CampbellReith
consulting engineers

11 Rosslyn Hill
London NW3 5UL

Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 12066-54
Revision: F1

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

Document History and Status

Revision	Date	Purpose/Status	File Ref	Author	Check	Review
D1	19/10/15	Comment	PCDjw12066-54-191015-11 Rosslyn Hill-D1.doc	P C Daniels	P C Daniels	E M Brown
F1	04/02/16	For Planning	PCDjw12066-54-050216-11 Rosslyn Hill-F1.doc	P C Daniels	P C Daniels	E M Brown

Document Details

Last saved	05/02/2016 17:34
Path	PCDjw12066-54-050216-11 Rosslyn Hill-F1.doc
Author	P C Daniels BSc MSc CEng MICE
Project Partner	E M Brown, BSc MSc CGeol FGS
Project Number	12066-54
Project Name	11 Rosslyn Hill, London NW3 5UL
Planning Reference	2015/2089/P

Contents

Appendix

1.0 NON-TECHNICAL SUMMARY

1.1. CampbellReith was instructed by the London Borough of Camden (LBC) to carry out an audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 11, Rosslyn Hill, London NW3 5UL - Planning Reference 2015/2089/P.

1.2. CampbellReith accessed the LBC Planning Portal and reviewed the latest revisions of submitted documentation against an agreed audit check list.

1.3. Following first issue of a BIA in March 2015 and the receipt of a number of detailed technical queries from a number of external sources, the BIA was revised and re-issued in August 2015.

1.4. The CampbellReith audit on the re-issued BIA was carried out in accordance with the Terms of Reference set by the LBC. The audit reviewed the BIA for potential impacts on land stability and local surface and groundwater conditions arising from the proposed basement development in accordance with LBC's policies and technical procedures.

1.5. Subsequent to the issue of the above audit, a number of additional technical comments were received from external sources and further revisions undertaken to the BIA. This current audit constitutes a revision to the original Campbell Reith audit, amended as necessary, to accommodate the updated information received.

1.6. The revised BIA includes screening, scoping, site investigation and impact assessment stages as required in the LBC planning Guidance document 'Basements and Lightwells (CPG4)' dated July 2015.

1.7. The qualifications of the authors, checkers and approvers of the revised BIA are in compliance with the requirements of CPG4.

1.8. Ground conditions at the site comprise Made Ground directly overlying the London Clay. Head (comprising ancient hillwash) may form a component of the identified Made Ground, towards the base.

1.9. The BIA confirms that there is no evidence of shrink-swell induced subsidence at 11 Rosslyn Hill or Lyndhurst Hall.

1.10. Groundwater monitoring undertaken during the period January to March 2015 and following the initial CampbellReith audit indicates groundwater levels of between 0.6m to 2.95m bgl. The BIA argues that groundwater flows in the Made Ground/Head are diverted around 11 Rosslyn Hill by the shielding effect of the sub-surface walls and foundations to Lyndhurst Hall.

1.11. Consideration should be given during any dewatering to avoiding loss of fines from beneath adjacent buildings e.g. Lyndhurst Hall, in order to preclude any associated settlement of the foundations.

1.12. Basement top slabs have been set below ground level partly with a view to permitting perched water within the Made Ground to flow across the site without undue impediment, as at present.

1.13. Differentials in basement foundation depths relative to 11 Rosslyn Hill and Lyndhurst Hall will be catered for by adopting suitably stiff perimeter walling to the basement excavations and stringent construction controls, backed up by movement monitoring. The foundations to 11 Rosslyn Hill will be locally underpinned with mass concrete.

1.14. Preliminary calculations have been provided for the RC design of the various basement perimeter walls based on appropriately conservative assumptions. The structural model for basement pile design is simplistic, but is probably conservative for reinforcement design purposes. More sophisticated calculations would be expected for detailed design. The sensitivity of wall design to pre-existing shear surfaces within the lower Made Ground/Head should be also assessed at detailed design stage.

1.15. Calculations have been undertaken of ground movements due to both pile installation and pile deflection consequent upon basement excavation. The calculations indicate the predicted damage category for both 11 Rosslyn Hill and Lyndhurst Hall to be Category 0 (negligible) and that the damage category for garages on the eastern side of the site would be Category 1 (very slight).

1.16. Void formers are to be adopted beneath the basement ground-bearing slabs. It has been confirmed in the revised BIA that ground heave outside the basement areas is expected to be small and that it will act to offset the settlements arising from wall installation and deflection.

1.17. It is recommended that an internal inspection of Lyndhurst Hall is carried out as part of the Party Wall Award to check the assumptions made in the GMA and building damage category assessments about the form and condition of the structure and finishes.

1.18. Given the need for suitably stiff propping and the correct sequencing of construction during basement construction together with a high level of construction control (including monitoring), a Basement Construction Plan (BCP) should be prepared and approved prior to work commencing on site. The BCP should include:

a) Detailed design and sequencing for temporary works noting the comments made in this audit.

b) Consideration of the impact of potential archaeological issues on the construction programme and the implications for design.

c) Confirmation of the appointment of Party Wall surveyors.

d) Proposals for excluding water from excavations and avoiding the loss of fines.

e) Confirmation of drainage proposals for the under slab voids.

f) Confirmation of proposals for monitoring and condition surveys with appropriate mitigation measures.

1.19. Queries and requests for clarification/further information which have been closed out by this audit are summarised in the Audit Query Tracker in Appendix 2.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by the London Borough of Camden (LBC) on 08 September 2015 to carry out a Category B Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 11, Rosslyn Hill, London NW3 5UL - Planning Reference 2015/2089/P.

2.2. Following first issue of a BIA in March 2015 and the receipt of a number of detailed technical queries from a number of external sources, the BIA was revised and re-issued in August 2015.

2.3. The CampbellReith audit on the re-issued BIA was carried out in accordance with the Terms of Reference set by the LBC. The audit reviewed the BIA for potential impacts on land stability and local surface and groundwater conditions arising from the proposed basement development in accordance with LBC's policies and technical procedures. The main third party issues raised regarding the initial BIA and the BIA author's responses were presented in Appendix 1 to the audit, together with further comments by CampbellReith.

2.4. Subsequent to the issue of the above audit, a number of additional technical comments were received from external sources and further revisions undertaken to the BIA. These were issued in the form of additional documentation rather than as an update to the text of the previously issued BIA. This current audit constitutes a revision to the original Campbell Reith audit, amended as necessary, to accommodate the updated information received.

2.5. A BIA is required for all planning applications with basements in the LBC in general accordance with policies and technical procedures contained within the following documents:

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

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

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

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

2.6. 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.

2.7. The BIA should evaluate the impacts of the proposed basement considering the issues of land stability, hydrology and hydrogeology via the process described within the GSD and should make recommendations for detailed design.

2.8. The LBC Audit Instruction described the planning proposal as '*Excavation to create basement extension and sub-basement plant room to east of property, demolition of single storey self-contained studio above and replacement with single storey studio as ancillary accommodation to main house, demolition and replacement of 2 x single story outbuildings above proposed basement extension to west of property*.'

The Audit Instruction noted the following:

a) The basement proposals involve a listed building and the site neighbours a listed building.

b) The site is not in an area subject to slope stability, surface water flow and flooding or subterranean (groundwater) flow constraints.

c) The application requires determination by the Development Control Committee (DCC).

d) The scope of the submitted BIA extends beyond the screening stage.

