

Basement Impact
Assessment Audit

Highgate School Dyne House
and Island Site

For
London Borough of Haringey

Project No.
13979-02

Date
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APPENDICES

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1.0 NON-TECHNICAL SUMMARY

- 1.1 CampbellReith was instructed by London Borough of Haringey, (LBH) to carry out an audit on the Basement Impact Assessment submitted as part of the Planning Submission documentation for Dyne House, Southwood Lane, Hornsey, London, N6 5EE (planning reference HGY/2023/0328).
- 1.2 The scope of the audit of the Basement Impact Assessment was agreed with Haringey as follows:
- Review for compliance with planning guidance and conditions stipulated by the London Borough of Haringey (policy DM8 of Haringey's Local Plan and policy DH7 of the Highgate Neighbourhood Plan).
 - Assess technical sufficiency of the submission, robustness of impact assessments and conclusions, and whether mitigation, where necessary, is described to avoid adversely affecting land stability and local ground and surface water conditions.
 - Present audit adopting the procedure presented in the Camden Planning Guidance: Basements (CPG) and Terms of Reference for BIA audits agreed with Camden.
- 1.3 The Basement Impact Assessment (BIA) has been carried out by A-squared Studio Engineers Ltd on behalf of Expedition Engineering Ltd. Further to the completion of a previous audit, the BIA was updated. This audit report considers BIA ref.: EXP-REP-XXX-001 Revision 03, dated 19 August 2024 and supporting documents as listed in Section 2.0.
- 1.4 The qualifications of the authors of the BIA were identified in the Hydrogeological Assessment Experience document in the revised BIA. Whilst the qualifications do not meet the requirements of the CPG, evidence of their experience in the field has been provided.
- 1.5 The proposals include the redevelopment and extension of Dyne House comprising excavation of a one-level basement and construction of a five-storey structure; demolition and replacement of the Gym and Geography Building with a one- to two-level structure with one- to three-level basement (Rear Block); demolition of the existing structure on the Island plot, excavation of a one-storey basement and construction of a two-storey structure over.
- 1.6 Screening and scoping assessments are presented, supported by desk study and intrusive ground investigation information.
- 1.7 The BIA confirms the site is underlain by Made Ground, Bagshot Formation, Claygate Member and London Clay Formation, and that all basements will be founded in the natural strata.
- 1.8 The BIA assumes the basement construction will follow a bottom-up methodology with the excavation retained by embedded retaining walls. An outline construction sequence has been presented as part of the revised BIA.
- 1.9 The CMMP primarily addresses logistics and provides only a high-level summary of the proposed construction methodology. It has not been amended since the BIA was updated and it is assumed to have been superseded by the structural arrangements and sequence prepared by Expedition.

- 1.10 A Flood Risk Assessment concluded that the site's flood risk from surface water and overland flows is low. The BIA notes low to high flood risk areas downslope to the east, which are not expected to impact the site's flood risk. The BIA states that the scheme will maintain the existing surface water discharge conditions using attenuation methods and incorporation of suitable SuDS solutions.
- 1.11 A drainage strategy has been submitted to, and accepted by, LBH Flood & Water management team.
- 1.12 The hydrogeological assessment suggests that groundwater may rise by 1m behind the proposed basements due to their construction and concludes that this is a cautious estimate. The BIA reports that the highest predicted groundwater level remains below the lowest level of the surrounding neighbouring residences (assumed single basement level).
- 1.13 The geotechnical parameters are presented in the BIA and are accepted as being a reasonable reflection of the ground conditions.
- 1.14 The BIA confirmed that, due to the nature of the ground, the removal of trees is not expected to cause ground swelling or heave and will have no impact on neighbouring properties.
- 1.15 The Slope Stability Assessment evaluated the impact of the proposed development on the stability of the site and did not identify any stability hazards associated with the basement proposals.
- 1.16 A Ground Movement Assessment has been undertaken to assess the impact on the neighbouring properties. The Building Damage Assessment shows that damage to neighbouring buildings is not expected to exceed Burland Category 1 (Very Slight) for all but two walls of the "Highgate School – Big School Building" and two walls of 16 Southwood Lane, where Category 2 (Slight) damage is predicted. The BIA suggests the software overestimates building damage and that reasonable adjustments result in the damage being reduced to Category 1 and Category 0. While this is considered reasonable for 16 Southwood Lane, it is not considered appropriate for one wall of the Big School Building due to its length. However, it should be noted that Category 2 damage is aesthetic, rather than structural, and the building belongs to the applicant.
- 1.17 The GMA confirmed no unacceptable impacts to the highways.
- 1.18 The GMA report indicates that a project-specific monitoring regime and Action Plan will be implemented. This has not been provided as part of the BIA submission.
- 1.19 A number of technical objections have been raised by neighbours to the scheme, many of which correspond with queries raised during the audit process. These objections are discussed in Section 4 and Appendix 1 of this audit report.
- 1.20 Considering the revised BIA (EXP-REP-XXX-001 Revision 03, dated 19 August 2024) and additional information presented, it can be confirmed that, subject to the usual planning conditions, the BIA meets the requirements of Policy DM18 of Haringey's Development Management Plan, Policy DH7 of the Highgate Neighbourhood Plan, and Camden Planning Guidance: Basements.

