CampbellReith
consulting engineers

Panther House
38 Mount Pleasant, The Brain Yard
156-164 Gray's Inn Road, WC1X

Basement Impact Assessment
Audit

For

London Borough of Camden

Project Number: 12336-03
Revision: F2

February 2017

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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 Panther House, 38 Mount Pleasant, London WC1X (planning reference 2015/6955/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 was able to access the latest revision of submitted documentation and reviewed it against an agreed audit check list.

1.4. The BIA has been carried out by a well known firm of consultants who possess relevant qualifications and experience.

1.5. The redevelopment consists of three separate buildings, one of which will be refurbished and has an existing basement which will be deepened to form a double storey. The other two buildings will be demolished behind a retained façade and a new basement will be constructed to match the existing. The new basement will be formed by a combination of underpinning and an interlocking secant bored pile retaining wall.

1.6. The BIA and supporting documents were previously audited and a final report was issued in March 2016. The applicant carried out design alterations to the proposals which include an increase in the depth of the basement beneath one of the buildings and requested that an additional audit be carried out on the revised BIA documents. The revised documents were received in January 2017.

1.7. A soils investigation has been undertaken which identified that the new single storey basement could be founded in the River Terrace Gravel. The deeper double storey basement will be formed in the London Clay. Additional investigation has shown that the basements and underpinning will encounter groundwater during construction. Alternative forms of grouting are being considered to control groundwater, subject to an approved Basement Construction Plan and Party Wall acceptability.

1.8. The site is located within a Critical Drainage Area. A Flood Risk Assessment and Surface Water Drainage Statement has been produced which identifies an acceptable low risk of flooding.

1.9. The provision of green roofs and below ground attenuation will reduce surface water run off rates and discharge volumes, resulting in a reduction to the risk of downstream flooding.

1.10. It is accepted that there are no slope stability concerns, no hydrogeological concerns and no hydrological concerns with respect to the development proposals.

1.11. There are a number of outstanding issues and it is recommended these can be provided within a Basement Construction Plan (BCP) which should include:

- Further investigation of groundwater equilibrium conditions and seasonal variations, as well as groundwater flow.
- Confirmation of whether jet grouting or permeation grouting will be employed.
- The presence of any basements in adjacent properties.
- Finalised temporary works proposals.
- Confirmation of any construction phasing.
- A refined ground movement assessment based on conservative analysis which reflects the final structural proposals and takes into account the comments in Audit paragraphs 4.17 to 4.24.

1.12. Queries and matters requiring further information or clarification as part of the BCP are summarised in Appendix 2 and discussed in Section 4.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 11 January 2016 to carry out a Category C Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for Panther House, 38 Mount Pleasant, WC1X Camden Reference 2015/6955/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

a) Guidance for Subterranean Development (GSD). Issue 01. November 2010. Ove Arup & Partners.

b) Camden Planning Guidance (CPG) 4: Basements and Lightwells.

c) Camden Development Policy (DP) 27: Basements and Lightwells.

d) Camden Development Policy (DP) 23: Water.

2.4. The BIA should demonstrate that schemes:

- maintain the structural stability of the building and neighbouring properties;
- avoid adversely affecting drainage and run off or causing other damage to the water environment; and,
- 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 "*Redevelopment of existing buildings to provide part 4 storey and part 7 storey building following partial demolition of existing Panther House and Brain Yard buildings for a mix of Class B1a (office), A1(retail) and A3(restaurant/café) uses, provision of a new 7 storey building at 156-164 Gray's Inn Road behind retained façade from existing building at 160-164 Gray's Inn Road to provide flexible Class A1/A3 (retail/restaurant) use at ground and basement levels and 13 self-contained residential units (C3) (4 x 1-bed, 7 x 2-bed and 2 x 3-bed) at upper floor levels*". The Audit

instruction also confirmed the property did not involve a listed building nor was a neighbour to a listed building.

