BIA – AUDIT QUERY TRACKER.

4 THE GROVE,

HIGHGATE, LONDON

N6 6JU

ISSUE RECORD

Rev	Date	Prepared by	Checked by	Notes
-	**27.10.23**	**Szilard Biro** BEng CEng MICE	**Jim Fraser** BEng CEng MIStructE	**First Issue.**
A	**29.05.24**	**Szilard Biro** BEng CEng MICE	**Jim Fraser** BEng CEng MIStructE	**Updated to Address Further Comment Received in May 2024.**

CONTENTS PAGE

DOCUMENT / DRAWING LIST.

Tier Drawings.

073-TCE-XX-LG-D-S-098 (P2).

073-TCE-XX-LG-D-S-099 (P2).

073-TCE-XX-00-D-S-100 (P2).

073-TCE-XX-ZZ-D-S-200 (P2).

073-TCE-XX-ZZ-D-S-201 (P2).

073-TCE-XX-ZZ-D-S-215 (P2).

073-TCE-XX-ZZ-D-S-216 (P2).

Tier Documents.

BIA Audit Query Tracker _ Tier _ Revision A – This Document _ Dated 29th May 2024.

Basement Impact Assessment _ Tier _ Revision A _ Dated 27th October 2023.

Ground Investigation Report _ Tier Environmental _ Reference TE1723-TE-00-XX-RP-GE-001 V01.

Flood Risk Assessment _ Tier Environmental _ Reference TE1723-TE-00-XX-RP-GE-002-V01 dated 22nd May 2023.

INTRODUCTION.

Tier Consult have been appointed to provide engineering services and prepare technical documents in support of No. 4 The Grove, London, N6 6JU Planning Application.

Comments were received from Campbell Reith, London Borough of Camden's Auditors, in September 2023, this document was prepared originally to direct the Reviewer to Tier Consult's Responses.

Further comments were received from Campbell Reith, London Borough of Camden's Auditors, in May 2024, this document has been revised to address those comments.

Additional calculations have been prepared and included in Appendix A, the key section of the BIA, "Ground Movement Assessment" has been repeated in this document for convenience.

The Engineering documents produced in support of this Planning Application have been listed in the first section of this document.

GROUND MOVEMENT ASSESSMENT (REPRODUCED FROM BASEMENT IMPACT ASSESSMENT).

The basement proposal is a modest extension, on plan, to the existing lower ground accommodation. In respect of its depth, it is less than one metre deeper than the foundation to the main body of the house and of a similar depth to the existing basement extension annotated as the “wine cellar” on the plans. Thus, to the west and south, the new basement is bounded by existing accommodation at a similar level.

To the north, is the new basement of No. 5, The Grove, with only a “sliver” of ground to be maintained between the two properties. The result of these boundary conditions is that, on three sides, there is minimal pressure on the walls (temporary / permanent) leading to minimal deflection / displacement of these walls horizontally which is the main driver of ground movement outside the wall as the ground seeks to replicate, albeit rotated by 90 degrees, the displacement of the wall.

There are pressures exerted on the underpins but this movement is likely to be small as the walls thereon will be subject to a continued vertical loading from the structure above. Settlement of the underpinned walls will be controlled largely by the quality of workmanship of the underpins and by the stiffness of the existing building.

However, calculations in Appendix A have been prepared to calculate the likely vertical settlements – these are limited to 2-3mm. The underpins have also been checked for At-Rest-Pressures applied by the retained ground under the house. This is resisted as a cantilever block without contribution from the building structure.

The use of At-Rest-Pressures, combined with the capacity of the soil to maintain the pins’ stability utilising cantilever action, maintains any horizontal movement to a minimum.

In addition to the above, the new basement is small, rectangular on plan, with an aspect ratio of 1.67 to 1.0. Surrounding ground movements are therefore dominated by corner effects, likely to reduce computed horizontal movements by 40-50%.

