

BASEMENT IMPACT ASSESSMENT

in connection with a proposed development
at

DERWEN
COMPTON AVENUE
LB HARINGEY



LBHGEO-4754-BIA

JUNE 2026

LBHGEO

CONSULTING ENGINEERS

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CONTENTS

CONTENTS	3
1. INTRODUCTION	6
1.1 BACKGROUND	6
1.2 BRIEF	6
1.3 HARINGEY BASEMENT POLICY	6
1.4 REPORT STRUCTURE	8
1.5 DOCUMENTS CONSULTED	9
2. THE SITE	10
2.1 SITE LOCATION	10
2.2 TOPOGRAPHICAL SETTING	11
2.3 SITE DESCRIPTION	12
2.4 NEIGHBOURING PROPERTIES	15
2.4.1 TREE TOPS	15
2.4.2 WOODLEY	15
3. PROPOSED BASEMENT DEVELOPMENT	16
4. DESK STUDY	19
4.1 SITE HISTORY	19
4.2 GEOLOGICAL & HYDROGEOLOGICAL INFORMATION	20
5. SCREENING & SCOPING ASSESSMENTS	22
5.1 SCREENING ASSESSMENT	22
5.1.1 SCREENING CHECKLIST FOR SUBTERRANEAN (GROUNDWATER) FLOW	22
5.1.2 SCREENING CHECKLIST FOR SURFACE FLOW AND FLOODING	23
5.1.3 SCREENING CHECKLIST FOR STABILITY	23
5.2 SCOPING ASSESSMENT	25
5.2.1 SCOPING FOR SUBTERRANEAN (GROUNDWATER) FLOW	25
5.2.2 SCOPING FOR SURFACE WATER FLOW AND FLOODING	26
5.2.3 SCOPING FOR STABILITY	26
6. GROUND CONDITIONS	28
6.1 INVESTIGATION DATA	28

6.2	GROUND MODEL	29
6.2.1	BAGSHOT FORMATION	29
6.2.2	CLAYGATE BEDS	29
6.2.3	LONDON CLAY FORMATION	30
6.2.4	GROUNDWATER	30
6.2.5	MODELLED GROUND CONDITIONS	30
7.	GEOTECHNICAL ASSESSMENT	32
7.1	BASEMENT CONSTRUCTION METHODOLOGY	32
7.1.1	GROUNDWATER	32
7.2	TEMPORARY WORKS	32
7.2.1	RETAINED FRONT ELEVATION	32
7.2.2	CROSSOVER BELOW FRONT ELEVATION	33
7.2.3	RETAINED SIDE ELEVATIONS	33
7.2.4	TOP-DOWN CONSTRUCTION	33
7.3	BASEMENT SLAB DESIGN	34
7.4	RETAINING WALL DESIGN	35
7.5	WATERPROOFING	35
7.6	EFFECT OF TREES	35
7.7	OUTLINE CONSTRUCTION SEQUENCE	36
8.	HEAVE ASSESSMENT	37
8.1	MODELLED UNLOADING	37
8.2	ANALYSIS METHODOLOGY	38
8.3	ANALYSIS RESULTS	38
8.3.1	SHORT TERM HEAVE	38
8.3.2	POST-CONSTRUCTION (LONG TERM HEAVE)	39
9.	GROUND MOVEMENT ASSESSMENT	40
9.1	NEIGHBOURING STRUCTURES CONSIDERED FOR EFFECT OF GROUND MOVEMENT	41
9.1.1	WOODLEY	41
9.1.2	TREE TOPS	43
9.2	SOURCES OF GROUND MOVEMENT	44
9.2.1	BASEMENT HEAVE	44
9.2.2	MOVEMENTS BEHIND THE PILE RETAINING WALL	44

9.3	IMPACT ON NEIGHBOURING STRUCTURES	44
9.3.1	WOODLEY SECTIONS FOR ANALYSIS	44
9.3.2	WOODLEY – GARAGE FRONT ELEVATION (SECTION A – A')	45
9.3.3	WOODLEY – GARAGE REAR ELEVATION (SECTION B – B')	45
9.3.4	WOODLEY – MAIN STRUCTURE FRONT ELEVATION (SECTION C – C')	46
9.3.5	WOODLEY – MAIN STRUCTURE REAR ELEVATION (SECTION D – D')	46
9.4	MOVEMENT MITIGATION FOR SECTION B – B'	46
10.	IMPACT ASSESSMENT	47
10.1	HYDROGEOLOGICAL IMPACT ASSESSMENT	47
10.1.1	EFFECTS OF GROUNDWATER ON EXCAVATION & CONSTRUCTION	47
10.1.2	EFFECTS ON GROUNDWATER TABLE	47
10.2	HYDROLOGICAL IMPACT ASSESSMENT	47
10.3	POTENTIAL STABILITY IMPACTS	47
10.3.1	EFFECT OF TREES	47
10.3.2	GROUND MOVEMENTS	47
10.3.3	DAMAGE TO HOST STRUCTURE	48
10.3.4	RESIDUAL IMPACTS	48
11.	STRUCTURAL MOVEMENT MONITORING	49
12.	CONCLUSION	50

DISCLAIMER

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No liability can be accepted for any inaccuracies or omissions in information provided by third parties or for any reliance on this document by a third party.

1. INTRODUCTION

1.1 BACKGROUND

Derwen is a large 20th Century detached property similar to other houses on Compton Avenue , which lies in the designated Highgate Conservation Area of the London Borough of Haringey.

The existing building is proposed to be redeveloped by extending this towards the rear and constructing a new basement. The basement is to feature two lightwells set in the rear patio and an underground garage accessed from a car lift in the front driveway.

The front and side elevations of the existing house are to be retained and will need to be supported throughout the development.

Two previous redevelopment schemes, inclusive of retention of the front façade and the construction of a basement, were previously granted permission by Haringey Council in August 2014 (Planning ref. HGY/2014/1334) and April 2017 (Planning ref. HGY/2016/3876), with little difference between these. Neither of these earlier proposals were implemented.

1.2 BRIEF

LBHGEO have been appointed to prepare a Basement Impact Assessment (BIA) for the present scheme in support of a forthcoming new planning application to be submitted to the London Borough of Haringey.

1.3 HARINGEY BASEMENT POLICY

The July 2017 Haringey Development Management DPD Policy DM18: Residential Basement Development and Light Wells reads as follows:

“A Householder extensions to existing basements, and the construction of new basements, including in existing dwellings will only be permitted where it can be demonstrated that the proposal:

- a. Will not adversely affect the structural stability of the application building, neighbouring buildings and other infrastructure, including the adjoining highway, having regard to local geological conditions;*
- b. Does not increase flood risk to the property and nearby properties from any source (see Policy DM24);*
- c. Avoids harm to the appearance or setting of the property or the established character of the surrounding area;*
- d. Will not adversely impact the amenity of adjoining properties by reason of noise or increased levels of internal or external activity;*
- e. Will not adversely impact the local natural and historic environment;*

And, where the proposed basement extends beneath the garden area:

- f. Will not cause loss, damage or long-term threat to trees of townscape or amenity value;*
- g. Maintains adequate soil depth satisfactory for preservation of landscaping consistent with neighbouring properties;*

And during the construction phase:

- h. Will not cause harm to pedestrian, cycle, vehicular and road safety, adversely affect bus or other transport operations, significantly increase traffic congestion, nor place unreasonable inconvenience on the day to day life of those living, working or visiting nearby; and*
- i. Will minimise construction impacts such as noise, vibration and dust for the duration of the works.*

B Proposals for basements must not include habitable rooms or other sensitive uses in areas prone to flooding where there is no reasonable means of escape.

C In determining applications for light wells, the Council will consider whether:

- a. The architectural character of the building is protected;*
- b. The character and appearance of the surrounding area is harmed; and*
- c. The development results in the loss of more than 50% of the front garden or amenity area.”*

The following policies in the Development Management DPD are also relevant to basement development and will be taken into account when assessing basement schemes:

- “Policy DM1: Providing High Quality Design”;
- “Policy DM21: Sustainable Design Layout and Construction”;
- “Policy DM24: Managing and Reducing Flood Risk”;

The 2017 Highgate Neighbourhood Plan provides additional requirements as part of Policy DH7: Basements, which reads as follows:

“Policy DH7: Basements

Where basement development does not fall in the scope of permitted development, and where there is evidence that there may be problems with drainage or flooding, applications for basement development will be supported only where they meet the requirements set out within this policy.

1. Impact Assessment requirements:

- I. Any assessment on the impact of a basement development should demonstrate that:*
 - i There will be no adverse effect from subterranean development on the structural stability of adjacent properties and associated potential damage;*
 - ii There will be no possibility of irreparable damage to the local water regime both in terms of ground water diversion and surface water flooding;*
 - iii There will be no individual or cumulative impact of development on the character and biodiversity of gardens and adjacent open spaces, particularly in designated conservation areas and those areas adjacent to Highgate’s Major Open Spaces (identified in 3.4.2).*

- II. *Where there is evidence that there have been problems with drainage or flooding, or desk top surveys indicate problems may arise, applicants will be required to demonstrate to the satisfaction of the LPA that development will not cause or exacerbate such problems.*
- III. *Under no circumstances should construction be allowed to proceed where there is evidence that damage to neighbouring properties would exceed Burland Scale 1.*

2. Protection for Neighbours:

Where a Construction Management Plan (CMP) is secured, it should be submitted, and must be approved by the LPA, prior to the commencement of works.

3. Limiting Environmental/Ecological Impacts:

- I. *Any basement development should normally be expected to allow for a minimum of one metre of permeable soil above any part of the basement beneath a garden to support biodiversity and larger trees/planting. This depth should be greater if necessary to preserve landscaping consistent with neighbouring properties.*
- II. *All basement developments should incorporate a positive pumped device or other suitable flood prevention device to avoid the risk of sewage backflow causing sewer flooding."*

1.4 REPORT STRUCTURE

This document commences with a characterisation of the site, including the topographical, geological and hydrogeological setting. The development history of the site and adjacent properties is also presented.

The report then proceeds to the BIA Screening and Scoping assessments whereby consideration is given to identifying the potential hydrogeological, hydrological and stability impacts that may be associated with the proposed basement development.

A ground model is then presented.

This is followed by an outline basement construction methodology and a prediction of the ground movements that may be caused by the development, informing a subsequent assessment of the potential damage to neighbouring structures.

Finally, a summary assessment of the potential basement impacts is provided.

1.5 DOCUMENTS CONSULTED

The following documents have been consulted:

- 2026 May Proposed Drawings Wolff Architects
Ref. 2531-PL -202-0, -209-0, -210-0, -211-0, -212-0, -213-0, -220-0, -222-0, -224-0, -226-0, -230-0, -232-0
- 2025 Nov Measured Building Survey Alan Rhodes Associates
Ref. 4914-2, 4914-3
- 2008 Mar Topographical Survey CSL Surveys
Ref. 08308S/1

2. THE SITE

2.1 SITE LOCATION

Derwen is situated on the western side of the private Compton Avenue, some 120m to the north of the junction with Hampstead Lane. The site may be located approximately by postcode N6 4LH or by National Grid Reference 527200, 187710.



SITE LOCATION PLAN

2.3 SITE DESCRIPTION

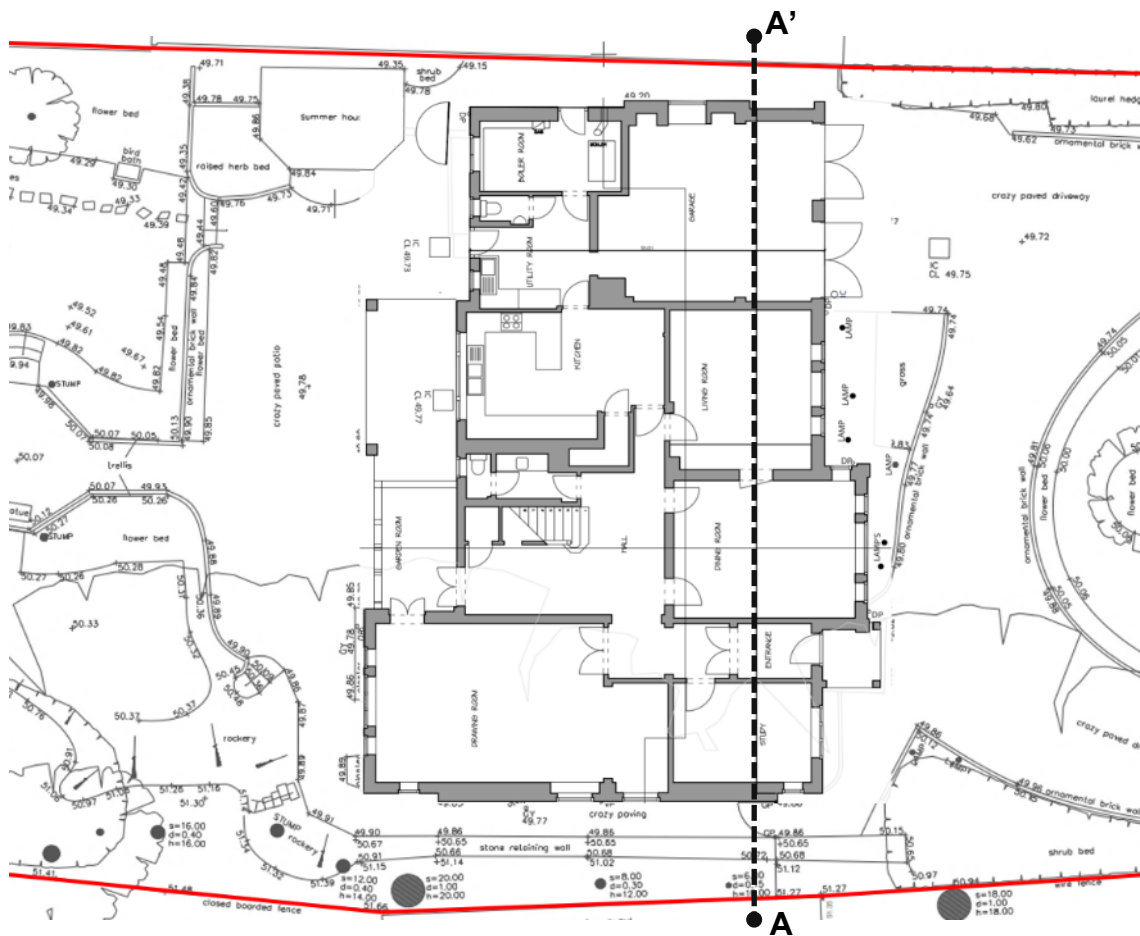
Derwen is a two-storey detached house with additional accommodation in the roof space. The house does not feature a basement.



