3 Eton Avenue, London NW3

Basement Impact Assessment

Prepared for

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Rev B

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3 Eton Avenue, London NW3

Basement Impact Assessment

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1.0 Introduction

The proposed redevelopment of 3 Eton Avenue, London NW3 comprises the construction of a basement under an existing 4 storey house including new light wells at the front and rear of the building.

Alan Baxter Ltd (ABA) have been appointed to provide civil and structural engineering input, together with input on heritage, in support of the planning application for the redevelopment of the site. The Client has also appointed BB Partnership as Architect and Lead Consultant and Southern Testing as Geotechnical Consultant.

This report describes the basement structural scheme design, an overall sequence of construction and considers the impact of the basement construction on adjacent properties, surface and groundwater flows and slope stability.

This report has been based on the following information:

- Historical maps and in house desk study
- Geological survey maps and BGS borehole records
- Proposed layout drawings by BB Partnership
- Site visits.
- Geotechnical site investigations carried out by Southern Testing in June 2017 (Appendix E)
- Arboricultural report prepared by Dr F. Hope (Appendix H)

In preparing the BIA reference has been made to the following London Borough of Camden documents:

- Camden Local Development Framework (LDF) Policy DP27
- Camden Planning Guidance – Basements and Lightwells CPG4
- Camden Geological, Hydrogeological and Hydrological Study – Guidance for Subterranean Development (GSD) prepared by ARUP

Note: As Arup GSD and Camden SFRA maps are in the public domain and already in possession of auditor Campbell Reith, copies of these had not been included in order to limit to size of the document uploaded on the Camden's Planning website. We have discussed this with Campbell Reith on previous BIA reports prepared by ABA and agreed this approach to be acceptable.

The BIA has been co-written by the following authors holding the stated qualifications:

Alan Baxter Ltd	David Probert	MEng
	Jim Gardiner	BSc MICE MIStructE
Southern Testing	Thomas Lees	MSci MSc CGeol FGS

The BIA has been reviewed by all three authors.

2.0 General description of the site, topography and services

Eton Avenue is located within the Belsize Park Conservation Area in the London Borough of Camden, to the north of Primrose Hill and the south of Parliament Hill. See drawing 1782/250/01 in Appendix A for a location plan.

The site is at the east end of the road and is occupied by a 4-storey late 19th century building, with a small garden at the front and a larger garden at the rear. The building is set back from the back of the pavement by approximately 6.0m and its footprint is approximately 19m long x 10m wide.

The building would have been originally conceived as a single residential property but has now been converted into four flats. Access to all levels is via the communal front entrance with a staircase in the northwest corner leading to the 1st, 2nd and 3rd floor. The client owns the flat at ground floor level, with sole access to the garden at the rear.

To the west of the site is 3a Eton Avenue, which is a small two- storey coach house built against part of the side wall of 3 Eton Avenue. A timber fence on a small brickwork wall divides the two gardens at the rear, with a railing between the two sites at the front.

To the east is 1 Eton Avenue, a large 4-storey Victorian house probably also converted into apartments. The two buildings are separated by a 2.0m wide passage with a brickwork wall built on the boundary. The gardens at the rear are also separated by timber fences sitting on small brickwork walls.

To the south of the site is the large rear garden of 28 Fellows Road. To the north, the boundary consists of a brickwork wall and a hedge that separates the front garden from the public footpath.

The site gently slopes to the south with levels ranging from approximately 55.10m AOD at the front to 54.00m AOD at the back.

See the attached drawing 1782/250/02 in Appendix A for the existing site plan and topography.

Drawing 1782/250/03 summarises our understanding of the existing statutory services around the site. The site has the usual array of services serving individual properties on Eton Avenue and appears to be clear of major services and tunnel obstructions in the ground. A 305mm diameter combined sewer runs under Eton Avenue and then connects into a 1143x762 brick sewer running under Primrose Hill Road.

3.0 Site history

Historical maps have been consulted as part of our desk study of the site, as summarised on drawing 1782/250/04 in Appendix B. For further information refer to the Heritage Statement also prepared by Alan Baxter in support of the planning application.

- Prior to the Industrial Revolution, the land between the northern edge of London and the settlement of Hampstead was predominantly open land in agricultural use with a few scattered farms and houses. The land was split between two freehold owners. The Dean and Chapter of Westminster acquired the northern part of the area at the beginning of the 14th Century. The southern tip of the conservation area, broadly the area between Lancaster Grove and Englands Lane was given to Eton College by Henry VI in 1449.
- By 1866-71 Ordnance Survey maps indicate large developments in the area, with part of the current street layout visible today to the north and south.