2.6. CampbellReith accessed LBC's Planning Portal on 27 January 2016 and gained access to the following relevant documents for audit purposes:

- Structural Report and Basement Impact Assessment dated December 2015 Eckersley O'Callaghan and Appendices:
- Appendix A – Outline Specification
- Appendix B – Design Parameters
- Appendix C – Proposed Structural Drawings
- Appendix D – Geotechnical Report (BIA) by GEA Ltd
- Appendix E – Ground Movement Assessment by GEA Ltd
- Appendix F – Construction Management Plan by Wates
- Appendix G – Flood Risk Assessment and Surface Water Drainage Statement by Robert West.

2.7. CampbellReith received revised information from Eckersley O'Callaghan on 02 March 2016 in response to the D1 revision of this report as follows:

- Basement Impact Assessment (BIA) by GEA Ltd
- Ground Movement Assessment by GEA Ltd

2.8. An email response from GEA on 23 March 2016 is included in Appendix 3 of the F1 Audit Report, following a request for clarification on the conclusions of the revised Ground Movement Assessment.

2.9. Following the issue of CampbellReith's F1 Audit Report dated March 2016, the applicant carried out design alterations to the proposals and requested that an additional audit be carried out on the revised BIA documents. These were made available on 27 January 2017 and consisted of:

- Structural Report and Basement Impact Assessment dated January 2017 by Eckersley O'Callaghan and Appendices:
- Appendix A – Outline Specification
- Appendix B – Design Parameters
- Appendix C – Proposed Structural Drawings

- Appendix D – Geotechnical Report (BIA) by GEA Ltd
- Appendix E – Ground Movement Assessment by GEA Ltd
- Appendix F – Construction Management Plan by Wates
- Appendix G – Flood Risk Assessment and Surface Water Drainage Statement by Robert West.

2.10. The BIA and all appendices were revised documents other than Appendix G which was unchanged from the previous issue.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	Yes	See BIA Section 1.5.
Is data required by Cl.233 of the GSD presented?	Yes	
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	Yes	See BIA Section 2.
Are suitable plan/maps included?	No	Location map only.
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	No	Extracts from Camden GHHS, EA and Strategic Flood Risk Assessment identifying site location could be provided.
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See BIA Section 4.1.2.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See BIA Section 4.1.1.
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See BIA Section 4.1.3.
Is a conceptual model presented?	Yes	See BIA Section 7.
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	See BIA Section 5.1.

Item	Yes/No/NA	Comment
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	See BIA Section 5.1.
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	N/A	
Is factual ground investigation data provided?	Yes	See BIA Section 3 and Appendix D.
Is monitoring data presented?	Yes	See BIA Section 3.2.
Is the ground investigation informed by a desk study?	Yes	See BIA Appendix Section 2.1. and 2.2.
Has a site walkover been undertaken?	Yes	See BIA Section 2.1.
Is the presence/absence of adjacent or nearby basements confirmed?	No	Not confirmed. See Audit paragraph 4.18
Is a geotechnical interpretation presented?	Yes	See BIA Section 3.1.
Does the geotechnical interpretation include information on retaining wall design?	Yes	See BIA Section 8.1.2, however, Young's Modulus/stiffness values (E_h and E'_h) are not included. These will be required for detailed design of the retaining walls.
Are reports on other investigations required by screening and scoping presented?	Yes	Ground Movement Assessment Report. Flood Risk Assessment and Surface Water Drainage Statement.
Are baseline conditions described, based on the GSD?	Yes	Although the presence and extent of basements beneath the neighbouring properties has not been confirmed.
Do the base line conditions consider adjacent or nearby basements?	Yes	Considered but not confirmed.
Is an Impact Assessment provided?	Yes	See BIA Section 9.

Item	Yes/No/NA	Comment
Are estimates of ground movement and structural impact presented?	Yes	See BIA Appendix E.
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	See BIA Section 9.
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	See BIA Section 10.
Has the need for monitoring during construction been considered?	Yes	See BIA Appendix E Section 6.2.
Have the residual (after mitigation) impacts been clearly identified?	Yes	See BIA Section 10.
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	Yes	On the basis of the assumptions made. However, there are queries on the analysis which require further information to be provided and the GMA refined as part of a Basement Construction Plan (see Audit paragraphs 4.17 to 4.24).
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	Yes	See Flood Risk Assessment and Surface Water Drainage Statement.
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	Yes	As above.
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	Category 0 (Negligible) to 1 (Very Slight) initially predicted then reassessed to be Category 0. However, there are queries on the GMA (see Audit paragraphs 4.17 to 4.24)
Are non-technical summaries provided?	Yes	See BIA Section 9.2.

