CampbellReith
consulting engineers

Gray's Inn Chambers
19-21 High Holborn
London, WC1R 5JA

Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 12336-56
Revision: F1

July 2016

Campbell Reith Hill LLP
Friars Bridge Court
41-45 Blackfriars Road
London
SE1 8NZ

T:+44 (0)20 7340 1700
F:+44 (0)20 7340 1777
E:london@campbellreith.com
W:www.campbellreith.com

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Author	Firoozeh Moghaddam BSc MSc DIC
Project Partner	E M Brown, BSc MSc CGeol FGS
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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 Gray's Inn Chambers, 19-21 High Holborn, London WC1R 5JA (planning reference 2016/0910/P). The basement is considered to fall within Category B 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 LBC's Planning Portal and gain access to the latest revision of submitted documentation and reviewed it against an agreed audit check list.

1.4. The proposed development is the replacement of an extension to the existing main building, to include one level of basement. The existing basement below the main building will be extended to join with the new basement development. On site, number 21 High Holborn is a Grade II Listed structure, as is the adjoining 22 – 23 High Holborn.

1.5. The BIA has been prepared by Geotechnical and Environmental Associates Ltd. The authors' qualifications are in accordance with LBC's requirements.

1.6. A desk study broadly in accordance with the GSD Appendix G1 has been provided for the proposed development.

1.7. Ground investigation has been undertaken on site and a geotechnical interpretation and a conceptual model are presented, which references historical borehole records. Additional ground investigation has been planned for later in 2016.

1.8. The BIA indicates that the proposed basement construction will utilise a contiguous bored pile retaining wall. A Civil and Structural Planning Report and Statement have been prepared by Aecom outlining the likely permanent works options, including recommendations for temporary works to limit stability impacts.

1.9. The BIA indicates that London Underground Limited's (LUL) Chancery Lane Station is in the vicinity of the site, and the escalator tunnels and shaft are within the development's zone of influence, although they are outside of LUL's defined exclusion zone. Consultation with LUL has commenced and is indicated to be ongoing.

1.10. A ground movement assessment (GMA) predicts damage typically not to exceed Burland category 0 with the exception of part of the existing structure. It is understood that these walls are to be rebuilt. The GMA should be revised for the final construction sequence and to address the comments raised in Section 4 and agreed with the Party Wall Surveyor. A second GMA addresses the potential impact to LUL assets; this is subject to separate approvals.

1.11. The BIA discusses the requirement for survey and monitoring of nearby structures during construction. Structures within the zone of influence should be monitored in line with recommendations of the Structural Engineer. For structures along the Party Walls, the monitoring should be agreed under the Party Wall Act.

1.12. The BIA indicates the site to be at low risk of groundwater flooding or impacting the wider hydrogeological environment, which is generally accepted. Longer term groundwater monitoring has been proposed and this should be provided to the Party Wall Surveyor.

1.13. It is accepted that there are no land stability impacts caused by slopes at or adjacent to the site, or caused by the proposed development assuming works progress as sequenced and designed by the structural engineer, as outlined in the BIA's supporting documents.

1.14. It is accepted that there are no surface water flooding or wider surface water flow impacts caused by the proposed development.

1.15. The criteria contained within CPG4 and DP27 have been met and the BIA demonstrates that the proposed development will not impact the wider land stability, surface water and hydrogeological environments. It is accepted that, subject to the agreement of the Party Wall awards, the BIA identifies the potential impacts arising out of the basement proposals and describe suitable mitigation.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 27th April 2016 to carry out a Category B Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for Gray's Inn Chambers, 19-21 High Holborn, London WC1R 5JA, Camden Reference 2016/0910/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: "Refurbishment, extension and part change of use of existing building to provide a mixture of uses including retail, office and ancillary uses, involving roof, rear and basement extensions comprising 897 sq m of additional floor space and associated plant. As part of a land use swap with 12 Gray's Inn Square (2016/0912/P)".