- No. 3 Eton Avenue was built in 1885 as a single family dwelling. On the 1954 Ordnance Survey, it occupies the full width of the plot, suggesting that it started life as a double-fronted house like its neighbours Nos. 1 and 5 Eton Avenue. The area by this time had been almost fully built up.
- Few changes appear to have been made to the property until the late 1950s/early 1960s, when the west side of the house was removed, and the so-called Coach House was built in its place, as shown on the OS map by 1959. The reason for this change is not known. The Second World War bomb damage map indicates only minor damage, to houses some distance away. It may have been in connection with the conversion of the remaining, western half of the house into flats.
- The ground-floor flat has been extended by the addition of a timber-framed conservatory to the rear, probably in the 1980s.

4.0 Form and condition of the existing structure

Our understanding of the existing structure is shown on drawings 1782/250/05-07 and is based on observations made on site and generally on our knowledge of buildings of this age and type.

The structure generally comprises loadbearing brickwork walls internally and around the perimeter of the building. The upper floors and roof are timber joists and rafters and the ground floor is also constructed with timber joists on sleeper walls.

Overall, the structure appears to be in reasonably good condition for a building of its age and type. There are some localised defects such as cracking in the flat brick arches over window openings, but these do not appear structurally significant.

5.0 Site geology

A summary of our initial understanding of the local geology and ground conditions is shown on drawing 1782/250/08 in Appendix B. The site is in an area of approximately 85.0-90.0m thick stratum of London Clay formation over a 3.5-4.5m thick layer of Thanet Sand overlaying the Chalk and Flint stratum.

A Local Area Borehole Study has also been carried out based on borehole records obtained from the British Geological Society (see drawing 1782/250/09). The geology around the site appears consistent with the local geology and comprises approximately 1.0m of Made Ground over Brown and Blue London Clay.

6.0 Neighbouring buildings

No.1 Eton Avenue is a slightly larger but broadly similar 4-storey detached house. The building is not listed and does not have a lower ground level or basement. The main house is located approximately 2.5m away from the side wall of No.3. At the rear, the side wall of a single storey extension to No.1 acts as the boundary wall between the two sites (see drawing No. 1782/250/05). In the rear garden of No. 1 there are three garages. From what can be seen from the site and from public areas, the structure of the building appears to be in good condition and comprises load bearing masonry with timber floors. The boundary wall between No.1 and No.3 is of brickwork construction with a timber fence built off the top and also appears to be in reasonable structural condition.

No. 67 Primrose Hill Road is located to the rear of No.1 Eton Avenue and is a 2 storey detached house. The rear wall of No.67 is built approximately 1m from the boundary wall to the rear garden of No. 3 Eton Avenue. The building is not listed and does not appear to have a basement. The building appears to be in good condition and comprises load bearing masonry with timber floors.

No.5 Eton Avenue (Windsor House) is also not listed and comprises a 4 storey detached house similar in size to No.1. The house is approximately 8.0m away from the side wall of No.3. From what can be seen from the site, it appears that the building comprises load bearing masonry walls with timber floors.

Between No.3 and No.5 is No.3a Eton Avenue, which is a small two-storey coach house built against the rear of the side wall of 3 Eton Avenue. A timber fence on a small brickwork wall divides the two gardens at the rear, with a railing between the two sites at the front. This building also appears to comprise load bearing masonry with timber floors and a timber roof.

7.0 The proposals

The proposed new building comprises the construction of a single storey basement under the house with light wells to the front and rear of the building. For proposed structural general arrangements and sections see drawings 1782/250/10-13.

The following key items have been considering in the design of the new basement:

- Ground conditions
- Groundwater regime
- Surface flow and flooding
- Slope and ground stability
- The structure of the existing adjacent construction
- The effects on surrounding and adjoining properties
- An appropriate sequence of construction and temporary works methodology

8.0 Characteristics of the Project

A new basement is proposed beneath the existing ground floor and extending to the front and rear of the building to form light wells.

The new basement will comprise a new reinforced concrete raft foundation and a reinforced concrete slab at ground floor level, with new internal reinforced concrete columns and reinforced concrete walls along the perimeter. The basement beneath the building will be designed to resist vertical loads from the superstructure, horizontal earth and groundwater pressures at the perimeter of the basement and upward loads from groundwater and heave on the raft foundation.