4.0 DISCUSSION

4.1. The Basement Impact Assessment (BIA) has been produced by a well known firm of consultants, Geotechnical and Environmental Associates (GEA) and has been produced by individuals who possess relevant qualifications and experience.

4.2. The BIA is contained within a Structural Report and Basement Impact Assessment (SR) by Eckersley O'Callaghan as its Appendix D.

4.3. The BIA and supporting documents were previously audited and a final report was issued in March 2016. The applicant carried out design alterations to the proposals which include an increase in the depth of the basement beneath one of the buildings and requested that an additional audit be carried out on the revised BIA documents. The revised documents were received in January 2017.

4.4. The redevelopment site consists of three separate buildings, Panther House, Brain Yard and 156-164 Gray's Inn Road. Panther House comprises three blocks which are to be refurbished and vertically extended around a central courtyard, which is to be infilled following the demolition of an existing basement area and insertion of new ground beams supported on piled foundations to support a new circulation core and toilet block. Following the demolition of the existing buildings on Brain Yard and Gray's Inn Road, a new double height basement is to be constructed between the retained Gray's Inn Road frontage and Panther House requiring the existing Brain Yard basement to be lowered. The new basement will be formed by a secant bored pile retaining wall along the western boundary (Gray's Inn Road) with the remaining walls underpinned down to the level of the proposed basement. Foundations below the internal columns of the new buildings will consist of bored piles and pile caps.

4.5. A soils investigation has been undertaken by Site Analytical Services in August 2015 comprising two boreholes and eight trial pits. This was supplemented by a further five trial pits to ascertain detailed boundary conditions and establish groundwater conditions in the new basement area of Brain Yard. A reassessment of borehole log level information has recently also been undertaken by Eckersley O' Callaghan. This work has determined that below a variable thickness of Made Ground, between 14.59m OD and 17.10m OD, River Terrace Deposits (sandy gravel) extend to levels of 13.69m OD and 14.70m OD and are underlain by London Clay to significant depth. Formation level for the proposed single-storey basement is 15.0m OD and with reference to BH2, could possibly be within the River Terrace Deposits. Excavation for the proposed double-storey basement below Brain Yard is likely to extend to approximately 13.0m OD and will therefore extend into the London Clay.

4.6. Groundwater monitoring and additional trial pitting have provided water levels, measured within standpipes, at levels of 13.72m OD and 16.20m OD and beneath the existing Brain Yard

basement at a level of 15.39m OD. On the basis of this monitoring, it can be anticipated that groundwater is likely to be encountered within the proposed underpinning and excavation operations. Section 8.1.1 of the BIA discusses possible mitigation measures to overcome potential problems during underpinning in the form of jet or permeation grouting. It is further stated that the use of jet grouting may be subject to agreement at party wall stage. Either methodology will need to be detailed to demonstrate its suitability as part of a Basement Construction Plan. The BIA recommends further groundwater monitoring to establish seasonal high levels and fluctuations and this is endorsed.

4.7. The BIA and SR have both identified that there is no increase in impermeable area across the ground surface above the basement and it is accepted that the surface water flow regime will be unchanged.

4.8. The site is located within a Critical Drainage Area Group 3-003 as defined by LBC's Surface Water Management Plan and a Flood Risk Assessment and Surface Water Drainage Statement has been carried out by Robert West and is included in the BIA as Appendix G. This has identified that the site has a low risk to flooding from surface water, sewers, reservoirs (and their artificial sources), groundwater and fluvial/tidal watercourses and it is accepted that no mitigation measures are required to reduce the risk further. A drain cavity pump station and anti-flood valve will be incorporated into the basement to prevent storm water surcharge.