A “traditional” settlement profile (resulting from excavation in front of a retaining wall) is therefore only possible on the east of the site, adjacent the public right of way. Based on Figure 2.11 of CIRIA C580, assuming a medium / high stiffness temporary wall, the maximum horizontal displacement, immediately behind the wall at ground level, beyond the influence of corner effects, is predicted to be 8mm. Dominated, as this excavation is, by corner effects, the likely maximum horizontal displacement is likely to be somewhat less than 4mm. This movement will be reducing to approximately zero at the excavation corners.

Again, based on Figure 2.11 of CIRIA C580, assuming a medium / high stiffness temporary wall, the maximum vertical displacement is predicted to be 6mm. Whilst the corner effect is often considered to be less pronounced for vertical movements, it is likely that the maximum will more likely be less than 4mm.

For both horizontal and vertical displacements, the decay is broadly linear, with this decay taking place in the pedestrian zone between the boundary wall and the road. Assessing a “fictional building” in this area to provide context, the limiting tensile strains are on the boundary between negligible and very slight. Acceptable in Planning terms.

On the north, south and west sides of the excavation, because of the minimal differential depth between new and existing foundations, both vertical and horizontal movements are predicted to be less than 3mm. Limiting tensile strains in the buildings on these boundaries (3, 4 and 5 The Grove) will therefore be negligible. In particular, it should be noted that both 3 & 5, The Grove, are outside the zone of influence of movements resulting from the works.

GROUND MOVEMENT ASSESSMENT (REPRODUCED) CONT'D.

The formation of the basement results in a net unloading of the ground of approximately 53kN/m^2. This will result in some heave of the ground. The calculation of this ground movement is based on the Newmark Stress Charts (allowing the calculation of the reduction of vertical stress effects with depth) and the Coefficient of Compressibility (Mv) calculated by Laboratory Consolidation Testing. The heave displacements resulting from the unloading, act in an opposite direction to those vertical displacements predicted to occur behind the temporary walls of the excavation.

The long-term heave, at the centre of the excavation, is predicted to be 8mm, reducing to 4mm at the centre of the long wall perimeter, reducing further to 2mm at the corners of the excavation. Short term movements might be expected to be some two thirds of these values. Again, the movements are very small and unlikely to have significant effect on 4, The Grove.

The neighbouring properties, 3 & 5 The Grove, are too remote from the excavation to be affected by the heave induced by the excavation.

Engineering calculations, in support of this section are included in Appendix A. These illustrate that settlements predicted for the underpinning and excavations are largely offset by the predicted heave.

ADDITIONAL AUDIT QUESTIONS – DATED MAY 2024.

Question 1.

The zone of influences assumed for the installation of the retaining wall and excavation of the basement should be clearly presented and the impact of any structures or relevant assets within the ZoI should be clearly identified. I'm not sure why a 'notional building' has been included in the assessment; does this relate the host building? If so, could they provide some clarification. Please note that the ZoI should considered the full length of the piles and the maximum depth of the basement excavation.

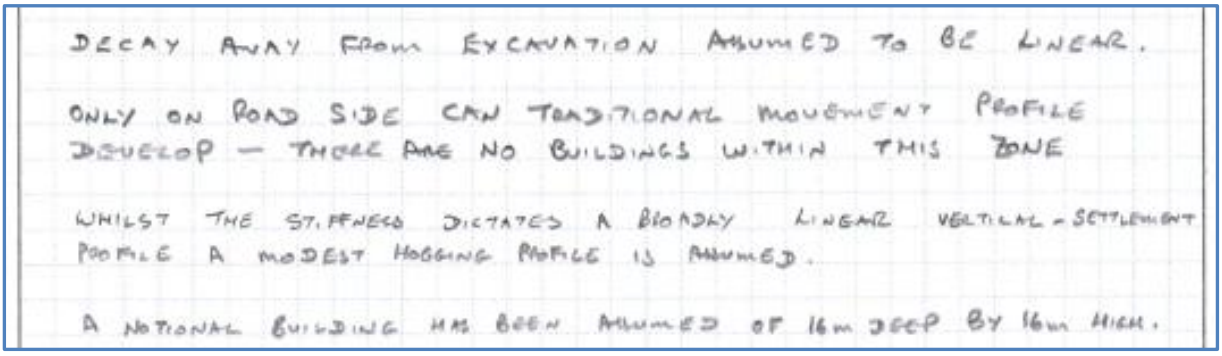
Settlements associated with the installation of the piles and the basement excavation have been added to an updated drawing - Heave Profile + Construction Settlements 073-TCE-XX-LG-D-S-098 (P2) as has the zone of influences. The calculations on which the Pile Installation Settlement is based are included in Appendix A of this document. Calculations predicting the Basement Excavation Settlements were submitted previously, in Appendix A of the BIA.