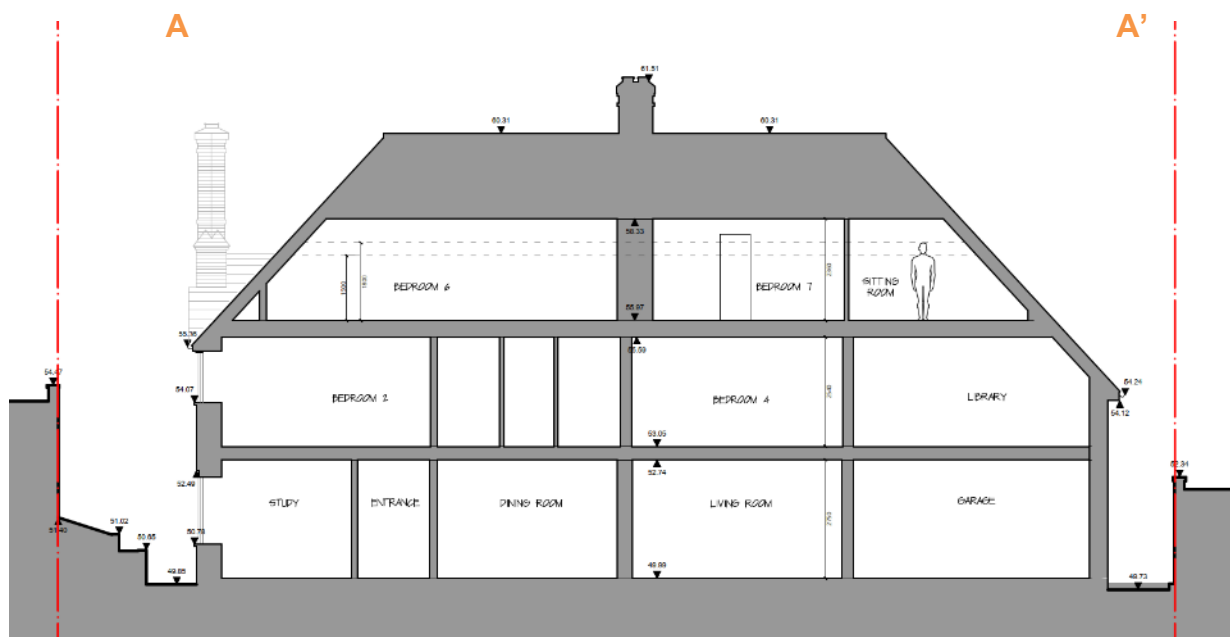
The building is situated on a flat platform partially excavated into the natural slope at the southern boundary of the site with Woodley.

The resultant approximately 1.5m high change in levels is facilitated by two masonry retaining walls, as pictured to the left.

Two oak trees and one sycamore are present immediately behind the retaining walls and the walls themselves appear bowed towards Derwen.



EXISTING GROUND FLOOR PLAN



EXISTING SECTION A-A



PLAN OF EXISTING EXTERNAL SITE FEATURES

The rear garden of the site features a patio area immediately behind the house, with a large lawn to the rear that has been partially terraced into the hillside so that steeper sloped areas are present near both the southern and northern boundaries.

Several mature trees are present both at the southern and the western boundaries of the site.



EXISTING REAR ELEVATION AND GARDEN

2.4 NEIGHBOURING PROPERTIES



2.4.1 TREE TOPS

Tree Tops neighbours the site to the north and features a large, two-storey house constructed in 2014 following demolition of the original 1920s building. The building includes a single storey garage extending up to the boundary with Derwen, with the southern wall of the garage forming a boundary retaining wall facilitating the change in levels between the properties. The Tree Tops ground floor is set approximately 1.2m below the ground floor level at Derwen, at an estimated level of +107.3m OD.

Tree Tops includes a large basement, extending to approximately 4m depth below the entirety of the building, including the single storey extension to the side and rear, up to the boundary with Derwen. The basement additionally extends below the rear garden area and forms a swimming pool at a lower level than that of the basement below the main building.

The basement is understood to have been excavated behind a perimeter contiguous bored pile retaining wall.

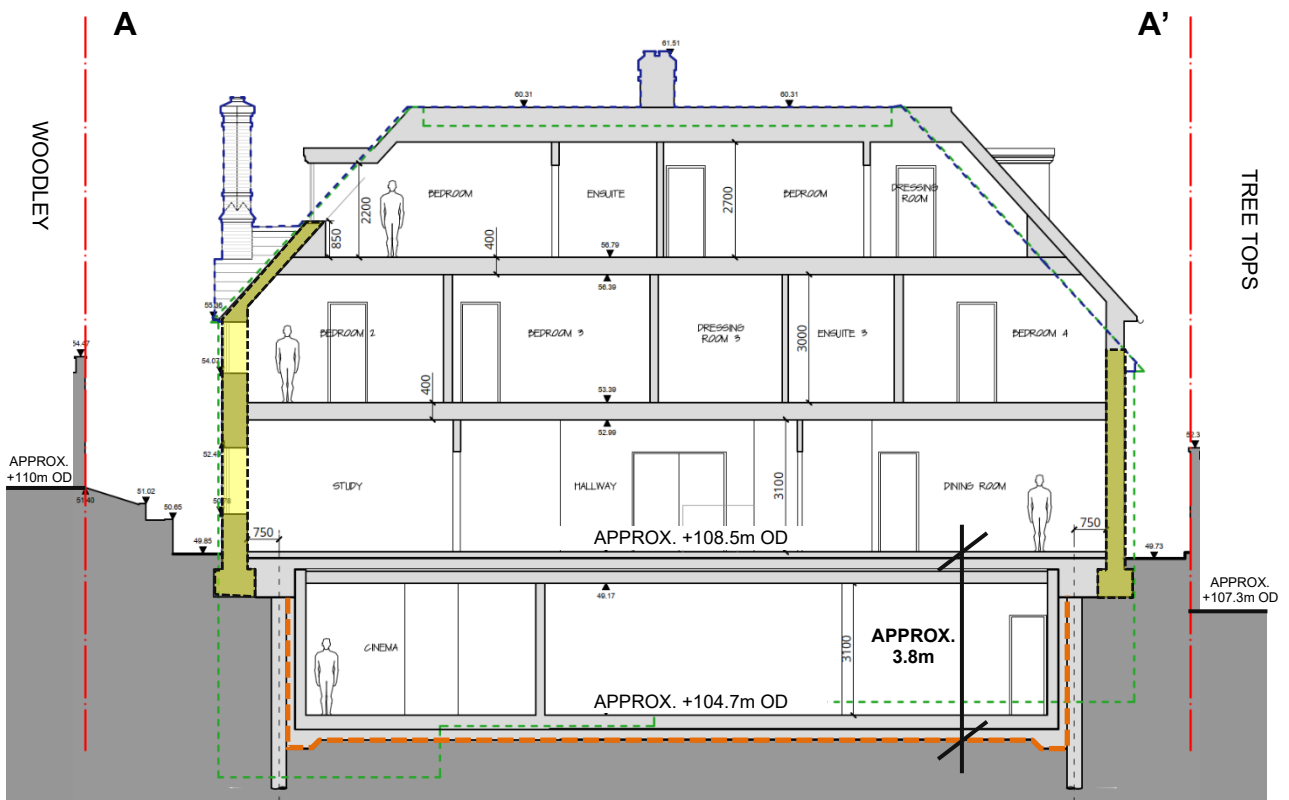
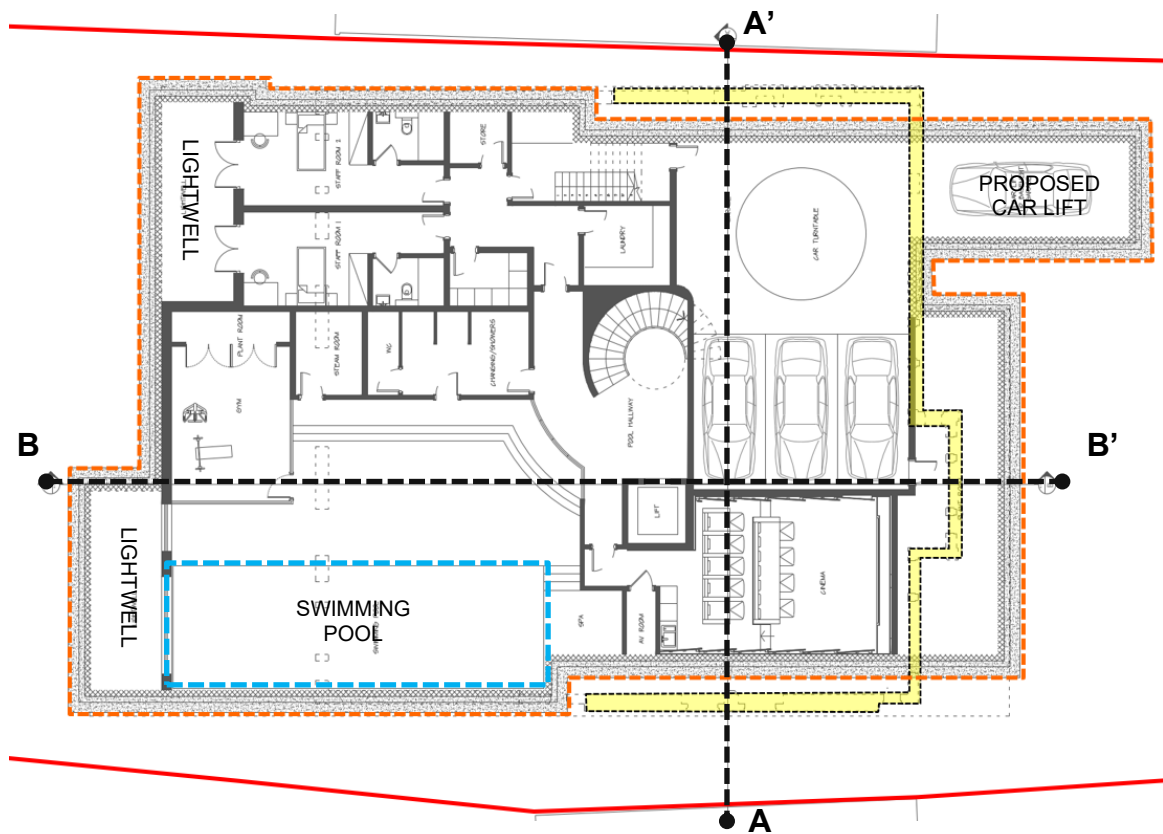
The 2022 householder application noted that the basement suffered from significant post-construction groundwater ingress.