9.0 Stage 1 - Screening

The purpose of the screening stage of the BIA is to identify any matters of concern which should be investigated further through the BIA process. The screening process has been undertaken as outlined in the Camden Planning Guidance – Basement and Lightwells CPG4 and the Camden geological, hydrogeological and hydrological study prepared by ARUP. The screening flow charts given in CPG4 have been used and are provided in Appendix C. They list the items identified as being relevant to this proposal and therefore requiring further assessment in the BIA.

9.1 Non-technical summary of the Stage 1 - Screening

The purpose of the screening stage is to identify any matters of concern which should be investigated further through the BIA process. These matters have been identified in the flow charts given in Appendix C and will be discussed further in the following Scoping Stage (stage 2).

10.0 Stage 2 - Scoping

The purpose of the scoping stage of the BIA is to define further the potential impacts identified within the screening stage as requiring additional investigation. The scoping stage has been undertaken as outlined in Camden Planning Guidance – Basements and Lightwells CPG4 and the Camden geological, hydrogeological and hydrological study prepared by ARUP.

10.1 Conceptual Ground model

To assist the scoping stage a conceptual ground model has been produced using the following;

- Information obtained during the screening stage of the BIA
- Readily available published data
- Application of hydrogeological principles

This is as follows:

Site location	Chalk Farm – Belsize Park, London NW3
Local geology	Made ground over London Clay. Beneath the thick stratum of London Clay is the Thanet Sands over the Chalk and flint stratum. See drawing 1782/250/08-09.
Local ground levels	The site gently slopes to the south-east with levels ranging from approximately 55.10m AOD at the front to 54.00m AOD at the back.
Local surface water or below ground water features	There are no significant surface water features nearby. The culverted river Tyburn passes approximately 200m to the west of the site.
Local groundwater level	The London Clay is effectively impermeable and will therefore prevent water from percolating vertically through the soil. Some ground water may be perched on the top of the clay in the made ground.
Local surface finishes	No.3 and the surrounding properties typically have hardstanding in the front driveways and soft landscaping in the rear gardens.

Current local surface water pathway	A proportion of local rainfall will be retained in the near surface soil (made ground and topsoil) with a proportion evaporating into the atmosphere or being taken up by plant and tree root systems. The remaining water within the topsoil is likely to either sit within the made ground or, where possible, follow the natural gradient of the land, to the south. A further proportion of local rainfall will run off the hard surfaced areas adjacent to site into the main combined surface and foul water sewers.

Using the above conceptual ground model, the potential issues identified during the screening stage are discussed further.

10.2 Hydrology (surface water flow and flooding)

3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	Yes, The area of hardstanding will slightly increase as part of the proposed development. See BBP's drawings FRB_PA_02-1 and FRB_55 in Appendix H.	

The proposed increase in hardstanding is approximately 1.8% from the existing. The increase of hardstanding is for light wells at the front and rear of the house which will be drained via gulleys discharging into the local sewer system. The increase in flows will be negligible.

The rest of the site is surrounded by walls/ fences on all sides and therefore is relatively isolated from surrounding surface water flows.

10.3 Hydrogeology (groundwater)

1b	Will the proposed basement extend beneath the water table surface	The proposed basement will be founded in the clay and therefore may be below a perched water table	

Further information is required on the ground water and whether this is significant, it will require groundwater monitoring to be carried out as part of any further site investigation.

4	Will the proposed basement development result in a change in the area of hard surfaced / paved areas?	Yes, The area of hardstanding will slightly increase as part of the proposed development. See BBP's drawings FRB_PA_02-1 and FRB_55 in Appendix H.	

The proposed increase in hardstanding is approximately 1.8% from the existing. The increase in hardstanding is at the front and rear of the house for the new light wells. The volume of rainfall seeping into the ground below will slightly decrease, however the difference will be negligible and is unlikely to affect the adjacent properties and nearby watercourses.

10.4 Slope and ground stability

5	Is the London Clay the shallowest strata on site?	Yes, Figure 3 of Arup Report - Camden Geological Map and the findings on site show the shallowest stratum on site is London Clay.	

The geology on site is made ground over London Clay. The proposed basement will be founded in the London Clay on a reinforced concrete raft. Clay has a tendency to expand and contract with changes in moisture content in the near surface soil due to changes in moisture levels. The proposed basement is to be founded approximately 3.5m into the clay which is well below the level that will be affected by seasonal variations in moisture content or tree roots.