2.0 INTRODUCTION

2.1 CampbellReith was instructed by London Borough of Haringey (LBH) on 9th August 2023 to carry out an audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for Dyne House and Island Site, Highgate School, Southwood Lane, London N6 5EE, reference HGY/2023/0328. The site is within the Highgate Neighbourhood Area.

2.2 The audit reviewed the BIA for potential impact on land stability and local ground and surface water conditions arising from basement development. An audit of land quality/contamination issues has not been undertaken and is outside the scope of this report.

2.3 A BIA is required for all planning applications with basements in Haringey in general accordance with policies and technical procedures contained within

- Development Management DPD. July 2017.
- Policy DH7 of the Highgate Neighbourhood Plan. May 2017

2.4 The BIA should demonstrate that schemes:

- a) maintain the structural stability of the building, neighbouring properties and adjoining highways and limit damage to neighbouring properties to Burland Category 1;
- b) do not increase flood risk to the property and nearby properties;
- c) avoid adversely affecting drainage and run off or causing other damage to the water environment;
- d) 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 and to make recommendations for the detailed design.

2.5 Although the site lies within the London Borough of Haringey Council, it was agreed that the audit of the screening, scoping and impact assessment would follow the procedure presented in the Camden Planning Guidance: Basements as it is widely known and is considered to provide a robust approach to the issues of concern.

2.6 LBH's Application for Planning Permission described the planning proposal as "*Redevelopment of Dyne House*", to include:

- Retention, refurbishment and extension of the principal five storey Dyne House structure (plus plant and lift over run);
- Demolition and redevelopment of the rear extension and associated buildings with a part one, part two storey structure;
- Retention of the Parade Ground open space, with new multi-use surface;

- Associated improvements to the Island Site access and underground tunnel, including demolition and redevelopment of service block; and
- Associated landscaping and improved provision for emergency services, servicing and disabled parking.

2.7 The BIA confirmed Dyne House and the Island Site involve, and are neighbour to, listed buildings.

2.8 CampbellReith accessed LBH's Planning Portal on 10th August 2023 and gained access to the following relevant documents for audit purposes:

- Highgate School Dyne House and Island Site Basement Impact Assessment (BIA) by Expedition Engineering Ltd. Ref. EXP-REP-404-001 Rev. 00. Dated 16th January 2023.
- Existing and Proposed Drawings (Appendix B of BIA).
- Construction Methodology and Management Plan (Appendix D of the BIA).
- Dyne House & Dyne House Tunnel Link building on the Island Site Highgate School. Sustainable Urban Drainage Statement by Expedition Engineering Ltd. Issue 00. Dated 16th January 2023.
- Highgate School. Dyne House & Island Site Tunnel Building. Design & Access Statement by Hopkins Architects. Ref A_HS-DH3_9350_D. Rev. D. Dated 13th January 2023.
- Dyne House & Dyne House Tunnel Link Building on the Island Site – Flood Risk Note for Planning) by Expedition Engineering Ltd. Issue 0. Dated 16th January 2023.
- Highgate School Campus Flood Risk Assessment by Edenvale Young, Project No EVY0753, revision B, dated 23 January 2023.

2.9 On 17th August 2023, Highgate School advised CampbellReith that a hydrogeological report they had commissioned was not on the website and provided it by email (Highgate School Dyne House – Hydrogeological Desk Study Report by Expedition Engineering Ltd. Ref.0063-RPT-001. Rev 01. Dated 16th July 2015).

2.10 The audit identified that the BIA on the planning website was not complete (Part 5 missing). A full copy of the BIA was provided CampbellReith by Highgate School by on 24th August 2023.

2.11 To address the queries raised in the previous versions of this audit report and subsequent correspondence (refer to query tracker in Appendix 3), CampbellReith was later provided with the following relevant documents:

- Highgate School Dyne House and Island Site Basement Impact Assessment by Expedition Engineering Ltd, Ref.: EXP-REP-XXX-001 Revision 03, dated 19 August 2024.
- Existing and Proposed Development Drawings (Appendix B of the BIA)
- Phase 1 and 2 Ground Investigation Report by Listers Geotechnical and Geoenvironmental Consultants, Ref.: 18.07.019, dated 13 November 2018.

