Independent Review of Detailed Basement Construction Plan (SECOND UPDATE – including Review of Representations by Objectors)

in connection with proposed

Pears Building at

Royal Free Hospital

Pond Street

London

NW3 2QG

for

LBH4302DBCP Ver. 3.0

December 2017

LBH WEMBLEY

ENGINEERING

Project No: LBH4302

Report Ref: LBH4302DBCP Ver. 3.0

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Foreword-Guidance Notes

GENERAL

This report has been prepared for a specific client and to meet a specific brief. The preparation of this report may have been affected by limitations of scope, resources or time scale required by the client. Should any part of this report be relied on by a third party, that party does so wholly at its own risk and LBH WEMBLEY disclaims any liability to such parties.

The observations and conclusions described in this report are based solely upon the agreed scope of work. LBH WEMBLEY has not performed any observations, investigations, studies or testing not specifically set out in the agreed scope of work and cannot accept any liability for the existence of any condition, the discovery of which would require performance of services beyond the agreed scope of work.

VALIDITY

Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances shall be at the client's sole and own risk. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should therefore not be relied upon in the future and any such reliance on the report in the future shall again be at the client's own and sole risk.

THIRD PARTY INFORMATION

The report may present an opinion on the disposition, configuration and composition of soils, strata and any contamination within or near the site based upon information received from third parties. However, no liability can be accepted for any inaccuracies or omissions in that information

1. Introduction

1.1 Project Background

It is proposed to construct a new four storey hospital building on the site of an existing car park building that will include a two-storey basement beneath the full footprint. The new basement levels will be similar to the existing basement levels that are cut into the hillside, but the basements will be extended laterally into the hillside in a southwards direction where they will require around 7m of excavation, and north-westwards where around 4m of excavation outside the footprint of the car park is required.

A draft Detailed Basement Construction Plan submitted by the applicant as part of a Section 106 Agreement was reviewed in January 2017 and that review resulted in numerous recommendations being provided for revisions to the submitted documents.

1.2 Brief

LBH WEMBLEY have since been commissioned to review a revised Detailed Basement Construction Plan submitted in October 2017. This report is an updated version of a review issued in November 2017 and additionally considers and comments upon representations that have been submitted by objectors.

1.3 Report Structure

The DBCP wording is reproduced in Section 2 of this report and the following Section 3 considers and comments on the evidence that has been identified by the Certifying Engineer for compliance of the various clauses of the DBCP wording in the S106 agreement. An independent assessment of the issues is not undertaken. Rather, the level of information provided in the DBCP (including the completeness of the submission and the technical sufficiency of the work carried out) is assessed for soundness and reasonableness in the context of the site, the development and the S106.

The next section, Section 4, sets out further information required for the plan to be considered as compliant.

Following this, Section 5 provides review and comment of representations that have been submitted by objectors to the DBCP submission.

1.4 Information Provided

The information submitted by the applicant comprises the following:

1. Detailed Basement Construction Plan by HTS, Revision E1 dated 12th October 2017
2. Details of Appointments (included as Appendix A to Document 1)
3. Second Supplementary Ground Investigation by Soil Consultants, Ref: 10006A/OT/SCW Rev 1 dated 31st August 2017 (included as Appendix B to Document 1).
4. Groundwater Testing Report by OGI, Ref: J17-592-011R-Rev1 dated 21st September 2017: (included as Appendix C to Document 1).
5. Geotechnical Design Report by A-square Studio Engineers, Ref 0261-RPT-002 Rev 1 dated 31st August 2017 (included as Appendix D to Document 1)

6. Structural Engineers Drawings, Specifications & Calculations by HTS, incl. Basement Calculations Ref:1415-4 dated September 2017, Surface Water Discharge & Attenuation Calculations dated May 2016 (included as Appendix E to Document 1)
7. Contiguous Bored Pile Wall Design by Bachy Soletanche, Ref: 37850-CW-DES-RPT Rev 3 dated 27th September 2017 (included as Appendix F to Document 1)
8. Bearing Pile Design by Bachy Soletanche, Ref: 37850-BP-DES-RPT Rev 2 dated 9th October 2017 (included as Appendix G to Document 1)
9. Impact of Tree Removal Technical Note by OGI, Ref: J17-592-014TN-Rev3 dated 10th October 2017 (included as Appendix H to Document 1)
10. Groundwater Collection Strategy by OGI, Ref: J17-592-0007R-Rev2 dated 2nd October 2017 (included as Appendix I to Document 1)
11. Temporary Works S106 Response by Willmott Dixon, including Temporary Works Designs by Toureen Ref: T4874 dated 2016, Tiley & Barret Ref: T4874-C_{01} Rev 1 dated 5th December 2016 and Lucking & Clark Ref:34115 dated March 2017 (included as Appendix J to Document 1)
12. Logistics/Sequence S106 Response by Willmott Dixon (included as Appendix K to Document 1)
13. Construction Management Plan by Willmott Dixon, Revision G dated 7th July 2017 (included as Appendix L to Document 1)
14. Ground Movement Assessment by A-square Studio Engineers, Ref: 0261-RPT-001 Rev 8 dated 11th October 2017 (included as Appendix M to Document 1)
15. Monitoring Action Plan by Willmott Dixon, Ref: G640/MAP/001 Revision F dated 9th October 2017 (included as Appendix N to Document 1) (SUPERCEDED)
16. Condition Surveys (included as Appendix O to Document 1)
17. Consultation with Locals (included as Appendix P to Document 1)
18. S106 Certifying Engineer's Review Report by CRH, Ref: 12449, dated 12th October 2017
19. Revised Monitoring Action Plan by Willmott Dixon, Ref: G640/MAP/001 Revision H dated 7th December 2017)