Clay also tends to change volume if there are significant changes in load on the soil. Initial calculations suggest the proposed building will weigh less than the excavated soil, which will result in the clay to expand and apply an upward force on the raft foundation. This will cause a small amount of heave which will tend to counteract some of the initial settlement caused by the excavation of the basement. Below ground drainage will be encased in concrete and suspended from the underside of the raft.

6	Will any tree/s be felled as part of the proposed development and/or any works proposed within any tree protection zones where trees are to be retained? (Note that consent is required from LB Camden to undertake any work to any tree/s protected by a Tree Protection Order or to tree/s in a Conservation Area if the tree is over certain dimensions).	Two trees close to the house are proposed to be felled: one small deciduous tree located at the front of the property and a poor quality cherry tree in the rear garden. Refer to the Arboricultural report and drawings in Appendix H.	

The small, young, deciduous tree located at the front of the property is of poor quality. The Cherry Tree close to the rear of the house is also noted as being of extremely poor quality, with less than 10 years of safe life expectancy, not worthy of a preservation order and recommended to be removed. The tree report also notes that both trees should not be used to adversely affect the proposed development.

The removal of the two trees will have a minor impact on the amount of ground water in the near surface soil. However, the trees are separated from No.1 Eton Avenue by a brick wall with a fence built off it. The tree roots are unlikely to pass beneath the foundations to this wall and therefore their removal should not affect the soil on the other side.

The proposed light wells at the front and rear of No.3 will be formed with reinforced concrete retaining walls founded approximately 3.5 m below ground level, well below the depth tree roots.

12	Is the site within 5m of a highway or pedestrian right of way?	The proposed front light well will be less than 5m from the back of the pavement to Eton Avenue.	

The edge of the proposed front light well will be approximately 3m from the pavement to Eton Avenue. The excavation will be propped during construction to prevent earth movements and the lightwell walls will be designed to withstand the appropriate surcharge loading on the public road. High-stiffness propping at frequent intervals to the retaining walls will be provided.

13	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes, the basement is being formed adjacent to neighbouring properties which do not have a basement.	

The proposed basement is likely to result in differential depths of the foundations relative to neighbouring properties. A ground movement assessment is to be carried out to determine the extent of any effects on the neighbouring properties. Investigation works to confirm the depth of the existing foundations will be required.

10.5 Non-technical summary of the Stage 2 - Scoping

A conceptual ground model was prepared, which was then used to identify the potential issues associated with the construction of the basement. These were discussed further and it was concluded that, in order to assess the impact of the potential issues identified in the scoping stage, the following information was needed:

- Groundwater levels
- Geology
- Depth of existing foundations.

A site investigation was carried out in June 2017 to provide this information (see section 11.0 below and information in Appendix E).

11.0 Stage 3 - Site Investigation and study

A site investigation was carried out by Southern Testing at No.3 Eton Avenue in June 2017. A copy of Southern Testing's report can be found in Appendix E and this includes a desk study and factual report. The site investigation included:

- 1 No. 15m deep borehole with a standpipe for groundwater monitoring
- Contamination sampling and testing
- 5 No. trial pits to expose the foundations to loadbearing walls

The geology of the site generally comprises a layer of Made Ground (reworked clay with sand and gravel) up to 1.2m thick overlaying a layer up to 1.6m thick of Head (firm brown silty gravelly clay) and then London Clay, proven to a depth of 15m BGL (39.07m AOD).

Water was not struck in the exploratory holes. However, water was noted in subsequent monitoring visits in June and July 2017. The following levels were measured:

Test Location	Date of Reading	27/06/2017	11/07/2017
	Depth to Base of Installation (m)	Standing Perched Water Level (m)	
BH1	15.00 BGL (39.07 AOD)	8.89 BGL (45.18 AOD)	5.26 BGL (48.81 AOD)

The above readings refer to perched groundwater sources that are likely to be associated with surface water from the interface between the made Ground and the Head deposits and possibly fissure flows within the underlying London Clay.

Based on the result of the site investigations and the size and depth of the proposed basement, it is anticipated that the anticipated ground movement due to heave of the London Clay can be conservatively quantified as 10-20mm. Of this upwards movement, approximately 50-60% will occur during the construction of the basement. Therefore the residual long term heave should be considered to be approximately 5-10mm. The design of the basement slab will take account of this.

There is evidence of lead contamination within the Made Ground. Made Ground will be excavated from site and classed as Hazardous under the Waste Acceptance Criteria (WAC), whilst the natural clay soils on site can be classed as inert under the WAC. For further details refer to the Southern Testing report.

