CampbellReith
consulting engineers

2 Oakhill Avenue
London, NW3 7RE

Basement Impact Assessment
Audit

For: London Borough of Camden

Project Number: 12466-94

Revision: F1

October 2017

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Project Number	12466-94
Project Name	2 Oakhill Avenue, London NW3 7RE
Planning Reference	2017/2614/P

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Appendix

1.0 NON-TECHNICAL SUMMARY

1.1. CampbellReith was instructed by London Borough of Camden, (LBC) to carry out an audit on the Basement Impact Assessment submitted as part of the Planning Submission documentation for 2 Oakhill Avenue (planning reference 2017/2614/P). The basement is considered to fall within Category B as defined by the Terms of Reference.

1.2. The technical appraisal of the proposal is being considered an amendment to the previous planning application 2013/6162/P, which gained planning permission following an audit of the basement proposal by Chelmer engineering consultants. Only the aspects that are considered to have significantly changed have been re-audited.

1.3. The structural considerations of the amended scheme have been produced by Elliott Wood consulting engineers, who are an experienced firm of consulting engineers. The original BIA was produced by CGL, who are established engineering consultants.

1.4. The proposal consists of constructing a single basement level beneath and to the side of an existing house. The garden level is also to be lowered to the rear to the level of the proposed basement.

1.5. The basement construction is proposed as being formed of common construction techniques, with an appropriate outline construction method also being provided.

1.6. Site investigations have confirmed the ground conditions as being a shallow depth of made ground overlaying sandy silty clay. Foundations to the basement will be situated in a suitable foundation strata.

1.7. Appropriate protection of the basement slab against ground movements of the clay sub soil is proposed.

1.8. Ground water has been identified as being below the proposed basement level, and it is accepted that ground water flows are unlikely to be impacted given the highest ground water.

1.9. A ground movement assessment was prepared by CGL in 2014 for the original scheme and has been revised for the current scheme. It concludes that damage to the neighbouring properties should not exceed Burland Category 1. A number of queries were raised with respect to the assessment which have been closed out by information and clarifications provided subsequently (as described in Section 4).

1.10. Queries and matters that required further information or clarification are summarised in Appendix 2. Considering the revised submissions, the BIA meets the criteria of CPG4.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 26/07/17 to carry out a reduced Category B Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 2 Oakhill Avenue, NW3 7RE.

2.2. The Audit was carried out broadly in accordance with the Terms of Reference set by LBC. Typically the audit reviews the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development, however in this instance only the scoping and impact assessment of stability and ground water have been audited due to a number of the technical aspects having been audited in a previous planning application.

2.3. A BIA is required for all planning applications with basements in Camden in general accordance with policies and technical procedures contained within

- Guidance for Subterranean Development (GSD). Issue 01. November 2010. Ove Arup & Partners.
- Camden Planning Guidance (CPG) 4: Basements and Lightwells.
- Camden Development Policy (DP) 27: Basements and Lightwells.
- Camden Development Policy (DP) 23: Water.

2.4. The BIA should demonstrate that schemes:

a) maintain the structural stability of the building and neighbouring properties;

b) avoid adversely affecting drainage and run off or causing other damage to the water environment;

c) avoid cumulative impacts upon structural stability or the water environment in the local area, and;

evaluate the impacts of the proposed basement considering the issues of hydrology, hydrogeology and land stability via the process described by the GSD and to make recommendations for the detailed design.

2.5. The planning proposal is described as *"Basement excavation and extensions to rear and side in connection with conversion of existing single family dwelling into 2 x 3 bedroom maisonettes (Class C3)."*

2.6. CampbellReith accessed LBC's Planning Portal on 21/08/17 and gained access to the following relevant documents for audit purposes:

- Structural plans, Elliott Wood
  - Lower ground floor plan, S.010 P2
  - Ground floor plan, S.020 P2
  - First floor plan, S.030 P2
  - Second floor plan, S.040 P2
  - Roof plan, S.050 P2
- Marked up Elliott Wood plans S.010 to S.050 P2
- Construction sequence drawings SQ01, SQ02, SQ03, Elliott Wood
- Letter addendum to ground movement assessment, CLG, 19/04/17
- GEA letter, 27th March 2017
- Desktop study and BIA report, GEA, July 2014
- GEA letter, 8th July 2014
- Review of revised BIA and CMS, August 2014
- Letter response to Chelmer Consultancy Independent Assessment, Price and Myers, 26th June 2014
- Construction Method statement, Rev A