2. DBCP

The S106 agreement stipulates that “the Council will not approve the Detailed Basement Construction Plan unless the Owner demonstrates by way of certification by a suitably qualified engineer from a recognised relevant professional body to the Council’s reasonable satisfaction that the Development can be constructed safely in light of the ground and water conditions and will control ground movements such that impact on the Neighbouring Properties is limited to “category 0 (negligible)” in accordance with the Eighth Schedule [The Burland Scale] annexed hereto.”

The DBCP is defined in the agreement as

> *a plan setting out detailed information relating to the design and construction of the basement forming part of the Development with a view to minimising any or all impacts of the Development on Neighbouring Properties (and in doing so to take into account at all times the findings and the recommendations in the document entitled "Civil & Structural Engineering Team - Internal Memo" dated 9th September 2015 by Historic England at the Ninth Schedule annexed hereto and the water environment and to provide a programme of detailed mitigating measures to be undertaken and put in place by the Owner with the objective of maintaining the structural stability of the Property and Neighbouring Properties as described in all of the following documents (being documents submitted with the Planning Application):*
>
> - *"the Basement Impact Assessment" by ESI dated October 2014;*
> - *"Basement Impact Assessment (Surface Water and Groundwater)" by ESI dated October 2014;*
> - *"Basement Impact Assessment Screening and Scoping Report Land Stability" by Soil Consultants dated 30th January 2015;*
> - *"Geo-environmental and Geotechnical Site Assessment" by RSK dated October 2014;*
> - *letter on BIA review from SDP (plus Appendices 1-7) dated 27.1.15;*
> - *Note on movements associated with excavation by GCG dated January 2015;*
> - *Surface water runoff supplementary information by SDP dated 6th February 2015;*
> - *calculations for storm sewer design by Micro Drainage dated 6.2.15;*
> - *email from Simon Myles on BIA matters dated 12.2.15*
>
> *and to include the following (to be submitted to the Council with the draft plan):*
>
> *(1) detailed ground movement analyses (to include consideration of slope stability) demonstrating that the impacts of any excavation and basement works (to be carried out pursuant to the Planning Permission) on St. Stephen's Church and/or Hampstead Hill School are acceptable such analyses to be informed by:*
>
> > *(i) additional ground investigation to better characterise the soil strength and groundwater regime at the Property and the slopes above the Property;*
> > *(ii) a specific study of the history of ground movements affecting all structures at the Neighbouring Properties; and*
> > *(iii) an analysis of the stability of the existing slopes and all historic excavations at and above the Property having particular regard to evidence of any actual or potential progressive movement.*

(2) a detailed construction methodology and sequence demonstrating how the stability of the buildings, structures and ground at the Neighbouring Properties shall be ensured throughout the Construction Phase and include:

(i) detailed design of the temporary and permanent support measures to be provided to the excavation demonstrating the parameters adopted and quantifying the extent of associated soil movements to be expected.

(ii) detailed design of any drainage measures required to preserve or improve the slopes above the excavation.

(iii) consideration of the impacts of the removal of any trees; and

(iv) consideration of groundwater removal from the excavation and any likely impacts of doing so.

(3) a detailed structural monitoring and contingency plan for the works setting out:

(i)specific location monitoring points;

(ii) monitoring equipment for movement and vibration;

(iii) frequency of monitoring;

(iv) responsibilities for implementation of the monitoring plan and contingency plan;

(v) criteria for assessment of monitoring data and comparison with predicted movements;

(vi) specific contingent actions to be take in response to any exceedance of criteria;

(vii) communication of the monitoring data to interested parties;

(viii) responsibilities for implementation of the contingent actions;

(ix) the resources required to enable implementation of the contingent actions; and

(x) the availability of the required resources.

(4) surface water drainage calculations indicating how the risk of sewer flooding is to be mitigated and to include the following key stages:-

(i) the Owner to appoint an independent suitably certified engineer (qualified in the fields of geotechnical and/or structural engineering) from a recognised relevant professional body having relevant experience of sub-ground level construction commensurate with the Development ("the Basement Design Engineer") AND for details of the appointment to be submitted to the council for written approval in advance (and for the Owner to confirm that any change in Basement Design Engineer during the Construction Phase with the Council in advance of any appointment); and,

(ii) the Basement Design Engineer to formulate the appropriate plan to fulfil the requirements of the Detailed Construction Basement Plan and at all times to ensure the following:-

(a) that the design plans have been undertaken in strict accordance with the terms of this Agreement incorporating proper design and review input into the detailed design phase of the Development and ensuring that appropriately conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties have been incorporated into the final design; and

(b) that the result of these appropriately conservative figures ensure that that the Development will be undertaken without any impact on the structural integrity of the Neighbouring Properties beyond "category 0 (negligible)" with reference to the Burland Category of Damage; and