- Ground Movement Assessment Report by A-Squared Studio Engineers Limited, Ref.: 1157-A2S-XX-XX-RP-Y-0002-01 Revision 01, dated 10 September 2024.
- Evidence of Expertise in Hydrogeology Technical Note by A-squared Studio Engineers Limited, Ref.: 1157-A2S-XX-XX-TN-Y-0001-00 Revision 00, dated 14 November 2023.
- Wallap Analyses undertaken by A-Squared Studio Engineers Limited
 - Section 1_SLS, dated 09 September 2024
 - Section 2_SLS, dated 09 September 2024
 - Section 3a_SLS, dated 09 September 2024
 - Section 3_SLS, dated 09 September 2024
 - Section 4_SLS, dated 09 September 2024

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Do BIA Author(s) credentials comply with CPG?	Yes	Evidence of expertise in Hydrogeology Technical Note. The qualifications of the authors of the BIA were identified in the Hydrogeological Assessment Experience document in the revised BIA. Whilst the qualifications do not meet the requirements of the CPG, evidence of their experience has been provided.
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	Outline basement construction sequence included in the revised BIA submission.
Are suitable plan/maps included	Yes	Appendix B of BIA
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	Section 3.2 of BIA.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	Section 3.1 of BIA.
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	Section 3.3 of BIA

Item	Yes/No/NA	Comment
Is a conceptual model presented?	Yes	Figure 5.2 of the revised BIA.
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	Section 3.2 of the revised BIA.
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	Section 3.1 of the revised BIA.
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes	Section 3.3 of the revised BIA.
Is factual ground investigation data provided?	Yes	Section 5 and Appendix D of BIA
Is monitoring data presented?	Yes	Groundwater monitoring data presented is from the 2015 GEA ground investigation (GI), the 2018 Lister Geotechnics GI, and the A2SI Ltd 2024 monitoring rounds.
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?	No	For school buildings only. The neighbouring properties are assumed to be founded at ground level for the ground movement/building damage assessment. For the hydrogeological assessment, it is assumed that all surrounding structures have a single storey basement.
Is a geotechnical interpretation presented?	Yes	

Item	Yes/No/NA	Comment
Does the geotechnical interpretation include information on retaining wall design?	Yes	
Are assessments and reports on other investigations required by screening and scoping presented?	Yes	Arboricultural and hydrogeological assessments, outline construction sequence, flood risk and surface water drainage assessments and strategies presented.
Are the baseline conditions described, based on the GSD?	Yes	Additional groundwater monitoring data has been presented in the revised BIA.
Do the baseline conditions consider adjacent or nearby basements?	Yes	The neighbouring properties are assumed to be founded at ground level for the ground movement/building damage assessment. For the hydrogeological assessment, it is assumed that all surrounding structures have a single storey basement.
Is an Impact Assessment provided?	Yes	Section 8 of the BIA
Are estimates of ground movement and structural impact presented?	Yes	Section 4.2.2 of the revised GMA.
Is the Impact Assessment appropriate to the matters identified by screening and scoping?	Yes	Additional information to support stability and hydrogeology assessments has been provided in the revised BIA.
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	Section 4.5.10 of the BIA

Item	Yes/No/NA	Comment
Have the residual (after mitigation) impacts been clearly identified?	Yes	
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	Yes	Section 4.2 of the revised GMA.
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 report state that damage to surrounding buildings will be no worse than Burland Category 1?	Yes	Section 4.2 of the revised GMA.
Are non-technical summaries provided?	Yes	Section 1 of the revised BIA.

4.0 DISCUSSION

- 4.1 The Basement Impact Assessment (BIA) has been carried out by A-squared Studio Engineers Ltd on behalf of Expedition Engineering Ltd. The qualifications of the authors of the BIA were identified in the Hydrogeological Assessment Experience document in the revised BIA and they hold a CEng. Whilst the qualifications do not meet the full requirements of the CPG, evidence of their experience in the fields of ground engineering, hydrology and hydrogeology has been provided.
- 4.2 The development is part of Highgate School and is divided into three plots: Dyne House, Gym and Geography Building (Rear Block), and The Island. The combined Dyne House and Gym and Geography Building plots measure approximately 0.56ha. The site lies on a hillside and the ground level within the combined plot varies from approximately 126mOD in the west to 111mOD in the east with an overall gradient of 8°. The Island plot to the west is separated from Dyne House by Southwood Lane. This is a smaller plot measuring 0.02ha and is relatively flat and level at approximately 126mOD. The sites are connected by a link tunnel beneath Southwood Lane.
- 4.3 Proposals include the redevelopment and extension of Dyne House comprising excavation to 4m bgl for a one-level basement and construction of a five-storey RC frame structure; the demolition and replacement of the Gym and Geography Building with a one to two-level structure with one to three-level basement with excavation depths between 4.00m and 11.00m bgl, referred to as the 'Rear Block'; the demolition of the existing structure on the Island plot, excavation to 4.50m bgl for a one-storey basement, and construction of a two-storey RC structure.
- 4.4 The BIA states "There are several listed buildings within the zone of influence of the proposed development, including the Highgate School Old School Building (Grade II Listed), Nos. 4 to 22 Southwood Lane (Grade II Listed residential properties), Highgate School Chapel (Grade II Listed), and the Highgate Tabernacle (Grade II Listed)."
- 4.5 The ground investigation reports and factual data are presented as part of the revised BIA and have been used to develop the ground model for the site.
- 4.6 A desk top study and intrusive ground investigation had been undertaken in 2015 prior to the preparation of the BIA. The BIA confirms the site is underlain by Made Ground to depths of between 1.00m and 1.50m below ground level (bgl), below which lies Bagshot Formation to depths of between 6.00m and 11.50m depth bgl, followed by the Claygate Member. The site stratigraphy varies from west to east, as shown in the cross-section Figure 5.2 of the BIA. There is a reduction in the thickness of the Bagshot Formation from west to east, with the Bagshot Formation being absent in the east of the site. Stratum depths illustrated in Figure 5.2 were updated in the revised BIA and now reflect the factual records.
- 4.7 A supplementary ground investigation was undertaken in 2018 by Listers Geotechnics and is mainly located at the west side of the site at the Island Site. The ground conditions encountered comprise Made Ground to 1.20m bgl and Bagshot Formation to 11.00mbgl followed by the Claygate Member to the depth of the ground investigation.