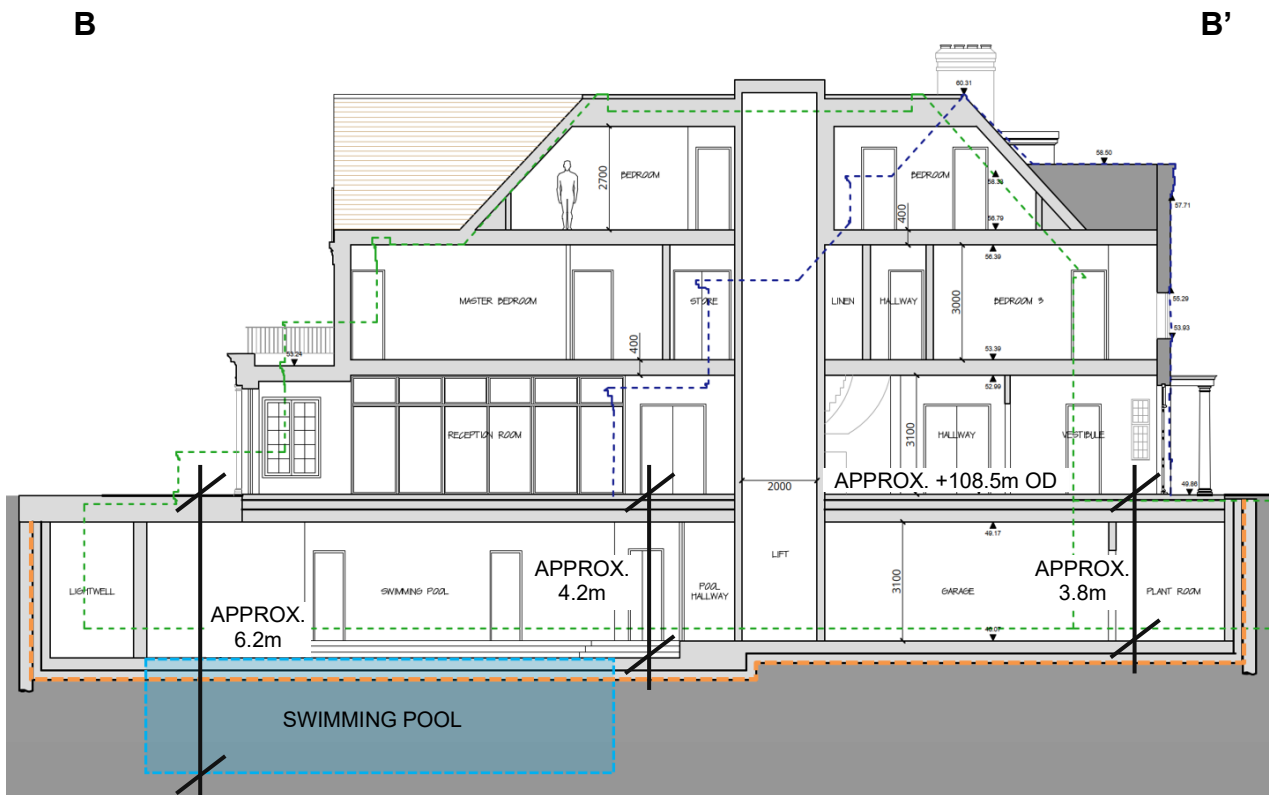
2.4.2 WOODLEY

Woodley is located to the south and upgradient of the site and similarly features a large two-storey house with a garage extension adjacent to the boundary with Derwen. Aside from a ground floor extension including a covered swimming pool towards the rear, the building fabric appears to have largely remained unchanged when compared to the original construction in the 1920s.

The building does not include a basement. The ground floor level of the building is situated at approximately +110m OD. The building is expected to be supported by shallow foundations bearing within the Claygate Beds that are potentially set above the ground floor level at Derwen.

The existing garden to the rear of the proposals is to remain unchanged. It is understood that the oak and sycamore trees at the boundary with Woodley are to be retained, while the cypress, birch and beech trees near the southwestern corner of the basement may be removed as part of the works.



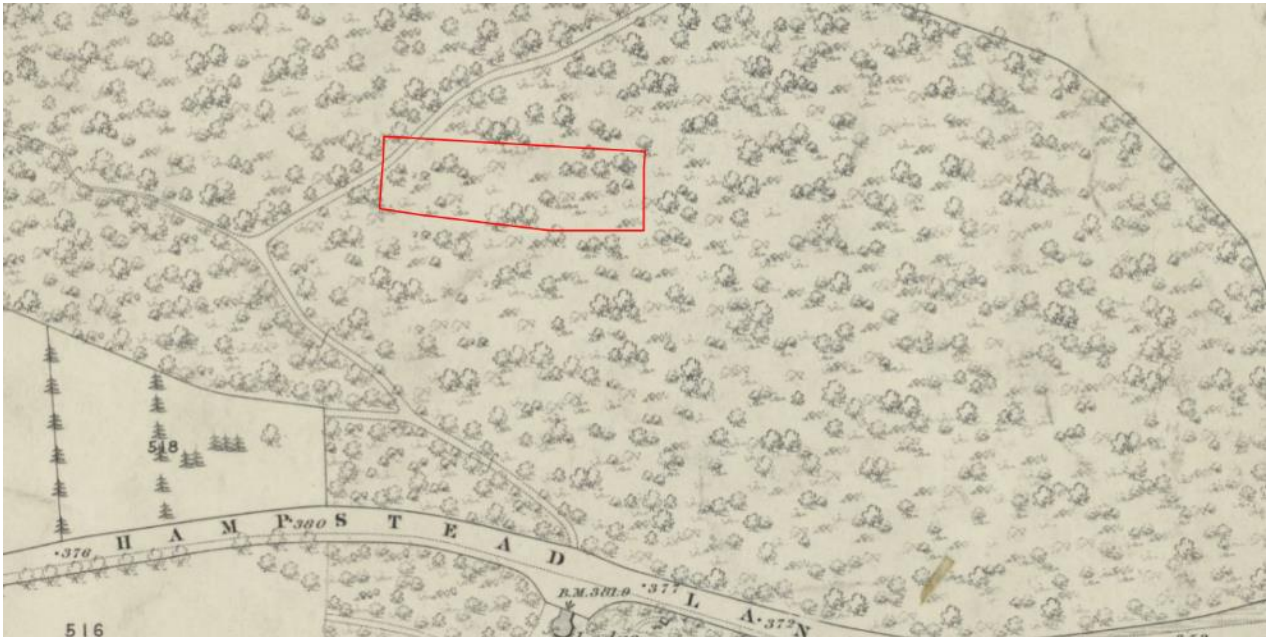


PROPOSED SECTION B-B'

4. DESK STUDY

4.1 SITE HISTORY

The site remained an undeveloped part of the Bishop's Wood to the north of Hampstead Lane until the early 20th Century. A path in the woods led through the rear part of the site.



1890s OS PLAN

Compton Avenue was established along with the nearby residential roads in the early 1920s-1930s.

As seen on the plan extract to the right, the front elevation of the building appears to be in line with the existing configuration, with a less developed rear part of the building in comparison.

The boundary with Woodley to the south appears to have also been originally formed by the two retaining walls that remain in place in the present day.

The configuration of Woodley garage extension at the boundary appears to align with the existing.



1930s OS PLAN

Derwen was been extended since around the 1980 with a two-storey rear extension.

The neighbouring Woodley was progressively extended with a swimming pool and other rear extensions since approximately the similar time.

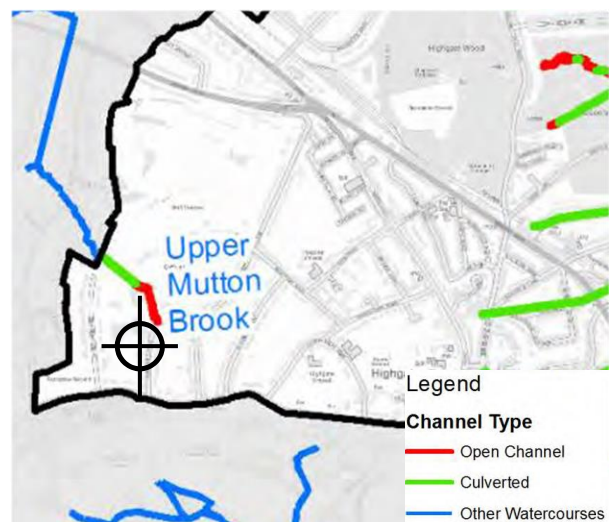
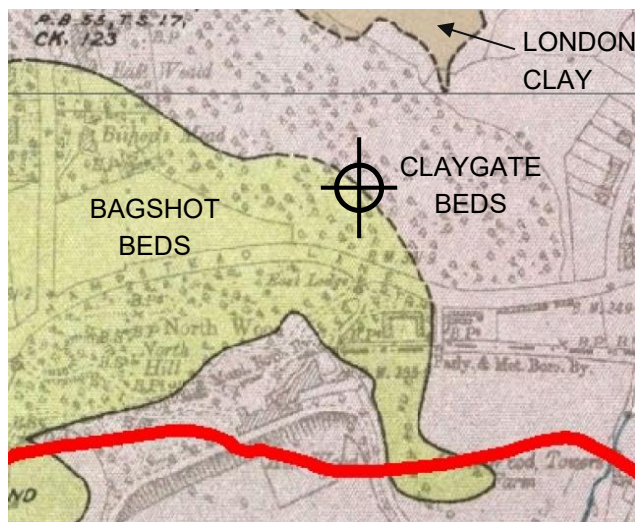
Tree tops, adjacent to the north, was replaced in 2014 by a new building with a large basement.



1940s AERIAL PHOTOGRAPHY

4.2 GEOLOGICAL & HYDROGEOLOGICAL INFORMATION

The British Geological Survey (BGS) archive records indicate that the site lies at the very fringe of the Bagshot Sand that cap the higher ground of Hampstead Heath and may be directly underlain by the Claygate Beds, with the London Clay present at depth.



EXTRACT OF FIGURE 2 OF THE CAMDEN CGHHS (LEFT) AND FIGURE 2.2 OF THE HARINGEY SFRA (RIGHT)

The Claygate Beds comprises a variable interbedded sequence of fine-grained sands, silts and firm to stiff clays.

The geological strata are arranged in a sub-horizontal fashion and, generally speaking, the lower beds are almost entirely composed of clay so that a well-known spring line emerges about halfway through the sequence. The upper sections of the Claygate contain several thicker deposits of sand, albeit that the evidence is that some of these are discontinuous lenses rather than continuous seams.

Figure 2.2 of the Haringey SFRA (above right) illustrates the presence of springs feeding the Upper Mutton Brook that appears as an open channel approximately 200m to the north of the site, within Highgate Golf Club at the northern end of Compton Avenue. This is the mid-Claygate spring line referred to in the previous paragraph.

Although no substantial groundwater table can be usually measured, given the interbedded nature of the clay and sand there are expected to be numerous intermittent near-surface groundwater flows within any more continuous permeable seams within the Upper Claygate Member,

5. SCREENING & SCOPING ASSESSMENTS

In absence of a clear guidance in terms of the Screening & Scoping stage for a Basement Impact Assessment in LB Haringey, this has been carried out with reference to Appendices E and F the Camden Geological, Hydrogeological and Hydrological Study (CGHHS). This process determines whether or not a full BIA is required.

5.1 SCREENING ASSESSMENT

The Screening Assessment consists of a series of checklists that identifies any matters of concern relating to the following:

- Subterranean (groundwater) flow
- Surface flow and flooding
- Slope stability

5.1.1 SCREENING CHECKLIST FOR SUBTERRANEAN (GROUNDWATER) FLOW

QUESTION	RESPONSE	JUSTIFICATION
Is the site is located directly above an aquifer?	Yes	The site is underlain by the Bagshot Sand and Claygate Beds.
Will the proposed basement extend beneath the water table surface?	Yes	Intermittent groundwater flows may be expected to be present within 3m of the ground surface and thus to be intercepted by the proposed basement excavations.
Is the site within 100m of a watercourse, well (used/disused) or potential spring line?	Yes	The site is located approximately 130m to the southwest of the recorded headwaters of the Upper Mutton Brook but the area does have the potential to include further spring lines
Is the site within the catchment of the pond chains on Hampstead Heath?	No	
Will the proposed development result in a change in the area of hard-surfaced/paved areas?	Yes	The proposed redevelopment includes an extension of the building towards the rear resulting in an increase of hard-surfaced/paved areas.
Will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No	The development will be subject to a SuDS Assessment undertaken by others, but infiltration is not envisaged and it is anticipated that the surface water runoff from the site will be discharged as per the existing arrangement.
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?	No	There appear to be no nearby natural ponds.

5.1.2 SCREENING CHECKLIST FOR SURFACE FLOW AND FLOODING

QUESTION	RESPONSE	JUSTIFICATION
Is the site within the catchment area of the pond chains on Hampstead Heath?	No	
As part of the site drainage, will surface water flows (e.g. rainfall and run-off) be materially changed from the existing route?	No	It is anticipated that the existing drainage arrangement discharging to the public sewer will be maintained.
Will the proposed basement development result in a change in the proportion of hard-surfaced/paved areas?	Yes	The proposed redevelopment includes an extension of the building towards the rear resulting in an increase of hard-surfaced/paved areas.
Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface-water being received by adjacent properties or downstream watercourses?	No	The new basement will be constructed immediately upgradient of the existing large and deep basement at Treetops. The latter will be dictating the profile and quality of instantaneous and long-term local surface-water being received by the adjacent property and downstream watercourse (Upper Mutton Brook).
Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	
Is the site in an area known to be at risk from surface water flooding, or is it at risk from flooding for example because the proposed basement is below the static water level of a nearby surface water feature?	No	The Environment Agency long term flood mapping confirms that the site is at a very low risk of surface water flooding, even accounting for climate change.

5.1.3 SCREENING CHECKLIST FOR STABILITY

QUESTION	RESPONSE	JUSTIFICATION
Does the existing site include slopes, natural or manmade, greater than 7 degrees?	No	The rear garden has been terraced into the hillside so that there are some minor areas greater than 7 degrees along the boundaries.
Does the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees?	No	Where possible, the existing slopes and retaining walls will be retained or reconstructed.

Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees?	No	Compton Avenue falls northwards at a slope of approximately 6 degrees.
Is the site within a wider hillside setting in which the general slope is greater than 7 degrees?	No	
Is London Clay the shallowest strata at the site?	No	The Bagshot Sand and Claygate Beds overlie the London Clay at depth.
Will trees be felled as part of the proposed development and/or are works proposed within tree protection zones where trees are to be retained?	Yes	There are a number of mature trees on site, near the proposed basement extent; some will be retained, while some are to be felled.
Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	No	
Is the site within 100m of a watercourse or a potential spring line?	Yes	The site is located approximately 130m to the southwest of the recorded headwaters of the Upper Mutton Brook but the area does have the potential to include further spring lines
Is the site within an area of previously worked ground?	No	
Is the site within an aquifer?	Yes	The site is underlain by the Bagshot Sand and Claygate Beds.
Will the proposed basement extend beneath the water table such that dewatering may be required during construction?	Yes	Intermittent groundwater flows may be expected to be present within 3m of the ground surface and thus to be intercepted by the proposed basement excavations.
Is the site within 50m of the Hampstead Heath ponds?	No	
Is the site within 5m of a highway or pedestrian right of way?	No	The proposed excavations for the basement will be undertaken at the closest approximately 10m away from the pavement of Compton Avenue.
Will the proposed basement significantly increase the differential depth of foundations relative to the neighbouring properties?	Yes	Woodley house, neighbouring the site to the south, does not feature a basement floor and therefore the proposal will increase the differential depth of foundations relative to this. Tree Tops house located to the north features a basement that extends to a level lower than the proposed basement at Derwen.

Is the site over (or within the exclusion zone of) tunnels, e.g. railway lines?	No	
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5.2 SCOPING ASSESSMENT

Where the checklist is answered with a “yes” or “unknown” to any of the questions posed in the flowcharts, these matters are carried forward to the scoping stage of the BIA process. The other potential concerns considered within the screening process have been demonstrated to be not applicable or not significant when applied to the proposed development.

The scoping produces a statement which defines further the matters of concern identified in the screening stage. This defining should be in terms of ground processes, in order that a site specific BIA can be designed and executed (Section 6.3 of the CGHHS).

5.2.1 SCOPING FOR SUBTERRANEAN (GROUNDWATER) FLOW

- *The site is underlain by an aquifer.*

The guidance advises that potentially the basement may extend into the underlying aquifer and thus affect the groundwater flow regime.

- *The basement may extend beneath the water table surface.*

The guidance advises that the groundwater flow may be altered by the proposed basement. Changes in flow regime could potentially cause the groundwater level within the zone encompassed by the new flow route to increase or decrease locally. For existing nearby structures then the degree of dampness or seepage may potentially increase as a result of changes in groundwater level.

- *The site may be within 100m of a potential spring line.*

The guidance advises that flow from a spring, well or watercourse may increase or decrease if the groundwater flow regime which supports that water feature is affected by a proposed basement.

If the flow is diverted, it may result in the groundwater flow finding another location to issue from with new springs forming or old springs being reactivated.

A secondary impact is on the quality of the water issuing or abstracted from the spring or water well respectively.

- *The proposed basement development will result in a change in the proportion of hard surfaced / paved areas.*

The guidance advises that the sealing off of the ground surface by pavements and buildings to rainfall will

result in decreased recharge to the underlying ground. In areas underlain by an aquifer, this may impact upon the groundwater flow or levels. In areas of non-aquifer (i.e. on the London Clay), this may mean changes in the degree of wetness which in turn may affect stability. The guidance advises that a change in the proportion of hard surfaced or paved areas of a property will affect the way in which rainfall and surface water are transmitted away from a property. This includes changes to the surface water received by the underlying aquifers, adjacent properties and nearby watercourses. Changes could result in decreased flow, which may affect ecosystems or reduce amenity, or increased flow which may additionally increase the risk of flooding.

5.2.2 SCOPING FOR SURFACE WATER FLOW AND FLOODING

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

The guidance advises that a change in the proportion of hard surfaced or paved areas of a property will affect the way in which rainfall and surface water are transmitted away from a property. This includes changes to the surface water received by the underlying aquifers, adjacent properties and nearby watercourses. Changes could result in decreased flow, which may affect ecosystems or reduce amenity, or increased flow which may additionally increase the risk of flooding.

5.2.3 SCOPING FOR STABILITY

- *Works are proposed within tree protection zones where trees are to be retained and several trees are proposed to be removed.*

The guidance advises that the soil moisture deficit associated with felled tree will gradually recover. In high plasticity soils (such as London Clay) this will lead to gradual swelling of the ground until it reaches a new value. This may reduce the soil strength which could affect slope stability. Additionally the binding effect of the tree roots can have a beneficial effect on stability and the loss of a tree may cause loss of stability.

- *The site may be within 100m of a potential spring line.*

The guidance advises that seasonal spring lines and changes to groundwater regimes within slopes can affect slope stability.

- *The site is underlain by an aquifer, and;*
- *The basement may extend beneath the water table surface.*

The guidance advises that dewatering can cause ground settlement. The zone of settlement will extend for the dewatering zone, and thus could extend beyond a site boundary and affect neighbouring structures. Conversely, an increase in water levels can have a detrimental effect on stability.

- *The proposed basement will significantly increase the differential depth of foundations relative to*

one of the neighbouring properties.

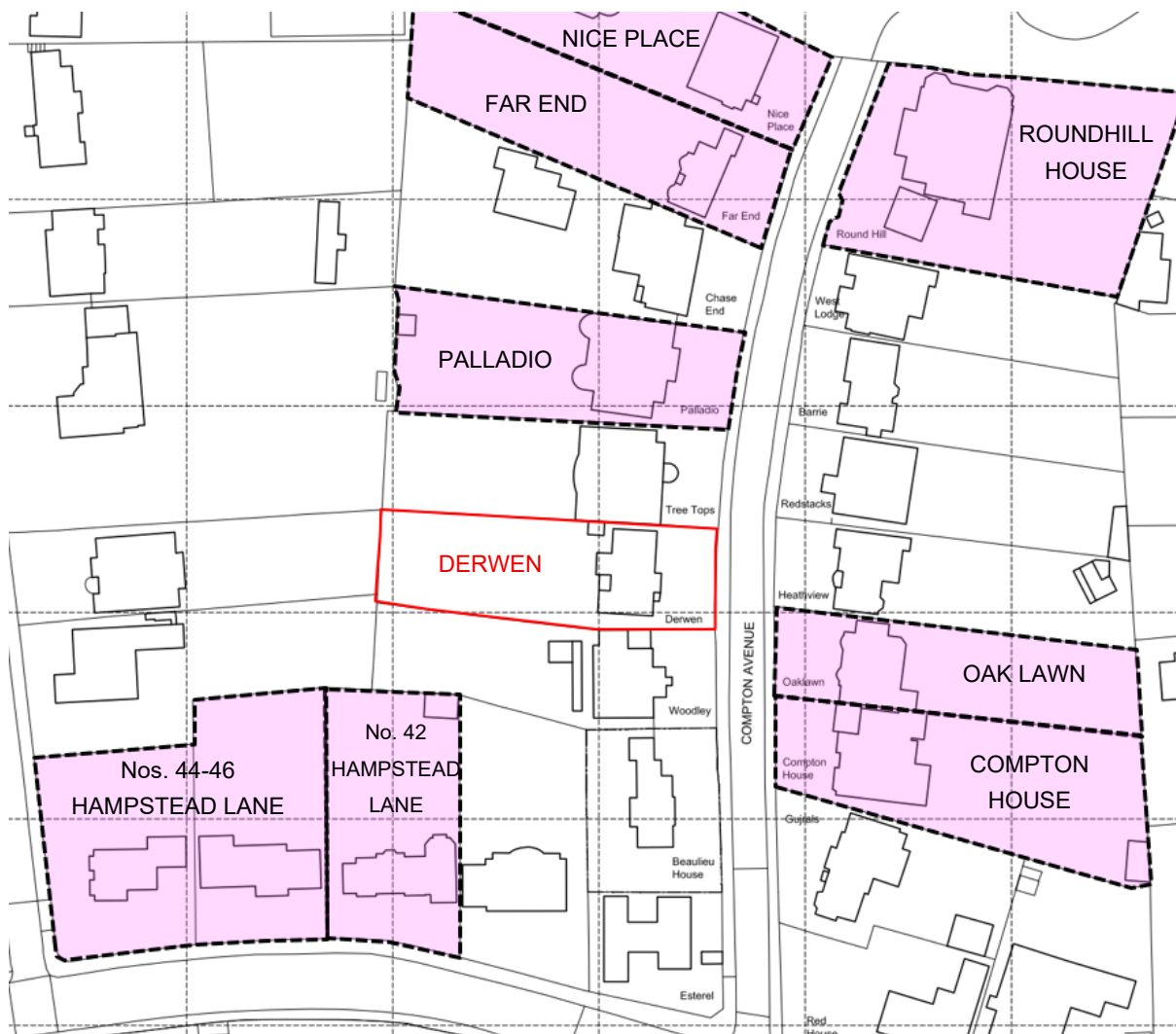
The guidance advises that excavation for a basement may result in structural damage to neighbouring properties if there is a significant differential depth between adjacent foundations.

6. GROUND CONDITIONS

6.1 INVESTIGATION DATA

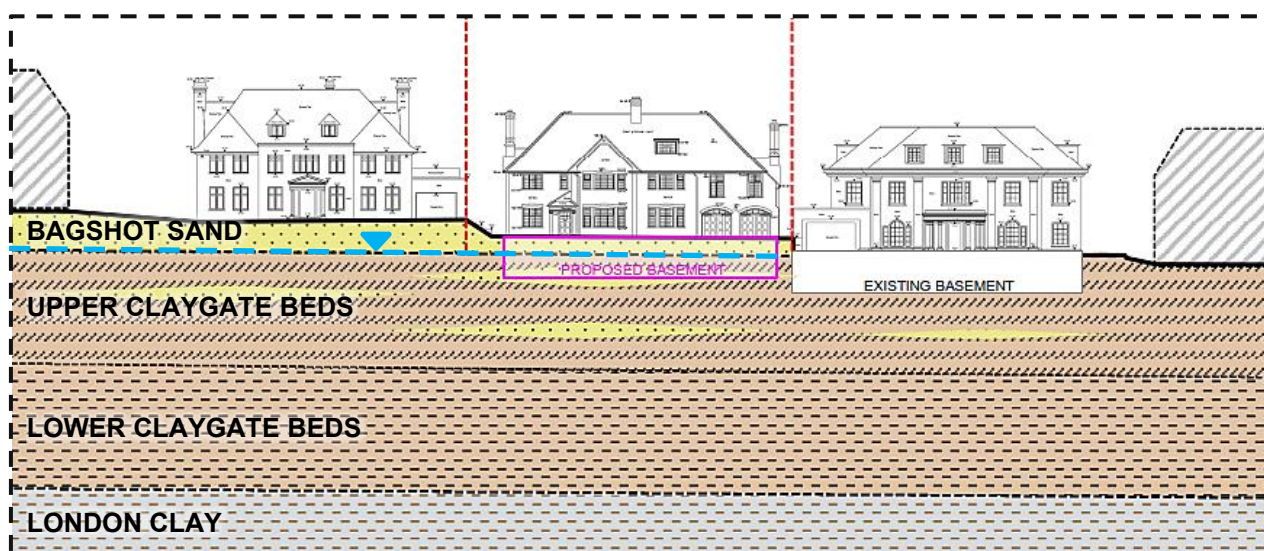
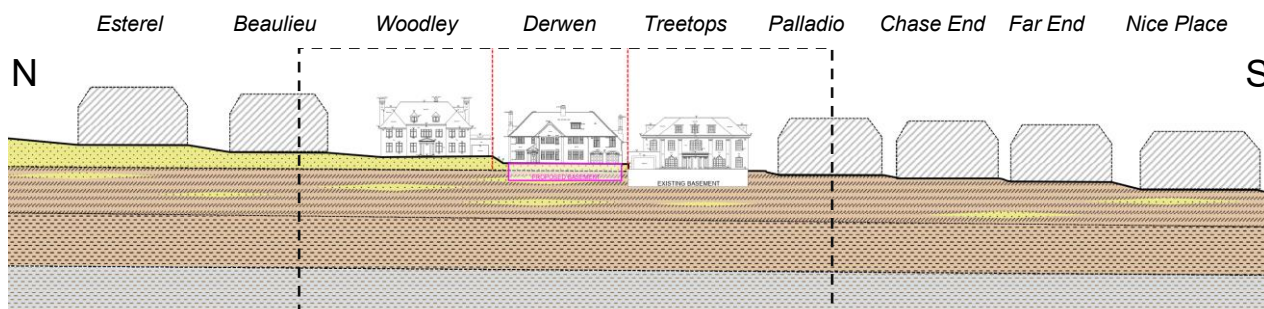
A number of ground investigations have been undertaken in the local area as presented on the plan below.

- | | |
|--|---|
| • 2004 May Palladio, Compton Avenue | LBH Wembley, Ref. LBH3338 |
| • 2007 Aug Roundhill House, Compton Avenue | LBH Wembley, Ref. LBH3663 |
| • 2011 Jul Nice Place, Compton Avenue | GEA, Ref. J11150 |
| • 2015 Mar Oak Lawn, Compton Avenue | Risk Management, Ref. RML 5731 |
| • 2015 Aug Compton House, Compton Avenue | Site Analytical Services, Ref. 15/23905 |
| • 2015 Nov Far End, Compton Avenue | Risk Management, Ref. RML 5928 |
| • 2019 Sep No. 42 Hampstead Lane | GEA, Ref. J14154 |
| • 2021 Dec Nos. 44-46 Hampstead Lane | GEA, Ref. J21167A |



6.2 GROUND MODEL

Beneath any shallow made ground and/or topsoil, there may be residual elements of the Bagshot Sand capping the interbedded sand and clay of the upper Claygate Beds, overlying the lower Claygate at around 10m depth and the London Clay itself at Formation at around 20m depth.