2.9. CampbellReith originally accessed the LBC Planning Portal on 15 October 2015 and examined the following reports and drawings relevant to the audit:

a) An 'Historic Building Report' prepared by Donald Insall Associates (DIA), dated March 2015 and subsequently revised and re-issued in July 2015.

b) The original BIA prepared by Alan Baxter & Associates (ABA), dated 24 March 2015 and the revised BIA, issued on 07 August 2015.

c) A ground investigation (GI) Factual and Interpretative Report prepared by Ground Engineering Ltd (GE), Ref: C13469 (included within the BIA), dated March 2015.

d) The 'Application for Planning Permission and Listed Building Consent for Alterations, Extension or Demolition of a Listed Building', dated 26 March 2015.

e) A 'Design and Access, Planning and Heritage Statement' prepared by Thomas Croft Architects (TCA), dated 2 April 2015.

f) An 'Outline Construction Logistics Plan' prepared by Paul Mew Associates (PMA), dated August 2015.

g) The following planning application drawings:

Existing Location and Site Plan.

Existing Lower Ground Floor Plan.

Existing Ground Floor Plan.

Existing Sections AA to DD.

Proposed Demolitions and Conversions Plan.

Internal Floor Area Sub-basement Plan.

Internal Floor Areas Lower Ground Floor Plan.

Internal Floor Areas Ground Floor Plan.

Proposed Lower Ground Floor Plan.

Proposed Ground Floor Plan.

Proposed Sub-basement Plan.

Proposed Sections AA to GG.

2.10. In addition to the above reports and drawings, the following technical responses to the planning application were examined as instructed by the LBC:

a) An 'Initial Appraisal of the Impacts on Lyndhurst Hall of the Proposed Basement Construction at 11, Rosslyn Hill, NW3', prepared by Corbett & Tasker, Structural Engineering (C&T), dated 27 May 2015.

b) A report entitled 'Opinion of Basement Impact Assessment for 11 Rosslyn Hill, London NW3 5UL', prepared by Geotechnical & Environmental Associates (GEA), dated 04 June 2015.

c) A report entitled '11 Rosslyn Hill, London NW3 5UL, Planning Application 2015/2089/P, 2015/2109/L', prepared by David Cooper & Co (DC&C), dated 18 June 2015.

2.11. This updated audit is based upon an examination of the following additional documents:

a) A report entitled 'Structural Engineering Note Responding to the Audit Report of the BIA by Campbell Reith Hill Dated October 2015', prepared by ABA and issued on 17 December 2015.

b) A report entitled 'Comments on Responses to ABA's Basement Impact Assessment', prepared by Geotechnical Consulting Group (GCG) and included within the above document.

c) A report entitled 'Geological & Hydrogeological Issues for Concern Arising from Planning Application 2015/2089/P, 11 Rosslyn Hill London NW3 5Ul', prepared by First Steps Ltd (FSL), dated 02 November 2015.

2.12. A very large number of objections have been lodged on the LBC portal by members of the public to the planning application but these are almost exclusively with respect to noise, vibration and loss of business which although very important matters, are subjects which lie outside the remit of this audit and therefore have not been addressed.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are the BIA author(s) credentials satisfactory?	Yes	
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	
Are suitable plans/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	
Slope and Ground Stability 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	
Hydrogeology (Groundwater Flow) Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	
Is a conceptual model presented?	Yes	
Slope and Ground Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	

Item	Yes/No/NA	Comment
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes	
Hydrogeology (Groundwater Flow) Scoping Provided? Is scoping consistent with screening outcome?	Yes	
Is factual ground investigation data provided?	Yes	
Is monitoring data presented?	Yes	Groundwater monitoring data.
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	
Is a geotechnical interpretation presented?	Yes	
Does the geotechnical interpretation include information on retaining wall design?	Yes	
Are reports on other investigations required by screening and scoping presented?	NA	No such reports were identified as being required.
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	

Item	Yes/No/NA	Comment
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	
Have the residual (after mitigation) impacts been clearly identified?	NA	
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	No	
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	Yes	
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	Yes	
Does the BIA report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	However, it is recommended that an internal inspection of Lyndhurst Hall is carried out as part of the Party Wall Award – see Appendix 1.
Are non-technical summaries provided?	Yes	

4.0 DISCUSSION

4.1. The revised BIA includes screening, scoping, site investigation and impact assessment stages as required in the LBC Planning Guidance document 'Basements and Lightwells (CPG4)', dated July 2015.

4.2. The qualifications of the authors, checkers and approvers of the revised BIA are in compliance with the requirements of CPG4.

4.3. 11 Rosslyn Hill is a Grade II listed building constructed sometime after 1770. The property comprises a three-storey detached house of load-bearing masonry construction with a lower ground floor. The lower ground floor is provided with light wells on certain elevations, extending to 1.6m or so below ground level (bgl). A vaulted cellar is located on the north-western side of the house. The building is considered to be in reasonable condition for its age and construction. Foundations to the building were noted from trial pit excavations to comprise corbelled brickwork set on concrete footings of varying thickness founded on the London Clay at depths of between 2 and 3m or so bgl.

4.4. A small detached single-storey brick-built flat-roofed building known as the 'Studio' located a short distance to the east of the main building forms part of the premises. 11 Rosslyn Hill has mature gardens with shrubs, large trees and a large grassed area to the west.

4.5. A substantial masonry building, Lyndhurst Hall (formerly Lyndhurst Chapel), is located in close proximity to 11 Rosslyn Hill (to the north-west and west) around which it partially curves. Lyndhurst Hall is also a listed building and is currently used as an orchestral recording studio. Lyndhurst Hall is a much larger building than 11 Rosslyn Hill and post-dates it.

4.6. The proposed development is to include the construction of three basements. A large 5.5m/6.5m deep 'swimming pool' basement constructed below the main building forecourt on the north-eastern side of the property (locally deepened to 7.5m bgl to house a plant room), a smaller 3.5m deep 'media' basement constructed adjacent to Lyndhurst Hall and a small 3m deep 'plant' basement at the southern extremity of the property to house central heating equipment.

4.7. British Geological Survey (BGS) Map Sheet 256 indicates ground conditions at the site to comprise possible Head Deposits (hillwash) overlying the London Clay. The north-south outcrop of the Claygate member is shown some distance to the west of the site. An infilled pond (possibly a former clay pit associated with former brick making) is indicated on historical mapping to the south of the property.

4.8. A ground investigation (GI) undertaken by GE in March 2015 comprising the sinking of 12 boreholes and 5 trial pits, identified ground conditions at the site to comprise 0.6 to 3.2m of Made Ground directly overlying the London Clay. It has been postulated by FSL that Head (as noted on the BGS mapping) may form a component of the 'identified' Made Ground, towards the base. The Head was described by FSL as ancient hillwash (potentially with pre-existing shear surfaces) derived from the Claygate and Bagshot Beds which overly the London Clay uphill from the site. Where continuous, the material was said to potentially act as a shallow aquifer. The greatest depth of 'Made Ground' was encountered in the suspected infilled former clay pit. The London Clay surface was found to generally follow the topography of the site, with a drop in level towards the south-east.

4.9. Standpipes were installed in four of the boreholes. Two of these were installed adjacent to Lyndhurst Hall and the others south-east and east respectively of 11 Rosslyn Hill. Groundwater monitoring was undertaken on five occasions during the period January to March 2015. Groundwater levels of between 0.6m to 2.95m bgl were recorded. The BIA confirms that groundwater pumping was sometimes required during trial pit excavation. Further groundwater monitoring was undertaken following the initial CampbellReith audit and although no details have been provided, ABA has confirmed that the results support the earlier observations.

4.10. Regarding topography and issues of ground/slope instability, the BIA confirms that the site is essentially level at an elevation of 79 to 80 mOD or so (having been originally benched into the locally sloping ($<7^{o}$) south-east facing hillside) and will remain so after the works. The site does not neighbour land, including railway cuttings and the like, with a slope greater than 7^{o}. On the basis of the above, there are no general slope/ground stability concerns at the site.

