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Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 12466-30

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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 26 Christchurch Hill (planning reference 2016/5974/P). The basement is considered to fall within Category C as defined by the Terms of Reference.

1.2. The Audit reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development in accordance with LBC's policies and technical procedures.

1.3. CampbellReith has obtained the latest revision of submitted documentation from LBC's website and received information directly from the BIA author and reviewed it against an agreed audit check list.

1.4. The BIA has been carried out by a well-known firm of consultants using individuals who possess suitable qualifications.

1.5. The property is a two storey detached listed house which will be extended by the construction of a single level basement below part of the house, extending out beneath its garden to link with a single storey outbuilding which will be reconstructed to include a two storey basement due to changes in external ground level.

1.1. A soils investigation has been undertaken which has identified that the basement will be founded in the Claygate Member and will encounter groundwater flow during construction.

1.2. The local hydrogeological environment, including the presence of local springlines, historic wells and groundwater flow, has not been considered in sufficient detail. Potential impacts and cumulative impacts should be considered, with suitable mitigation measures presented for both the temporary and permanent conditions.

1.3. The SER states that permeation grouting may be necessary to control groundwater inflows. Further consideration of this requirement, together with an enhanced groundwater investigation will be required to respond to the concerns of Dr Harding and this audit.

1.4. Part of the basement will be constructed using tunnelling techniques as it will be within the root protection zone of a tree which has a tree preservation order. Elsewhere, the basement will be constructed using underpinning, secant piling and reinforced concrete retaining walls.

1.5. Additional information has been requested concerning piling (method, diameter, length), retaining wall calculations, underpinning details and bay layout, geotechnical design parameters,

ground movement analysis and monitoring, temporary works procedures and concerns regarding previous flooding to Willow Road.

1.6. It is accepted that the small increase in the area of soft landscaping will have little effect on the hydrogeology of the area although additional details are requested of measures to prevent flooding of the basement due to rain falling onto the sunken courtyard.

1.7. It is accepted that there are no slope stability concerns with the proposal.

1.8. Queries and requests for further information are discussed in Section 4 and summarised in Appendix 2.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 11 November 2016 to carry out a Category C Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 26 Christchurch Hill, Camden Reference 2016/5974/P.

2.2. The Audit was carried out in accordance with the Terms of Reference set by LBC. It reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development.

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; and,

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. LBC's Audit Instruction described the planning proposal as the *"Construction of a basement extension under the modern wing of GII listed dwelling house (C3) and garden incl. demolition and rebuild of detached garden studio (C3). Secondary glazing to main house. Associated works"* and confirmed that the basement proposals involves a Grade II listed building situated within the Hampstead Conservation Area.

2.6. CampbellReith accessed LBC's Planning Portal on 22 November and 7 December 2016 and gained access to the following relevant documents for audit purposes:

- Basement Impact Assessment (BIA) dated October 2016 by Geotechnical & Environmental Associates
- Structural Engineer's Report Version 4 (SER) dated October 2016 by Price & Myers
- Construction Management Plan (CMP) dated October 2016 by Price & Myers
- Aboricultural Survey Report dated October 2016 by Wassells
- Architects Existing & Proposed Plans, Sections and Elevations dated October 2016 by Erica Jong Architects, drawing nos. 0036.P.00.001C, 002C, 003E, 004B, 010A; P.20.001C, 005B, 006B, 007C, 101E, 102E, 103D, 104C, 105B, 106B, 110B
- Consultation letter report by Dr Vicki Harding, Tree Officer, Heath & Hampstead Society

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	Yes	BIA and Section 1.3.2.
Is data required by Cl.233 of the GSD presented?	Yes	BIA and SER.
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	Yes	
Are suitable plan/maps included?	No	BIA refers to relevant maps but does not provide annotated examples.
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	No	
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	BIA, Section 3.1.2.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	No	Dr Vicki Harding's letter indicates that local springlines, wells and hydrogeological flow issues have not been fully considered.
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	BIA, Section 3.1.3.
Is a conceptual model presented?	Yes	BIA, Section 7.
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	BIA, Section 4.1.