- 4.8 Standpipe monitoring undertaken in 2015 reported a perched water table in the Bagshot Formation and Claygate Member, at depths of 7.80m to 8.20m bgl (117.50m OD) and 5.10m to 5.60m bgl (c.105m OD), respectively. Groundwater monitoring in 2018 recorded levels between 8.00m and 10.50m bgl in BH01 and BH02 at the Island site (approximately 116.5m to 118mOD). The latest monitoring in 2024 by A2SI found groundwater at 8.54m bgl in BH01 at the Island site, with BH02 recorded as dry down to 8.00m bgl, while the boreholes to the south of Southwood Lane were recorded to have groundwater levels between 2.70m and 8.30m bgl.
- 4.9 In the GMA report the site has been simplified and the ground model divided into two separate soil zones, A and B, to take into account the changes in elevation of the ground surface and the differences in the strata. Zone A represents the western portion of the site including the Island Plot and Zone B represents the eastern portion of the site, where the Bagshot Formation is absent. The BIA confirms all basements will be found in the natural strata, not in the worked ground identified in the east of the site.
- 4.10 A conceptual site model plan and section were provided as part of the hydrogeological assessment to outline the relationship between soil strata and the proposed development and groundwater levels or pathways. In addition, the scoping exercise in Section 4.1 of the revised BIA provides an explanation of the potential impacts identified during the screening stage, effectively serving as a conceptual model.
- 4.11 Surface water and flooding screening confirms the development will increase the amount of hardstanding areas. However, a Flood Risk Assessment has been carried out for the site and concluded that the flood risk from surface water and overland flows is low. The BIA states that there are areas of low to high flood risk surrounding the eastern section of the site. These are located downslope of the site and are therefore not anticipated to affect the site's flood risk potential.
- 4.12 The BIA advises that the scheme will maintain the existing surface water discharge conditions using attenuation methods and the incorporation of suitable SuDS solutions. Potential impacts to surface water and flooding resulting from the large increase in impermeable areas are addressed by the Sustainable Urban Drainage Statement document.
- 4.13 The Sustainable Urban Drainage Statement document describes drainage strategies to avoid an increase to the surface water flood risk and offsite flows to the sewer network, and states Thames Water will support the current proposal concerning a combined sewer diversion although re-engagement with Thames Water is required. LBH's Flood & Water Management team is satisfied with the proposals.
- 4.14 The subterranean (groundwater flow) screening confirms the site is underlain by Secondary 'A' Aquifers, both the Bagshot Formation and Claygate Member. The boundary between the Bagshot Formation and Claygate Member, which crosses the site, is a potential spring line. The BIA notes that, based on local knowledge and a site walkover, there is no evidence of existing spring lines on or immediately adjacent to the site.