(c) that the Basement Design Engineer having confirmed that the design plans have been undertaken in strict accordance with this Agreement and includes a letter of professional certification confirming this and that the detailed measures set out in sub-clauses (1) to (7) inclusive below have been incorporated correctly and appropriately and are sufficient in order to achieve the objectives of the Detailed Basement Construction Plan;

(1) reasonable endeavours to access and prepare a detailed structural appraisal and conditions survey of all the Neighbouring Properties to be undertaken by an independent suitably qualified and experienced chartered surveyor (and for details to be offered if this is not undertaken in full or part);

(2) a method statement detailing the proposed method of ensuring the safety and stability of Neighbouring Properties throughout the Construction Phase including temporary works sequence drawings and assumptions with appropriate monitoring control risk assessment contingency measures and any other methodologies associated with the basement and the basement temporary works;

(3) detailed design drawings incorporating conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties prepared by the Basement Design Engineer for all elements of the groundworks and basement authorised by the Planning Permission together with specifications and supporting calculations for both the temporary and permanent basement construction works;

(4) the Basement Design Engineer to be retained at the Property throughout the Construction Phase to inspect approve and undertaking regular monitoring of both permanent and temporary basement construction works throughout their duration and to ensure compliance with the plans and drawings as approved by the building control body;

(5) measures to ensure the on-going maintenance and upkeep of the basement forming part of the Development and any and all associated drainage and/or ground water diversion measures order to maintain structural stability of the Property the Neighbouring Properties and the local water environment (surface and groundwater);

(6) measures to ensure ground water monitoring equipment shall be installed prior to Implementation and retained with monitoring continuing during the Construction Phase and not to terminate monitoring until the issue of the Certificate of Practical Completion (or other time agreed by the Council in writing); and

(7) amelioration and monitoring measures of construction traffic including procedures for co-ordinating vehicular movement with other development taking place in the vicinity and notifying the owners and or occupiers of the residences and businesses in the locality in advance of major operations delivery schedules and amendments to normal traffic arrangements.

(iii) the Owner to appoint a second independent suitably certified engineer (qualified in the fields of geotechnical and/or structural engineering) from a recognised relevant professional body having relevant experience of sub-ground level construction commensurate with the Development ("the Certifying Engineer") AND for details of the appointment of the certifying engineer to be submitted to the council for written approval in advance; and

(iv) for the Certifying Engineer to review the design plans and offer a 2 page review report to the Council confirming that the design plans have been formulated in strict accordance with the terms of this Agreement and have appropriately and correctly incorporated the provisions of sub-clauses (1) to (7) inclusive above and are sufficient to achieve the objectives of the Detailed Basement Construction Plan AND should any omissions, errors or discrepancies be raised by the Certifying Engineer then these to be clearly outlined in the report and thereafter be raised directly with the Basement Design Engineer with a view to addressing these matters in the revised design plans.

(v) only thereafter shall the Owner submit the agreed finalised version of the Detailed Basement Construction Plan to the Council for its written approval with:

(a) a letter of professional certification from the Certifying Engineer confirming that the Detailed Basement Construction Plan is an approved form and has been formulated in strict accordance with the terms and clauses of this Agreement;

(b) evidence that the Owner has meaningfully and actively consulted local interested parties/local residents groups on the provisions of the plan prior to submission of the plan to the Council;

(c) a statement summarising all representations received by the Owner pursuant to the consultation with local interested parties;

(d) evidence that the Owner (in preparing the plan for submission to the Council) has taken account of any representations received pursuant to subclause 2.16(v)(b) hereof and sought to address any issues raised;

(e) confirmation in writing from Members Briefing that the plan is agreed or (in the event of the plan having been referred to the Development Control Committee on the recommendation of Members Briefing) confirmation in writing from the Development Control Committee that the plan is agreed

(vi) The Owner to respond to any further questions and requests for further information about the submitted plan from the Council AND IN THE EVENT that a further technical assessment be required then the Owner agrees to reimburse the Council for any costs expended which requires the instruction of an independent assessment in order to resolve any unresolved issues or technical deficiencies in the Council's consideration of the submitted plan

The DBCP provides the Council with the ability to act should the Owner not provide demonstration, in advance, that "*appropriately conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties have been incorporated into the final design"* and that "*the Development will be undertaken without any impact on the structural integrity of the Neighbouring Properties beyond "category 0 (negligible)" with reference to the Burland Category of Damage*".

3. Evidence of DBCP compliance with S.106 Agreement

3.1 Sub-Clause (1) Ground movement and slope stability assessments

There is a requirement for detailed ground movement analyses demonstrating that the impacts of the approved excavation and basement works on St. Stephen's Church and Hampstead Hill School are acceptable (Burland Damage Category 0).

Document 14 (Appendix M) predicts the following ground movements resulting from the works:

St. Stephen's Church

- *Additional vertical settlement affecting the church excluding the tower:* *1mm.*
- *Additional horizontal ground movement affecting the church excluding the tower:* *3mm.*
- *Additional vertical settlement affecting the church tower:* *1mm.*
- *Additional horizontal ground movement affecting the church tower:* *3mm.*

Hampstead Hill School

- *Additional vertical settlement affecting the school:* *1mm.*
- *Additional horizontal ground movement affecting the school:* *4mm.*

St Stephen's Church

The Burland Classification has been used to show that movements to the main body of the church are predicted to result in of Category 0 (Negligible) damage.

