitably experience contractor and ground-works sub-contractor for these works. The contractor's proposed sequence of works and propping designs will be reviewed by the permanent works Engineer.

The programme must provide sufficient time to allow the works to be executed methodically and in a controlled manner.

Control of Construction Works.

The Principle Contractor will have a full-time Site Agent on site, and a qualified site Engineer available at all times, making routine inspections and thus supervising the works. The permanent works Engineer will make regular routine inspections, as will the Approved Inspector or Building Control Officer. Monthly progress meetings will be held on site, with inspections by the clients' CA and design team members.

The soils exposed in the excavations will be reviewed by the Contractor's site Engineer, and the permanent works Engineer informed if different from that anticipated from the borehole logs.

Building movement monitoring will be used to confirm the ground/structure is behaving as anticipated, and the works are being executed to a high standard of workmanship. Reports will be reviewed weekly by the Principle Contractor, the CA, the permanent work engineer, and also by the Party Wall Surveyor during these works. Movement monitoring will continue for at least three months after the basement and Lower Ground floor slab are complete.

Monitoring points will be fixed to the party wall, to the flank wall of No 60, and to the front and rear facades of Nos 58 and 58B. Points will generally be installed in pars, fixed at low and high level. Points will be monitored for vertical and lateral movement. Trigger values will be agreed with the adjoining owners' Party Wall Surveyors, but would be anticipated to set at 60% (amber) and 100% (red) of the anticipated movement for the stage reached. If amber values were reached, then the works may proceed, but if red values were reached then the over-all situation should be reviewed by the project Engineer in conjunction with the Principle Contractor's site Engineer, and the Party Wall Surveyor.

Sustainable Drainage Systems.

The total area of roofs and hard surfacing is currently approximately 177m2, draining to the public sewer. A small area of rear roof canopies and paving drain freely to the rear garden.

The proposed total impermeable area will be 246m2. It is proposed to drain only 177m2 of this to the public sewer, and the remainder will require to be attenuated before draining to the rear garden. Thus, the quantity and flow rates discharged from the property into the public sewer would not be increased and the *status quo* would be maintained. The quantity and flow rate of rainwater discharged to the rear garden and then onto land downhill, would also not be increased.

To attenuate the flows from approximately 70m2 of roofs and paved areas, it is proposed to install proprietary soak-aways. These would be located in the rear garden, where the soils are sufficiently permeable. Peak flows during rain events would be stored in the soak-aways, and then gradually released into the surrounding soils.

The general direction of flow of water within the ground is from the north to the south (following the general topography of the ground slopes). The basement would impinge into one of the discrete water-bearing layers only at the front end of the basement. The majority of the basement would lay several metres higher than the water-bearing layers across the majority of the site. This is the downstream end to the site. Therefore, the basement would not impede any existing tendency for ground water to flow from the uphill, front end of the site towards the downhill, rear of the property.

Thus, the local ground water levels within the Claygate Member would not be encouraged to rise due to water flows being (partially) impeded from flowing across the property. There would therefore be no benefit or requirement to inset the basement from the boundaries of the property.