- 4.15 A site-specific hydrogeological assessment using PLAXIS 3D was conducted to assess the cumulative impact of existing basements and the proposed basement on the groundwater regime. The assessment indicates a potential groundwater level rise of approximately 1.00m immediately behind the proposed basement but also adds that the assessment is conservative, assuming a continuous flow between the Bagshot Formation and the Claygate Member where none is shown to exist.
- 4.16 Correspondence attached to this report notes that the recorded groundwater table is generally a few metres below existing ground floor/lower ground floor levels at the school. Given that the existing building footprint is cut into the slope, minimal excavation work is expected after demolition, prior to the installation of all basement perimeter walls. It is therefore accepted that dewatering will be undertaken within a groundwater cut-off wall, and no impact is anticipated beyond the basement footprint from dewatering.
- 4.17 The BIA outlines that the basement construction will follow a bottom-up methodology. The excavation will be retrained by embedded retaining walls, which will be temporarily propped until the permanent slabs are installed, except for the sheet pile walls on the east side, which will be cantilevered. The structure is to be supported on bored piles constructed at lower level. Correspondence appended to this report confirms that the scheme design now intends to avoid ground anchors, opting instead for conventional corner bracing, shoring, and flying shores as the baseline design option.
- 4.18 The outline structural arrangements prepared by Expedition are included in the revised BIA including information about the Island Site, along with a Construction Methodology and Management Plan (CMMP). The CMMP primarily addresses logistics and provides only a high-level summary of the proposed construction methodology. The CMMP contradicts the construction sequence described in the revised BIA and is therefore considered to have been superseded by the structural arrangements and sequence prepared by Expedition.
- 4.19 The geotechnical parameters, including those for retaining walls, are presented in the BIA and GMA reports and are considered to be appropriately conservative. Outline retaining wall calculations have been carried out using WALLAP to inform and validate the assumptions made in the GMA, and these have been included in the revised BIA. It is noted that the modulus of elasticity for the Bagshot Formation has been taken as 34 MPa in the WALLAP analyses, compared to 44 MPa in the GMA and BIA. However, this difference is not expected to have a significant impact, as the use of a lower stiffness is more conservative.
- 4.20 It is noted that the staged excavation levels in Section 2_SLS of the WALLAP analyses coincide with the proposed dewatering levels; this may need to be revisited in the detailed design.
- 4.21 Several trees will be felled to accommodate the proposed development. The Claygate Member and London Clay strata are classified as having a high-volume change potential with potential risk of shrink-swell subsidence due to removal of trees and seasonal variations in groundwater table. However, the revised BIA notes that most of the trees to be removed are in areas underlain by the Bagshot Formation, which is not expected to cause ground swelling or heave and concludes that there will be no impact to neighbouring properties.

- 4.22 A Slope Stability Assessment was conducted using the GeoStudio SLOPE software to evaluate the stability of the site and surrounding area after the proposed development. The assessment considered both local and global slip mechanisms during the temporary case. The results indicate that the slope remains stable with adequate factors of safety.
- 4.23 A Ground Movement Assessment (GMA) and damage assessment are provided to demonstrate that ground movements and consequential damage to neighbouring properties will meet the requirements LBH's policy and Highgate Neighbourhood Plan.
- 4.24 The Ground Movement Assessment (GMA) evaluated the impacts of various construction stages using two alternative methods: analysing the effects of unloading/overburden removal and additional structural loading with PDisp; and assessing wall-induced ground movements and excavation movements using empirical CIRIA curves in XDisp. For the latter, a propped retaining wall solution during the temporary stage was modelled with the CIRIA C760 ground movement curves for high-stiffness walls in stiff clay increased by a factor of between 1 and 3. In contrast, a low-stiffness approach was used for the retaining wall on the east side where the wall will be unpropped in the temporary case with the ground movement curves increased by a factor of 3. It is understood the ground movement excavation curves adopted in XDisp were increased to align with the WALLAP analyses results. Ground movements associated with sheet pile wall installation were modelled using the CIRIA C760 contiguous pile wall curve. Noting that the curve is based on data from sheet pile wall installation as well as contiguous pile walls, and considering other conservative assumptions made in the GMA, this was deemed suitable for the scenario.
- 4.25 The results of the Building Impact Assessment currently indicate damage to neighbouring buildings will not Exceed Category 1 (Very Slight) for all but two walls of the "Highgate School – Big School Building" and two walls of "16 Southwood Lane" where Category 2 (Slight) damage is predicted. The software adopted divides walls into short segments which can be unrepresentative of actual behaviour and the damage category for these walls was reduced to Burland Category 1 (Very Slight) and Burland Category 0 (Negligible) by combining segments. Combining segments for the walls at 16 Southwood Lane (16S-02 and 16S-06) appears reasonable, however walls BS01 and BS02 at the Big School Building are c. 13m and 15m in length and therefore combining the segments may not be appropriate.
- 4.26 It is noted that Burland Category 2 is indicative of aesthetic damage, as opposed to structural damage and the building "Highgate School – Big School Building" is in the ownership of the applicant. The outcomes of the GMA therefore comply with Haringey's Policy DM18, which states that "the proposed development should not adversely affect the structural stability of the application building, neighbouring buildings, and other infrastructure, including the adjoining highway." Additionally, it aligns with the Highgate Neighbourhood Plan DH7, which requires that "damage to neighbouring properties should not exceed Burland Damage Category 1 (Very Slight)."
- 4.27 Contour plots indicate settlement along Southwood Lane is between 0 and 10mm, while Kingsley Place shows a range from 0 to 5mm.