The report explains that The Burland Classification idealises any building as a simple beam in bending/shear and horizontal strain and that due to the height of the tower it is not considered that the Classification is valid as the tower has a length to height ratio much less than 1 and so is outside the range of the simple beam idealisation.

The report considers that it is more suitable to consider the total and differential settlements of the tower foundation and any impact these would have on the tilt of the tower. A maximum tilt of 1 in 35000 is predicted as a result of the works which is some two orders of magnitude less than that at which it is asserted that tilting becomes noticeable.

Hampstead Hill School.

The assessment reports that as a result of the calculated deformations, a Category 0 (Negligible) classification is estimated.

3.1.1 Sub-Clause (1) (i) Additional ground investigation

There is a requirement for additional ground investigation to be undertaken to better characterise the soil strength and groundwater regime at the Property and in the slopes above the Property.

Document 3 (Appendix B) reports investigation to gather additional information on soil strength and groundwater. The additional ground investigation has included additional rotary, dynamic percussion and

cable percussion boreholes taken to various depths, pressuremeter testing and the installation of additional standpipes, piezometers and inclinometers. It is noted that over forty boreholes of one sort or another have been completed in relation to the Pears building over the last 3 years.

Document 5 (Appendix D) is a Geotechnical Design Report (GDR) presenting an interpretation of ground investigations and setting out recommendations for the key geotechnical strength and groundwater parameters to be used for the assessment of ground movement and for ground engineering design at the site.

The ground model comprises Made Ground overlying Head Deposits / Affected London Clay, Weathered London Clay, and the Lambeth Group. The underlying Thanet Sand and Chalk Formation are considered to be too deep to influence the situation.

3.1.2 **Sub-Clause (1) (ii) Study of the history of ground movements**

There is a requirement for a specific study of the history of ground movements affecting all structures at the Neighbouring Properties.

Document 14 (Appendix M) provides a specific study of the historical ground movements.

3.1.3 **Sub-Clause (1) (iii) Analysis of the existing slopes and historic excavations**

There is a requirement for an analysis of the stability of the existing slopes and all historic excavations at and above the Property having particular regard to evidence of any actual or potential progressive movement.

Document 14 (Appendix M) provides a movement analysis that broadly accords with the reported historical ground movements.

The Ground Movement Assessment (GMA) analysis suggests movements of the church due to its construction loading (occurring before 1901) of up to 60mm, with additional later movements up to 10mm resulting from past excavation and construction associated with the Royal Free Hospital and car-park.

The predicted historical ground movements have been compared and contrasted against the anecdotal and factual movement evidence and the assessment concludes that these historical movements of the church and school buildings *"may not be related to the existing hospital structures construction and are likely to have been induced by other sources, possibly due to soil desiccation".*

3.2 **Sub-Clause (2) Statement of construction methodology and sequence**

There is a requirement for a detailed construction methodology and sequence demonstrating how the stability of the buildings, structures and ground at the Neighbouring Properties shall be ensured throughout the Construction Phase.

Document 12 (Appendix K) describes a detailed construction methodology and sequence.

3.2.1 Sub-Clause (2) (i) Temporary and permanent support measures and quantification of movement

There is a requirement for detailed design of the temporary and permanent support measures to be provided to the excavation demonstrating the parameters adopted and quantifying the extent of associated soil movements to be expected.

Document 7 (Appendix F) This document is the Bachy Soletanche design report for the contiguous bore pile retaining wall that will be the principal element of the development in regards to preventing movement of the slope upon which the Church and School site.
The design has adopted the parameters provided in the GDR (document 5) and the report includes an assessment of the lateral displacements that will occur at the top of the wall as a result of the wall yielding inwards during excavation of the new basement. In the section of wall of concern, opposite St. Stephen's, the report states that these wall deflections are *"expected to be less than 10mm*".

3.2.2 Sub-Clause (2) (ii) Design of drainage to preserve or improve slope stability

There is a requirement for detailed design of any drainage measures required to preserve or improve the slopes above the excavation.

Document 10 (Appendix I) provides details of the drainage systems that are proposed to collect near-surface water behind the new retaining wall and to prevent any rise in the groundwater upslope of the wall that could affect St Stephen's Church and Hampstead Hill School.

3.2.3 Sub-Clause (2) (iii) Consideration of the impacts of the removal of any trees

There is a requirement for consideration of the impacts of the removal of any trees.

Document 9 (Appendix H) provides an assessment of the impact that the planned tree removal will have and includes guidance for mitigation measures to reduce the potential impact.

3.2.4 Sub-Clause (2) (iv) Consideration of any excavation de-watering

There is a requirement for consideration of the impacts of groundwater removal from the excavation.

The CE refers to Appendices H & I (Documents 9 and 10) but neither of these addresses the removal of water from the excavation.

Section 4.4 of Document 1) states the following:
"During the construction, any water entering the basement will be collected and discharged. This system will not drain the ground water but simply collect any water passing through the basement perimeter, hence the ground water collection during construction will have no impact to the surrounding area or properties."

3.3 Sub-Clause (3) Structural monitoring and contingency plan

There is a requirement for a detailed structural monitoring and contingency plan for the works.

Document 15 (Appendix N) is a Monitoring Action Plan.