From this drawing, it can be seen that there are no buildings within the ZoI hence the use of the "Notional Building for Context".

This was noted in the previous BIA & Calculations as noted below.

A "traditional" settlement profile (resulting from excavation in front of a retaining wall) is therefore only possible on the east of the site, adjacent the public right of way.

For both horizontal and vertical displacements, the decay is broadly linear, with this decay taking place in the pedestrian zone between the boundary wall and the road. Assessing a "fictional building" in this area to provide context, the limiting tensile strains are on the boundary between negligible and very slight.



To summarise, the additional basement proposed is very modest with all nearby buildings at similar founding levels as illustrated on Drawing 098. The only operation likely to have any effect on any surrounding building is the underpinning of No. 4 which will have a very modest effect on the Application Building – 4, The Grove.

ADDITIONAL AUDIT QUESTIONS – DATED MAY 2024.

Question 2.

The assessment for the underpinning beneath the host building does not consider any movement occurring during construction. As mentioned in the D1 revision of the audit (issued in September 2023) it is a requirement of LBC policy that the assessment use moderately conservative or cautious estimates.

As the control of movement during underpinning is predominantly limited by good workmanship, conservative values of 5-10mm movement are typically assumed per lift of underpinning.

The assumptions made within the GMA are therefore not considered to be appropriately conservative especially as the proposed underpinning is within a sand stratum. Please note that due to the host structure being a listed building, impact of the underpinning to 4 The Grove should be included in the assessment.

The underpinning depth is just over one metre deep, a very modest lift. This will allow a highly controlled series of excavations in the “clay rich and granular Bagshot Formation”. The Client is well aware of the Listed Status of their building and the need to apply high levels of control to the workmanship associated with the underpinning.

The implication of the “clay rich” nature of the ground is that it is better able to maintain shape during the excavation of the underpins.

Given the minimal depth of the underpins, the clay rich nature of the ground, and the controls that will be imposed during the works, we do not expect settlements of any significance to occur during the underpinning. We don’t agree, therefore, that the assessments undertaken by Tier are not appropriately conservative.

However, notwithstanding the above, an assessment of the Tensile Strains induced in the wall of No. 4 has been carried out based on LBC-Policy-ground-movements prescribed for underpinning. These calculations are included in Appendix A of this document. They show that localised strains in the wall, resulting from 5mm of deflection, both vertically and horizontally, are not greater than 0.07% - equivalent to cracks of approximately 1mm.

The lower end of the LBC Policy Range has been used because of the very limited depth of the underpins.

As noted above, the additional basement proposed is very modest with all nearby buildings at similar founding levels as illustrated on Drawing 098. The only operation likely to have any effect on any surrounding building is the underpinning of No. 4 which will have a very modest effect on the Application Building – 4, The Grove.

AUDIT QUERY TRACKER RESPONSES – DATED SEPTEMBER 2023.

1. Provide evidence of suitable qualifications/ experience, as set out in the CPG, for the subterranean (groundwater) flow assessment.

This has been addressed in the BIA, however some more detail is provided below. We reproduce clause 4.45 from Camden Planning Guidance (CPG).