11.1 Non-technical summary of Stage 3 - Site investigation and Study

A site investigation comprising a borehole, trial pits, soil testing and groundwater monitoring has been carried out by Southern Testing in 2017 in order to validate the assumptions of the conceptual ground model with regards to the geology and groundwater levels. The actual geology and groundwater has been found to be generally consistent with the initial conceptual ground model.

12.0 Stage 4 - Impact Assessment

The impact assessment stage of the BIA describes the impacts of the proposed basement development on the environment and how this will be mitigated in the design and construction.

12.1 Updated Ground Model

The ground model from the scoping stage has been updated to reflect the findings from the site investigation and shall be used to inform the design of the basement, its construction and assess its effects on the potential issues highlighted in the scoping stage.

Site location	Chalk Farm – Belsize Park, London
Local geology	There is up to 1.6m made ground over Head and London Clay to a proven depth of 15m BGL (39.07m AOD).
Local ground levels	The site gently slopes to the south-east with levels ranging from

	approximately 55.10m AOD at the front to 54.00m AOD at the back.
Local surface water or below ground water features	There are no significant surface water features nearby. The culverted river Tyburn passes approximately 200m to the west of the site.
Local groundwater level	Perched groundwater from both surface water entries and fissure flows was identified with levels varying between 45.18m AOD in June 2017 and 48.81m AOD in July 2017.
Local surface finishes	No.3 and the surrounding properties typically have hardstanding in the front driveways and soft landscaping in the rear gardens.
Current local surface water pathway	A proportion of local rainfall will be retained in the near surface soil (made ground and topsoil) with a proportion evaporating into the atmosphere or being taken up by plant and tree root systems. The remaining water within the topsoil is likely to either sit within the made ground or, where possible, follow the natural gradient of the land, to the south, finding its way into more permeable layers. A further proportion of local rainfall will run off the hard surfaced areas adjacent to site into the main surface water sewers.

12.2 Proposed structural design

The architect has proposed a new basement beneath the existing ground floor and extending to the front and rear of the building to form light wells.

The new basement will comprise a new reinforced concrete raft at basement level and a reinforced concrete slab at ground floor level, with new internal reinforced concrete columns and brick masonry walls and reinforced concrete walls along the perimeter. See section 12.3 for further details.

12.3 Construction of the basement structures

The new basement structure will be formed with a reinforced concrete box. The basement beneath will be designed to resist vertical loads from the superstructure, horizontal earth and local groundwater pressures at the perimeter of the basement and upward loads from groundwater and heave on the basement raft.

The construction sequence allows for a steel grillage on temporary piles to be installed in the temporary case to support the walls at ground floor while the basement is excavated and the permanent structure of the basement is built. A bottom-up sequence of construction will be adopted to build the structure below ground and the structural perimeter walls at ground level will be underpinned with reinforced concrete pins to form the walls below ground.

A contiguous piled wall will be used at the back, in the rear garden area, in order to support the excavation to form the new basement structures. This has been chosen to maintain structural stability and integrity to the adjacent existing structure during and after the construction of the basement. The piles are set back from the adjacent structures by approximately 0.75m from the face of the walls to the centre line of the piles. This is a sufficient distance to enable them to be built without physical damage to the adjacent walls. A reinforced concrete retaining wall will be constructed inside the contiguous piled wall to complete the basement box. Calculations for the design of the retaining wall are given in Appendix F2.

The new reinforced concrete structure to the front light well will generally be formed within propped king post walls and will also comprise concrete slabs and walls.

The site investigation has indicated the ground is capable of supporting the loads and construction techniques being proposed. Allowable bearing pressures in the order of 125kN/m^2 have been allowed for spread foundations, which is sufficient for these forms of construction.

It is conservatively anticipated that the potential long term heave will be approximately 10-12mm. The reinforced concrete basement raft will be designed to resist the upwards forces from ground heave.

CPG27 requires the proposed basements to avoid cumulative impacts upon structural stability or the water environment.

On the basis of the measurements to date, groundwater ingress is not expected to be a problem in terms of dewatering issues during construction (refer to section 17.1 of Southern Testing report in Appendix E for further details). In any case, an allowance for some dewatering will be made to deal with perched water sources e.g. within the made ground/base of existing foundations, in the form of intermittent pumping from strategically placed collector sumps.

For the longer term condition, seepage entries from fissure flow within the clays and any perched water from within the overlying made ground should be allowed for in the design of the basement area e.g. provision of waterproofing measures, and also for hydrostatic pressure on the basement raft.