2.7. Following the D1 issue of this audit report the following additional information was received from the applicant which has been included in Appendix 3:

- Audit Query tracker responses, CGL, 26/09/17 (it is noted that reference to para 4.15 should be 4.14)
- Clarification email, CGL, 26/09/17.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	N/A	This consideration has been previously audited as part of planning application 2013/6162/P by an independent auditor.
Is data required by Cl.233 of the GSD presented?	N/A	This consideration has been previously audited as part of planning application 2013/6162/P by an independent auditor.
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	N/A	This consideration has been previously audited as part of planning application 2013/6162/P by an independent auditor.
Are suitable plan/maps included?	N/A	This consideration has been previously audited as part of planning application 2013/6162/P by an independent auditor.
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	N/A	This consideration has been previously audited as part of planning application 2013/6162/P by an independent auditor.
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	N/A	Land stability screening of the proposal has been previously audited as part of planning application 2013/6162/P by an independent auditor.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	N/A	Hydrogeology screening of the proposal has been previously audited as part of planning application 2013/6162/P by an independent auditor.
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	N/A	Hydrology screening of the proposal has been previously audited as part of planning application 2013/6162/P by an independent auditor.
Is a conceptual model presented?	Yes	Desktop study report.

Item	Yes/No/NA	Comment
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	A scoping statement has been provided for all items identified from screening.
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	A scoping statement has been provided for all items identified from screening.
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	N/A	The hydrogeology scoping of the proposal has been previously audited as part of planning application 2013/6162/P by an independent auditor.
Is factual ground investigation data provided?	Yes	
Is monitoring data presented?	Yes	Water level monitoring data is presented in section 5.3 of the BIA.
Is the ground investigation informed by a desk study?	Yes	Desktop study report.
Has a site walkover been undertaken?	N/A	
Is the presence/absence of adjacent or nearby basements confirmed?	Yes	The figures used in the ground movement assessment indicate that the neighbouring buildings do not contain basement levels.
Is a geotechnical interpretation presented?	N/A	
Does the geotechnical interpretation include information on retaining wall design?	Yes	Section 8.1 of the BIA.
Are reports on other investigations required by screening and scoping presented?	Yes	Ground movement assessment.
Are the baseline conditions described, based on the GSD?	Yes	
Do the base line conditions consider adjacent or nearby basements?	N/A	Nearby basements are not identified.

Item	Yes/No/NA	Comment
Is an Impact Assessment provided?	Yes	Section 9.0 of the BIA.
Are estimates of ground movement and structural impact presented?	Yes	GMA.
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	All items raised from screening and scoping have been discussed for impact.
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	Mitigation measures to be considered within the design are discussed in section 9.0 of the BIA.
Has the need for monitoring during construction been considered?	No	Monitoring has been recommended by the GMA but no details have been provided.
Have the residual (after mitigation) impacts been clearly identified?	Yes	
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	Yes	Initial queries exist with respect to the ground movement and building damage assessment have been addressed in subsequent clarifications.
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	Yes	
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	Yes	Initial queries exist with respect to the ground movement and building damage assessment have been addressed in subsequent clarifications.
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	Initial queries exist with respect to the ground movement and building damage assessment have been addressed in subsequent clarifications.
Are non-technical summaries provided?	No	

4.0 DISCUSSION

4.1. An original application (2013/6162/P) was made in 2013, with planning permission granted in 2015. The original proposal was audited by Chelmer, who considered the proposal satisfactory with respect to the requirements of CPG4.

4.2. A new planning application (2017/2614/P) has been submitted, which although a new application, is being considered as an amendment to the original application for auditing purposes and assessing compliance to CPG4. Given the modest amendments to the original proposal, only the scoping and impact assessment for stability and ground water aspects of the proposal are to be assessed, with the surface water aspects considered not significantly changed to warrant further audit.

4.3. The structural considerations of the amended scheme have been produced by Elliott Wood consulting engineers, who are a well-known firm of engineering consultants with extensive experience in basement design.

4.4. The original BIA and desk study for planning application 2013/6162/P was produced by GEA, who are established engineering consultants. The BIA and desk study has not been updated since it was approved for the previous planning application.