4.11. The BIA confirms that the London Clay is the shallowest 'natural' stratum at the site, locally overlain by Made Ground/Head as noted above. The London Clay is known to be susceptible to shrink/swell effects. Laboratory plasticity test results confirmed the clay to be of high volume change potential. Live tree roots were observed in all of the exploratory holes sunk on the site and evidence of soil desiccation up to 3.5m bgl was recorded. Nevertheless, the BIA confirms that there is no evidence of shrink-swell induced subsidence at 11 Rosslyn Hill or Lyndhurst Hall.

4.12. The BIA confirms that 11 Rosslyn Hill does not lie within 100m of a watercourse, well or potential spring line, nor within 50m of Hampstead Heath ponds. The closest known watercourses are the tributaries of the former Rivers Fleet and Tyburn. However, the tributaries are at some distance from the site and are known to have been culverted many years ago to form part of the local sewer network. The closest 'potential' spring line is that along the boundary between the London Clay and overlying Claygate Beds. However, as noted above, this strata boundary lies some distance to the west of the site. On the basis of the above, there are

no stability issues arising from the basement being located in proximity to any of the water features discussed.

4.13. The BIA confirms that the site does not lie within an aquifer (the London Clay is relatively impermeable), although there may be some water flow as a result of local sand lenses, fissures etc. The majority of groundwater flow at the site is expected to occur within the Made Ground/Head.

4.14. It is argued in the BIA that existing and also future south-easterly groundwater flows in the Made Ground/Head are/will be diverted around 11 Rosslyn Hill by the shielding effect of the sub-surface walls and foundations to Lyndhurst Hall which have been shown in trial pits to have been taken down to the London Clay. The BIA includes sketches showing current and postulated future groundwater flow directions following construction of the basements, and these are shown to be the same.

4.15. The need for dewatering during construction will be a function of the expected rate of groundwater flow through the Made Ground/Head and the transmissivity of the perimeter walling to the basements – see below regarding the forms of piling proposed. Consideration should be given during any dewatering to avoiding loss of fines from beneath adjacent buildings e.g. Lyndhurst Hall, in order to preclude any associated settlement of the foundations.

4.16. The BIA confirms that the site does not lie within 5m of a highway or pedestrian right of way or over or within the exclusion zone of any tunnels e.g. railway lines.

4.17. The proposed basements will result in a differential in foundation depths relative to 11 Rosslyn Hill and Lyndhurst Hall. However, this will be catered for by adopting suitably stiff perimeter walling to the basement excavations and stringent construction controls, backed up by movement monitoring.

4.18. Regarding surface water flows and flooding, the BIA confirms that the site does not lie within the catchment area of the ponds on Hampstead Heath and thus will have no influence on the water flow to the ponds.

4.19. With respect to the area of impermeable surfacing in the new development and changes to the route, profile or quality of surface water flows received by adjacent properties or downstream watercourses, the revised BIA has confirmed that there will be no increase in the area of impermeable surfacing and that the top of the basement roof slabs are to be set at levels which maintain the existing flow regime within the Made Ground/Head. It is proposed that there will thus be no increase or change in quality of the surface water discharged to local drainage systems.

4.20. With regard to the risk of flooding of the basement due to surface water, sewer surcharging, groundwater, canals and other artificial sources, or fluvial/tidal flooding, it is confirmed in the BIA that the proposed basement is at low risk of such flooding. The BIA shows the site not to have been directly affected during the flood events of 1975 and 2002. However, the basement should nevertheless be tanked to cope with any groundwater presence.

4.21. Concerning subterranean (groundwater) flows, the BIA confirms that the site does not lie directly above an aquifer, within 100m of a watercourse, well, pond or potential spring line, nor below a defined water table – although as noted above, there may be perched water within the Made Ground/Head. It is considered that the above, together with the hypothesised groundwater shadowing effect of the foundations to Lyndhurst Hall and the relative impermeability of the London Clay, should mean that any groundwater flow into or around the basements will be limited.

4.22. Regarding the question of whether or not more surface water than at present from rainfall will be discharged into the ground (e.g. via soakaways or SUDS), surface water will be discharged via current systems i.e. into the local sewers. The London Clay is not suitable for the adoption of SUDS.

4.23. Perimeter walls to the new basements are to comprise either contiguous or secant bored piles. Piles are to be either 600mm diameter or 450mm diameter as appropriate. The walls to the media basement immediately adjacent to Lyndhurst Hall are to be of the contiguous type as are the walls at the northern end of the swimming pool basement. All other walls i.e. those which wrap around the southern and south-western flanks of the swimming pool basement and those which enclose the plant basement are to be secant piled walls. Secant piling has been selected in the southern areas to seal off the expected greater head of groundwater arising from the increased depth to the top of the London Clay in the area of the suspected infilled former brick pit.

4.24. In order to avoid settlement of the foundations to Lyndhurst Hall due to a loss of fines, it must be ensured that there are no groundwater flows into the media basement during construction. This should be addressed in a Basement Construction Plan (BCP).

4.25. Permanent propping of all basement walls will be provided by the roof slabs and ground-bearing slabs. Temporary propping will be adopted during construction as required. It has been confirmed that a stiff propping system will be used. Basement top slabs have been set below ground level partly with a view to permitting perched water within the Made Ground to flow across the site without undue impediment as at present. The proposed sequencing of basement construction is generally outlined on sketches presented within the BIA.

4.26. Basement ground-bearing slabs will be constructed over a compressible void former to limit heave pressures following excavation. A granular drainage layer will also be provided to prevent the build-up of groundwater pressures on the underside of the slabs. Water from the drainage layers will be pumped (presumably) into the local sewers. Water quantities are expected to be small. This should be confirmed.

4.27. The foundations to 11 Rosslyn Hill will be locally underpinned with mass concrete in areas of closest proximity to the new basements.

4.28. Preliminary calculations have been provided in the updated (current) BIA for the reinforced concrete (RC) design of the various basement perimeter retaining walls. Groundwater level for all basements has been taken as 0.5m bgl. This is conservative and does not rely on any consideration as to whether or not the foundations to Lyndhurst Hall act as a barrier to groundwater flow. Account has been taken of the surcharge to the media basement walls arising from the Lyndhurst Hall foundations.

4.29. Soil pressures have been derived assuming 'at-rest' conditions. This is appropriate for the high stiffness propping system that will be adopted for the perimeter walling. However, the comment by FSL that the Head Deposits which may lie towards the base of the 'Made Ground' may contain pre-existing shear surfaces should be considered in the evaluation of retaining wall pressures. Although the effects of any such shear surfaces on wall pressures should be addressed by the stiff propping system proposed for the basement walls, the sensitivity or otherwise of the design to such shear surfaces should be considered in the BCP.

4.30. The adoption of a simply supported beam model where the piles span between upper and lower basement slab levels (assuming no moment restraint) is simplistic, but is probably conservative for reinforcement design purposes. More sophisticated calculations would be expected for detailed design. It should be noted that the pile calculations have not been checked in detail as this falls outside the remit of the audit process.

4.31. With regard to GMA, calculations of the horizontal and vertical movements (settlements) at ground level arising from construction of each of the 3 basements have been undertaken in general accordance with the empirical methodology outlined in CIRIA C580 amended in accordance with the recommendations of Ball, Langdon and Creighton as published in Ground Engineering, September 2014. Calculations have been undertaken of ground movements due to both pile installation and pile deflection consequent upon basement excavation.

4.32. Predictions of the possible damage category for elements of Lyndhurst Hall and 11 Rosslyn Hill consequent upon the induced ground movements have been undertaken in accordance with the further recommendations of CIRA C580, except for the main hall and some other parts of Lyndhurst Hall, where the complexity or nature of the structure does not lend itself to the CIRIA

C580 simplified approach which is intended for plain wall type structures. In these cases, an engineering evaluation (based on available drawings) has been made of the significance to the structure of the predicted ground movements.