The effect of the new basement on groundwater is further discussed in section 12.9 below.

12.4 Sequence of construction for the basement

The structural proposals have been developed to suit normal construction techniques. A construction sequence of the basement and the temporary works required has been carefully considered and will be used for the purposes of undertaking the structural design. This sequence demonstrates that the works can be executed with due regard to the local amenity. A sequence of construction for the basement is summarised below and illustrated on drawings 1782/250/20 and 1782/250/21 together with sub-sequence drawings 1782/250/22-24 in Appendix G.

The site is accessed from Eton Avenue with adequate space on site for construction vehicles to manoeuvre and unload. The design of the basement is such that it requires no access from the neighbouring properties during construction.

Phase 1 – Demolition

1. Demolish the rear conservatory to the property.
2. Remove internal non-loadbearing walls at ground floor and form new structural openings in loadbearing walls.
3. Form a temporary opening through the front façade to provide temporary access to the flats above, bridging over the area of the proposed works.

Phase 2 – Piling

4. Locally remove timber floor at ground floor level at the location of temporary piles.
5. Install contiguous piled walls at the rear and construct temporary piles.

6. Bore holes for king post wall at the front and install temporary king post columns.

Phase 3 – Install temporary works

7. Locally cut pockets through the brick walls.
8. Install needles to form a steel grillage on the temporary piles. Pack between needles and walls. Remove column at ground floor level.

Phase 4 – Underpin and excavate

9. Demolish the ground floor and install horizontal props to the walls at ground floor level.
10. Carry out
    a. Underpinning to party wall with No.3a Eton Avenue and reinforced concrete walls in sections under the main house (see drawing 1782/250/22)
    b. Installation of king post wall in the front garden (see drawing 1782.250/23)
    c. Construct capping beam in the rear garden (see drawing 1782/250/24)
11. Gradually reduce the levels across the footprint of the proposed basement. Install horizontal props as required.

Phase 5 – Construction of new basement structure.

12. Install underground drainage.
13. Cast blinding and complete the construction of the raft foundation, leaving pockets around the position of the temporary piles.
14. Construct RC walls and columns at basement level.
15. Construct the new reinforced concrete ground floor slab on the top of the new basement walls. Replace steel column at ground floor.
16. Pack between the underside of the new ground floor slab and the existing walls above ground floor level.
17. Remove the steel grillage and break down the temporary piles.
18. Infill holes in the raft foundation and make good holes through the walls above ground floor level.

Phase 6 – Remedial works

19. Remove the temporary access gantry and make good brickwork to the front façade.
20. Repair the minor cracks that may have occurred and redecorate.

12.5 Programme

Although the works described in section 12.3 and 12.4 are relatively demanding from a structural point of view, they are not unusual and will be carried out in a careful and controlled manner using normal construction techniques. The site has good access allowing for relatively straightforward removal of spoil. The demolition of the existing structure and the construction of the basement are expected to last around 6-8 months. A detailed construction programme will be prepared by the Contractor, once one is appointed.

12.6 Construction Management Plan

- The Contractor will be required to submit his own detailed Construction Management Plan and Site Waste Management Plan prior to work commencing on site. The contents of this plan must be in accordance with The London Borough of Camden's guidance and be agreed by them.
- The Contractor will be required to demonstrate due diligence and commitment toward minimising environmental disturbance to local residents and will be required to complete the work in accordance with the Considerate Constructors Scheme standards.
- Noise, dust and vibration will be controlled by employing best practicable means as prescribed in legislation such as; The Control of Pollution Act, 1972; The Health & Safety at Work Act, 1974; The Environmental Protection Act, 1990; Construction Design and Management Regulations, 1994 and The Clean Air Act, 1993. Noise, vibration and dust monitoring to be implemented.
- The contractor will need to produce a Traffic Management Plan. This should carefully consider vehicle movements and their impact on other road users, pedestrians, residents and the environment. Mitigation measures should be implemented where necessary.
- The contractor will erect site hoarding to define the boundaries of the site.
- Working hours to be restricted as required by the London Borough of Camden.
- Vehicles should be washed and cleaned before leaving site and vehicles should not be left idling.
- Measures should be adopted to prevent site runoff of water or mud.
- Water to be used as a dust suppressant.
- Skips should be covered.
- All temporary works are to be designed by a qualified Temporary Works Coordinator.
- Movements of surrounding buildings should be monitored throughout construction, the results reviewed and action taken to mitigate excessive movements. The detailed proposals for monitoring will be confirmed by the appointed Contractor as part of their detailed Construction Management Plan.