3.3.1 Sub-Clause (3) (i) Location of monitoring points

There is a requirement for the plan to set out specific monitoring points.

Document 15 (Appendix N) includes specific monitoring points.

3.3.2 Sub-Clause (3) (ii) Monitoring equipment

There is a requirement for the plan to set out specific monitoring equipment for movement and vibration.

Document 15 (Appendix N) includes specific monitoring equipment.

3.3.3 Sub-Clause (3) (iii) Monitoring frequency

There is a requirement for the plan to set out a specific monitoring frequency.

Document 15 (Appendix N) includes a specific monitoring frequency.

3.3.4 Sub-Clause (3) (iv) Responsibility for implementation of the monitoring and contingency plans

There is a requirement for the plan to name a specific person with responsibility for implementing the monitoring and contingency plans.

Document 15 (Appendix N) names the Basement Design Engineer.

3.3.5 Sub-Clause (3) (v) Assessment criteria

There is a requirement for the plan to set out specific assessment criteria.

Document 15 (Appendix N) includes specific assessment criteria.

3.3.6 Sub-Clause (3) (vi) Contingent actions

There is a requirement for the plan to set out specific contingent actions.

Document 15 (Appendix N) sets out a procedure to call a review meeting of an Engineering Review Panel and sets out potential mitigation measures that *"could be put into place following an engineering design panel review"*.

3.3.7 Sub-Clause (3) (vii) Communication

There is a requirement for the plan to allow for specific communication of the monitoring data to interested parties.

Document 15 (Appendix N) includes a system of information sharing.

3.3.8 Sub-Clause (3) (viii) Responsibility for implementation of the contingent actions

There is a requirement for the plan to name a specific person with responsibility for implementing the contingent actions.

Document 15 (Appendix N) names the Basement Design Engineer and the Engineering Review Panel.

3.3.9 Sub-Clause (3) (ix) Resources required to enable implementation of the contingent actions

There is a requirement for the plan to identify the resources required to enable implementation of the contingent actions.

The CE refers to Document 15 (Appendix N) but that document does not appear to identify the resources required.

3.3.10 Sub-Clause (3) (x) Availability of the required resources

There is a requirement for the plan to identify the availability of the resources required to enable implementation of the contingent actions.

The CE refers to Document 15 (Appendix N) but that document does not appear to address the availability of resources required for implementation of contingent actions.

Document 5 (Appendix D) does state that *"Willmott Dixon should have access to an available stockpile of suitable backfill material as an immediate contingency, if required, to backfill the excavation."*

The same document also states: "*Contingency measures (probably backfilling or temporary propping) should be fully designed and ready for quick fabrication and installation if movement trends continue past the red trigger limit and damage to the neighbouring properties is exceeding allowable limits."*

3.4 Sub-Clause (4) Surface water sewer capacity calculations

There is a requirement for calculations indicating how the risk of sewer flooding is to be mitigated.

Document 6 (Appendix E) sets out these calculations.

3.5 Sub-Clause (i) Basement Design Engineer (BDE)

There is a requirement for the Owner to appoint an independent suitably certified engineer (qualified in the fields of geotechnical and/or structural engineering) from a recognised relevant professional body having relevant experience of sub-ground level construction commensurate with the Development ("the Basement Design Engineer") AND for details of the appointment to be submitted to the council for written approval in advance (and for the Owner to confirm that any change in Basement Design Engineer during the Construction Phase with the Council in advance of any appointment).

Document 1 contains a letter from HTS that confirms their appointment as BDE.

3.5.1 Sub-Clause (ii) (a) BDE - Conservative modelling, design plans, design review

There is a requirement for the Basement Design Engineer to ensure that the designs have been undertaken in strict accordance with the terms of this Agreement incorporating proper design and review input into the detailed design phase of the Development and ensuring that appropriately conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties have been incorporated into the final design.

The CE refers to section 1.3 (fig 4) of Document 1 and to Document 2 (Appendix A).

Section 1.3 of Document 1 is a description of the design team.

Fig 4 of Document 1 is a letter from HTS including the following text *"In our professional opinion, we confirm, that best endeavours have been used to ensure that the design of the basement and the Detailed Basement Construction Plan are in accordance with the S106 agreement and appropriate conservative modelling relating to the local ground conditions, water environment and structural condition of neighbouring properties has been incorporated into the final design."*

Document 2 (Appendix A) is a collection of capability statements from the various members of the design team.

3.5.2 Sub-Clause (ii) (b) BDE - Damage impact assessment

There is a requirement for the Basement Design Engineer to ensure that the result of the above appropriately conservative figures ensure that that the Development will be undertaken without any impact on the structural integrity of the Neighbouring Properties beyond "category 0 (negligible)" with reference to the Burland Category of Damage.

The CE refers to section 7 of Document 1 and to Document 14 (Appendix M), which describes the predicted impacts to be "category 0 (negligible)" with reference to the Burland Category of Damage.

3.5.3 Sub-Clause (ii) (c) BDE - Letter of professional certification

There is a requirement for the Basement Design Engineer to issue a letter of professional certification confirming that the design plans have been undertaken in strict accordance with the S106 Agreement **AND** that the detailed measures set out in sub-clauses (1) to (7) inclusive have been incorporated

correctly and appropriately **AND** that these are sufficient to achieve the objectives of the Detailed Basement Construction Plan (ie. that the Development can be constructed safely and that the impact on the Neighbouring Properties will be limited to category 0).