- 4.28 Due to the sloping nature of the site, significant out-of-balance forces are observed around the Rear Block basement. The authors of the GMA consider the use of XDisp suitable for the level of assessment required for the BIA/GMA, provided that the retaining wall designer takes into account that movements remain within the specified limits. Correspondence appended to this report confirms that earth retention systems will be designed to limit deflections to those specified in the GMA. This will be achieved through temporary propping arrangements and detailed surcharge conditions at the rear of the slope as presented in the construction sequence.
- 4.29 A Thames Water sewer runs through the site between the current Dyne House and Geography Building. This is subject to a separate impact assessment and approvals process. However, it is noted that the current scheme design intends to avoid ground anchors, opting for conventional corner bracing, shoring, and flying shores instead.
- 4.30 The GMA report indicates that a project-specific monitoring regime and Action Plan will be implemented. This plan will outline lines of responsibility, establish trigger levels consistent with those in the GMA, and define appropriate mitigation measures. These have not been provided as part of the BIA submission.
- 4.31 A number of objections have been lodged in respect of the application, including a technical objection prepared by Alan Baxter Associates (ABA) on behalf of Southwood Lane residents (see Appendix 1). This audit process supported a number of ABA's queries in respect of the development. ABA suggest that not all sensitive properties have been considered in the impact assessment and this should be confirmed. A contour plan showing the results of the analyses and their impact on potentially affected properties has been presented in the revised BIA and GMA submission.
- 4.32 ABA suggest that a sheet piled retaining wall is not appropriate for the large basement beneath the rear site. CampbellReith is of the opinion that such a solution may be viable but note that the scheme is subject to further design development with the final construction methodology and sequence likely to be determined once a contractor has been appointed. The adopted scheme will have to demonstrate that the wall and any required props can be constructed and will provide the stability required in the temporary and permanent cases.
- 4.33 ABA also query the use of the CIRIA C760 curves for ground movement assessments for large excavations. CampbellReith would note that the CIRIA C760 curves are based on a number of large excavations and that the building damage assessment has been undertaken on the assumption of larger ground movements than would be predicted using a standard CIRIA C760 approach.

5.0 CONCLUSIONS

- 5.1 The Basement Impact Assessment (BIA) has been carried out by A-squared Studio Engineers Ltd on behalf of Expedition Engineering Ltd. Further to the completion of a previous audit, the BIA was updated. This audit report considers BIA ref.: EXP-REP-XXX-001 Revision 03, dated 19 August 2024 and supporting documents as listed in Section 2.0.
- 5.2 The qualifications of the authors of the BIA were identified in the Hydrogeological Assessment Experience document in the revised BIA. Whilst the qualifications do not meet the requirements of the CPG, evidence of their experience in the field has been provided.
- 5.3 The proposals include the redevelopment and extension of Dyne House comprising the excavation of a one-level basement and construction of a five-storey structure; the demolition and replacement of the Gym and Geography Building with a one- to two-level structure with one- to three-level basement (Rear Block); the demolition of the existing structure on the Island plot, excavation of a one-storey basement and construction of a two-storey structure over.
- 5.4 Screening and scoping assessments are presented, supported by desk study and intrusive ground investigation information.
- 5.5 The BIA confirms that the site is underlain by Made Ground, Bagshot Formation, Claygate Member and London Clay Formation, and that all basements will be founded in the natural strata.
- 5.6 The BIA assumes the basement construction will follow a bottom-up methodology with the excavation retained by embedded retaining walls. An outline construction sequence has been presented as part of the revised BIA.
- 5.7 The CMMP primarily addresses logistics and provides only a high-level summary of the proposed construction methodology. However, it has not been amended since the BIA was updated and contradicts the construction sequence described in the revised BIA. It is therefore considered to have been superseded by the structural arrangements and sequence prepared by Expedition.
- 5.8 A Flood Risk Assessment concluded that the site's flood risk from surface water and overland flows is low. The BIA notes low to high flood risk areas downslope to the east, which are not expected to impact the site's flood risk. The BIA states that the scheme will maintain the existing surface water discharge conditions using attenuation methods and incorporation of suitable SuDS solutions.
- 5.9 A drainage strategy has been submitted and accepted by LBH Flood & Water management team.
- 5.10 The hydrogeological assessment suggests that groundwater may rise by 1m behind the proposed basements due to their construction and concludes that this is a cautious estimate. The BIA reports that the highest predicted groundwater level remains below the lowest level of the surrounding neighbouring residences (assumed single basement level).