GROUND MODEL – SECTION ALONG COMPTON AVENUE

6.2.1 BAGSHOT FORMATION

The site is expected to be immediately underlain by a shallow capping of Bagshot sand, which typically comprises medium dense pale brown silty sand.

6.2.2 CLAYGATE BEDS

The Upper Claygate Beds comprise firm, becoming stiff, orange-brown silty, very sandy clay, frequently interbedded with more permeable sand layers noted to be of similar composition to the overlying Bagshot beds. This layer is variable in depth across the slope, tending to reduce downgradient towards the north.

Below around 7-10m depth, the Claygate grades to a brown and grey silty sandy clay, with only occasional permeable seams of sand and silt.

The predominantly cohesive layers of the Claygate are considered to be of medium volume change potential.

6.2.3 LONDON CLAY FORMATION

The London Clay is present below the Claygate Member and comprises stiff, becoming very stiff, grey fissured silty clay.

6.2.4 GROUNDWATER

Groundwater is present within the Bagshot Formation and the more permeable lenses of the Claygate Beds. Experience shows that a permanent ground water table may not be present and that the groundwater presence and pressure head in any confined aquifers can vary in response to rainfall periods.

The presence of groundwater at this site is evidenced by the reported basement groundwater problems affecting the adjacent downgradient site to the south.

6.2.5 MODELLED GROUND CONDITIONS

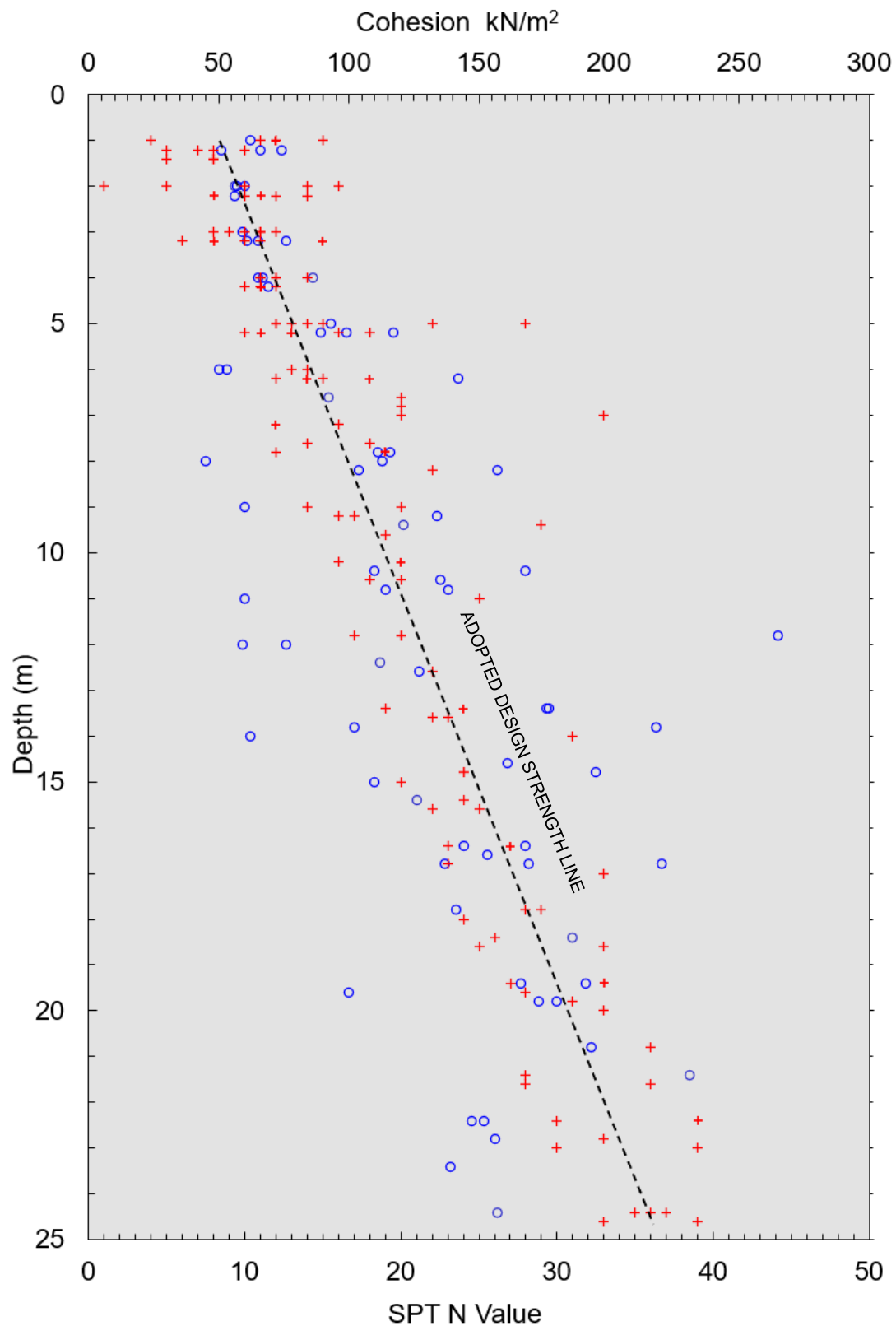
The following soil stiffness model has been used for analysis of ground movements:

ADOPTED DESIGN GROUND STIFFNESS MODEL			
Stratum	Assumed Upper Boundary Level	Undrained Elastic Modulus E_u (kN/m ²)	Drained Elastic Modulus E' (kN/m ²)
Claygate Member	+108m OD	31,250 kN/m ² at upper boundary increasing to 195,000 kN/m ² at 35m depth	25,000 kN/m ² at upper boundary increasing to 155,000 kN/m ² at 35m depth

The design strength profile of the Claygate Member has been based on consideration of data from a number of nearby investigations extending up to 25m depth in the local area.

A combined strength profile for the clay has been derived from these tests and is shown overleaf.

A design strength profile has been taken as an average Undrained Cohesion (C_u) of 50kN/m² at the surface of the clay stratum increasing by 7kN/m² per m depth of penetration into the clay. This is indicated by the dashed line on the plot overleaf.



*Adopted design line (shown dashed on the graph) = Undrained Cohesion $C_u = 50 + (7 \times z)$

7. GEOTECHNICAL ASSESSMENT

7.1 BASEMENT CONSTRUCTION METHODOLOGY

Following temporary support of the front and side elevations, the existing building will be largely demolished to make way for the basement construction.

The basement is expected to require excavations of approximately 4m depth, extending into the Claygate Member. The depth of excavation will be locally deepened to 6.2m depth for the swimming pool.

It is anticipated that these excavations will be formed inside a basement retaining wall formed by cast-in-situ reinforced concrete secant bored piling.

7.1.1 GROUNDWATER

A key consideration in the design of the basement retaining walls will be the expected presence of groundwater at shallow depth.

As described, there is a risk of substantial seepages of groundwater being encountered within the full extent of the proposed basement.

Therefore a secant bored pile wall will be required in order to safely form the basement excavations. A continuous bored pile wall arrangement is not likely to succeed in excluding groundwater from the basement excavations and is not recommended. At this stage it is envisaged that 300mm or 450mm diameter piles may be sufficient to provide the required stiffness in conjunction with the temporary works described below.

7.2 TEMPORARY WORKS

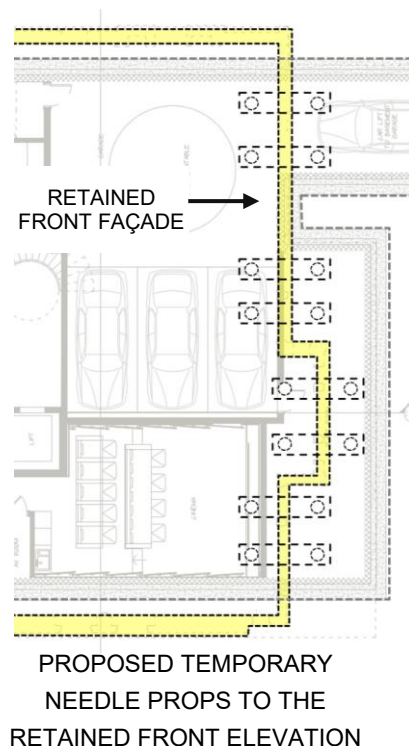
The safe temporary support of the retained front and side elevations will be a necessary precursor to demolition of the main structure.

7.2.1 RETAINED FRONT ELEVATION

The new basement front perimeter wall will sit outside the front elevation of the house.

Sacrificial piles are to be thus installed on both sides of the retained front elevation, with needle props constructed through the elevation to transfer support of the retained elevation from the existing foundations to the temporary piles.

The façade will then need to be supported by these temporary piled foundations throughout the subsequent basement excavation works and until the loading of the façade has been safely transferred to new permanent foundations at the perimeter by means an arrangement of new supporting beams.



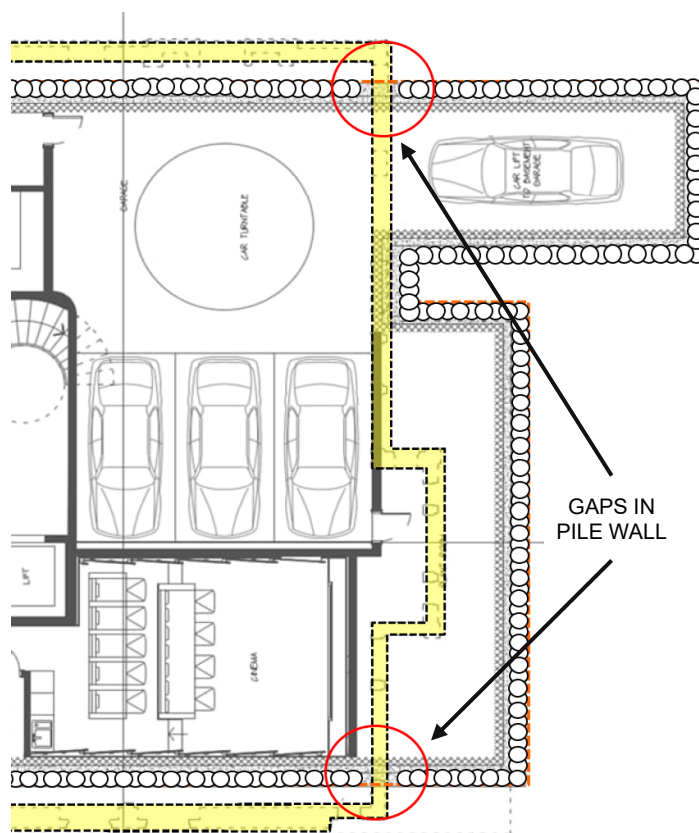
7.2.2 CROSSOVER BELOW FRONT ELEVATION

As the basement passes underneath the front elevation to form the plant room and the car lift, access for the piling rig will be obstructed leaving two gaps.

It is envisaged that infilling of these gaps will need to be undertaken by means of local excavation with initial grout injections to seal any residual groundwater inflows from permeable strata followed by in-situ reinforced concrete construction.

7.2.3 RETAINED SIDE ELEVATIONS

The new basement flank perimeter walls will sit inside the house footprint. The retained side elevations will be supported on their existing foundations, but it will be critical to maintain full lateral support of the ground beneath them by means of continuous movement monitoring in conjunction with positive propping applied using an observational methodology or to adopt a top-down construction methodology.



LOCATIONS OF UNAVOIDABLE GAPS IN THE PILED WALL

7.2.4 TOP-DOWN CONSTRUCTION

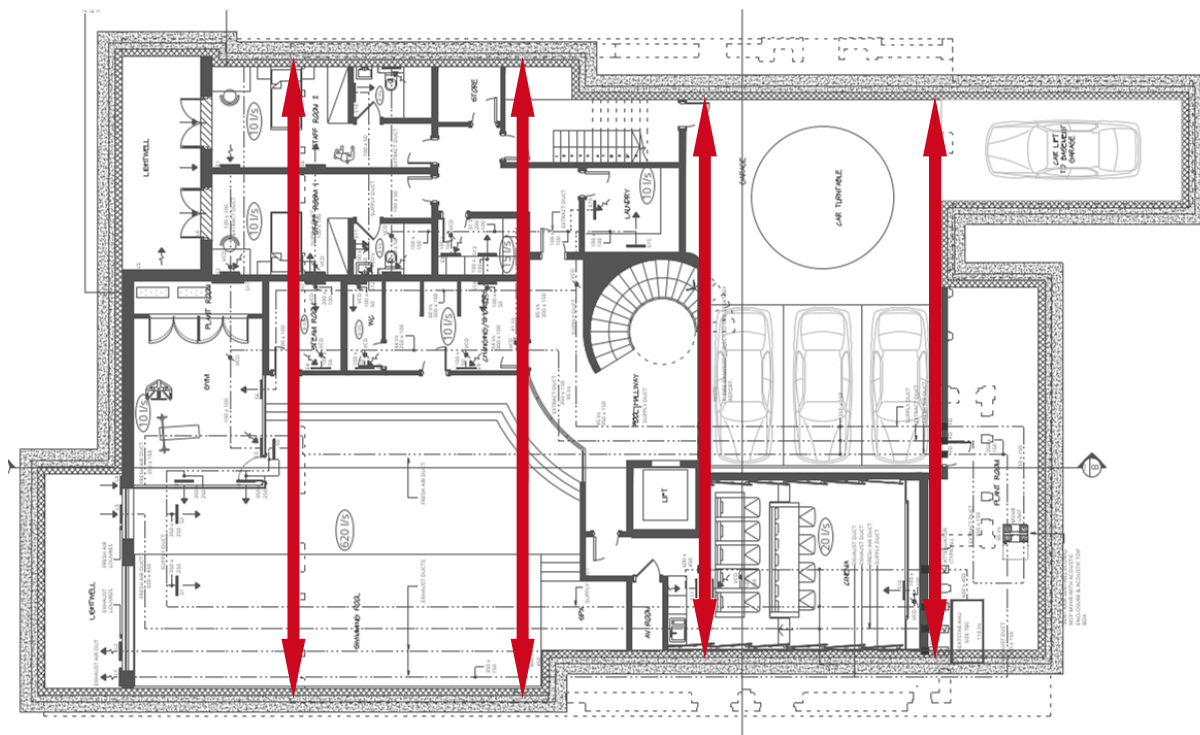
As noted above, retention of the existing side elevations will require high stiffness variable propping of the soil that supports their foundations in order control any yielding and ensure the stability of these.