Applicants should consider the flowchart below to determine whether or not to carry forward to the scoping stage of the Basement Impact Assessment. Where certain factors are present or proposed, for example geological setting, proximity to Hampstead Heath Ponds catchment, or an intention to undertake dewatering as part of the site works, this flowchart will identify that a hydrogeological assessment will be required. If this is the case, it should be prepared by:

A Hydrologist with the "CGeol" (Chartered Geologist) qualification from the Geological Society of London; and

A Fellow of the Geological Society of London.

The consideration above has identified that a Hydrogeological Assessment is not required since perched ground water is in excess of 7.0m below the basement level. That being the case, input from individuals with the qualifications noted above is not required.

2. Confirm the depth and distance of the foundations of the existing property and neighbouring houses in relation to the proposed basement extension.

From the list of drawings noted in the Campbell Reith Audit, it may be that not all the drawings were examined in the previous review. Tier's Engineering drawings are now listed at the beginning of the BIA, a new drawing has been added to amplify this information.

3. Provide an outline construction sequence of the underpinning of the host listed building.

This has been added to Drawing 073-TCE-XX-LG-D-S-099.

3. Clarify how the basement walls will be cast against the sheet piles to prevent damage occurring during the removal of the sheet piles.

Other comments from the LPA have affected the basement construction. The location of the sheet piles has changed, there are now installed wholly within the site boundary and will remain in-situ following the concreting of the "basement box".

AUDIT QUERY TRACKER CONT'D.

4. Provide fully dimensioned drawings with levels to confirm the maximum depth of underpinning to be carried out beneath the existing foundations.

As noted above, it may be that not all the drawings were examined in the previous review. A full set of drawings has been prepared and they are listed below.

- 073-TCE-XX-LG-D-S-098 (P1).
- 073-TCE-XX-LG-D-S-099 (P2).
- 073-TCE-XX-00-D-S-100 (P2).
- 073-TCE-XX-ZZ-D-S-200 (P2).
- 073-TCE-XX-ZZ-D-S-201 (P2).
- 073-TCE-XX-ZZ-D-S-215 (P2).
- 073-TCE-XX-ZZ-D-S-216 (P2).

5. Include consideration of settlement from underpinning the host listed building within the GMA.

This consideration has been added to the text of the BIA. Calculations in support of those statements are included in Appendix A of the report.

5. Provide clarification of potential movements resulting from the removal of the sheet piles and associated impacts.

As noted above, the sheet piles are no longer to be removed.

6. Confirm the bearing capacity for the proposed basement foundations.

Calculations have now been added to Appendix A of the report.

7. Provide the proposed loading of the new foundations.

Calculations have now been added to Appendix A of the report.

8. Provide outline retaining wall calculations to show the design is suitable for the ground conditions at the site.

Calculations have now been added to Appendix A of the report.

APPENDIX A – ADDITIONAL CALCULATIONS.

PROJECT No: SE23/0073

SHEET No: 1 OF 2

DATE: MAY '2024

BY: JF

CHECKED:

PROJECT: 4, THE GROVE, HIGHGATE.

SUBJECT: GROUND MOVEMENT ASSOCIATED WITH SHEET PILE INSTALLATION.

GROUND MOVEMENTS DUE TO SHEET PILE INSTALLATION.

GUIDANCE IS TAKEN FROM CIRIA C580.

FIGURE 2.8 AS A GUIDE FOR THIS WALL.

ASSESMENT IS THAT BOTH VERTICAL & HORIZONTAL MOVEMENTS (MAX) MAY BE TAKEN AS 0.05 % OF WALL DEPTH.

EAST WALL

PILE DEPTH $\simeq$ 128.600 − 123.700 = 4.9m

MAX δ = $0.05 * 10^{-2} * 4900$ = 2.45mm

INFLUENCE ZONE.

FOR HORIZONTAL MOVEMENT UP TO 7.5m FROM WALL.

FOR VERTICAL —"— 10.0m —"— "—

MAX MOVEMENTS 2.5mm. ∴ LARGELY INSIGNIFICANT.