4.5. A number of documents and letters have been produced both providing new information, and reiterating previously supplied information under the previous planning application, with respect to amended proposal and its relation to the previously approved proposal. These are listed in section 2.

4.6. The proposal consists of constructing a single basement level beneath an existing three storey house that is also to extend to the side and rear of the super structure, along with a dropped garden level to the entire rear garden to match the proposed basement level. The proposed basement level is to extend to a depth of 3m.

4.7. The original proposal was for the basement walls to comprise a combination of L-shaped underpinning walls to the existing building, and contiguous piled walls with an RC lining wall where the basement extends to the rear garden and along boundaries where there is no existing structure above. The amended proposal consists solely of mass concrete underpinning beneath the existing party wall with an internal liner retaining wall, and L-shaped retaining walls to the rest of the basement perimeter, with no piling proposed. Three sides of the existing building are to be supported on steelwork and supported on internal columns within the basement.

4.8. The foundations to the previous proposal consisted of a combination of piled foundations beneath internal load bearing columns and the basement slab, and ground bearing underpinning where underpinning has been provided to the perimeter wall. The piled foundations were to be designed to resist heave forces generated by the unloading of the clay soil. The amended proposal omits piled foundations in favour of a suspended basement slab spanning between retaining wall toes and pad foundations, with heave protection provided beneath the basement slab.

4.9. It is stated in the BIA that shallow foundations are to be designed for 125kPa where bearing into the firm orange-brown silty sandy clay. It is accepted that the proposed foundation solution provides a feasible solution in terms of transferring loads to a soil stratum of adequate bearing capacity.

4.10. The ground conditions have been confirmed via borehole investigation as a shallow depth of made ground underlain by The Claygate Member proven to 15m. The claygate member has been identified as a secondary A aquifer. Ground water monitoring was carried out and identified ground water at a depth of between 4.5mbgl and 6.4mbgl, which is below the proposed basement formation of 3mbgl.

4.11. It has been stated by GEA that upon review of the amended proposal their advice on the potential impacts on ground water remain unchanged from that of the previous scheme. It is accepted that the amended proposal does not significantly alter the massing within the ground, or affect the ground water transportation routes differently to that of the previous proposal. It is therefore accepted that the previous audits conclusions are can be accepted with regards to the impact on ground water flows.

4.12. It has been identified that the historic river Westbourne runs approximately 25m to the north of the site. It has been identified that this river is now thought to be fully culverted below ground and is unlikely to impact on the proposed basement development, which has been investigated via ground water level monitoring.

4.13. The potential for heave of the underlying Claygate Member has been discussed in the BIA, and a recommended is made that a more detailed analysis of heave is carried out once the basement has been finalised. An estimate of heave assessment has subsequently been carried out and it is confirmed that heave protection will be provided beneath a suspended basement slab.

4.14. The initial ground movement assessment by CGL in 2014 considered both underpinning and piled retaining walls. This has been revisited to consider the current scheme which relies on underpinning techniques to form all the basement walls and concludes that damage to the neighbouring properties should not exceed Burland Category 1. A number of queries were

raised with respect to the assessment which have been addressd by supplementary information as follows:

- The 2014 GMA states that Alluvium is present only in BH1 and that it lies below the depth of the proposed underpinning and is therefore not likely to be encountered during construction. However, reference to BHs 2 and 3 shows that 'black organic matter' which is generally an indicator of alluvial soils, was also encountered. This could have an impact on ground stability during construction. CGL have confirmed that the contractor will observe the soils in order to manage this on site.
- Table 4 in the 2014 GMA summarises predicted settlement associated with underpinning. Clarification of the predicted settlement along Section C-C was requested. The supplementary information confirms that total settlement should not exceed 12mm, resulting in building damage not exceeding Category 1.
- In both the 2014 GMA and the 2017 update, CGL advise the likely horizontal deflections will be less than 2mm. This is based on 'experience with similar basements in the area' and 'review of monitoring data for similar projects'. Evidence of this experience (which suggests 2-3mm) has since been provided.
- The letter report refers to a ground bearing slab. As noted above, it has been confirmed that the slab is to be suspended.