12.7 Ground Movements and Structural Damage

A ground movement assessment has been carried out in accordance with CIRIA C760 and the impact of ground movements on nearby structures has been assessed in accordance with the Burland Categories of damage – see Appendix F1.

The damage categories for the neighbouring buildings are summarised below:

- **No.1 Eton Avenues:** The building falls into Burland Category 0 (Negligible). No mitigation measures are required.
- **Garages to No.1 Eton Avenue:** The assessed damage falls into Burland Category 0 (Negligible). No mitigation measures are required.
- **No.3a Eton Avenue:** The assessed damage falls into Burland Category 1 (very slight), within the acceptable limits set out by Camden's planning guidance on basements in CPG4. Mitigation measures are described in section 12.8.
- **No.5 Eton Avenue and No.67 Primrose Hill:** Both buildings fall into Burland Category 0 (negligible) and therefore within the acceptable limits set out by Camden's planning guidance on basements in CPG4.

This form of assessment is conservative. In reality any damage is likely to be less than identified in this assessment and generally dependant on the Contractor's skill and care.

Other nearby buildings have not been assessed, as they are sufficiently far from the proposed basement for the damage to be negligible.

A qualitative assessment has been carried out in relation to the effects of heave on the neighbouring buildings. In our experience of numerous basements of a similar size and geology, the effect of heave will be negligible. The small movements that do occur as a result of heave will cause an upward movement which will counteract some of the downward movements due to the construction of the underpinning and excavation.

12.8 Mitigation Measures

In line with CPG4, mitigation measures will be implemented to control ground movement.

- The structural proposals have been designed to provide stiff supports to the basement retaining walls in the temporary and permanent cases. The stiff reinforced concrete retaining walls and contiguous piled wall will be propped during construction, limiting ground movement during construction and in the permanent case.
- High-stiffness propping at frequent intervals to the retaining walls will be provided during construction. This will make the construction of the basement trickier for the contractor but will reduce movements caused by the excavation behind the retaining wall and the effect of the basement construction on neighbouring properties.
- During the construction of the basement the contractor will be required to undertake monitoring of the groundwater levels and ground conditions encountered to ensure that the assumptions and findings from the BIA remain valid.
- Movements of surrounding buildings will be monitored throughout construction, the results reviewed and action taken to mitigate excessive movements. The detailed proposals for monitoring will be confirmed by the appointed Contractor as part of their detailed Construction Management Plan.
- Due to the depth of the basement a general unloading of the soil beneath the basement is expected to produce some heave as the clay expands. This has been considered as part of

our design and the basement raft foundation has been designed to take account of upwards ground heave forces. Below ground drainage will be encased in concrete and suspended from the underside of the raft.

- The distance of the piled retaining wall from the existing structures has been carefully considered to be sufficiently far away to allow for its construction without physical damage to the adjacent structures. Piling at these distances is common and well understood.

In summary, with careful sequencing and temporary propping as shown on the assumed sequence of construction drawings movements will be very small and will not result in structural damage to the adjacent walls or adjoining properties.

For No.3a Eton Avenue, cracks that can be easily treated during normal redecoration will be repaired at the end of the works on site. This will leave the existing adjacent buildings in a state equivalent to Burland Category 0. A specific provision for this will be made as part of the party wall awards which will be negotiated between the Building Owner and the Adjoining Owners.

12.9 Impact of basement on groundwater, surface water and soil

The existing building is currently founded on London Clay. The addition of a new basement level will lower the current foundation level. However, this will still be well within the London Clay stratum.

The identified minor perched ground water sources are likely to be associated with both surface water from the made ground and potentially fissure flow within the London Clay. On the basis of the measurements to date, groundwater ingress is not expected to be a significant problem during construction. Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1×10^{-9} m/s and 1×10^{-14} m/s, with an even lower vertical permeability. Accordingly, the groundwater flow rate is anticipated to be negligible.

Any groundwater flows will likely follow the local/regional topography which in this instance comprises locally slight falls to the south-east. Because of the very slight falls in the local/regional topography (hence negligible hydraulic gradient) and the very low/impermeable nature of the underlying clay materials, there is negligible risk of the proposed basement walls causing a “damming effect” or mounding of water on the upstream faces.

In light of the above observations, it is concluded that the construction of the proposed basement will not block any significant flow of perched water in the ground and will have negligible effect on the area’s hydrology or water levels in the vicinity of the proposed building.