4.33. The calculations indicate the predicted damage category for both 11 Rosslyn Hill and Lyndhurst Hall to be Category 0 (negligible) and that the damage category for garages on Haverstock Hill on the eastern side of the site would be Category 1 (very slight).

4.34. Given that void formers are to be adopted beneath the basement ground-bearing slabs, ground heave will occur as a result of basement excavation, both within the footprint of the basements and outside them. It has been confirmed in the revised BIA that ground heave outside the basement areas is expected to be small and that the effect on the surrounding buildings will not be a cause for concern. Ground heave will act to offset the settlements arising from wall installation and deflection.

4.35. Although currently predicted ground movements for LyndHurst Hall are generally small, given the complexity of the building and in particular, the main hall and although the available drawings are believed by ABA to be a good representation of the as-built construction, it is recommended that an internal inspection of Lyndhurst Hall is carried out as part of the Party Wall Award to check the assumptions made in the GMA and building damage category assessments about the form and condition of the structure and finishes.

4.36. A preliminary construction management plan (CMP) has been submitted with the planning documents. However, given the need for suitably stiff propping and the correct sequencing of construction during basement construction together with a high level of construction control (including monitoring) so as to limit ground movements and any associated damage to Lyndhurst Hall or 11 Rosslyn Hill, a BCP should be prepared and approved prior to work commencing on site. The BCP should include contingency provisions in case movements indicate the likely exceedance of predicted values. It is essential that the designer's requirements are fully specified in the BCP so that the contractor is fully aware of the levels of compliance required.

4.37. Potential archaeological issues should be catered for in the BCP so that the timing of wall propping is not compromised.

5.0 CONCLUSIONS

5.1. The revised BIA includes screening, scoping, site investigation and impact assessment stages as required in the LBC planning Guidance document 'Basements and Lightwells (CPG4)' dated July 2015.

5.2. The qualifications of the authors, checkers and approvers of the revised BIA are in compliance with the requirements of CPG4.

5.3. Ground conditions at the site comprise Made Ground directly overlying the London Clay. Head (comprising ancient hillwash) may form a component of the identified Made Ground, towards the base. This material may contain pre-existing shear surfaces. Where continuous, the Head may act as a shallow aquifer.

5.4. The BIA confirms that there is no evidence of shrink-swell induced subsidence at 11 Rosslyn Hill or Lyndhurst Hall.

5.5. Groundwater monitoring was undertaken during the period January to March 2015. Groundwater levels of between 0.6m to 2.95m bgl were recorded. Further groundwater monitoring undertaken following the initial CampbellReith audit supports the earlier observations.

5.6. A groundwater model is postulated in the BIA where it is argued that existing and also future south-easterly groundwater flows in the Made Ground/Head are/will be diverted around 11 Rosslyn Hill by the shielding effect of the sub-surface walls and foundations to Lyndhurst Hall.

5.7. Consideration should be given during any dewatering to avoiding loss of fines from beneath adjacent buildings e.g. Lyndhurst Hall, in order to preclude any associated settlement of the foundations. Consideration should be given to adopting secant piling in lieu of contiguous piling for the media basement piles.

5.8. Basement top slabs have been set below ground level partly with a view to permitting perched water within the Made Ground to flow across the site without undue impediment, as at present.

5.9. The proposed basements will result in a differential in foundation depths relative to 11 Rosslyn Hill and Lyndhurst Hall. However, this will be catered for by adopting suitably stiff perimeter walling to the basement excavations and stringent construction controls, backed up by movement monitoring.

5.10. The foundations to 11 Rosslyn Hill will be locally underpinned with mass concrete in areas of closest proximity to the new basements.

5.11. Preliminary calculations have been provided for the RC design of the various basement perimeter walls and the assumptions made with respect to soil, surcharges and groundwater are accepted. The adoption of a simply supported beam model for basement pile design is simplistic, but is probably conservative for reinforcement design purposes. More sophisticated calculations would be expected for detailed design. The sensitivity of wall design to pre-existing shear surfaces within the lower Made Ground/Head should also be assessed at detailed design stage.

5.12. Calculations of the horizontal and vertical movements (settlements) at ground level arising from construction of each of the 3 basements have been undertaken together with predictions of the possible damage category for elements of Lyndhurst Hall and 11 Rosslyn Hill. The calculations indicate the predicted damage category for both 11 Rosslyn Hill and Lyndhurst Hall to be Category 0 (negligible) and that the damage category for garages on the eastern side of the site would be Category 1 (very slight).

5.13. It has been confirmed in the revised BIA that ground heave outside the basement areas is expected to be small and that the effect on the surrounding buildings will not be a cause for concern. Ground heave will act to offset the settlements arising from wall installation and deflection.

5.14. It is recommended that an internal inspection of Lyndhurst Hall is carried out as part of the Party Wall Award to check the assumptions made in the GMA and building damage category assessments about the form and condition of the structure and finishes.

5.15. Given the need for suitably stiff propping and the correct sequencing of construction during basement construction together with a high level of construction control (including monitoring), a BCP should be prepared and approved prior to work commencing on site. The BCP should include contingency provisions in case movements indicate the likely exceedance of predicted values.

Appendix 1: Technical Queries & Responses

Technical Queries Raised on the Various BIA Submissions plus ABA Responses & CampbellReith Audit Comments

Company Name & Dates	N°	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
A) Corbett & Tasker Structural Engineering (C&T)	1 (a)	The structure of Lyndhurst Hall appears to comprise a combination of load-bearing masonry and steel framing with timber and concrete floors and corbelled brick foundations. In some areas, the foundations are supported on mass concrete strip footings, possibly the result of underpinning. There is a 27m high vaulted roof structure over the main studio within Lyndhurst Hall, supported on masonry walls inlaid with fragile stained-glass windows.	The hall roof structure is not vaulted but comprises iron trusses with timber purlins and rafters. The ceilings are suspended below this structure.	No comment.	'Vaulting' refers to the roof shape and not the material adopted in construction. A thorough survey of the nature and condition of the hall structure is required and also a GMA and structural damage assessment. The plasterwork is brittle and susceptible to movement induced damage.	The roof to Lyndhurst Hall main hall comprises iron trusses supported on six equally spaced masonry piers. The plaster ceiling suspended below the trusses has been formed to a vaulted design. The adjacent stairwell to the east is a robust cellular masonry structure. A GMA has shown that the roof piers generally lie outside the predicted zone of likely ground movement consequent upon basement construction. The stairwell lies within it. Drawing 1693/01/332 shows CIRIA C580 predicted horizontal and vertical movements to the eastern-most roof supports to be small, with slightly larger movements predicted for the stairwell. The above movements are significantly less than (the expected) seasonal movements.	It is recommended that an internal inspection of Lyndhurst Hall is carried out as part of the Party Wall Award to check the assumptions made about the form and condition of the structure and finishes.
	2 (b)	Very limited consideration is given within the BIA to the special form of construction of Lyndhurst Hall and its susceptibility to damage from ground movement. No internal inspection has been made of the building and there are no studies within the BIA of the hall's construction or a full assessment of the impact of the proposed basement construction on its structural fabric.	A study of the construction of Lyndhurst Hall based on an examination of available original architect's drawings shows the (main) building to comprise load-bearing masonry walls founded on strip footings bearing on the London Clay. External walls are heavily buttressed and robust. Brickwork is constructed with lime mortar and hence is more tolerant of movement than modern forms of construction. The building is in good condition. The building is not particularly susceptible to ground movement induced damage and will not be adversely	ABA should confirm the appropriateness of the building damage assessment methods adopted for Lyndhurst Hall and advise whether further investigation of the structure is required.	The studies undertaken are noted. However, the historical architectural drawings should be corroborated by reference to accurate and current 'as-built' drawings. The large clear spans, triple-height walls (in places unbraced by intermediate floors), the historic glazing and other brittle finishes make this structure more 'sensitive' to movement than those braced with cross-walls and intermediate level floors. Up to date information on the building structure is not readily	The concept of 'as-built' drawings is a modern one and such drawings would not have been made at the time the building was constructed. The available drawings of Lyndhurst Hall are considered to provide a good record of the building. Where foundations have been investigated, they have been found to be as shown on the drawings. The parts of Lyndhurst Hall described by C&T (the main hall) are outside the predicted zone of	It is recommended that an internal inspection of Lyndhurst Hall is carried out as part of the Party Wall Award to check the assumptions made about the form and condition of the structure and finishes.