This support must be provided throughout the full basement height and in order to assist this it is considered that, once the perimeter piling has been completed, it would be prudent to form the new ground floor. The completed ground floor slab can thus provide rigid lateral propping to the top of the piled retaining walls prior to the basement excavation.

Due to the size of the proposed basement, spanning approximately 22m north to south and up to 38m west to east, it is anticipated that this ground floor slab will require intermediate temporary vertical support inside the basement during construction.

It is therefore envisaged that the ground floor slab will be locally thickened to form a series of stiffened transverse beams that will be supported on temporary piles until this support can be replaced by internal basement walls.

An indicative arrangement for these beams is shown on the sketch below.



In addition to the ground floor propping beams described above temporary, and depending upon the stiffness of the piled wall itself, consideration should be given to the introduction of walings and temporary steel propping spanning the full width of the new basement at two further levels close to the above beam positions until the basement floor is cast to provide adequate horizontal propping in the permanent scenario. An intermediate level of propping may be required at mid excavation height and a low level propping may be required just above the basement floor level.

7.3 BASEMENT SLAB DESIGN

In order for the completed new basement structure to act as a rigid element that can interact with and accommodate the envisaged ground forces without deflection it is important that there is sufficient continuity of reinforcement across the floor slab areas.

Due to the depth of excavation within the Claygate Member there will be inevitable basement heave forces acting upon the underside of the new basement floor slab. The forces will reach a maximum towards the centre of the basement area and will either need to be capable of substantial redistribution of these forces or to be protected from them.

The introduction of compressible materials beneath some slab areas can potentially be used to deliberately redistribute the maximum heave forces to the peripheral areas and hence relieve the structural requirements for certain areas.

The potential for heave movement is analysed and discussed further in Section 7 of this report.

7.4 RETAINING WALL DESIGN

The following soil parameters can be considered in the permanent design of the basement retaining walls.

RETAINING WALL DESIGN PARAMETERS			
Stratum	Bulk Unit Weight	Effective Cohesion	Effective Friction Angle
	(kN/m ³)	(c' - kN/m ²)	(ϕ' - degrees)
Claygate Beds	20	Zero	20

Conventional retaining wall design programmes often default to the use of active earth pressure coefficients, whereby some soil movement behind the wall is permitted in order to take advantage of the degree to which the soil can support itself, reducing the work to be done by the wall. This approach is not always suitable for basement situations, where relatively limited soil movements can induce damage to nearby structures.

A key issue is where significant soil movements behind the wall cannot be tolerated, as is the case near the retained side elevations of the existing buildings, where any soil movement behind the new basement retaining wall could induce damage to the high level foundations. In this case the use of active earth pressure coefficients would therefore not be appropriate and these should not be used for the design. At rest earth pressures should instead be applied to the design of all critical areas of the basement walling in order to ensure that sufficient reinforcement is incorporated to provide the required resistance to yielding.

7.5 WATERPROOFING

While the secant piled retaining wall should essentially prevent groundwater from entering the excavations, the permanent below-ground structure must be waterproofed and designed to withstand hydrostatic pressures in accordance with BS8102:2022, Code of Practice for the Protection of Below-Ground Structures against Water Ingress.

A design hydrostatic level of +108.5m OD, approximately equivalent to the existing ground floor level, is recommended for the purposes of assessing hydrostatic pressures at this location.

7.6 EFFECT OF TREES

Twelve trees are present near the proposed basement. It is understood that the majority of these, including the mature oak and sycamore trees at the southern boundary, may be retained and protected during the works. Based on the Arboricultural Impact Assessment undertaken for the previously consented scheme with a similar basement extent to the currently proposed, three trees may require removal to enable the proposed works.

The proposed depth of the new basement should obviate any potential issues associated with shrink-swell movement of London Clay as influenced by moisture extraction due to the tree roots.

It is understood a new Arboricultural Impact Assessment will be commissioned to assess the impact of the proposals on the retained trees at the southern boundary of the site.

7.7 OUTLINE CONSTRUCTION SEQUENCE

The following outline sequence of construction is envisaged and will be subject to confirmation and detailed design by the structural engineer:

1. Install external frame to support the side and front elevations.
2. Sacrificial temporary piles installed in front and behind the retained façade to provide temporary support.
3. Install further internal framework / scaffolding to support the façade from the temporary piles.
4. Undertake controlled demolition of the rear of the existing building and the internal structure.
5. Construct the new basement piled retaining wall.
6. Construct pile capping beams.
7. Install high level propping to piled walls as in situ r/c downstand beams within ground floor slab across the basement.
8. Undertake top-down excavation to the basement.
9. Install intermediate mid-height propping as required when excavation level reaches half depth.
10. Install low-level propping as required above basement FFL.
11. Cast basement slab and allow curing.
12. Remove temporary propping.
13. Construct basement liner walls.

8.2 ANALYSIS METHODOLOGY

The analysis of ground movement due to unloading has been undertaken using classic modified Boussinesq elastic theory, assuming fully flexible foundations permitting the uniform loading/unloading of a semi-infinite elastic half-space and using the soil parameters for stratified homogeneity identified in Section 6.2.5.

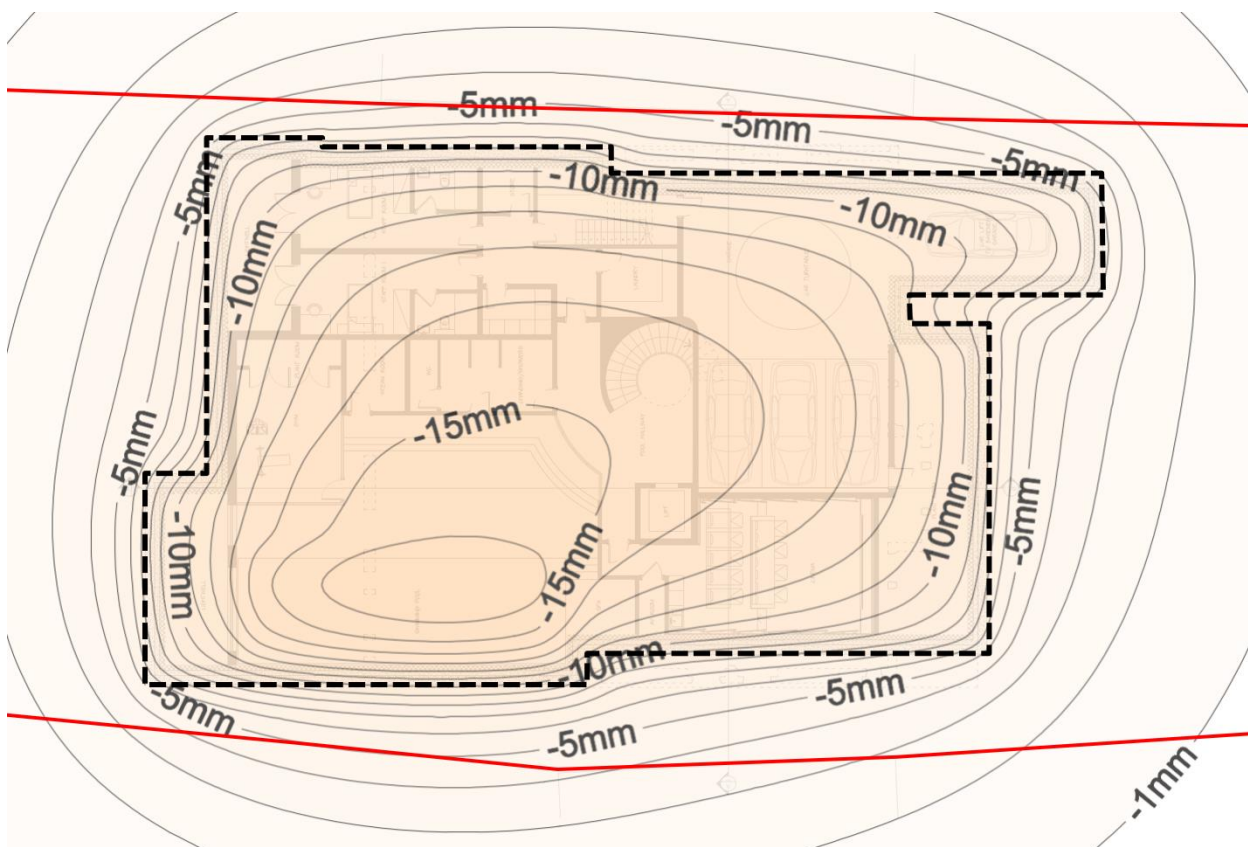
Poisson's Ratios of 0.5 and 0.1 have been used for short term (undrained) and long term (drained) conditions respectively.

The analysis calculates the theoretical Boussinesq elastic stress decrease due to the applied net loading/unloading over the given foundation areas at the mid-level of each analysis layer. Short-term and long-term displacements are then calculated at each calculation point for each stratum, using the given values of Stiffness Moduli and Poisson's Ratio of the whole area of the site on a 1m calculation grid.

8.3 ANALYSIS RESULTS

8.3.1 SHORT TERM HEAVE

The analysis shown below suggests that around 10mm of short term heave could occur, with a maximum of approximately 15mm of uplift in the area of the deepest excavation to form the basement swimming pool.



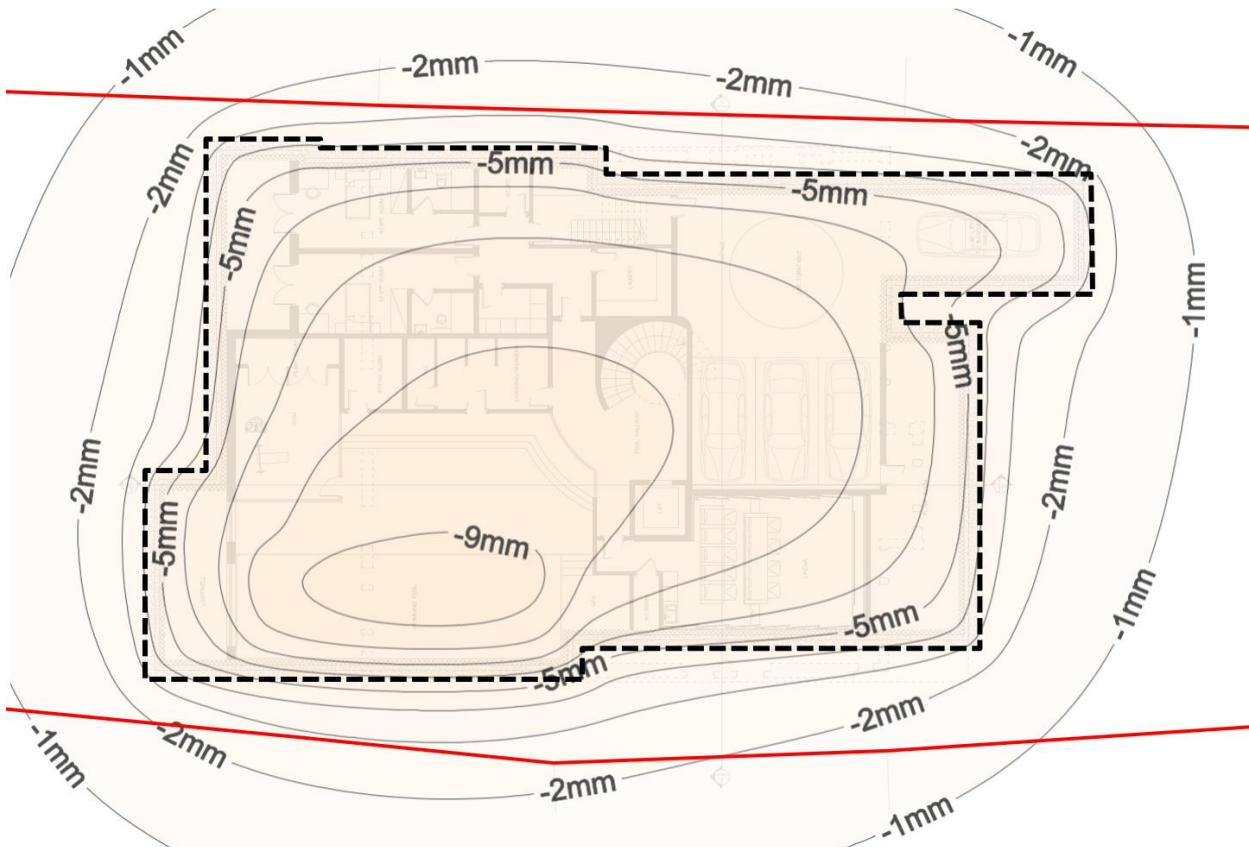
THEORETICAL SHORT-TERM HEAVE DUE TO BASEMENT EXCAVATION

However, this short-term heave can be largely ignored as it will be essentially completed before the new basement slab is cast.

