CampbellReith
consulting engineers

22-23 Denmark Place & 26 Denmark Street, WC2H 8NN

Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 12336-07
Revision: D1

February 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	A J Marlow, BSc CEng MIStructE FConsE
Project Partner	E M Brown, BSc MSc CGeol FGS
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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 22-23 Denmark Place & 26 Denmark Street, London WC2H 8NN (planning reference 2015/6939/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 basement development is 11 metres deep generally, with some areas increased locally to 15 metres below ground level. It is an island site, constrained by Charing Cross Road, Andrew Borde Street, St Giles High Street and Denmark Street. The three levels of basement straddle the eastbound Crossrail running tunnel and the Northern Line escalator box that serves Tottenham Court Road Station.

1.6. Two soils investigations have been undertaken which show Made Ground underlain by River Terrace Deposits (Lynch Hill Gravel), underlain by London Clay. The basement will be constructed through the Gravel and will be founded in the London Clay. Groundwater will be encountered towards the base of the Lynch Hill Gravel.

1.7. The basement perimeter will be formed by a secant bored pile retaining wall adjacent to the piled wall of the escalator box. The ground slab will initially be constructed and a "top down" form of construction will be adopted, thus minimising movement effects on the surrounding properties. The installation of the retaining wall will marginally affect the level of the groundwater table local to the site which flows from north to south.

1.8. Enabling works require the deepening of an existing basement at 28 Denmark Street by underpinning its surrounding walls, although no details are provided, and the temporary relocation of 22 Denmark Place, which would otherwise suffer significant damage.

1.9. It is recommended that a Basement Construction Plan (BCP) is provided and approved prior to commencement on site and this should include a refined GMA/building damage assessment with all the construction activities analysed.

1.10. A movement monitoring proposal is discussed in principle but specific details are requested as part of the BCP so that actual movements can be compared with predicted values during the construction process in order to minimise potential damage.

1.11. It is accepted that there are no slope stability concerns, no hydrogeological concerns and no hydrological concerns with respect to the development proposals. A Flood Risk Assessment, requested by LBC, has been reviewed and its conclusions are accepted.

1.12. Detailed underpinning proposals for 28 Denmark Street and detailed proposals for the monitoring of ground movements on surrounding properties are also requested and this should be included as part of the BCP.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 20 January 2016 to carry out a Category C Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 22-23 Denmark Place & 26 Denmark Street, London, WC2H 8NN, Camden Reference 2015/6939/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 *"Variation of Condition 2(approved plans) of planning permission 2012/6858/P date 31/03/15 to repair and restore 22 Denmark Place and 26 Denmark Street; demolish and rebuild 23 Denmark Place as a single storey structure; temporary moving of 22 Denmark Place to facilitate development approved under 2012/6858/P; provision of venue space at ground and basement level within 22 Denmark Place*

and 26 Denmark Street to replace the 12 Bar Club and minor amendments to the elevations of the approved passageway through 21 Denmark Street". The Audit Instruction also confirmed the property involved listed buildings.

2.6. CampbellReith accessed LBC's Planning Portal on 4 February 2016 and gained access to the following relevant documents:

- Basement Impact Assessment (BIA) dated November 2015 by Engenuiti and Appendices:
  - Appendix A – Geological Map and Ordnance Survey Maps
  - Appendix B – Aquifer, Well Record, Water Catchments and Flood Maps
  - Appendix C – Drawings of Existing and Proposed Works
  - Appendix D – Site Investigations
  - Appendix E – Proposed Structural Drawings
  - Appendix F – Substructure Performance and Soil Structure Interaction

2.7. The introduction to the BIA referred, in Section 1.1, to a Zone 1 Civil and Structural Engineering Stage 3 Report and a Flood Risk Assessment that were not present on the LBC Planning Portal. An initial overview of the Ground Movement Assessment in Appendix F of the BIA identified that software input information for FREW and XDisp analyses could be made available.

2.8. Engenuiti were contacted by CampbellReith and the following additional information was made available electronically between 10 and 24 February 2016:

- Flood Risk Assessment dated September 2012 by Project Centre
- Appendices for Flood Risk Assessment
- Zone 1 Structural Design Criteria date February 2016 by Enguiti
- Skanska construction sequence dated February 2016
- Basement temporary works strategy dated December 2015 by Engenuiti
- Basement construction sequence dated December 2015 by Engenuiti
- FREW & Xdisp Input and Output Data undated by A2 Studio

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	Yes	See Introduction of BIA
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 1.
Are suitable plan/maps included?	Yes	See BIA Appendices A to C.
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	See BIA Section 2.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See BIA Section 2.
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See BIA Section 2.
Is a conceptual model presented?	Yes	See BIA Section 1.2.
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	See BIA Section 4.