4.15. A construction sequence and temporary works details have been produced that show the formation of the basement structure. The existing walls are to be supported on mini piles via needle beams that are to be braced and used as plunge columns as the ground level is reduced. The party wall is to be underpinned with mass concrete underpinning, and a L-shaped retaining wall constructed internally to this to resist lateral forces. The underpinning and retaining walls are to be constructed in a hit and miss sequence, with their faces cross propped across the basement in the temporary case. These outline temporary works are considered suitable for the proposed development, and are to be developed further during detailed design and are to be implemented following best practise and good workmanship.

4.16. It is confirmed that the supplementary information presented in Appendix 3 has addressed the queries raised in the initial audit report.

5.0 CONCLUSIONS

5.1. An original planning application was made in 2013. The original proposal was audited by a third party, who considered the proposal satisfactory. This application in effect represents an amended proposal to the 2013 application, of which only the stability and hydrogeology scoping and impact assessment will be re-audited.

5.2. The structural considerations of the amended scheme have been produced by Elliott Wood consulting engineers, who are an experienced firm of consulting engineers. The original BIA was produced by GEA, who are established geotechnical consultants. GMAs have been provided by CGL, who are also geotechnical consultants.

5.3. The proposal consists of constructing a single basement level beneath and to the side of an existing house. The garden level is also to be lowered to the rear to the level of the proposed basement.

5.4. The proposal is to provide underpinning to the party wall, with an inboard liner wall. To the perimeter of the basement the wall is to be formed by L shaped retaining walls. The remaining ground floor walls are to be supported on steel columns internally within the basement.

5.5. The foundations are proposed as being shallow pad foundations internally, and shallow ground bearing from the toes of the retaining walls to the perimeter. This will situate the foundations within sandy silty clay at approximately 3mbgl.

5.6. Site investigations have confirmed the ground conditions as being a shallow depth of made ground overlaying The Claygate Member, which is identified as a secondary aquifer. Ground water was monitored as being between 4.5mbgl and 6.4mbgl.

5.7. It is accepted that ground water flows are unlikely to be impacted given the highest ground water level being recorded some 1.5m above the proposed formation level.

5.8. Heave protection is proposed beneath the suspended basement slab, with 12mm of heave anticipated.

5.9. A ground movement assessment was prepared by CGL in 2014 for the original scheme and has been revised for the current scheme. It concludes that damage to the neighbouring properties should not exceed Burland Category 1. A number of queries raised in the initial audit have been addressed in supplementary information provided.

5.10. An appropriate outline construction method and sequence of construction has been produced, that indicates the basement walls constructed in a hit and miss sequence, with cross propping provided across the basements.

5.11. Queries and matters that required further information or clarification are summarised in Appendix 2. Considering the revised submissions, the BIA meets the criteria of CPG4.

Appendix 1: Residents' Consultation Comments

Residents' Consultation Comments

Surname	Address	Date	Issue raised	Response
Redacted	1A Oakhill Avenue	28/06/2017	Proposal most damaging to the neighbouring properties and environment.	A ground movement assessment has been provided which, with the supplementary information is Appendix 3, is accepted.
Redacted	1A Oakhill Avenue	28/06/2017	Excavation to cause great damage to the water table.	The applicant has carried out appropriate site investigations to indicate that the proposed basement will be above the ground water level.
Redacted	1A Oakhill Avenue	28/06/2017	Concerns regarding differential settlement.	A ground movement assessment has been provided which, with the supplementary information is Appendix 3, is accepted.
Alaghband	23 Heath Drive	05/07/17	Disruption to ground water flow	The applicant has carried out appropriate site investigations to indicate that the proposed basement will be above the ground water level.

Appendix 2: Audit Query Tracker

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Audit Query Tracker

Query No	Subject	Query	Status	Date closed out
1	Stability	Heave calculation revised to use accurate dead loading of existing building.	Closed	20/10/17
2	Stability	Clarification required about the form of construction of the basement slab	Closed	20/10/17
3	Stability	Clarification of assumptions and statements made in ground movement and building damage assessment as described in Section 4.	Closed	27/10/2017