4.9. The surface water strategy for the development incorporates the addition of green roofs onto the new roof space and the provision of below ground attenuation had identified potential reductions in peak run off rates and discharge volumes resulting in a reduction to the risk of downstream flooding.

4.10. It is accepted that there are no slope stability concerns regarding the basement development.

4.11. It is accepted that no known ponds, springlines or wells are in close vicinity to the site and that the site is outside the Hampstead pond chain catchment area.

4.12. Although it is evident that GEA provided a thorough screening process within the BIA, it would be beneficial if the requirements of CPG4 were followed accurately by the inclusion of map extracts from the LBC GSD, Environment Agency and the LBC Flood Risk Management Strategy identifying the site location on each map. These extracts would help to support statements made in the BIA screening process.

4.13. It is noted that the revised BIA and SR both now refer to a secant bored pile retaining wall which inherently provides more protection against groundwater inflows during construction than the previous contiguous piled wall. It is accepted that this cut-off construction is unlikely to have a significant effect as groundwater will be able to continue to flow around the proposed

substructure. However, the construction methodology to allow underpinning within the water bearing gravels remains to be confirmed.

4.14. The BIA recognises that the excavation of the 4m deep basement will induce heave and potential groundwater uplift forces on the basement floor slab and these precautions have been followed through into the SR.

4.15. The revised SR contains a comprehensive construction sequence and identifies an indicative temporary works scheme necessary to maintain the stability of surrounding buildings during construction. Plans and elevations of underpinning bays have also been provided as have movement monitoring proposals. Details and trigger levels should be agreed as part of the party wall awards.

4.16. Section 8.1.2 of the BIA provides retaining wall parameters which are incomplete as Young's Modulus/ horizontal stiffness values (Eh and E'h) for the different strata are not included. These will be required for detailed design.

4.17. A ground movement assessment has been undertaken by GEA. Oasys Pdisp has been used to model the heave movements due to unloading. It appears that only movements due to excavation have been considered with no reference made to the additional unloading as a result of demolition. Heave movements in the order of 12mm are predicted in the centre of the excavation in the short term with 12mm also predicted post construction. These movements reduce towards the edge of the excavations. It is also noted that settlement due to the new building loads do not appear to have been considered. Heave mitigation measures such as transmitting the heave forces into the wall piles or to tension piles or a void or layer of compressible material to be incorporated into the design are suggested in the BIA.

4.18. Oasys Xdisp has been used to predict the ground movements due to underpinning, piling and excavation in front of the retaining walls together with the resulting damage to the neighbouring properties. It is stated in Section 6 of the GMA that 'it is understood that the adjoining buildings have lower ground floors/basement levels and foundations for these properties have therefore been placed at levels between 18 and 17m OD'. The validity of this information cannot be verified and it is requested the depth of the foundations be determined prior to detailed design or the maximum differential depth assumed.

4.19. The basement has been modelled as two separate rectangles to represent the area of the new basement (Area 1) which extends to 15m OD and the area of the existing basement being deepened (Area 2). 'No ground movement curves' have been assigned where the two rectangles meet to avoid 'doubling up' effects in the programme. However, corner stiffening effects have been used. This is considered incorrect as there are no walls here to justify the use of stiffening effects which would reduce ground movements at corners.

4.20. BH2 indicates that the northern and southern walls to Area 1 which will be underpinned to 15m OD could be within the water bearing granular deposits. However, ground movement curves for the installation of planar diaphragm walls in stiff clay have been assigned to these walls to model the underpinning. Additionally for the excavation, these have been modelled as excavations in front of a wall in stiff clay. A sensitivity analysis should be undertaken to demonstrate that the ground movements due to underpinning and excavation in granular soils where groundwater is likely to be encountered would be no worse than currently predicted.

4.21. The piled wall in Area 1 extends to 12m AOD (3m embedment depth). Confirmation is requested on whether the wall embedment depth assumed satisfies the requirements of Section 6.3.5 of CIRIA C580 which states 'the wall toe level should be the deeper of that required to satisfy load bearing capacity, hydraulic cut-off and uplift, global stability or lateral stability'.