2.6. CampbellReith accessed LBC's Planning Portal on 28 April 2016 and gained access to the following relevant documents for audit purposes:

- Planning Statement dated February 2015 by Savills.
- Site Investigation & Basement Impact Assessment Report (ref J15193, Final, Issue 2) dated 26 November 2015 by Geotechnical and Environmental Associates Ltd.
- Civil and Structural Planning Report (RIBA Stage 2, Revision A) dated 29 January 2016 by Aecom.
- Redevelopment Structural Stability Statement dated 12 April 2016 by Aecom.
- Neighbouring Structures Plans and Sections (Revision P1) dated 13 April 2016 by Aecom.
- Ground Movement Assessment Report (ref J15193A, Final, Issue 6) dated 30 March 2016 by Geotechnical and Environmental Associates Ltd.
- Escalator Movement Report (Ref 60472955, Issue 01) dated 23 March 2016 by Aecom.
- Site Location Plan, Existing Plans and Elevations, Proposed Plans and Elevations, dated February 2016 (Revision PL1) by John Mather Architects.

2.7. Subsequent to the issue of the initial audit report, a Technical Note dated 13 June 2016 was prepared by Aecom in response to the queries raised (refer to Appendix 3). This revised report considers that additional information.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	Yes	The author's qualifications are in accordance with CPG4 guidelines for all sections.
Is data required by Cl.233 of the GSD presented?	Yes	A desk study broadly in line with the GSD Appendix G1 has been provided.
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?	Yes	
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	Yes	
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	
Is a conceptual model presented?	Yes	

Item	Yes/No/NA	Comment
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes	
Is factual ground investigation data provided?	Yes	
Is monitoring data presented?	Yes	Whilst the provided data only presents the monitoring undertaken in the course of summer, information submitted subsequently by the client's appointed engineer advises that monitoring will be carried on up until the start of construction in early 2017.
Is the ground investigation informed by a desk study?	Yes	
Has a site walkover been undertaken?	Yes	
Is the presence/absence of adjacent or nearby basements confirmed?	Yes	Basements and foundation levels for adjacent structures have been identified. Underlying LUL structures related to Chancery Lane station have been identified.
Is a geotechnical interpretation presented?	Yes	
Does the geotechnical interpretation include information on retaining wall design?	Yes	The BIA provides an overview of retaining wall and foundation options. More detail is provided in Aecom's structural assessment. 450mm diameter CFA piles are proposed, to a maximum of 15m bgl, to be sleeved where closest to the LUL structures.

Item	Yes/No/NA	Comment
Are reports on other investigations required by screening and scoping presented?	Yes	
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	
Are estimates of ground movement and structural impact presented?	Yes	
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	
Has the need for monitoring during construction been considered?	Yes	Movement monitoring is discussed and recommended for the adjacent structures, including the LUL escalator shaft. Discussion with LUL has also been recommended.
Have the residual (after mitigation) impacts been clearly identified?	Yes	Discussion on the construction sequence and temporary propping is presented in regards mitigating ground movements.
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	Yes	
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	Yes	The proposed basement development does not change the current drainage / run-off arrangements.
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	Yes	This assumes that longer term groundwater monitoring confirms the basement will not interact with the groundwater within the

Item	Yes/No/NA	Comment
		River Terrace Deposits.
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	The majority of walls / structures are indicated to be within Damage Category 0 'Negligible'. Damage Category 2 'Slight' is predicted for part of the existing building. It has been confirmed in subsequent information provided that these walls are to be substantially demolished and rebuilt.
Are non-technical summaries provided?	Yes	

4.0 DISCUSSION

4.1. The proposed development is the demolition of a four storey extension to the existing main building to be rebuilt to six storeys, with one level of basement formed at approximately 4.6m below ground level (bgl). The existing basement below the main building will be extended to join with the new basement development. On site, number 21 High Holborn is a Grade II Listed structure, as is the adjoining 22 – 23 High Holborn, the Cittie of Yorke public house. The site is also within the Bloomsbury Conservation Area.

4.2. 21 High Holborn partially overlies the LUL Chancery Lane Station escalator tunnel, which is 12m below the existing basement level. Contiguous piles for the proposed basement would be installed within 4m laterally of the escalator shaft. Whilst this is subject to a separate approvals process, it is noted that Aecom's Civil and Structural Planning Report provides guidance for minimising impact to LUL structures, which includes: limiting differential deflections to 2mm in the vicinity of the escalator shaft to prevent impact to escalator machinery; ensure net loading of existing foundations in the vicinity of LUL assets is no greater than 5% of current loads; provide a statement of risk management to LUL in relation to pile installation in advance of construction commencing.