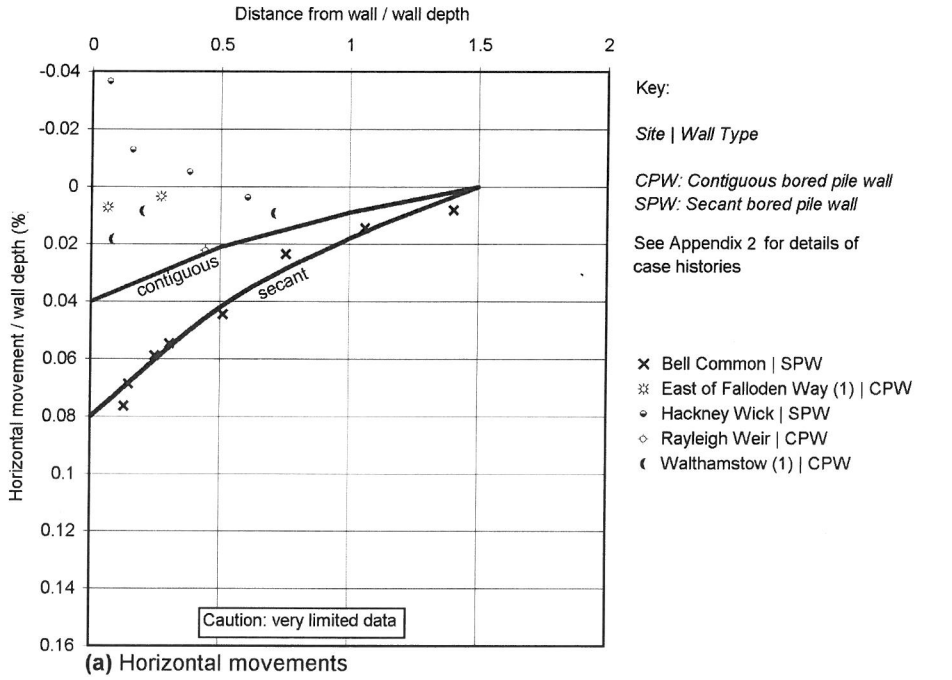
(PARTICULARLY AS NO BUILDINGS EXIST IN THIS AREA)

NORTH WALL

GROUND MOVEMENT LIMITED BY:

- MINIMAL ACTIVE WEDGE
- CORNER EFFECTS
- AREA SURROUNDED BY BASEMENTS AT SIMILAR LEVELS.

∴ MOVEMENTS ARE VERY SMALL & LIMITED TO SMALL AREAS OF GARDEN.