Item	Yes/No/NA	Comment
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	However, screening and scoping considered incomplete pending issues raised by Dr Vicki Harding being addressed.
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes	BIA, Sections 4.1.
Is factual ground investigation data provided?	Yes	BIA, Section 5.
Is monitoring data presented?	Yes	BIA, Section 5.4.
Is the ground investigation informed by a desk study?	Yes	BIA, Section 1.3. However, requires additional information.
Has a site walkover been undertaken?	Yes	BIA, Section 1.3.
Is the presence/absence of adjacent or nearby basements confirmed?	Yes	BIA, Section 2.3.
Is a geotechnical interpretation presented?	Yes	BIA, Section 8. However, requires additional information.
Does the geotechnical interpretation include information on retaining wall design?	Yes	BIA, Section 8.1.1. However, requires additional information.
Are reports on other investigations required by screening and scoping presented?	Yes	Aboricultural Survey Report
Are baseline conditions described, based on the GSD?	Yes	
Do the base line conditions consider adjacent or nearby basements?	Yes	
Is an Impact Assessment provided?	Yes	BIA, Section 9. However, requires updating pending further assessment.
Are estimates of ground movement and structural impact presented?	Yes	BIA, Section 11.

Item	Yes/No/NA	Comment
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	However, screening and scoping considered incomplete pending hydrogeological issues raised by Dr Vicki Harding being addressed.
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	No	BIA Section 12.3 discussed mitigation in general only.
Has the need for monitoring during construction been considered?	Yes	BIA Section 12.4 but without providing any proposals.
Have the residual (after mitigation) impacts been clearly identified?	No	
Has the scheme demonstrated that the structural stability of the building and neighbouring properties maintained?	No	
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	No	BIA Section 9.0. Pending additional hydrogeological assessment, this may require further consideration.
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	No	Additional structural and hydrogeological information and assessment to be provided and impacts considered.
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	BIA Section 12.1. However, this has not been demonstrated.
Are non-technical summaries provided?	Yes	BIA Section 9.1.

4.0 DISCUSSION

4.1. The Basement Impact Assessment (BIA) has been produced by a well-known firm of consultants, Geotechnical & Environmental Associates (GEA) and the authors possess suitable qualifications in accordance with the requirements of CPG4.

4.2. A Structural Engineer's Report (SER) has been produced by Price & Myers and includes its own BIA Screening and Scoping Section as Section 7. As the authors of this report are Chartered Structural Engineers, not in accordance with CPG4 requirements, and the responses to some of the Screening Questions are at variance to GEA's responses, it will be assumed that GEA's responses take precedence. The SER also refers to the "BIA being completed by GEA" and thus confirms that Price & Myers document pre-dates the GEA BIA.

4.3. The property is a two storey detached Grade II listed house constructed C.1810 which has a separate single storey outbuilding in the garden. It is proposed to extend the existing house, which will include the excavation and construction of a single level basement below the northwestern section of the house, extending out beneath the northwestern part of the garden and the outbuilding, where the basement will become two storey due to a change in external ground level. The floor level of the basement is shown on the Architect's drawings as varying between 100.93m AOD and 100.06m AOD, dependent upon room usage.

4.4. A soils investigation has been undertaken by GEA which established that Made Ground and Head Deposits overlay the Claygate Member of the London Clay Formation. The upper surface of the Claygate Member was found at levels varying between 101.60m AOD and 101.00m AOD and extended to the maximum depth investigated of 97.40m AOD and 89.45m AOD, ie the basement floor construction will be founded in the Claygate Member.

4.5. Standpipes were installed in each borehole and groundwater levels were monitored on three separate occasions with the level varying between 100.43m AOD and 101.57m AOD and groundwater flowing in a southeasterly direction in keeping with the general topography, ie basement construction will encounter groundwater flow.

4.6. The SER states that permeation grouting may be necessary to control the inflow of groundwater and it is considered that this comment was made prior to completion of the BIA groundwater assessment. Further consideration of this issue is requested and both documents should take note of the contents of a letter report prepared by Dr Vicki Harding, Tree Officer for Heath & Hampstead Society in which valuable local insight and experiences have been detailed concerning the local water table and problems that were encountered during the construction of a basement at No.22 Christchurch Hill in 2008. A variation in construction techniques to cater for the issues identified should be provided.

4.7. It has been demonstrated in Dr Harding's report that the site is close to known ponds, springlines and wells and the BIA should reconsider the scope of the current groundwater investigation in order to adequately respond to the concerns in her report. This should include considering the potential impacts to the wider hydrogeological environment.