Company Name & Dates	N°	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
			affected.		available and would need to be obtained from additional surveys and data gathering.	ground movements arising from basement construction.	
	3 (c)	No 'Structural Stability Assessment' is included in the BIA (for Lyndhurst Hall) as required by Clause 2.41 of Camden Planning Guidance document CPG4 for basements in close proximity to listed buildings.	A structural stability assessment was undertaken for both Lyndhurst Hall and 11 Rosslyn Hill. It was concluded that the form of construction of the buildings is such that there are no significant issues arising from the proposed basement construction. An assessment of the impact of the proposed basement construction on Lyndhurst Hall shows the anticipated impact to fall well within the requirements stipulated in LBC planning policy.	The GMA and building damage assessment undertaken assume stringent construction and quality controls and rigorous monitoring set against rationally designed trigger levels. There should also be contingency provisions in place should on-going movements indicate the likely exceedance of predicted values. It is essential that the designer's requirements are fully specified in the contract documents for the works so that the contractor is fully aware of the levels of compliance required.	The required 'Structural Stability Assessment' is an additional requirement over and above a building crack width assessment. The Structural Stability Assessment which has been undertaken by ABA has not been seen by C&T. In the absence of an internal inspection of Lyndhurst Hall by ABA and in the absence of a study of 'as-built' drawings, such an assessment must be considered incomplete.	Access to Lyndhurst Hall has not been granted. However, a good understanding has been gained of the structural arrangement of the hall. Predicted movements of the hall are minor.	The LBC requirements regarding the undertaking of a 'Structural Stability Assessment' should be clarified by ABA and any residual compliance issues over and above the work already undertaken should be addressed. It is recommended that an internal inspection of Lyndhurst Hall is carried out as part of the Party Wall Award to check the assumptions made about the form and condition of the structure and finishes.
	4 (d)	No drawings of Lyndhurst Hall are provided in the BIA and no sections provided showing the relationship between the proposed basements and the hall. Approximate section sketches (with notes) through the hall and the media and swimming pool basements have been drawn which show possible issues and conflicts between the new and existing structures.	Drawings are provided in the revised BIA which show the structural arrangement of Lyndhurst Hall and the relationship between the hall and the proposed basements. C&Ts sketches suggest possible existing underpinning to the footings of Lyndhurst Hall. However, the original building plans clearly show that the walls were constructed on mass concrete strip footings. This is consistent with the findings of the (single) trial pit excavated adjacent to the footings of Lyndhurst Hall recorded in the BIA.	It should be confirmed whether or not drawing information for Lyndhurst Hall is based on as-constructed details or design details.	The drawings which have been provided are noted. The findings of a single trial pit cannot be considered to be representative of the whole of Lyndhurst Hall. It is understood that Lyndhurst Hall has been modified many times and that underpinning has been undertaken at certain locations. The historical drawings provided by ABA are not representative of the current situation and are misleading. There appears to be a potential conflict between the media basement and the footings to Lyndhurst Hall. A drawing is	Three further trial pits have been excavated along Lyndhurst Hall to confirm footing details/depths. Foundation details are in accordance with expectations, based on the historical drawings – corbelled brick footings sitting upon mass concrete strip foundations, bearing on London Clay. This gives a high level of confidence that the record drawings are an accurate representation of the building construction. No underpinning was encountered. Any further comments on the layout of Lyndhurst Hall would require the supply of drawings clarifying where existing arrangements are believed to differ from the record drawings or for access to be granted to the	The correspondence between the revealed footing details and the historical drawings is encouraging but is not direct evidence of a correspondence between the internal building structure and the original drawings. It is recommended that an internal inspection of Lyndhurst Hall is carried out as part of the Party Wall Award to check the assumptions made about the form and condition of the structure and finishes.

Company Name & Dates	N°	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
					required to clarify this.	building to permit an internal inspection to be made. It is considered that there is adequate clearance between the media basement and the footings to Lyndhurst Hall.	
	5 (e)	The BIA movement predictions and crack assessments using the Burland scale are based on the methodology set out in CIRIA C580. However, no account has been taken of likely ground movements on the stability or cracking of the triple-height vaulted roof to Lyndhurst Hall. The results of an approximate (vertical & horizontal) assessment have been sketched. It is well known that the Burland damage assessment procedure cannot be used in isolation as measure of possible property damage.	The roof structure to Lyndhurst hall is not vaulted. The closest masonry pier supporting the roof is some 14m from the proposed swimming pool basement. Ground movements predicted at this distance are very small and will have negligible impact on the roof support structure. The ground movement profiles provided by C&T are mis-leading in that they are consistent with an unpropped excavation, whereas a top down construction methodology is proposed for the swimming pool basement where the roof slab will act as a very stiff high level prop.	The swimming pool basement is shown on the BIA sequence drawings to be constructed by top down methods at the north-western end only.	The term 'vault' refers to the shape rather than the form of construction. It is reiterated that crack widths are only one aspect of degree of damage.	Ground movements of the main hall to Lyndhurst Hall adopting the CIRIA C580 approach to GMA are predicted to be small. Consultations with Geotechnical Consulting Group (GCG) have indicated that: a) The CIRIA C580 approach to GMA gives an upper bound result and that a more sophisticated analysis would be likely to result in a reduction in predicted movement and, b) A Burland damage category assessment is only relevant to a structure than can be considered to be equivalent to a plain masonry wall. ABA notes that ground movements in the hall area are predicted to be very small to zero.	It is agreed that crack widths are not the only aspect of building response to be considered. Additional considerations are building configuration, condition and sensitivity - ABA have acknowledged this in their updated calculations/appraisals. The Burland plain wall model does not in general apply to the main hall of Lyndhurst Hall, although it probably does apply to the adjacent stairwell. The model is also most likely not appropriate for some of the other walls within the building – again, ABA are aware of this. It is recommended that an internal inspection of Lyndhurst Hall is carried out as part of the Party Wall Award to check the assumptions made about the form and condition of the structure and finishes.
	6 (f)	Only one trial pit was dug to ascertain the foundations to Lyndhurst Hall and the results assumed to be representative of the entire building frontage. A single pit is however unlikely	The trial pit was excavated at the location of the proposed media basement and the results are consistent with the record drawings of the footing arrangements to Lyndhurst Hall.	Given the important structural and potential hydrogeological, implications, it is recommended that the footing details to Lyndhurst Hall facing the site are	The foundation exposure at a single location is unrepresentative. The existing drawings are architect's proposals and not 'as-built' drawings. On this basis, more survey work is	Further trial pits have been excavated along the main east-facing elevation of Lyndhurst Hall. This confirms the validity of the historical drawings with respect to	No comment.