8.3.2 POST-CONSTRUCTION (LONG TERM HEAVE)

The post construction analysis, factoring in the reduced net unloading following the rebuilding suggests that additional internal heave of less than 10mm is predicted to occur.

It should be noted that the piled basement retaining walls will tend to constrain heave movements to within the excavation footprint and hence the theoretical minor heave movement indicated below to extend outside the site boundaries are not to be expected in practice.



THEORETICAL LONG TERM (POST-CONSTRUCTION) HEAVE DUE TO BASEMENT CONSTRUCTION

9. GROUND MOVEMENT ASSESSMENT

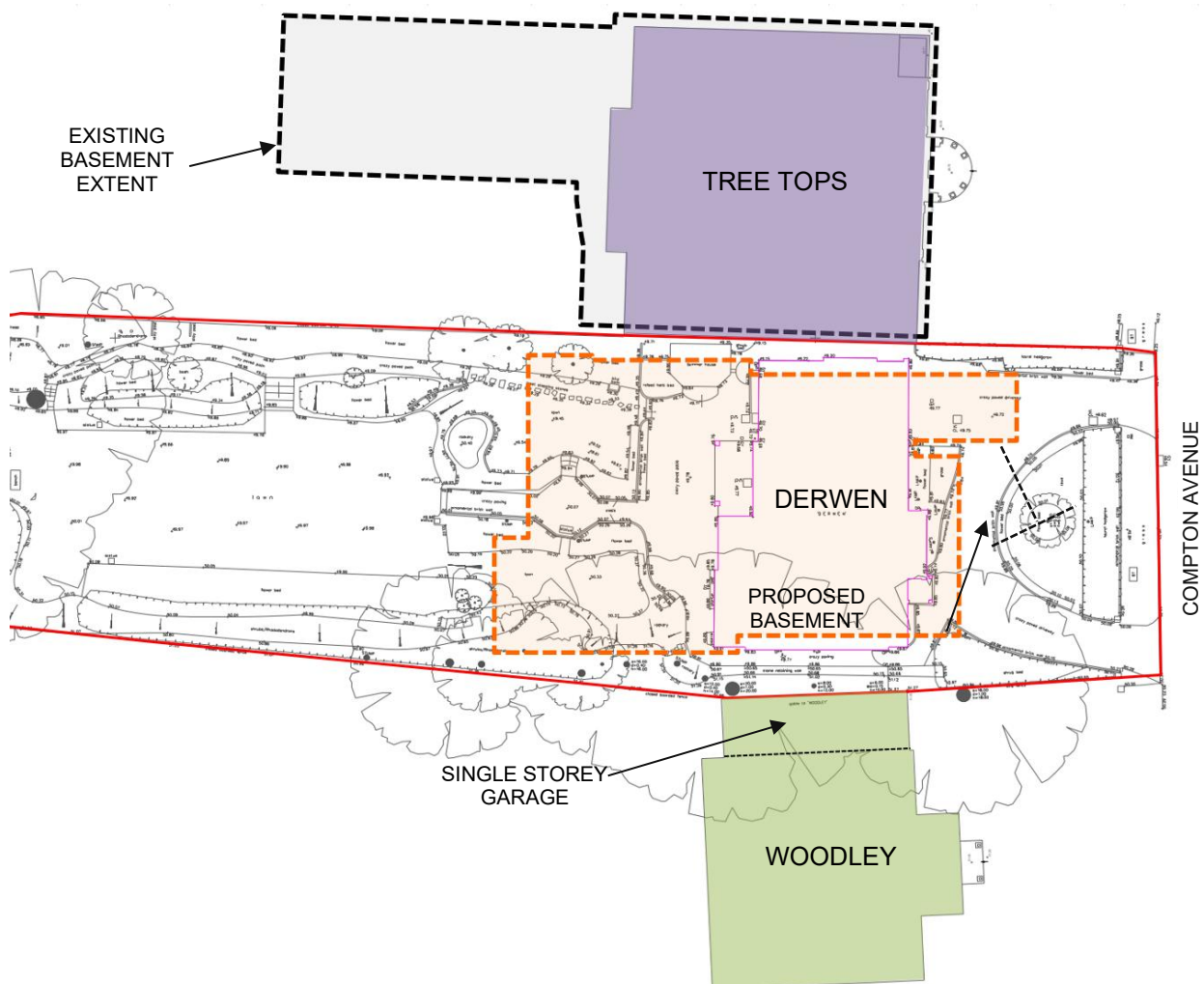
The 2017 Highgate Neighbourhood Plan states that '*under no circumstances should construction be allowed to proceed where there is evidence that damage to neighbouring properties would exceed Burland Scale 1*'.

This refers to the Burland damage category shown below:

Category of damage	Description of typical damage (ease of repair is underlined>	Approximate crack width (mm)	Limiting tensile strain, ϵ_{lim} (%)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible	<0.1	0.0 to 0.05
1 Very slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection	<1	0.05 to 0.075
2 Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly.	<5	0.075 to 0.15
3 Moderate	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable lining. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5 to 15 or a number of cracks >3	0.15 to 0.3
4 Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Services pipes disrupted.	15 to 25, but also depends on number of cracks	>0.3
5 Very severe	This requires a major repair, involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	Usually >25, but depends on numbers of cracks	

BURLAND DAMAGE CATEGORIES

9.1 NEIGHBOURING STRUCTURES CONSIDERED FOR EFFECT OF GROUND MOVEMENT



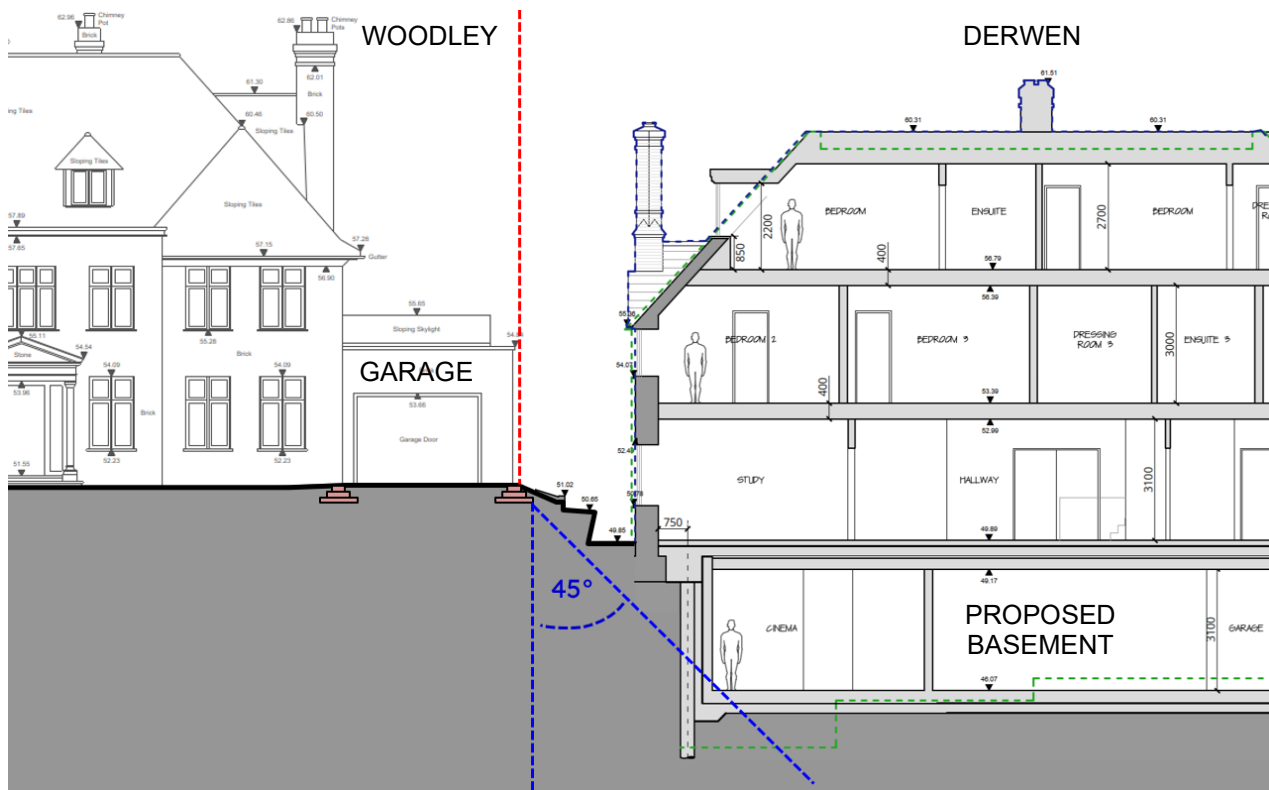
9.1.1 WOODLEY

Woodley, a two storey detached house, is present to the south of the site and the ground floor level of the property is set at approximately +110m OD, some 1.5m above the existing ground floor level of Derwen.

Immediately adjacent to the boundary with Derwen is a single storey garage extension, which is believed to form part of the original building as constructed in the 1920s.

While the detailed configuration and depths of the foundations to the building and its extensions is not currently known, it may be expected that this comprises shallow strip foundations.

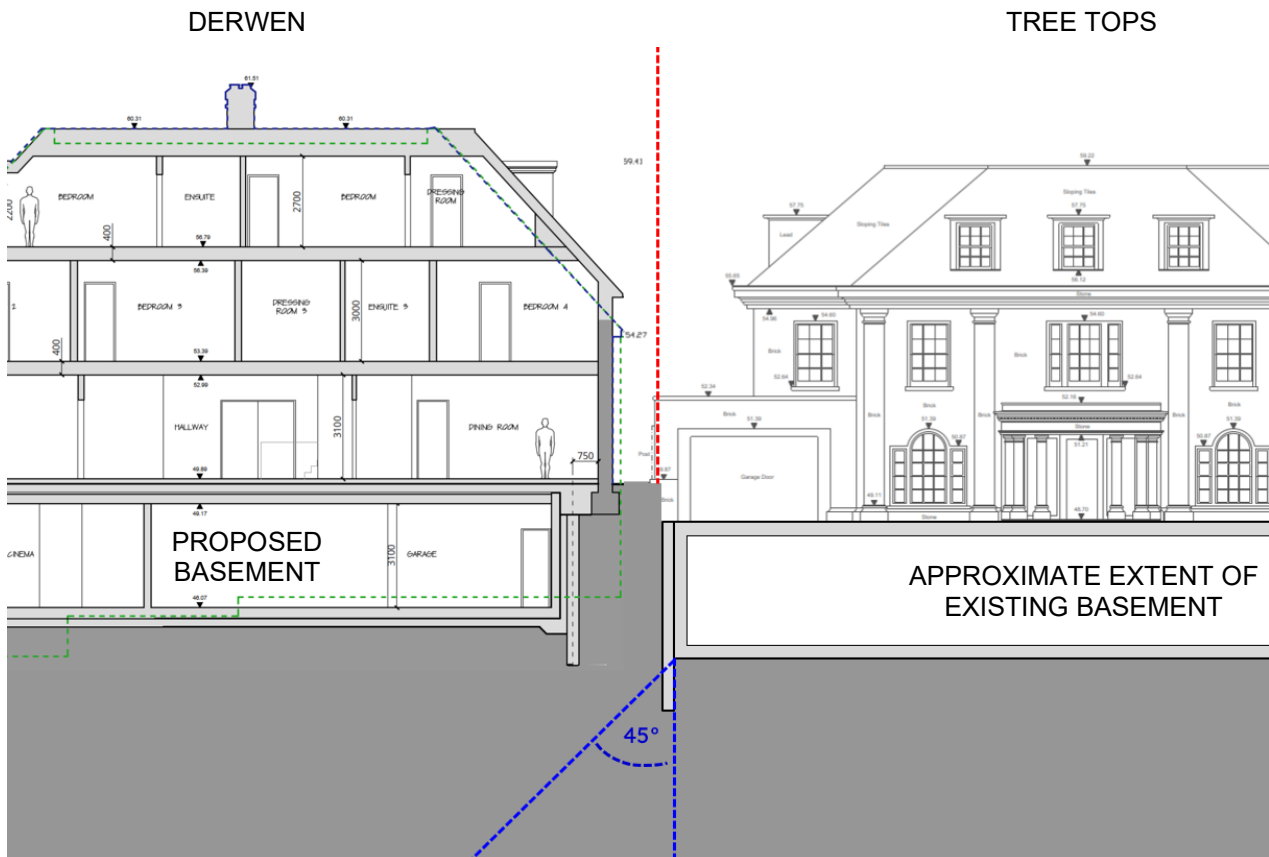
It is therefore conservatively assumed that these are situated at a shallow depth (<1m), with a founding level situated above the ground floor level at Derwen.