Document 1 (Fig 4) is a letter from HTS confirming that *"best endeavours have been used to ensure that the design of the basement and the Detailed Construction Plan are in accordance with the S106 agreement."*

3.5.3.1 Sub-Clause (ii) (c) (1) BDE - Structural assessment of Neighbouring Properties

There is a requirement for the Basement Design Engineer to confirm that reasonable endeavours have been made to access and prepare a detailed structural appraisal and conditions survey of all the Neighbouring Properties.

Document 16 (Appendix O) includes schedules of condition for neighbouring properties.

3.5.3.2 Sub-Clause (ii) (c) (2) BDE - Method statement for mitigation including assumptions, temporary works sequence, monitoring, contingency actions

There is a requirement for the Basement Design Engineer to confirm that the DBCP incorporates a method statement detailing the proposed method of ensuring the safety and stability of Neighbouring Properties throughout the Construction Phase, including temporary works sequence drawings, and assumptions with appropriate monitoring control risk assessment contingency measures and any other methodologies associated with the basement and the basement temporary works.

Document 13 (Appendix L) is a Construction Management Plan.

3.5.3.3 Sub-Clause (ii) (c) (3) BDE - Detailed Design Drawings

There is a requirement for the Basement Design Engineer to confirm that the DBCP includes detailed design drawings incorporating conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties prepared by the Basement Design Engineer for all elements of the groundworks and basement authorised by the Planning Permission together with specifications and supporting calculations for both the temporary and permanent basement construction works.

Documents 6 and 11 (Appendices E & J) contain detailed design drawings

3.5.3.4 Sub-Clause (ii) (c) (4) BDE - Present on site, responsible for monitoring and approving the temporary and permanent works

There is a requirement for the Basement Design Engineer to be retained at the Property throughout the Construction Phase to inspect approve and undertaking regular monitoring of both permanent and temporary basement construction works throughout their duration and to ensure compliance with the plans and drawings as approved by the building control body.

Document 1 (section 9) states:

"*Heyne Tillett Steel are appointed to carry out regular inspections during the construction of both the basement and the superstructure. The inspections are to commence prior to the demolition of the existing structure and continue throughout the construction process in order to maintain control over the construction process and prevent non-compliances with the design documentation. In addition to this, Heyne Tillett Steel will be reviewing the weekly records of movement monitoring in order to prevent excessive movement and damage caused by the construction of the basement and superstructure to neighbouring structures…"*

3.5.3.5 Sub-Clause (ii) (c) (5) BDE - To ensure maintenance of water diversion and drainage measures affecting stability of the Property and neighbouring properties

There is a requirement for the Basement Design Engineer to confirm that the DBCP includes measures to ensure the on-going maintenance and upkeep of the basement forming part of the Development and any and all associated drainage and/or ground water diversion measures order to maintain structural stability of the Property, the Neighbouring Properties and the local water environment (surface and groundwater).

Document 1 (section 5.2) states:

"*The GCS* [groundwater collection system] *will be designed to have redundancy and be designed maintenance free. The upper land drains will be fully accessible."*

3.5.3.6 Sub-Clause (ii) (c) (6) BDE - To ensure installation and maintenance of water monitoring equipment

There is a requirement for the Basement Design Engineer to confirm that the DBCP includes measures to ensure ground water monitoring equipment shall be installed prior to Implementation and retained with monitoring continuing during the Construction Phase and not to terminate monitoring until the issue of the Certificate of Practical Completion (or other time agreed by the Council in writing).

Document 3 (Appendix B) describes the groundwater monitoring equipment that has been installed.

3.5.3.7 Sub-Clause (ii) (c) (7) BDE - To confirm amelioration and monitoring measures of construction

There is a requirement for the Basement Design Engineer to confirm that the DBCP includes amelioration and monitoring measures of construction traffic including procedures for co-ordinating vehicular movement with other development taking place in the vicinity and notifying the owners and / or occupiers of the residences and businesses in the locality in advance of major operations delivery schedules and amendments to normal traffic arrangements.

Document 13 (Appendix L) includes details of the proposed construction traffic management.

3.6 **Sub-Clause (iii) Certifying Engineer (CE)**

There is a requirement for the Owner to appoint a second independent suitably certified engineer (qualified in the fields of geotechnical and/or structural engineering) from a recognised relevant professional body having relevant experience of sub-ground level construction commensurate with the Development ("the Certifying Engineer") AND for details of the appointment of the certifying engineer to be submitted to the council for written approval in advance

Document 1 refers to CRH as the Certifying Engineer.

3.6.1 **Sub-Clause (iv) CE - Two-page review report confirming (1) to (7)**

There is a requirement for the Certifying Engineer to review the design plans and offer a 2 page review report to the Council confirming that the design plans have been formulated in strict accordance with the terms of this Agreement and have appropriately and correctly incorporated the provisions of sub-clauses (1) to (7) inclusive above and are sufficient to achieve the objectives of the Detailed Basement Construction Plan AND should any omissions, errors or discrepancies be raised by the Certifying Engineer then these to be clearly outlined in the report and thereafter be raised directly with the Basement Design Engineer with a view to addressing these matters in the revised design plans to 2-page review report.