Company Name & Dates	N°	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
		to be typical. It is understood that Lyndhurst Hall was partially underpinned during the conversion works in the early 1990s and that in some areas, there are basements, resulting in foundations being of various depths throughout the building.	It is not necessary to undertake investigations to confirm every detail of the existing foundations. There is now a good level of confidence as to the footing depths etc. Based on the available drawings, the only works possibly entailing underpinning were those related to the installation of a lift pit between Lyndhurst Hall and Lyndhurst cottage on the opposite side of the hall to N° 11 Rosslyn Hill. A basement forms part of the original building on the opposite side of the hall (west) to N° 11 Rosslyn Hill. There will inevitably be variable foundation depths within the building.	confirmed by further trial pitting. No comment.	required. No comment.	footing profiles. No comment.	No comment.
	7 (g)	The foundations to Lyndhurst Hall will strongly influence the design and construction of the adjacent media basement and require more extensive consideration in the BIA. Where the foundations to Lyndhurst Hall are more shallow, they may not form a barrier to water flow through the Made Ground under the Hall as postulated in the BIA. Underground features should be properly considered in the location, design and construction of the new basement. A section is provided which shows the existing foundations and proposed media basement which suggests that the basement is too close to Lyndhurst Hall.	The footing depths shown on the original Lyndhurst Hall drawings together with the trial pit information are consistent with the footings being founded on the London Clay. It is inconceivable that the architect for Lyndhurst Hall would have founded the building within the overlying Made Ground. The good condition of the building after 130 years affirms that. Based on the above founding depths, Lyndhurst Hall must act as a cut-off to perched water as described in the BIA. The section produced by C&T is incorrect. There will be no clash between the proposed construction and the hall footings. The correct relationship between the existing footings and the proposed construction is shown in the revised BIA.	See above comments regarding further trial pitting.	Accurate and thorough surveys must be used to confirm the drawing records for Lyndhurst Hall to inform proposed basement layouts and details. Accurate 'as- built' survey drawings will be required.	Further trial pits have been undertaken as noted above.	No comment.

Company Name & Dates	N°	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
	8 (h)	Perimeter wall design in the BIA is very basic and only assumes a 10kN/m^2 surcharge. This is significantly lower than the likely ground pressure beneath the foundations to Lyndhurst Hall and which will provide a lateral surcharge load to the nearby basement. A pile design was undertaken for a 600mm diameter contiguous piled wall whereas the media basement walls are shown to be 450mm diameter. Deflections were not calculated, either for the short term or the long-term.	The typical retaining wall calculations provided in the original BIA (and reproduced in the revised BIA) were specifically for the swimming pool basement. It is not a requirement of planning to include calculations for all elements of a project. This is undertaken at detailed design stage. However, additional calculations have now been included for the media basement walls in response to C&Ts comments. Detailed calculations considering long-term effects are not required at planning stage.	The BIA should make it clearer as to which calculations refer to which structure. Indicative calculations are required for all the various retaining wall situations. Consistent soil parameters and ground conditions are to be assumed.	The additional calculations are noted. More detailed calculations, drawings and method statements are required to fully understand the structural movements of the basement walls and the impact on Lyndhurst Hall.	The level of calculation detail provided is in line with LBC planning policy. However, because of comments received, additional calculations have now been provided to cover other basement walls.	Account has been taken in the revised calculations of the surcharge to the media basement walls arising from the Lyndhurst Hall foundations. The current basement perimeter wall calculations are very simplistic, but probably conservative with respect to reinforcement provision. More sophisticated calculations would be expected for detailed design. The sensitivity of wall design to pre-existing shear surfaces within the lower Made Ground/Head should be assessed at detailed design stage.
	9 (i)	Structure and ground movements arising from basement construction are highly dependent on the quality of workmanship and the construction methodologies employed by the contractor. Horizontal movements are most damaging and one way to control this is to ensure that the wall is sufficiently stiff and adequately propped.	A high stiffness propping system will be used in combination with high levels of site supervision to control workmanship and construction methodology.	As noted above, it is essential that the designer's requirements are fully specified in the contract documents for the works so that the contractor is fully aware of the levels of compliance required.	A detailed construction methodology is critical to the success or failure of the project. Further details of the propping are required.	A detailed construction methodology will be developed at detailed design stage in accordance with standard practice.	No comment.
	10 (j)	The BIA provides very little information on the quality of workmanship that will be employed during construction of the basements, nor on the propping arrangements. No information is given on ground movement monitoring or monitoring of Lyndhurst Hall	The end-section of the swimming pool basement is to be constructed using top-down construction methods as shown in the construction sequence within the BIA. Initial proposals for the propping to the media basement are also shown. The monitoring arrangements will be confirmed	Again, as noted above, it is essential that the designer's requirements are fully specified in the contract documents for the works so that the contractor is fully aware of the levels of compliance required.	Further details of the proposed monitoring are required.	Monitoring requirements and details will be agreed as part of the Party Wall process.	No comment.

Company Name & Dates	N^{o}	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
		for movement.	as part of the Party Wall agreement.				
	11 (k)	Extended construction periods increase the risk of ground movements. Archaeological findings could give rise to such extended construction periods and hence a greater risk of ground movement.	Any archaeology will be within the Made Ground i.e. at shallow depth.	Potential archaeological issues should be catered for in the construction plan so that the timing of propping is not compromised.	The discovery of archaeology will be likely to prolong the construction period and hence increase project risks and costs.	Further archaeological investigations are being undertaken and will be reported separately by Pre-Construct Archaeology Ltd (PCA).	Potential archaeological issues should be catered for in the construction plan so that the timing of propping is not compromised.
	12 (l)	The media basement as shown on drawings in the BIA is too close to Lyndhurst Hall and will be very difficult to construct due to potential undermining of the foundations to the hall for which the founding levels are uncertain – see sketch.	The C&T sketch showing the foundation arrangements is mis-leading as it does not show the mass concrete footings to the hall (verified by trial pit excavation) and their depth below ground level.	The C&T sketch also does not show the piled wall as extending from ground level. See above comments on the need for further exploration and foundation verification.	The media basement is most likely too close to Lyndhurst Hall and should be located further away.	It is confirmed that the current basement location is OK.	No comment.
	13 (m)	The BIA movement predictions are understood to be based on limited data, uncorroborated by numerical analysis and thus are indicative only with the risk that actual movements may be higher.	The CIRIA C580 approach adopted is an industry standard approach and provides a conservative estimate of movements.	However, the method assumes good quality workmanship and good construction control. As noted above, this must be conveyed to the contractor.	Numerical analysis is required to fully understand the effects of ground movement on Lyndhurst Hall.	GCG have said that the CIRIA C580 approach to GMA gives an upper bound result and that a more sophisticated analysis would be likely to result in a reduction in predicted movement.	No comment.
	14	Based on first hand testimony regarding the refurbishment works undertaken at Lyndhurst Hall in the early 1990s, a very significant flow of water was encountered during construction of the basement and lift pit, requiring the installation of a 1.2m diameter dewatering well to 5.5m below ground floor level. This well is still being pumped today. It was postulated at the time that the water inflow may have been attributable to the River Fleet and/or due to a period of heavy rainfall at the time of excavation.	The course of the former River Fleet is some 400m to the east of the site. A drain carrying rainwater from the roof adjacent to the lift pit location may have been the source of the water described. Nevertheless, the lift pit is on the opposite side (west) of Lyndhurst Hall to the proposed media basement (and N^{O} 11 Rosslyn Hill). It is postulated that a groundwater build-up could exist on the upstream side of Lyndhurst Hall arising from the cut-off to groundwater flow caused by the	It is recommended that further groundwater monitoring is undertaken to confirm hydrogeological conditions.	Further hydrological studies and groundwater monitoring are required to confirm hydrological conditions.	Additional groundwater monitoring has been undertaken. The monitoring has confirmed that groundwater is diverted around Lyndhurst Hall by the foundations, creating a 'shadow' effect immediately to the south.	Basement wall design is not dependent upon a complete understanding of the groundwater flow regime to the south of Lyndhurst Hall as all walls have now been designed assuming a groundwater level of 0.5m bgl. Basement top slabs have been set below ground level partly with a view to permitting perched water within the Made Ground to flow across the site without undue impediment.