The above section illustrates that, based on a worst case assumption, the proposed basement excavations at Derwen will extend below the 45 degree theoretical line of support of the foundations at Woodley, prompting further assessment of the potential movement.

9.1.2 TREE TOPS

Tree Tops neighbours the site to the north and features a large two-storey house constructed in 2014 with a basement extending below the entire footprint and extending beyond this towards the rear. The basement was constructed using a piled wall retaining wall around its perimeter and extends to approximately 4m depth, to an estimated level of +103.3m OD, some 1.4m below the proposed basement level at Derwen near the boundary with Tree Tops.



Thus, as shown on the above section drawing comparing the proposed basement at Derwen with the existing basement at Tree Tops, the new basement excavations will not extend into the theoretical line of support to the neighbouring structure.

Hence the building will not be expected to experience any ground movement as a result of the works.

9.2 SOURCES OF GROUND MOVEMENT

9.2.1 BASEMENT HEAVE

As described in Section 8, it is anticipated that heave movements to neighbouring structures due to the basement excavation will be of negligible magnitude.

9.2.2 MOVEMENTS BEHIND THE PILE RETAINING WALL

Secant pile retaining walls are to be constructed around the entire perimeter of the proposed basement.

Some minor horizontal and vertical soil movements can be expected to occur during installation of the pile but provided that the completed wall is designed to be sufficiently stiff and is adequately propped there should be minimal soil movement due to wall yielding during subsequent excavation in front of the wall.

The CIRIA¹ movement prediction guidance is based mainly upon evidence gathered from very large-scale projects, with little account of smaller well-propped or top-down construction projects. It is noted that, despite the assumption of a “high stiffness” condition, the CIRIA guidance predicts up to 7mm of vertical movement and up to 12mm of horizontal movement occurring at ground level immediately behind the basement wall.

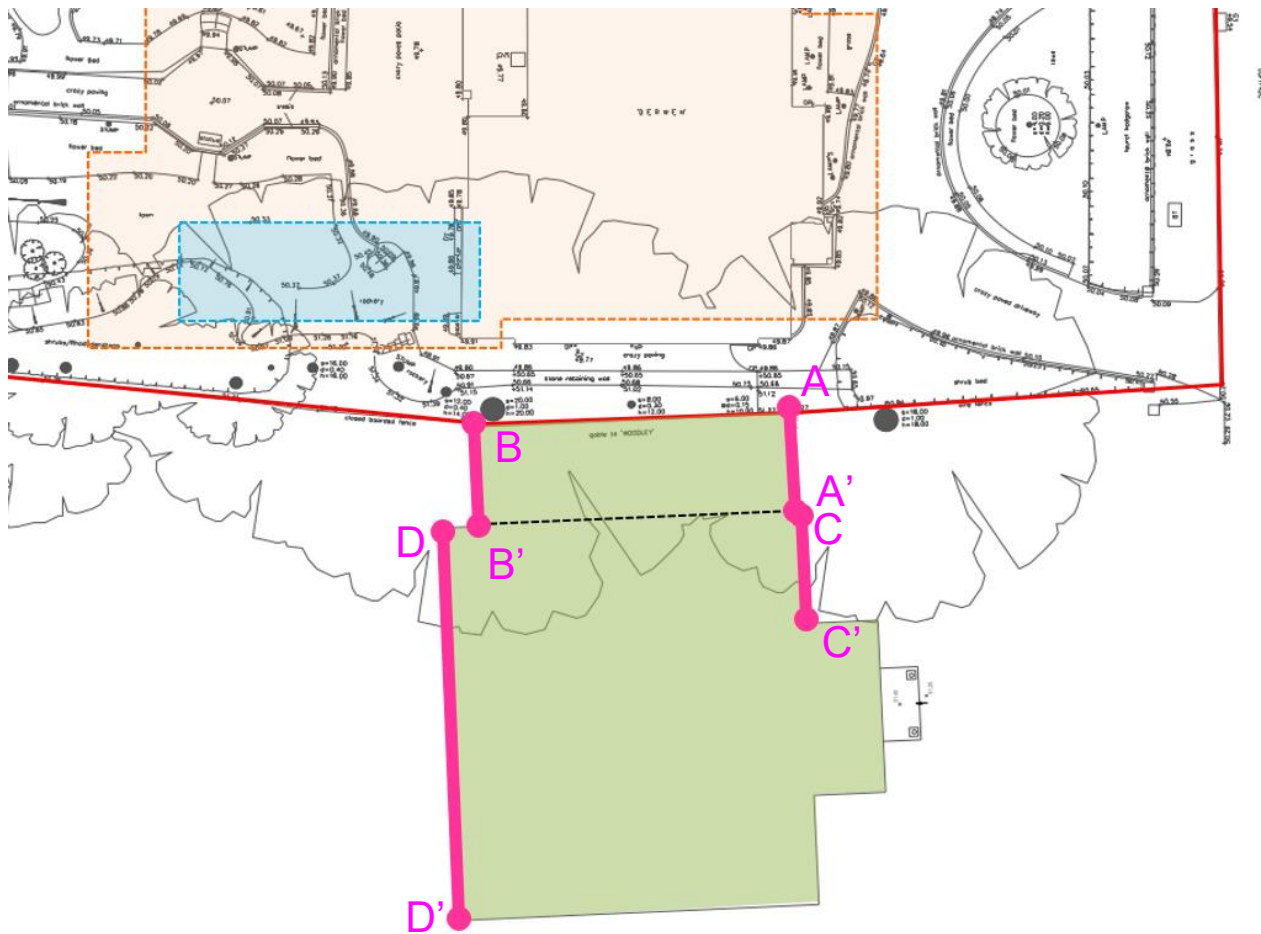
9.3 IMPACT ON NEIGHBOURING STRUCTURES

As per Section 9.1 above, only Woodley to the south of Derwen is expected to be affected by the proposed basement excavations.

9.3.1 WOODLEY SECTIONS FOR ANALYSIS

The closest perpendicular walls of the neighbouring Woodley to the basement are the garage elevations; located approximately 4m away from the proposed basement excavations.

¹ CIRIA 760: ‘Guidance on embedded retaining wall design’



9.3.2 WOODLEY – GARAGE FRONT ELEVATION (SECTION A – A')

This section represents the front wall of the flat-roofed garage extension to Woodley. The length (L) of this wall is taken as 4.5m with the wall height (H) of 3.5m. This wall is located away from the deeper piling required to form the basement swimming pool.

The maximum horizontal strain, ϵ_h ($\Delta h / L$) is assessed as 0.0130%, producing a maximum deflection ratio $\Delta / L = -0.02222$, within a limiting tensile strain of 0.035%, for a Burland Category 0 'Negligible' condition.

9.3.3 WOODLEY – GARAGE REAR ELEVATION (SECTION B – B')

This section represents the rear wall of the flat-roofed garage extension to Woodley. The length (L) of this wall is taken as 4.5m with the wall height (H) of 3.5m. This wall is located directly behind the deeper pile wall required to form the basement swimming pool.

The maximum horizontal strain, ϵ_h ($\Delta h / L$) is assessed as 0.0735%, producing a maximum deflection ratio $\Delta / L = -0.02222$, within a limiting tensile strain of 0.095%, for a Burland Category 2 'Slight' condition.

9.3.4 WOODLEY – MAIN STRUCTURE FRONT ELEVATION (SECTION C – C')

This section represents the front wall of the main Woodley building, extended up until the building steps forward near the main entrance. The length (L) of this wall is taken as 5m with the wall height (H) of 6m. This wall is located away from the deeper piling required to form the basement swimming pool.

The maximum horizontal strain, $\epsilon_h (\Delta h / L)$ is assessed as 0.0381%, producing a maximum deflection ratio $\Delta / L = -0.02$, within a limiting tensile strain of 0.055%, for a Burland Category 1 'Very Slight' condition.

9.3.5 WOODLEY – MAIN STRUCTURE REAR ELEVATION (SECTION D – D')

This section represents the rear wall of the main Woodley building. The length (L) of this wall is taken as 17m with the wall height (H) of 6m. This wall is located in the area predicted to be affected by the deeper piling required to form the basement swimming pool.

The maximum horizontal strain, $\epsilon_h (\Delta h / L)$ is assessed as 0.0386%, producing a maximum deflection ratio $\Delta / L = -0.00647$, within a limiting tensile strain of 0.045%, for a Burland Category 0 'Negligible' condition.

9.4 MOVEMENT MITIGATION FOR SECTION B – B'

Based on the CIRIA empirical ground movement model, the movements due to installation and excavation in front of the proposed deeper section of the piled retaining wall to form the basement swimming pool are predicted to lead to an estimated damage within Burland Category 2 'Slight' to the rear wall of the neighbouring garage extension at Woodley, which is in excess of the Category 1 'Very Slight' limit set by Highgate Neighbourhood Plan.

However, as described in Section 9.2.2, the CIRIA movement prediction is believed to represent a worst case scenario for this particular development. The proposed top-down basement construction methodology, combined with the proposed additional propping and continuous movement monitoring to the retained elevations as well as neighbouring properties is expected to provide sufficient control over the resultant horizontal movements to limit any potential damage to acceptable levels, within Burland scale Category 1 'Very Slight'.

10. IMPACT ASSESSMENT

10.1 HYDROGEOLOGICAL IMPACT ASSESSMENT

10.1.1 EFFECTS OF GROUNDWATER ON EXCAVATION & CONSTRUCTION

The proposed basement excavations will likely intercept groundwater inflow from the Bagshot Sand and the more permeable zones of the underlying Claygate Beds.

The proposed construction method demonstrates that, where necessary, the groundwater can feasibly be excluded from the proposed excavations.

Owing to the proposed secant wall retaining wall construction, significant dewatering of the excavations throughout construction is not expected to be required. In addition, the basement structure will be fully waterproofed in the permanent situation.

10.1.2 EFFECTS ON GROUNDWATER TABLE

An intermittent groundwater table is expected to be locally present within sandy seams below the site. The new basement will be constructed immediately upgradient of an existing larger and deeper basement at Treetops. The latter will therefore be dictating the general groundwater flow and hence the proposed basement will not form a barrier to flow and cannot be expected to have any significant impact.

10.2 HYDROLOGICAL IMPACT ASSESSMENT

The proposed development will increase the hardstanding area on the site and therefore will be required to provide sufficient drainage attenuation in order to maintain the present water discharge regime.

There will be also a need to provide Sustainable Drainage Systems (SuDS) to provide an overall reduction in discharge rates.

10.3 POTENTIAL STABILITY IMPACTS

10.3.1 EFFECT OF TREES

The basement excavations will be undertaken to a sufficient depth to obviate the potential adverse effect of trees. It is understood that the impact of the basement upon the trees to be retained will be assessed separately by an arboriculturist.

10.3.2 GROUND MOVEMENTS

A key requirement for basement design is to avoid excessive damage to neighbouring properties.

The 2017 Highgate Neighbourhood Plan states that '*under no circumstances should construction be allowed to proceed where there is evidence that damage to neighbouring properties would exceed Burland Scale 1*'.

The predicted neighbouring buildings damage levels due to ground movements associated with the

proposed development have been analysed and estimated to be limited to Burland scale Category 1 'Very Slight', provided that the basement construction methodology, inclusive of continuous movement monitoring, is followed.

10.3.3 DAMAGE TO HOST STRUCTURE

The host building will be almost entirely removed and reconstructed behind the retained front and side elevations as part of the development. It has been assessed that there will be negligible post-construction movement of the new building.

10.3.4 RESIDUAL IMPACTS

Given good workmanship during the underpinning and the piling process, negligible impacts are predicted to occur to the surrounding structures and infrastructure.

11. STRUCTURAL MOVEMENT MONITORING

A competent temporary works engineer must be engaged not only to take responsibility for the temporary frame structure that must prop and support the retained front and side elevations of the property; it is vital that the temporary works engineer is geotechnically competent and also take full design responsibility for the design stability of the below ground structure throughout the proposed works and maintains sufficient supervision of the excavation progress and management control of the top-down construction and the three levels of propping that have been described.

Continuous movement monitoring of retained elevations and the neighbouring property at Woodley will be critical to ensure safe and proper control of the basement project.

The setting up of any traffic light system of movement criteria is pointless unless it is embedded with a detailed contingency plan that states exactly who is responsible for monitoring the movement and exactly what actions they must take in each circumstance. The contingency plan is equally worthless if the correct resources are not available for deployment at the right moment to enable the contingent action to be undertaken.

Most important perhaps is the need for an understanding by the contractor that there are actions that must be undertaken as soon as there are any signs of any movements that do not fit within the temporary works engineer's expectations for any particular event or stage of the works. The intention here is very much to observe and identify any early warning signs so that any tendency for unacceptable movement can be investigated and mitigated long before any limits of acceptability are reached.

12. CONCLUSION

This basement impact assessment has demonstrated that, given adequate design and workmanship, the proposed basement can be safely completed with no adverse ground-related impacts upon the neighbouring properties or the wider environment.