Document 19 is a review report by the CE.

3.6.2 **Sub-Clause (v) (a) CE - Letter of professional certification**

There is a requirement for the Owner to provide a letter of professional certification from the Certifying Engineer confirming that the Detailed Basement Construction Plan is an approved form and has been formulated in strict accordance with the terms and clauses of the S106 Agreement.

Document 19 includes a statement as follows: "*Campbell Reith has reviewed the information submitted in the Willmott Dixon "Detailed Basement Construction Plan" and is satisfied that it is in a form approved by the Basement Design Engineer and Certifying Engineer and has been formulated in accordance with the relevant terms and clauses of the Section 106 Agreement"*

3.6.3 **Sub-Clause (v) (b) Consultation with locals**

There is a requirement for evidence that the Owner has meaningfully and actively consulted local interested parties/local residents groups on the provisions of the plan prior to submission of the plan to the Council.

Document 17 (Appendix P) contains details of these consultations.

3.6.4 **Sub-Clause (v) (c) Statement of locals' representations**

There is a requirement for a statement summarising all representations received by the Owner pursuant to the consultation with local interested parties.

Document 17 (Appendix P) contains details of these representations.

3.6.5 **Sub-Clause (v) (d) Addressing of locals' representations**

There is a requirement for evidence that the Owner (in preparing the plan for submission to the Council) has taken account of any representations received pursuant to sub-clause (v) (b) and has sought to address any issues raised.

Document 17 (Appendix P) contains details of how the representations have been addressed.

3.6.6 **Sub-Clause (v) (e) Agreement of DCC**

There is a requirement for confirmation in writing from Members Briefing that the plan is agreed or (in the event of the plan having been referred to the Development Control Committee on the recommendation of Members Briefing) confirmation in writing from the Development Control Committee that the plan is agreed.

3.7 **Sub-Clause (vi) Resolution of issues**

There is a requirement for the Owner to respond to any further questions and requests for further information about the submitted plan from the Council.

4. Discussion

The DBCP has been significantly revised since the original version and now provides the required evidence that the proposed development should not affect the neighbouring properties.

However, it was considered that the DBCP required a more robust movement monitoring and contingency plan than was been presented. This is because a key factor in determining the acceptability of the construction proposals is that observation of instrumentation placed in and around the slopes where the excavation is planned to commence will provide assurance that acceptable movements can subsequently be expected in the more sensitive excavation zone directly below the church. In addition, this initial area of excavation in the south will extend to greater depths than those planned for the more sensitive area below the church and hence are expected to constitute a worst case scenario, providing comfort of lesser movement expectations in the less deep area but more sensitive area.

The monitoring plan has now been revised (Document 19) with the intention that it should provide greater assurance that a sufficiently rapid response to exceedances of predetermined trigger levels will actually prevent further movements from reaching limits of unacceptability. The previous plan was somewhat unspecific and it had been perceived that there was scope for misunderstandings to arise about exactly who is responsible for setting the various trigger levels required, receiving and reviewing the automated monitoring data and implementing the emergency response plan.

The S106 identifies the key person to take responsibility for formulating the appropriate plan to be the Basement Design Engineer (BDE), Najib Sheeka of Heyne Tillett Steel, who is to be retained at the property throughout the Construction Phase in order to oversee the works and to ensure compliance with the requirements.

It is considered essential that the management structure demanded by the S106 is complied with fully and hence, while A-squared have been identified as the provider of action and trigger levels for the monitoring plan, these must be subject to approval by the BDE (and the CE).

The monitoring surveyor is named as the party receiving the automated monitoring data but the information is planned to be passed immediately to the BDE for review should any trigger levels be exceeded.

The BDE is now correctly identified as the person responsible for leading the review and the instigation of a contingent response to any exceedance of trigger levels.

There were three sub-clauses of the S106 that did not appear to have been adequately addressed as follows:

4.1 **Sub-Clause (3) (vi) Specific Contingent actions**

There is a requirement for the plan to set out specific contingent actions.

Document 15 (Appendix N) set out a procedure to call a review meeting of an Engineering Review Panel and sets out potential mitigation measures that *"could be put into place following an engineering design panel review"*.

This was not considered to constitute a sufficiently robust contingency plan.

The plan now more clearly places responsibility with the BDE for ultimately controlling the deployment of mitigation.

4.2 Sub-Clause (3) (ix) Resources required to enable implementation of the contingent actions

There is a requirement for the plan to identify the resources required to enable implementation of the contingent actions.

Document 15 (Appendix N) did not identify the resources required. The revised plan now identifies, in section 9.3.3, the resources required.

4.3 Sub-Clause (3) (x) Availability of the required resources

There is a requirement for the plan to identify the availability of the resources required to enable implementation of the contingent actions.

Document 15 (Appendix N) did not appear to address the availability of resources required for implementation of contingent actions. The revised plan now identifies, in section 9.3.4, the availability of the resources required.