Company Name & Dates	N°	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
			sub-surface walls and footings.				
	15	Based on the groundwater flows experienced during construction of the lift shaft at Lyndhurst Hall, it is concluded that the site hydrology is far more complicated than assumed in the BIA, where groundwater flows are assumed to be around Lyndhurst Hall rather than under it. A more detailed study is considered necessary to fully understand the effects of the proposed basements on Lyndhurst Hall and 11 Rosslyn Hill, including the identification of the source of the above water and measurement of the flow rate.	Comprehensive site investigation and groundwater monitoring undertaken to inform the BIA do not indicate the groundwater regime at the site to be complex.	The presence or otherwise of significant subterranean flows which could be impacted by the basements should be confirmed. It is recommended that further long-term groundwater monitoring is undertaken to confirm hydrological conditions. This may mean that extra standpipes should be installed to the north of Lyndhurst Hall.	As above.	As above.	As above.
B) Geotechnical & Environmental Associates (GEA)	0	The CIRIA C580 methodology adopted in the BIA to assess ground movements is considered too simplistic given that excessive ground movements would have a significant impact on Lyndhurst Hall.	No comment made, but see earlier comment that the CIRIA C580 approach adopted is an industry standard approach and provides a conservative estimate of movements.	See above.	No comment.	No comment	No comment.
	1	A structural assessment of Lyndhurst Hall should be undertaken as required by Clause 2.41 of Camden Planning Guidance document CPG4 to address the potentially sensitive nature of the hall to movement.	A detailed desktop study has been undertaken of Lyndhurst Hall and its history, supplemented with visual observations (external) and physical investigations to develop an understanding of the structure and condition of the hall. Although access to the building has not been granted, it is considered that the assessment	Note the above comments as to the complicated structural form of Lyndhurst Hall and also the recommendations for further exploratory investigation of footing depths.	See above.	No comment	No comment.

Company Name & Dates	N°	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
			undertaken is sufficient to ensure that basement design is of a high standard and is appropriate for the site.				
	2	The construction sequence provided in the BIA provides a brief overview of site operations rather than a detailed stage by stage excavation plan. A construction sequence should be included in the BIA where all excavation stages are defined by level and extent.	The information provided in the BIA is appropriate for planning purposes and will be developed in more detail as the design develops.	See comments above regarding the need for the contractor to be made fully aware of the need for a high level of construction control etc.	ABA's comments are noted but a more detailed pile design would have been expected, given the importance of Lyndhurst Hall.	It is not considered by GCG to be necessary to undertake a more detailed pile analysis at this stage. It is considered by GCG that given the relative positions of the different parts of the proposed basement, the sequence of operations is unlikely to have an effect on Lyndhurst Hall.	Provided the principle of installing propping of sufficient stiffness in a timely manner is made clear at all stages of development of the method statement (ABA to check), it is agreed that the finer aspects of the methodology to be followed will form part of detailed design.
	3	Consideration does not appear to have been given to the temporary works required to maintain the stability of Lyndhurst Hall while the piling matt is prepared.	The external walls to Lyndhurst Hall are of thick load-bearing masonry founded well below piling mat (existing ground) level. Piling rigs will be of modest scale.	No comment.	No comment.	No comment.	No comment.
	4	A single trial pit has been excavated to determine the nature and depth of the foundations to Lyndhurst Hall. Further ground exploration should be undertaken to ascertain the nature of the foundations to Lyndhurst Hall fronting the basements.	Desk study information is now provided in the revised BIA showing the footing arrangements (size and depth) for Lyndhurst Hall.	See above comments regarding further ground investigation.	No comment.	No comment.	No comment.
	5	The simply supported beam model as adopted in the BIA is considered wholly inadequate (for the design of the piles to the media basement). The surcharges arising from the Lyndhurst Hall foundations should be incorporated.	The wall calculations included within the BIA did not cover the walls to the media basement. A calculation to cover this is now included in the revised BIA (including surcharge effects). A more detailed analysis than that undertaken is not appropriate at planning stage.	No comment.	The level of detail to be provided should be such as to demonstrate that the proposals will not cause harm.	It is considered by GCC that a more detailed analysis is not necessary other than to justify a reduction in predicted ground movements from those derived from the application of the CIRIA C580 methodology. The size of pile and reinforcement provision have no real significance in terms of buildability or movement assessment. The most significant factor is the sequence	Account has been taken in the revised calculations of the surcharge to the media basement walls arising from the Lyndhurst Hall foundations. The current basement perimeter wall calculations are very simplistic, but probably conservative with respect to reinforcement

Company Name & Dates	N°	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
						of propping and excavation.	provision. More sophisticated calculations would be expected for detailed design. The sensitivity of wall design to pre-existing shear surfaces within the lower Made Ground/Head should be assessed at detailed design stage. ABA to ensure that propping and the sequencing of excavation and construction of all basements is sufficiently robust so as to limit ground movements to acceptable values.
	6	A full soil/interaction type of analysis (long and short-term) is required of the basement construction sequence e.g. WALLAP to ascertain bending moments etc. and wall deflections. The predicted movements should then be used to inform the assessment of wall stiffness category in CIRIA C580 so that the most appropriate ground movement curves are adopted to predict ground movement outside the basement excavation.	The level of detail described by GEA goes beyond that required at planning stage and is a matter for detailed design. Irrespective of the output of any analyses, the proposal is to use high stiffness props to support the basement walls in both the temporary and permanent cases.	No comment.	Lyndhurst Hall is a sensitive building and it would be appropriate to justify the stiffness category to be adopted in nearby basement construction. A high stiffness wall would be expected. More detailed analysis would permit the optimisation and categorisation of wall stiffness and for ground movements to be ascertained directly rather than adopting the CIRIA C580 charts.	It is confirmed by GCG that a high stiffness propping system is required in all basements to safeguard Lyndhurst Hall and 11 Rosslyn Hill.	No comment.
	7	The maximum heave movements within and surrounding the basement due to net unloading should be calculated. Total expected movements should be used to derive likely building strains to prove the acceptability of the design. If the design is not acceptable, it will have to be revaluated e.g. the use of	The proposal is to use high stiffness props to support the basement walls. Detailed calculations are unnecessary as it would not be appropriate to use propping which does not achieve this.	ABA appear possibly to have misunderstood the question which it is believed was referring to heave and long-term swelling movements arising from vertical stress relief following bulk excavation of the basements.	As above.	As above.	A void former is currently proposed below all basements allowing for 50mm of heave to occur. ABA has confirmed that ground heave outside the basement areas is expected to be small and that the effect on surrounding buildings will