Item	Yes/No/NA	Comment
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	See BIA Section 4.
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes	See BIA Section 4.
Is factual ground investigation data provided?	Yes	See BIA Appendix D.
Is monitoring data presented?	Yes	See BIA Section 3.3.
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	See BIA Section 1.2.
Is a geotechnical interpretation presented?	Yes	See BIA Section 3.
Does the geotechnical interpretation include information on retaining wall design?	Yes	See BIA Sections 3.4 to 3.6.
Are reports on other investigations required by screening and scoping presented?	Yes	Flood Risk Assessment provided. Relocation of 22 Denmark Place. Crossrail and LUL CDS submissions.
Are baseline conditions described, based on the GSD?	Yes	
Do the base line conditions consider adjacent or nearby basements?	Yes	See BIA Section 4 and Appendix F.
Is an Impact Assessment provided?	Yes	See BIA Section 4.
Are estimates of ground movement and structural impact presented?	Yes	See BIA Appendix F.

Item	Yes/No/NA	Comment
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	See BIA Section 4.
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	See BIA Section 4.
Has the need for monitoring during construction been considered?	Yes	Skanska Construction Sequence.
Have the residual (after mitigation) impacts been clearly identified?	Yes	See BIA Section 4.
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	No	See Audit paragraph 4.19
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?	No	
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	No	Anticipated damage on some of the properties exceeds Category 2 although the affected buildings are owned by the developer.
Are non-technical summaries provided?	No	However the BIA is well written and concise and is easily understandable.

4.0 DISCUSSION

4.1. The Basement Impact Assessment (BIA) has been produced by a well-known firm consultants, Enguiti, and has been reviewed and approved for use by individuals who possess relevant qualifications and experience.

4.2. The development proposals form part of a major redevelopment of St Giles Circus associated with alterations and improvements at Tottenham Court Road Station. The footprint of the basement proposal is constrained by the Northern Line escalator box and Charing Cross Road to the west, Andrew Borde Street to the north, the retained facade on St Giles High Street to the east and the retained buildings to the south on Denmark Street. The basement typically consists of a 11 metre deep excavation within embedded secant piled retaining walls, with areas of 15 metre deep basement to accommodate plant areas. The three levels of basement straddle the eastbound Crossrail running tunnel and the Northern Line escalator box that serves Tottenham Court Road Station.

4.3. An initial soils investigation was carried out in May 2008 which was supplemented by further works between October 2014 and March 2015. These explorations have revealed the site to consist of Made Ground above the Lynch Hill Gravel member of the River Terrace Deposits, below which lies the London Clay. The basement will be formed in the London Clay but will be subjected to groundwater towards the bottom of the Lynch Hill Gravel.

4.4. Monitoring during the later investigation determined that the groundwater level will be encountered approximately 5 metres below ground level and that the flow was from north to south. To the north of the site, the groundwater flow is already interrupted by the existing basement of Centre Point. The proposed development is likely to slightly increase groundwater levels to the north and slightly decrease levels to the south of the site. It is accepted that groundwater will still be able to flow around the development site, however.

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

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

4.7. It is accepted that the proposal will not alter the existing proportion of hard surfaces and paved areas and, hence, the quantity of local rainfall entering the existing sewer system.

4.8. It is accepted that the site is not in Food Risk Zone based upon Camden Flood Risk Management Strategy maps and is not identified as a street that flooded in either 1975 or 2002. However, LBC have advised the development team that, based upon Environment Agency modelling, there is a potential surface water flood risk in the vicinity of St Giles Circus and suggested that detailed hydraulic modelling of the sewers in the vicinity of the site should be completed to inform the flood risk assessment. A Flood Risk Assessment has been carried out

by Project Centre dated September 2012. CampbellReith has reviewed this document and accepts that the surface water flood risk does not appear necessary to complete detailed hydraulic modelling of the combined sewers in the vicinity of the site.

4.9. In order to facilitate these works, it is necessary to remove an existing basement slab at 28 Denmark Street, underpin the surrounding walls by up to 1.20 metres and reinstate a new basement slab. No details of proposed methodology is provided but the surrounding properties are owned by the developer. However, the adjacent properties, 27 Denmark Street and 59 St Giles High Street, are both Grade II listed and, hence, detailed proposals are requested of the underpinning to 28 Denmark Street.

4.10. The ground movement assessment included in Appendix F of the BIA indicates the Oasys software FREW has been used for the retaining wall analysis. The movements from the FREW analysis were used in the assessment of building damage although this will only account for the excavation and it is unclear if the movements from pile installation have been considered. It is further noted that an excavation depth of 11m is indicated in the analysis, however, there are areas of excavation up to 15m deep and these do not appear to be accounted for. Ground movements as a result of underpinning to 28 Denmark Street also do not appear to be assessed.

4.11. The ground levels given in m AOD in the BIA and the ground investigation report differ from the levels used in the ground movement analysis.