- 5.11 The geotechnical parameters are presented in the BIA and are accepted as being a reasonable reflection of the ground conditions.
- 5.12 The BIA confirmed that, due to the nature of the ground, the removal of trees is not expected to cause ground swelling or heave and will have no impact on neighbouring properties.
- 5.13 The Slope Stability Assessment evaluated the impact of the proposed development on the stability of the site and did not identify any hazards associated with the basement proposals.
- 5.14 A Ground Movement Assessment has been undertaken to assess the impact on the neighbouring properties. The Building Damage Assessment shows that damage to neighbouring buildings is not expected to exceed Burland Category 1 (Very Slight) for all but two walls of the "Highgate School – Big School Building" and two walls of 16 Southwood Lane, where Category 2 (Slight) damage is predicted. The BIA suggests the software overestimates building damage and that reasonable adjustments result in the damage being reduced to Category 1 and Category 0. While this is considered reasonable for 16 Southwood Lane, it is not considered appropriate for one wall of the Big School Building due to its length. It should be noted that Category 2 damage is aesthetic, rather than structural and the building belongs to the applicant.
- 5.15 The GMA confirmed no unacceptable impacts to the highways.
- 5.16 The GMA report indicates that a project-specific monitoring regime and Action Plan will be implemented. This has not been provided as part of the BIA submission.
- 5.17 A number of technical objections have been raised by neighbours to the scheme, many of which correspond with queries raised by this and the previous audit. These objections are discussed in Section 4 and Appendix 1 of this audit report.
- 5.18 Considering the revised BIA (EXP-REP-XXX-001 Revision 03, dated 19 August 2024) and additional information presented, it can be confirmed that, subject to the usual planning conditions being implemented, the BIA meets the requirements of Policy DM18 of Haringey's Development Management Plan, Policy DH7 of the Highgate Neighbourhood Plan and Camden Planning Guidance: Basements.

Appendix 1

Consultation Responses

Residents' Consultation Comments

Objector	Address	Date	Issue raised	Response
Highgate Society	10A South Grove, N6 6BS	18/05/23	Claygate Formation not proven	See audit paragraph 4.50 to 4.10
			Impermeable area tripling in size	See audit paragraphs 4.11 to 4.13
			Basement groundwater diversion and waterlogging	See audit paragraphs 4.11 to 4.16.
			Hydrogeological study based on old data and superseded scheme	See audit paragraphs 4.5 to 4.16.
Southwood Lane Residents Association	Given as: Southwood Lane	22/05/23	Justification for 'very slight' damage assessment for fragile buildings	See audit paragraphs 4.21 to 4.27.
			Use of sheet piling questionable (after Alan Baxter Associate)	See audit paragraph 4.29 & 4.30.
Kingsley Place Residents Association	23b Kingsley Place, N6 5EA	21/04/23	Settlement and subsidence of 18 th and 19 th century properties	See audit paragraphs 4.21 to 4.27.
			Topographically challenging site	See audit paragraphs 4.21.
Alan Baxter Associates	Not given	22/05/23	Suitability of, and ground movements associated with, sheet piling	See audit paragraphs 4.21 to 4.28.
			Concerns over temporary works (anchors, propping arrangements)	See audit paragraph 4.17 & 4.18.
			Consideration of unbalanced loads on retaining walls	See audit paragraph 4.28.
			Assessments based on data obtained in 2015	See audit paragraphs 4.5 to 4.16.

Objector	Address	Date	Issue raised	Response
			Impacts of potential 2m rise in groundwater level need further consideration	See audit paragraphs 4.11 to 4.16.
			Suitability of X-Disp for large basement and application of CIRIA curves for sheet piling	See audit paragraphs 4.21 to 4.28.
			Not all sensitive structures assessed	See audit paragraphs 4.21 to 4.27.

Appendix 2

Audit Query Tracker

Basement Impact Assessment Audit
Highgate School Dyne House and Island Site

Audit Query Tracker

Query No	Subject	Query	Reference	Status
1	BIA	Evidence of expertise in hydrogeology and hydrology not provided	See Section 4.1	Closed out
2	BIA	Ground model requires justification or revision to reflect ground investigations of 2015 and 2018	See Sections 4.5 to 4.10	Closed out
3	BIA	Outline structural arrangements referred to but not provided	See Sections 4.17 & 4.18	Closed out
4	Screening and scoping	Spring lines not taken forward to scoping	See Section 4.15	Closed out
5	Screening and scoping	Flood risk to be reported consistently and impact assessment updated where necessary	See Sections 4.11 to 4.13	Closed out
6	Stability	Impacts of potential shrink-swell to be assessed and mitigated	See Section 4.21	Closed out
7	Stability	Input and selected output data from P-Disp, X-Disp and Slope required for audit	See Sections 4.21 to 4.27	Closed out
8	Stability	Suitability of X-Disp in steeply sloping ground to be confirmed	See Section 4.26	Closed out
9	Stability	Outline structural information required to support assumptions made in ground movement assessment	See Sections 4.17 & 4.18	Closed out
10	Stability	Proposals to restrain retaining wall at western edge of rear basement to be confirmed.	See Sections 4.17, 4.18 & 4.23	Closed out
11	Stability	Proposals to support eastern edge of excavation beneath the Parade Ground to be confirmed	See Sections 4.17, 4.18 & 4.23	Closed out
12	Stability	Impacts on/of dewatering to be confirmed following clarification of retaining wall construction	See Section 4.14	Closed out
13	Stability	Impacts on highway to be confirmed	See Section 4.25	Closed out