4.22. Category 0 to 1 (Negligible to Very Slight) damage is predicted for the neighbouring properties. It is stated in Section 5.1.1 that the assessment is considered to be conservative due to an overestimation of ground movements where the separate areas meet. This is not accepted as the areas where the separate rectangles meet have been assigned 'no ground movements' which means ground movements have not been calculated at these points.

4.23. It is further stated in Section 6.1.1 of the GMA that a 'manual assessment' based on an upper limit of 5mm movement from the underpinning indicates the walls predicted to be Category 1 damage reduce to Category 0 on this basis. This statement is not accepted as although movements due to underpinning largely depends on good workmanship, this also assumes a dry excavation and given the potential issues with underpinning in water bearing granular soils, which the BIA itself highlights, an upper limit of movement of 5mm is considered to be an underestimate. Additionally, there are other queries on the GMA as discussed above.

4.24. The GMA/building damage assessment should be refined with the above comments on the approach considered and submitted as part of a Basement Construction Plan following confirmation of details on the construction methodology and the structural proposals. Mitigation measures as required by CPG4 should be proposed once the ground movement assessment is reconsidered for structures with predicted damage of Category 1 or greater.

4.25. It is recommended that the outstanding issues highlighted in this discussion are provided within a BCP.

5.0 CONCLUSIONS

5.1. The BIA has been carried out by a well known firm of consultants who possess relevant qualifications and experience.

5.2. The redevelopment consists of three separate buildings, one of which will be refurbished and has an existing basement which will be deepened to form a double storey. The other two buildings will be demolished behind a retained façade and a new basement will be constructed to match the existing. The new basement will be formed by a combination of underpinning and an interlocking secant bored pile retaining wall.

5.3. A soils investigation has been undertaken which identified that the new single storey basement will be formed within either Made Ground, the River Terrace Gravel, or the London Clay. The deeper double storey basement will be formed in the London Clay. Additional investigation has shown that the basements and underpinning will encounter groundwater during construction and alternative forms of grouting are being considered, subject to an approved Basement Construction Plan and Party Wall acceptability.

5.4. The site is located within a Critical Drainage Area. A Flood Risk Assessment and Surface Water Drainage Statement has been carried out which identifies an acceptable low risk to flooding.

5.5. The provision of green roofs and below ground attenuation will reduce surface water run off rates and discharge volumes, resulting in a reduction to the risk of downstream flooding.

5.6. It is accepted that there are no slope stability concerns, no hydrogeological concerns and no hydrological concerns with respect to the development proposals.

5.7. The BIA could be improved by the inclusion of map extracts from CPG4 source documents, showing the site location, to support statements made in the screening process.

5.8. There are a number of outstanding issues and it is recommended these can be provided within a Basement Construction Plan which should include:

- Further investigation of groundwater equilibrium conditions and seasonal variations, as well as groundwater flow.
- Confirmation on whether jet grouting or permeation grouting will be employed.
- The presence of any basements in adjacent properties.
- Finalised temporary works proposals.
- Confirmation of any construction phasing.

5.9. A refined ground movement assessment based on conservative analysis which reflects the final structural proposals and takes into account the comments in Audit paragraphs 4.17 to 4.24.

Appendix 1: Residents' Consultation Comments

None

Appendix 2: Audit Query Tracker

Audit Query Tracker

Query No	Subject	Query	Status	Date closed out
1	BIA-Screening	Map extracts from CPG4 source documents showing site location	Open - to be included in Basement Construction Plan (BCP)	N/A
2	Hydrogeology	Further investigation of groundwater level and flow	Open - to be included in BCP	N/A
3	Stability	Presence of any basements in adjacent properties	Open - to be included in BCP	N/A
4	Stability	Final temporary works scheme	Open - to be included in BCP	N/A
5	Stability	Confirmation of any construction phasing	Open - to be included in BCP	N/A
6	Stability	Ground movement assessment and building damage	Open – final version incorporating the comments on the approach discussed in Audit paragraphs 4.17 to 4.24 to be included in BCP	N/A

Appendix 3: Supplementary Supporting Documents

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