4.8. Due to a root protection zone for a tree that is subject to a tree preservation order, the part of the basement within the tree protection zone is required to maintain an approximately 1.60m thickness of soil above the roof of the basement. The basement in this zone will be formed using tunnel construction/pipe-jacking directional boring techniques which are described in the SER.

4.9. Elsewhere, the garden perimeter walls to No.5 Well Road, the nearest adjacent property, and two of the external walls of the existing house will require underpinning. Further details and an underpinning bay layout are requested.

4.10. Secant piling and an inner concrete lining wall will be utilised to form the basement below the southernmost wall of the existing house and the western wall adjacent to Well Road below the outbuilding. The SER states that the indicated 600mm diameter piles might reduce to 450mm diameter depending upon the results of the ground investigation. It is requested that a coordinated response is provided, a firm pile diameter proposal made, and that the Ground Movement Assessment is modified appropriately.

4.11. Structural design sketches within the SER assume that the basement construction will be founded in "clay" and that measures to overcome heave forces will be incorporated. These details should be coordinated with the results of the BIA as this has shown that the founding material will be the Claygate Member.

4.12. Section 8.1.1 of the BIA provides retaining wall parameters which are incomplete as stiffness values for the different strata are not included. These values are requested. Justification is requested for the recommended adhesion factor of 0.6 for pile design in the Claygate Member.

4.13. An assessment of ground movements within and surrounding the excavation has been undertaken using OASYS geotechnical modelling software programs X-Disp and P-Disp. There are several references to a contiguous bored piled wall in the GEA report whereas elsewhere in the report a secant piled wall is indicated. A secant piled wall has been modelled in the ground movement analysis. Retaining wall proposals should be consistent across all the documents, with the GMA reflecting the actual solution to be adopted.

4.14. In the P-Disp analysis model, the stiffness values given in Section 10.2 for the Made Ground (E=22MPa and E'=13Mpa) are not considered reasonably conservative. The following clarifications are requested for the P-Disp model:

- Soil profiles for the undrained and drained cases are included in both models which are referred to as 'short term and total movements';
- For the drained case, it is unclear what the values for the unloading relate to;
- The shape of the excavation modelled is unclear from the contours plots.

4.15. Regarding the X-Disp analysis model, the tunnelled section of the basement is modelled as a planar diaphragm wall which GEA state is the worst case. Further clarification of this assumption is requested.

4.16. Justification is requested on the appropriateness of the curves for stiff clay from CIRIA C580 which are used in the analysis given the soils encountered at the level of the proposed basement are mainly described as firm sandy silt.

4.17. In addition to the above comment, in relation the analysis referencing C580 the following queries on the analysis which are raised:

- For the installation movements, the level to which the movement curves have been applied is above the base level of the underpinning/pile toe level. Clarification is requested.
- The different areas of the proposed basement have been modelled separately. Combined movements from the installation and excavation beneath the existing house have been used to undertake a damage assessment in one model with a separate model for the installation and excavation movements for the tunnelled area and area beneath the existing studio building. This is not considered to be appropriate. The cumulative effects of all the construction activities across the whole basement area should be considered together to undertake the building damage assessment.

4.18. Categories 0 to 2 (Negligible to Slight) damage impact is predicted for the property itself together with No 5 Well Road. Given the queries above, it is not accepted (as stated in the BIA) that the assessment is "considered conservative and that the movements predicted are likely to be an overestimate".

4.19. Mitigation measures as required by CPG4 should be proposed once the ground movement assessment is reconsidered, as outlined above, for structures with predicted damage impact greater than Category 1.

4.20. Whilst monitoring of ground movements is discussed in general terms, no specific proposal has been made and a monitoring specification for the works is requested taking into account any revised Ground Movement Assessment to be undertaken.

4.21. The SER contains a proposed sequence of work but does not provide an indicative temporary works proposal for the secant piling, reinforced concrete retaining walls and underpinning process. This is requested.

4.22. The SER does not provide any design calculations for the reinforced concrete retaining walls, as required by CPG4, and these are requested.

4.23. The BIA acknowledges that a limited area of existing soft landscaping will be excavated which will be replaced by a sunken courtyard at basement level. This is shown pictorially on Architect's drawing no. 010A, which identifies how the scheme has been developed in order to minimise this potential impact. It is accepted that this equates to a very small proportion of the soft landscaping across the site as a whole. It is proposed to drain the sunken courtyard into the existing sewer system and details are requested of measures to prevent potential flooding of the basement.