The total area of hardstanding on site will be slightly increase as part of the proposed works, meaning the amount of water reaching the sewer system will slightly increase by approximately 1.8% (See BBP’s drawings in Appendix H). This is considered to be negligible.

There is evidence of lead contamination within the Made Ground. Made Ground excavated from site should be classed as Hazardous under the Waste Acceptance Criteria (WAC), whilst the natural clay soils on site can be classed as inert under the WAC. All spoil from the excavation of the made ground will be disposed of site to a licenced tip in accordance with current good practice.

12.10 Impact of the proposed development on existing trees

Forensic and Planning Arboricultural Consultant Dr Frank Hope visited site in November 2016 and carried out an arboricultural impact assessment relating to the trees within 3 Eton Avenue. A copy of the arboricultural impact assessment report is included in Appendix H.

There are four trees on site:

Tree T1: This is a small, young, deciduous tree located at the front of the property, which has been given a BS 5837 category ratings C1. The tree report recommends that this tree should not be used to adversely affect the development at the front of the property.

Tree T2: This is an extremely poor quality Cherry, located within the rear garden of the property, close to the eastern boundary. The tree has been given a BS 5837 category ratings U (Unsuitable for retention) and it is also recommended that it should not be used to adversely affect the development.

Tree T3: This is a large mature, poor quality Horse Chestnut, located to the rear boundary of the property. It has a BS 5837 category ratings C1, borderline U.

Tree T4: This is also a Horse Chestnut tree, located in the rear garden to the west of tree T3. It has a BS 5837 category ratings C1, borderline U.

Trees from adjacent properties are separated by brick-built boundary walls, which the arboriculturalist advises should prevent many of the roots from spreading into the site.

It is proposed to remove tree T1 and T2 and to retain tree T3 and T4. The Arboriculturalist has produced a recommended minimum distance to construction for each of the retained tree types on site. The design of the proposed basement has been developed in such a way to be outside these areas. Tree protection during works will ensure that works will not compact the soil where roots are growing.

The development will therefore have no adverse impact in relation to significant existing trees suitable for retention.

12.11 Baseline values vs. as constructed (impacts after application of mitigation measures)

The impacts of the proposals have been determined by comparing the baseline situation with the hypothetical as constructed basement situation taking into account the application of mitigation measures. Refer to the table below.

Attribute	Baseline value	As constructed value (impacts after application of mitigation measures)
Groundwater levels	Perched groundwater from both surface water entries and fissure flows was identified with levels varying between 48.81m AOD and 45.18m AOD.	No expected significant changes from baseline values.
Structural integrity of surrounding structures	Burland Category 0	Generally Burland Category 0, with Burland Category 1 (within acceptable limits outlined in CPG4) for No.3a Eton Avenue. Cracks that can be easily treated during normal redecoration will be repaired at the end of the works on site. This will leave the existing adjacent buildings in a state equivalent to Burland Category 0.
Contamination	Elevated concentrations of lead	Contaminated excavated material to be removed as discussed in 11.0
Trees	Two trees on site have been classified to be of low quality or value and not to be used to adversely affect the development at the front of the property. They will therefore be removed. Two further trees at the back of the property will not be affected by the proposals.	No expected significant changes from baseline values.

12.12 Non-technical summary of the impact assessment (Stage 4)

A basement impact assessment, as required for planning by the London Borough of Camden, has been undertaken by Alan Baxter Ltd and Southern Testing for the proposed basement in the plot of No.3 Eton Avenue.

The engineering rationale and construction issues associated with the proposed construction of the new basement have been explored and summarised in this report. A structural scheme design has been prepared along with a construction sequence to demonstrate that the proposals can be built safely by a contractor with the right skill and care without causing detriment to the local groundwater regime, slope stability, surface water regime or adjacent structures.

The structural proposals and construction methodology for the proposed basement has been developed with due regard to the existing site constraints and site specific ground conditions. The structure has been designed to maintain the stability and integrity of the surrounding land and existing structures. Anticipated ground movements have been shown not to cause structural damage to the existing buildings. A qualitative assessment of the effects of heave on neighbouring buildings has been carried out, and the expected movements are deemed to be negligible. The small movements that do occur will counteract some of the downward movements due to the construction of the underpinning and excavation. Ground movements are limited to acceptable values by a combination of the structural design, suitably designed temporary works and good workmanship. For the areas where very slight damage may occur, cracks that can be easily treated during normal redecoration will be repaired at the end of the works on site.

The proposals will have negligible impact on the local ground water regime and are resistant to the risk of surface water flooding from sewers.

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