Company Name & Dates	N°	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
		different propping arrangements or piles.					not be a cause for concern.
	8	Monitoring requirements are to be defined. The minimum requirements are considered to comprise the installation of inclinometers within all piles and precise levelling and 3D monitoring of Lyndhurst Hall. The BIA is to include contingency measures should movements be greater than predicted.	Detailed monitoring, trigger levels etc. will be subject to agreement under the Party Wall act. However, it is confirmed that external wall elevations to Lyndhurst Hall and basement walls will be monitored for movement in all directions throughout basement construction against pre-set trigger levels.	See comments above regarding the need for the contractor to be made fully aware of the need for a high level of construction control etc.	The ABA response is considered to be reasonable.	No comment.	No comment.
	9	There is a need for a Construction Management Plan as per the requirements of Camden Planning Guidance document CPG4 in relation to existing buildings.	It is expected that this will form a condition to planning consent being given.	It is considered that a Construction Management Plan is necessary.	The ABA response is considered to be reasonable.	No comment.	No comment.
	10	Groundwater has been measured as being as shallow as 0.5m bgl but the designs do not appear to address this, particularly for the temporary works to prepare the piling area close to Lyndhurst Hall. The choice of contiguous rather than secant piles adjacent to Lyndhurst Hall is questioned given the high groundwater level and the possibility of groundwater inflow and the loss of fines, potentially leading to settlement.	The nature and depth of the foundations to Lyndhurst Hall have been shown in the BIA to act as a barrier to flow resulting in low groundwater levels on the downstream (N° 11 Rosslyn Hill) side. Secant piled walls are adopted for basement construction to the south of the site outside the Lyndhurst Hall cut-off influence zone.	See above comments regarding further ground investigation.	It is considered that ABA may be making generalised assumptions regarding the extent to which groundwater flow is cut off by Lyndhurst Hall. Standpipe measurements confirm the presence of ground water at the site and this should be considered in design.	No comment.	ABA has confirmed that all basements have been designed assuming groundwater at 0.5m bgl. This is likely to be conservative. ABA should give consideration to the possibility of groundwater inflow into the basement excavation in the short term and a loss of fines, potentially leading to settlement of Lyndhurst Hall.
	11	In summary, detailed design will need to be undertaken together with monitoring before during and after construction by a reputable contractor. A structural appraisal of the hall will need to be undertaken as part of	No comment.	See comments above regarding the need for the contractor to be made fully aware of the need for a high level of construction control etc.	No comment.	No comment.	No comment.

Company Name & Dates	N°	Technical Queries Raised on 1st BIA Issue (27/05/15 & 04/06/15)	Alan Baxter & Associates (ABA) Responses in Revised BIA to Technical Queries Raised on 1st BIA Issue (07/08/15)	CampbellReith 1st Audit Comments on Technical Queries Raised on 1st BIA Issue & ABA Responses (19/10/15)	Further Technical Queries Raised (Although pre-dating the audit, these further queries were not available to CampbellReith at the time of the 1st audit and were therefore not assessed) (05/10/15)	Alan Baxter & Associates (ABA) Responses to Further Technical Queries Raised (17/12/15)	CampbellReith 2nd Audit Comments on All Queries Raised to Date & Further ABA Responses (04/02/16)
		the baseline study.					
	12	It is considered that the BIA has not taken adequate cognisance of the presence of Lyndhurst Hall which is immediately adjacent to one of the basements (the media basement). As such, it has not adequately addressed the impacts of the basement which is the key aim of a BIA.	No comment.	BIA now revised to more clearly address Lyndhurst Hall.	No comment.	No comment.	No comment.

Note: The above comments are not direct quotations nor numbered exactly as per the original documents, although the order of comments has been preserved. The comments are a summary of the points made under the various headings. Reference should be made to the original documents for an exact record of the various submissions.

CampbellReith
consulting engineers

Appendix 2: Audit Query Tracker

Audit Query Tracker

	Subject	Query	Status	Date closed out
1	BIA	Qualifications of retaining wall design checkers to be confirmed.	Closed. This issue has been resolved.	04/02/16
2	Hydrogeology	The presence or otherwise of groundwater flow across the site is to be confirmed. If potential impacts are identified, additional long-term groundwater level monitoring should be undertaken within the existing standpipes at the site for the purpose of confirming groundwater levels and flow directions.	Closed. Additional trial pits have been undertaken and have verified that the footings to Lyndhurst Hall bear directly on the London Clay and therefore act as a barrier to groundwater flow. Additional groundwater monitoring has been undertaken. The monitoring has confirmed generally low groundwater levels at the site and is said to support the groundwater model previously established of local groundwater flow being diverted around Lyndhurst Hall.	04/02/16
3	Hydrogeology/Stability	Further trial pit investigation should be undertaken to confirm the founding depths along the Lyndhurst Hall frontage facing 11 Rosslyn Hill.	Closed. Additional trial pits have been undertaken as noted above. The information confirms the foundation details to Lyndhurst Hall to be as expected based on the record drawings i.e. corbelled brick footings on mass concrete foundations.	04/02/16
4	Hydrogeology/Stability	GI exploratory locations to be confirmed.	Closed. The GI location plan and section drawings (including key plans) have been amended to show revised numbering for some of the exploratory points. It is assumed that these are now correct.	04/02/16
5	Hydrogeology/Hydrology	It is not clear how groundwater from the new land drains leading from the southern light wells to 11 Rosslyn Hill is to be disposed of. This matter should be addressed.	Closed. These land drains have now been deleted from the scheme.	04/02/16
6	Ground Stability	The need or otherwise for a compressible sub-slab void former beneath the basement	Closed. It is now confirmed that a 100mm thick void former will be adopted below the ground-	04/02/16

	Subject	Query	Status	Date closed out
		ground-bearing slabs should be clarified.	bearing slabs in all basements. This will be reviewed at detailed design stage.	
7	Stability	Outline wall designs should be included for the two-storey section of basement to accommodate the swimming pool plant room. Also, for the plant basement to the south of 11 Rosslyn Hill.	Closed. Calculations have now been included for the perimeter walls to all basements. Although probably conservative (but see comments on checks required for pre-existing shear surfaces) these are simplistic and will have to be refined at detailed design stage.	04/02/16
8	Stability	Groundwater level and soil parameter discrepancies are to be resolved in the basement wall designs.	Closed. Additional calculations have been submitted as above. Groundwater and soil parameter discrepancies have been rectified. A groundwater level of 0.5m bgl has now been assumed in all calculations. This is conservative.	04/02/16
9	Stability	Each basement should be addressed separately and clearly in the ground movement prediction calculations.	Closed. Each basement is now addressed separately and further diagrams provided to provide greater clarity.	04/02/16
10	Stability	Confirmation to be given as to whether or not it is valid to determine induced strains and to make damage category assessments for Lyndhurst Hall based on the CIRIA C580 approach and whether any further investigation of the structure is required.	Closed. This issue has been commented upon by Geotechnical Consulting Group (GCG) – see Appendix 1 for details.	04/02/16
11	Stability	Full soil-structure interaction modelling of all basement walls with all construction stages represented would be expected for detailed design.	Closed. To be provided in a BCP.	04/02/16
12	Stability	It is essential that the designer's requirements are fully specified so that the	Closed. To be provided in a BCP.	04/02/16

	Subject	Query	Status	Date closed out
		contractor is fully aware of the levels of compliance required i.e. the high levels of site supervision to control workmanship and construction methodology, together with rigorous monitoring set against rationally designed trigger levels, contingency provisions etc.		
13	Stability	The building damage category assessments should be re-submitted – see Section 4 and 5 for details.	Closed. A revised GMA and building damage category assessment have been submitted.	04/02/16
14	Stability	An evaluation should be made of the long-term heave affects due to net unloading in the areas surrounding the basements with particular reference to Lyndhurst Hall and 11 Rosslyn Place and the building damage category assessments updated as necessary.	Closed. It has been confirmed in the revised BIA that ground heave outside the basement areas is expected to be small and that the effect on the surrounding buildings will not be a cause for concern. Ground heave will act to offset the settlements arising from wall installation and deflection.	04/02/16
15	Stability	An internal inspection/survey of Lyndhurst Hall should be made – see Sections 4 and 5 for details.	Closed. It is recommended that an internal inspection of Lyndhurst Hall is carried out as part of the Party Wall Award to check the assumptions made in the GMA and building damage category assessments about the form and condition of the structure and finishes.	04/02/16
16	General	Potential archaeological issues should be catered for in the BCP so that the timing of propping is not compromised.	Closed. To be provided in a BCP.	04/02/16

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