4.3. The proposed development will necessitate a number of services diversions. The temporary works design and method statements for the diversions should be reviewed by the structural engineer to ensure that there are no potential stability issues, that the works are programmed to prevent concurrent works leading to cumulative impacts, and that the diversion works should be monitored to ensure ground / structural movements are within the limits of those predicted.

4.4. The BIA indicates the site to be at low risk of groundwater flooding or impacting the wider hydrogeological environment, which is generally accepted. During the ground investigation, groundwater was encountered below basement level. However, groundwater monitoring has only been undertaken during summer months and it was recommended that monitoring continue over a longer period, including a winter season, to confirm that mean groundwater levels will not interact with the basement. The client's appointed engineer has confirmed that the monitoring will be continued through the autumn and winter until the start of construction in early 2017. If further monitoring indicates there will be interaction, additional assessment of the cumulative impact to groundwater flow should be considered.

4.5. Additional ground investigation is planned. The contractor should make provision for suitable trial excavations to be undertaken in advance of the main works to investigate the presence of deeper Made Ground, variation in the River Terrace Deposits and any perched groundwater across the site.

4.6. The contractor should make suitable contingency plans to deal with any perched water encountered during construction. In the long term, the permanent structure will require suitable waterproofing to be provided in line with best practise.

4.7. Results of ground movement assessments (GMAs) are provided, which have been undertaken in accordance with CIRIA C580. The GMAs assess the tunnel structures as well as the adjoining property/party walls. Mitigation in terms of limiting lateral deflections is discussed with reference to relevant building damage categories. Category 0 'Negligible' is identified as the impact to the majority of structures. Damage Category 2 'Slight' is predicted to two walls within the subject site and supplementary information advises that these are to be substantially demolished and rebuilt. Some discrepancies have been noted in the GMA, such as the building heights and soil conditions (sand versus clay). However, it is accepted that provided there is good control of workmanship, ground movements outside the excavation will be small. An updated GMA and building damage assessment should be agreed as part of the Party Wall award.

4.8. The BIA and supporting documents do not specify the spacing of the piles for the contiguous retaining wall. It is assumed that for the 450mm piles proposed the spacing would follow CIRIA C580 recommendations of 550mm centre to centre spacing, and that this has formed the basis of the GMAs. This has been confirmed by the structural engineer.

5.0 CONCLUSIONS

5.1. The BIA has been prepared by Geotechnical and Environmental Associates Ltd. The authors' qualifications are in accordance with LBC's requirements.

5.2. A desk study broadly in accordance with the GSD Appendix G1 has been provided for the proposed development.

5.3. Additional ground investigation has been proposed for later in 2016. If this indicates any substantial changes to the current conceptual model then the potential impacts should be re-assessed.

5.4. An outline structural design by Aecom is presented, which includes permanent and temporary works, and recommendations to contractors. Careful control and sequencing of temporary propping will be crucial in limiting ground movements and should be agreed with the scheme's structural engineer. Monitoring should be undertaken, as advised by the structural engineer, and as agreed under the Party Wall Act and with LUL. Discussions with LUL should continue throughout the works and the potential impacts on their infrastructure is party to separate approvals.

5.5. Ground movement assessments (GMAs) have been undertaken which include impact assessments in line with the Burland Scale. The assessed impacts to existing structures are typically negligible (Burland Category 0), although some existing walls are predicted to experience damage equivalent to Category 2 'Slight'. It has been confirmed that these walls are to be demolished and rebuilt. Some discrepancies exist within the GMAs which should be revised and agreed with the Party Wall Surveyor.

5.6. For audit purposes it is assumed first that for the 450mm piles proposed for the contiguous retaining wall, the spacing would follow CIRIA C580 recommendations of 550mm centre to centre spacing, and that this has formed the basis of the GMAs. It was later confirmed that piles will be installed at 550mm centres in accordance with CIRIA C580.

5.7. The BIA indicates the site to be at low risk of groundwater flooding or impacting the wider hydrogeological environment, which is generally accepted. Additional groundwater monitoring should be undertaken to include a winter season as proposed in supplementary information provided by the engineer. Should this indicate interaction and potential partial cut-off of groundwater flow by the proposed basement, then the impact assessment will need to be further revised.

5.8. It is accepted that there are no land stability impacts caused by slopes at or adjacent to the site, or caused by the proposed development assuming works progress as sequenced and designed by the structural engineer.