Basement Impact Assessment Audit
Highgate School Dyne House and Island Site

14	Stability	Confirmation that all sensitive structures assessed	See Sections 4.21 to 4.26	Closed out
15	Hydrogeology	Ground model to be updated to include groundwater levels and pathways	See Sections 4.5 to 4.10	Closed out
16	Hydrogeology	Justification to be provided for using 2015 baseline data	See Sections 4.5 to 4.10	Closed out
17	Hydrogeology	Justification required to support conclusion that basements beneath Dyne House and the Island site will not alter findings of 2015 assessment	See Sections 4.5 to 4.10	Closed out
18	Hydrogeology	Justification required to support conclusion of no impact to surrounding properties	See Sections 4.10 to 4.16	Closed out
		Neighbouring ground levels vary, and the impact of the rear basement and seasonal fluctuations could bring groundwater close to ground level locally. Presentation of a model results map with potential receptors identified would allow the impacts to be assessed.		Closed out
19	Hydrogeology	Impacts of groundwater level changes in shadow of basements to be confirmed	See Sections 4.10 to 4.16	Closed out
	Note Only	ABA suggests that a sheet piled retaining wall is not appropriate for the large basement beneath the rear site. CampbellReith notes the solution is subject to further design development which will be required to demonstrate the wall and any required props can be constructed and provide the stability required in the temporary and permanent cases.	See Sections 4.29 & 4.30	

Appendix 3

Supplementary Supporting Documents

Audit Query Tracker and
Correspondence

Basement Impact Assessment Audit:
Groundwater, Dyne House,
HGY/2023/0328 – Stephen Buss

Maritta Elias
CampbellReith
15 Bermondsey Square
London SE1 3UN

22 August 2024

Basement Impact Assessment Audit: Groundwater, Dyne House, HGY/2023/0328

Dear Maritta

Thank you for asking me to review the groundwater aspects of another new submission of the basement impact assessment for Dyne House (Expedition Engineering Ltd report EXP-REP-404-002 Rev 03). Following our meeting with A-squared on the 7 August 2024 there were a few outstanding hydrogeological points:

1. Taking account of neighbours' basements, with knowledge of the actual location and depth of these basements.
2. Considering seasonal changes in groundwater level.
3. Dealing with the potential for a spring line to be present, as highlighted in the screening assessment.

Neighbours

A neighbouring basement has been used as a target in the model. It's not clear whether this is a real basement, with a known depth; or a generic basement at an estimated depth, that has been put into the model at the point of maximum groundwater level rise.

Neighbouring buildings have been listed for consideration in the GMA (Section 7.2), so I was expecting to see a survey or inventory of basements surrounding the school to demonstrate that they had all been taken into account in the hydrogeological impact assessment.

Seasonal Changes

Recognising that all of the historical groundwater level measurements were taken at times of low groundwater levels, the baseline groundwater level in the model has been raised by 1 m. There is no justification for this but seems like a reasonable change in water level.

To look at this another way, we could ask: what seasonal variation would lead to the water table reaching the neighbouring basement? If I visually compare the unsaturated zone thicknesses below the neighbouring basement in Figures 6-1 and 6-2 it seems like there is still about 2 m unsaturated zone below the neighbouring basement in Figure 6-2. From this, I expect that even if the groundwater level rose by 3 m in the winter, the neighbouring basement would remain just

above the water table. I think it is unrealistic to expect that there will be a 3 m change in groundwater level in the Bagshot Formation here so I assess that – given the simulated rise in level due to the basement construction at this location – the modelled neighbouring basement is safe.

Spring lines

It is appropriate for the potential impact on spring lines to not be screened out in Section 3.1: the boundary between the Bagshot Formation and the Claygate Member is a spring line at other locations. This point has now been carried forward to the scoping stage in Section 4.2 and it says that there is no historical manifestation of a spring line.

I am happy to accept that interpretation as, looking at the historical maps in the report, I can see that there are no historical springs, wells or watercourses rising within the potentially impacted area.

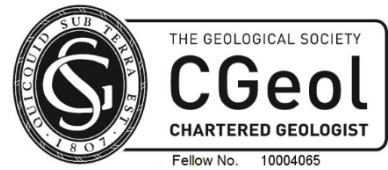
Summary

I am satisfied that all of the hydrogeological points that we made have been picked up on and attended to. My only outstanding comment is that I remain unsure whether all of the neighbours' basements have been reviewed in the model.

Yours sincerely



Dr Stephen Buss MA MSc FGS CGeol
Owner / Principal Hydrogeologist



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