4.12. It is noted the approach used to predict ground movements i.e. how the results of the FREW analysis was used in the building damage assessment using x-disp has not been detailed in the ground movement assessment.

4.13. Figure 5 in Appendix F indicates predicted damage on the affected properties mainly ranging from negligible to slight (Category 0 to 2), however, moderate (Category 3) is indicated for 16, 22 and 23 Denmark Place with a severe (Category 4) damage indicated for the southern elevation to 22 Denmark Place.

4.14. 22 Denmark Place is indicated to be temporarily relocated in order to facilitate piling operations and minimise the effects of construction on this property, which would otherwise be significant, according to the results from the ground movement analysis. It is understood the full details of this operation are detailed in a report by Abbey Pinford although this document is not included as part of the BIA supporting documents.

4.15. 23 Denmark Place is indicated to be dismantled; however, the anticipated damage to 16 Denmark Place is not discussed any further although this building is believed to be in the ownership of the applicant and therefore of less significance.

4.16. Section 4.2 of the Structural Engineering Zone 1 Design Criteria indicates various methods to control heave as a result of excavation such as a heave retention slab and retaining wall to

protect the Crossrail tunnel, however, the magnitude of the anticipated heave as a result of excavation has not been provided. It is unclear from Appendix F of the BIA if heave movements as a result of basement excavation has been analysed.

4.17. Although the BIA and its supporting documentation represents a substantial submission, it is recommended that a Basement Construction Plan (BCP) is provided prior to construction commencement which should include detailed underpinning proposals for 28 Denmark Street and detailed proposals for the monitoring of ground movements on surrounding properties.

4.18. A ground movement monitoring system is discussed in principle in Section 6.7 of the Zone 1 Structural Design Criteria document utilising targets on the developers buildings previously monitored by Crossrail together with the escalator box and the existing buildings surrounding the potential excavation. Detailed proposals are requested as part of the BCP.

4.19. Despite the queries with respect to the GMA, it is acknowledged that the proposal methodology should prevent damage to surrounding structures exceeding acceptable limits, subject to appropriate detailed design and good control of workmanship. The GMA/building damage assessment should be refined and submitted as part of the BCP. This should include all the proposed activities such as pile installation, worst case excavation depth and underpinning. The approach used in the analysis and the damage assessment should be detailed in the GMA. Predicted heave movements as a result of excavation are also requested to be submitted.

4.20. A Conceptual Design Statement (CDS) submission has been made to Crossrail as well as to the LUL Tottenham Court Road Station Upgrade Team and these are currently being updated to reflect the Construction Sequence document recently developed by Skanska in conjunction with Enguiti.

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 basement development is 11 metres deep generally with some areas increased locally to 15 metres below ground level. It is an island site, constrained by Charing Cross Road, Andrew Borde Street, St Giles High Street and Denmark Street. The three levels of basement straddle the eastbound Crossrail running tunnel and the Northern Line escalator box that serves Tottenham Court Road Station.

5.3. Two soils investigations have been undertaken which show Made Ground underlain by River Terrace Deposits (Lynch Hill Gravel), underlain by London Clay. The basement will be constructed through the Gravel and will be founded in the London Clay. Groundwater will be encountered towards the base of the Lynch Hill Gravel.

5.4. The basement perimeter will be formed by a secant bored pile retaining wall adjacent to the piled wall of the escalator box. The ground slab will initially be constructed and a "top down" form of construction will be adopted, thus minimising movement effects on the surrounding properties. The installation of the retaining wall will marginally affect the level of the groundwater table local to the site which flows from north to south.

5.5. Enabling works require the deepening of an existing basement at 28 Denmark Street by underpinning its surrounding walls although no details are provided.

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. A Flood Risk Assessment, requested by LBC, has been reviewed and its conclusions are accepted.

5.7. It is recommended that a Basement Construction Plan is provided and approved prior to commencement on site and this should include:

- Detailed underpinning proposals for No 28 Denmark Street
- A refined GMA/building damage assessment predicting vertical and horizontal movements as a result of all the basement construction activities such as piling, excavation, underpinning and also heave movements
- Detailed monitoring scheme for potentially affected structures.

Appendix 1: Residents' Consultation Comments

None

Appendix 2: Audit Query Tracker

Audit Query Tracker

Query No	Subject	Query	Status/Response	Date closed out
1	Stability	Detailed underpinning proposals for 28 Denmark Street.	To be provided as part of a Basement Construction Plan.	N/A
2	Stability	Detailed proposals for the monitoring of ground movements on surrounding properties.	To be provided as part of a Basement Construction Plan.	N/A
3	Stability	Refined ground movement analysis taking into consideration all construction activities with detailed analysis methodology in the GMA	To be provided as part of a Basement Construction Plan.	N/A

Appendix 3: Supplementary Supporting Documents

None

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