4.24. It is accepted that the site is not in a Flood Risk Zone based upon Camden Flood Risk Management Strategy maps and is not identified as a street that flooded in either 1975 or 2002 but is adjacent to Willow Road, which flooded in both events. The effect of the development on Willow's Road's flood potential, and other potentially 'sensitive' receivers, should be reconsidered.

4.25. It is accepted that there are no slope stability concerns regarding the proposed development.

5.0 CONCLUSIONS

5.1. The BIA has been carried out by a well-known firm of consultants using individuals who possess suitable qualifications.

5.2. The property is a two storey detached listed house which will be extended by the construction of a single level basement below part of the house, extending out beneath its garden to link with a single storey outbuilding which will be reconstructed to include a two storey basement due to changes in external ground level.

5.3. A soils investigation has been undertaken which has identified that the basement will be founded in the Claygate Member and will encounter groundwater flow during construction.

5.4. The local hydrogeological environment, including the presence of local springlines, historic wells and groundwater flow, has not been considered in sufficient detail. Potential impacts and cumulative impacts should be considered, with suitable mitigation measures presented for both the temporary and permanent conditions.

5.5. The SER states that permeation grouting may be necessary to control groundwater inflows. Further consideration of this requirement, together with an enhanced groundwater investigation will be required to respond to the concerns of Dr Harding and this audit.

5.6. Part of the basement will be constructed using tunnelling techniques as it will be within the root protection zone of a tree which has a tree preservation order. Elsewhere, the basement will be constructed using underpinning, piling and reinforced concrete retaining walls.

5.7. Additional information has been requested concerning piling (method, diameter, length), retaining wall calculations, underpinning details and bay layout, geotechnical design parameters, ground movement analysis and monitoring, temporary works procedures and concerns regarding previous flooding to Willow Road.

5.8. It is accepted that the small increase in the area of soft landscaping will have little effect on the hydrogeology of the area although additional details are requested of measures to prevent flooding of the basement due to rain falling into the sunken courtyard.

5.9. It is accepted that there are no slope stability concerns with the proposal.

Appendix 1: Residents' Consultation Comments

Residents' Consultation Comments

Surname	Address	Date	Issue raised	Response
Grange	Unknown	04/12/16	Ancient water course, mains water pipe failure, damage to trees	See 4.6, 4.7 & 4.23
Goodier	Weatherall Lodge, Well Road	30/11/16	Ancient water courses, subsidence, sink holes	See 4.6, 4.7, 4.13 – 4.18 & 4.23
Goldstein	24 Well Road	-	Damage to tree; water table problems, sink holes	See 4.6, 4.7 & 4.23
Harding	Heath & Hampstead Society	-	Ancient water courses, water table, inadequate groundwater investigation, impacts to surrounding roads / structures	See 4.6, 4.7 & 4.23

Appendix 2: Audit Query Tracker

Audit Query Tracker

Query No	Subject	Query	Status	Date closed out
1	Stability	Further underpinning details and bay layout	Open	
2	Stability/Hydrogeology	Update hydrogeological screening assessment; reconsideration of groundwater investigation and construction techniques to respond to Dr Harding's report; assess potential impacts and propose mitigation	Open	
3	Stability	Coordinated response to pile method / diameter / length requirement	Open	
4	Stability	Reassessment of heave forces	Open	
5	Stability	Geotechnical design parameters to be reconsidered	Open	
6	Stability	GMA contiguous piled wall references to be amended, P-Disp and X-Disp model assumptions and analyses to be modified, see 4.13 to 4.17	Open	
7	Stability	Burland damage categories to be reconfigured based upon revised GMA and mitigation to be provided	Open	
8	Stability	Ground Movement Monitoring Specification required	Open	
9	Stability	Indicative temporary works proposal for piling, retaining walls and underpinning required	Open	
10	Stability	Retaining wall design calculations required	Open	

11	Hydrology	Drainage details to prevent basement flooding from sunken courtyard required	Open	
12	Hydrology / Hydrogeology	Effect of development on Willow Road and other 'sensitive' receivers flood potential required (see audit tracker 2)	Open	

Appendix 3: Supplementary Supporting Documents

None

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