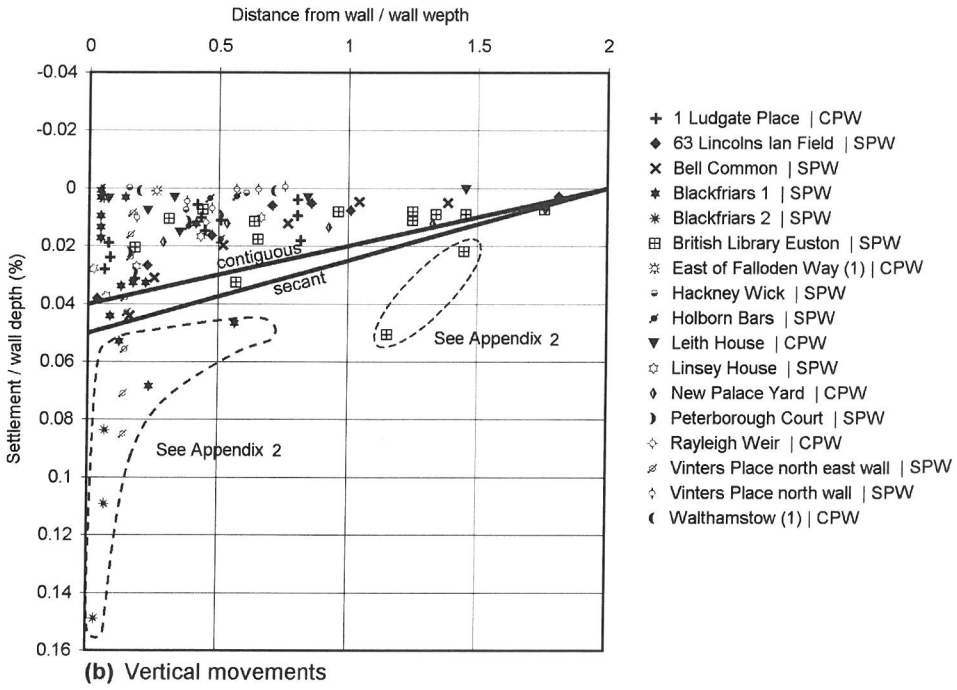


Figure 2.8 *Ground surface movements due to bored pile wall installation in stiff clay*

EXTRACT FROM CIRIA C580.
FOR 4, THE GROVE, HIGHGATE.
PROJECT SE23/0073.
SHEET 2 OF 2.

PROJECT No: SE23/0073

SHEET No: 1 OF 2.

DATE: MAY 2024.

BY: JF.

CHECKED:

PROJECT: 4, THE GROVE, HIGHGATE.

SUBJECT: TENSILE STRAINS BASED ON LBC POLICY Js DURING UNDERPINNING.

TENSILE STRAINS INDUCED BY DEFLECTIONS OF 5mm VERTICALLY & 5mm HORIZONTALLY. [MOVEMENTS AS DIRECTED BY LBC POLICY AND ARE GREATER THAN THOSE PREDICTED]

VERTICAL J.

ASSUME SAGGING OF 5mm OVER 10.0m LENGTH OF UNDERPINS.

BASED ON BURLAND & WROTH (1974), BENDING STRAIN IS GIVEN BY THE FOLLOWING.

$$\Delta/L = \left(\frac{L}{12t} + \frac{3I}{2tLH} \cdot \frac{E}{G}\right) \varepsilon_{bv}$$

WHERE:

$L = 10m$, $H = 10m$ (TO EAVES), $I = H^3/12$ (SAGGING)

$t = H/2$ (SAGGING) $= 5m$, $E/G = 2.6$.

$$\frac{0.005}{10} = \left(\frac{10}{12*5} + \frac{3.10^3}{12*2*5*10*10} \cdot 2.6\right) \varepsilon_{bv}$$

$\varepsilon_{bv} = 0.06\ \%$.

HORIZONTAL J

ASSUME WALL SAGS OUTWARD BY 5mm OVER 10m LENGTH.

BASED ON ELASTIC BENDING:

$\sigma/y = E/R$

$\therefore \quad \varepsilon_{bH} = y/R$ WHERE y = WALL THICKNESS & R = RADIUS CURVATURE

R IS RELATED TO THE CHORD LENGTH & DEFLECTION BY

$(CH/2)^2 = 2.R.J - J^2$

$R = (10/2)^2 + 0.005^2 / (2 * 0.005)$

$= 2500\ m$

PROJECT No: SE23/0073.

SHEET No: 2 OF 2.

DATE: MAY 2024

BY: JF.

CHECKED:

PROJECT: 4 THE GROVE, HIGHGATE.

SUBJECT: TENSILE ε_s BASED ON LBC POLICY J_s CONT'D.

TENSILE STRAINS CONT'D.

HORIZONTAL J CONT'D.

ε_{DH} = 0.3275 / 2500 (WALL IS BRICKS THICK)

= 0.01 %.

FOR MAXIMUM TOTAL BENDING STRAIN ε_b:

ε_b = ε_{DH} + ε_{BV}

= 0.07 %

BASED ON THE BURLAND CRITERIA THIS STRAIN FALLS INTO CATAGORY 1 – VERY SLIGHT (APPROXIMATE CRACK WIDTH 1mm).

ANY CRACKING IS OVER AN EXTREMELY LIMITED AREA.

DEFLECTIONS BASED ON LBC POLICY.