Appendix 3: Supplementary Supporting Documents

Audit Query Tracker Query No	Subject	Query (25/08/2017)	CGL response (26/09/2017)
1	Stability	Heave calculation revised to use accurate dead loading of existing building.	4.13 – The slab will span onto pad foundations, therefore following the same rationale as set out in the CGL report, total heave would be expected to be of the order of 12mm based on a net loading of 57kPa (excavation of 62kPa with slab load of 5kPa following conversation with Elliott Wood). This would be expected to occur within the centre of the excavation and would not have a significant effect on neighbouring structures. 4.14 – The floor slab is to span onto pad foundations with heave protection beneath. 4.15a – Comment on potential alluvial soils and that these could have an impact on ground stability is noted. The stability of the soils will be observed and managed by the contractor during excavation of the underpins. 4.15b – Assuming a cu of 60 kPa at formation level would give a stiffness (E' = 27MPa) and a predicted total settlement of some 9mm under net loading for a 1.2m wide footing – allowing for no excavation adjacent to the foundation (e.g. excluding the effects of long term heave). The VDISP input/output from the original BIA have been checked and are correct – the influence of the basement excavation reduces the predicted settlement to some 2.9mm total, increasing to 7.9mm with the underpin workmanship allowance. 4.15c – Long term and short term heave could potentially reduce the displacements experienced in the short term as seen in the response to 4.15b above. Noting this, a total underpin settlement of some 7mm short term, plus 5mm workmanship could potentially lead to an immediate settlement of some 12mm at the location of Section C-C in the short term. The span at section C-C is assumed to be 6m, therefore 12mm of settlement would give an angular distortion of 1:500.

			On this basis, in the short term, the angular distortion would be on the limit of Cat 0/Cat 1 damage as based on Rankin's work[1]. This is consistent with the previous findings of the BIA. 4.15d – Underpin walls are relatively thick members compared to the lateral loads they support and, when properly cured and properly, they do not deflect much. The key to ensuring this lies with the contractor, who must provide adequate temporary support to restrict lateral movements/rotation at the top and toe of the wall. In the more than 200 BIA reports and subsequent build-outs that CGL have been involved with, we have had only one case where lateral movements have been higher than predicted – this was due to contractor error in the compaction of underpin backfill material. Monitoring data for smaller, residential projects are rare, however CGL has previously provided Campbell Reith with evidence of monitoring data for a substantial underpinning project (circa 7m of underpinning), which recorded very low movements (of the order of 2mm to 3mm). For the most part, however, it is not possible to provide monitoring data directly as they are considered to be commercially sensitive. 4.15e – Elliott Wood to confirm
2	Stability	Clarification required about the form of construction of the basement slab	See responses above
3	Stability	Clarification of assumptions and statements made in ground movement and building damage assessment as described in Section 4.	See responses above.

[1] Rankin, W.J., Ground movements arising from urban tunnelling: predictions and effects, *From Bell, F.G., Culshaw, M.G., Cripps, J.C. & Lovell, M.A (eds) 1988. Engineering geology of underground movements, Geological Society Engineering Geology Special Publication No 5. Pp. 79-92.*

RE: 2 Oakhill Avenue
Richard Ball
to:
LizBrown@campbellreith.com
26/09/2017 15:53
Cc:
"w.grant@elliottwood.co.uk"
Hide Details
From: "Richard Ball" <RichardB@cgl-uk.com>
To: "LizBrown@campbellreith.com" <LizBrown@campbellreith.com>
Cc: "w.grant@elliottwood.co.uk" <w.grant@elliottwood.co.uk>

Dear Liz,

Further to my last e-mail - response to point 4.15e should read, 'as confirmed by Elliott Wood'.

Kind regards,

Richard

Richard Ball, Technical Director

CGL
Providing Ground Solutions
Tel: 01483 310600
cgl-uk.com

150t sections of a new rail bridge in Lincoln were lifted into place last month by one of the world's largest (1200t) mobile cranes. CGL helped to overcome poor ground conditions with designs to provide temporary ground support for safe operation of the crane under high outrigger and counterweight loads.

From: Richard Ball
Sent: 26 September 2017 15:43
To: 'LizBrown@campbellreith.com' <LizBrown@campbellreith.com>
Cc: 'w.grant@elliottwood.co.uk' <w.grant@elliottwood.co.uk>
Subject: 2 Oakhill Avenue

Dear Liz,

Further to your recent report on the above site I've been asked to issue our responses to you directly.

I trust these provide the required clarification.

Kind regards,

Richard

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