5.9. It is accepted that there are no surface water flooding or wider surface water flow impacts caused by the proposed development.

5.10. The criteria contained within CPG4 and DP27 have been met and the BIA demonstrates that the proposed development will not impact the wider land stability, surface water and hydrogeological environments.

5.11. It is accepted that, subject to the agreement of the Party Wall awards, the BIA identifies the potential impacts arising out of the basement proposals and describes suitable mitigation.

Appendix 1: Residents' Consultation Comments

None

Appendix 2: Audit Query Tracker

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Audit Query Tracker

Query No	Subject	Query	Status/Response	Date closed out
1	Ground Investigation	Additional groundwater monitoring should be undertaken, notably during a winter season. If groundwater interacts with the proposed basement then the potential impact should be further considered.	Closed. However, it should be ensured during the agreement of the Party Wall Award that the groundwater monitoring is continued as offered.	7th July 2016
2	Land Stability	Confirmation of pile configuration in contiguous wall required.	Closed.	7th July 2016
3	Land Stability	Confirmation of mitigation or remedial measures required where predicted damage exceeds Burland Category 1.	Closed. However, the GMA is to be revised and agreed with the Party Wall Surveyor.	7th July 2016

Appendix 3: Supplementary Supporting Documents

AECOM
Midcity Place
71 high Holborn
London WC1V 6QS
www.aecom.com

020 7061 7713 tel

Technical Note

Project	19-21High Holborn
Subject	Response to Basement Impact Assessment Audit
Date	13 June 2016
Technical Note Number	01
Prepared by	David Rafferty CEng MIStructE Alexander Conrad MSc CGeol FGS

This note has been produced in response to the Campbell Reith Audit of Basement Impact Assessment Audit, dated May 2016 and reference 12336-56 (Revision D1). The comments from the Audit Tracker are as follows:

Query Number	Subject	Query
1	Ground Investigation	Additional groundwater monitoring should be undertaken, notably during a winter season. If groundwater interacts with the proposed basement then the potential impact should be further considered.
2	Land Stability	Confirmation of pile configuration in contiguous wall required.
3	Land Stability	Confirmation of mitigation or remedial measures required where predicted damage exceeds Burland Category 1.

Query 1

Additional ground water monitoring is to be undertaken in the Autumn up until the start of construction in early 2017. This will complement the ground water information already gathered to date which proves groundwater levels within the River Terrace Deposits. Based on experience of local ground conditions it is not anticipated that future groundwater levels will differ substantially from those measured to date. Local groundwater flows are likely to be at a modest gradient towards the east / southeast based on the local topography and inferred strata boundaries. Due to the very limited extent of the development, it is not anticipated that the construction of the basement will cause any significant impact on the regional groundwater regime. Any effect of increased groundwater levels due to a damming effect of the basement is likely to be very minor and of local extent. Even if higher groundwater levels were to be encountered in future monitoring, given the relatively small extent of the basement extension relative to the existing situation, it is not anticipated that there will be a negative impact to the regional groundwater regime or detrimental effect on any existing or proposed structures.

Query 2

The piles will be installed at 550mm centres in accordance with CIRA C580.

Query 3

The existing elevations noted as being subject to damage exceeding Burland Category 1 are being substantially demolished and rebuilt as part of the works, as such no further mitigation is considered necessary.

London

Friars Bridge Court
41- 45 Blackfriars Road
London, SE1 8NZ

T: +44 (0)20 7340 1700
E: london@campbellreith.com

Birmingham

Chantry House
High Street, Coleshill
Birmingham B46 3BP

T: +44 (0)1675 467 484
E: birmingham@campbellreith.com

Surrey

Raven House
29 Linkfield Lane, Redhill
Surrey RH1 1SS

T: +44 (0)1737 784 500
E: surrey@campbellreith.com

Manchester

No. 1 Marsden Street
Manchester
M2 1HW

T: +44 (0)161 819 3060
E: manchester@campbellreith.com

Bristol

Wessex House
Pixash Lane, Keynsham
Bristol BS31 1TP

T: +44 (0)117 916 1066
E: bristol@campbellreith.com

UAE

Office 705, Warsan Building
Hessa Street (East)
PO Box 28064, Dubai, UAE

T: +971 4 453 4735
E: uae@campbellreith.com