5. Representation by Objectors

5.1 Information Provided

The principal information submitted most recently by objectors to the scheme comprises the following:

- Joint report by Eldred Geotechnics Ltd and First Steps Ltd, dated 8th November 2017. (Appendix 2 to Birketts Response)
- Report by Stephenson Davenport Structural Associates Ltd, dated 9th November 2017 (Appendix 3A to Birketts Response)
- Report by Stephenson Davenport Structural Associates Ltd, dated 8th November 2017 (Appendix 3B to Birketts Response)
- Letter on Pond St. monitoring proposals by Stephenson Davenport Structural Associates Ltd, dated 20th October 2017
- Letter from drk planning, dated 13th November 2017 (Appendix 6 to Birketts Response)
- Email to Camden from Jeffrey Gold, dated 6th December 2017

5.2 Joint report from Eldred Geotechnics Ltd and First Steps Ltd

This is a fourteen page document prepared by Michael Eldred and Michael De Freitas (the StS experts) on behalf of St Stephens. The report has caused concern as a result of the language used. The report vehemently discredits the professional competence of other experts engaged in the project. The report is in six parts that are addressed as follows (references to individual numbered paragraphs of the document are provided in brackets):

5.2.1 Part 1 Confidence in the Numerical Model.

The document asserts that confidence in the numerical ground model used (PLAXIS) can only be gained if it is able to re-create the known history of the site. However, while the StS experts accept that the model has not been used to assess movements due to

- Desiccation
- Tree removal
- Localised small scale/shallow slope instability
- Accidental over-excavation
- Ground borne vibration

they seem to be of the opinion that the finite element ground model could and should have included all these possible sources of movement. We disagree.

It is a fallacy to suggest (paras 5, 15 and 16) that the model needs to be able to demonstrate the movements due to cause X for it to be valid for predicting movements due to cause Y. The applicant's experts have explained that one conclusion that may be drawn from their modelling is that the recorded past movements of the church building cannot be explained simply by consideration of foundation settlement due to loading or to ground movements due to past excavations on the neighbouring site. The

applicant's experts suggest (DBCP Appendix M) that an alternative cause (such as clay desiccation) must be considered at least in part responsible.

We agree. It is not true to say (para 10) that the DBCP does not provide commentary upon the displacements that are calculated to have occurred historically. On the contrary it is of significance that the model demonstrates that the reported movements cannot be explained by stress changes alone.

The GMA does not show (para 12) that the Royal Free Hospital has variously risen, moved eastwards and moved southwards by 40mm to 50mm in the past or that it will do so in the future and it would indeed be a very strange model that did suggest as much.

The model does not explain the reported StS aisle walls and nave columns settlement relative to the tower at the east and the narthex at the west (para 13). We agree with the StS experts that this would not be a logical expectation of downslope movement and again it points to some other mechanism of failure.

The suggestion (para 14) by the StS experts that it is intuitively wrong to expect that the ground surrounding a large excavation in a pseudo elastic medium might be expected to rise is surely mistaken. The reverse is generally true.

The GMA does not show (paras 17 & 18) that the StS tower has settled 60 mm and then risen by 65 to 66mm. This is again would be a somewhat strange suggestion.

The vertical profile of the strata levels used in the model is stated in section 4.2 of the GMA. The Figures 0261-02, -03 and -04 are representations of what was logged by the various investigations, and do not form part of the adopted ground model. The latter was produced as expected with the input of a chartered geologist and contrary to the suggestion of the StS experts does not appear to contain "lumpy features" (para 19.1).

The manner in which the modelled stiffness varies with the geology is also described in section 4.2 of the GMA (Table 4.2). Hence it is wrong (para 19.2) to suggest that this is not the case.

The GMA explains the "disturbing inputs" that were used in the model in section 4.3. Hence it is wrong (para 19.3) to suggest that this is not the case. Section 4.3 of the GMA explains what has been modelled and section 4.4 of the GMA explains the sequence.

The GMA results for the historic church movement are of interest, but overall, as apparently conceded by the StS experts (para 22), the plots of historic movement demonstrate that the model cannot reproduce the historic movement of the ground. At this point it becomes reasonably clear that the historic movement must be primarily attributed to some alternative cause and to a methodology other than that which has been modelled. However, the StS experts do not appear to accept this logic and instead state that the model is unacceptable (para 23) for predicting ground movement due to the proposed excavations for the new development.

The StS experts criticise (para 22) the role played by the Certifying Engineer, (Elizabeth Brown of Campbell Reith) accusing her of either not having properly undertaken the duties required of the Certifying Engineer, or of having undertaken them incompetently. As both allegations would be a serious breach of a code of professional conduct, this is a complaint that should be raised under the disciplinary procedures of the Geological Society of London since Ms. Brown is a chartered Fellow of that society. We disagree with these allegations.

5.2.2 **Part 2 Assessment of Damage Levels**

The StS experts criticise the use of the Burland Damage Category assessment as being wholly inappropriate for the church (paras 24, 25 & 26).

However, the DBCP reference to the Burland Methodology is a specific requirement of the S106 and of the guidance to current Camden Local Plan Policy A5.

CPG4 explains further

> *"Where a BIAs identifies risk of damage to properties by subsidence this risk should be described using the Burland Scale. The Burland Scale methodology has been adopted for projects internationally and has been used by the Building Research Establishment and the Institution of Structural Engineers, London. The classification system of the scale is based on the ease or repair of visible damage"…..*
>
> *…"In the Burland Scale the damage to properties caused by subsidence may be considered in three broad categories: (i) visual appearance or aesthetics, (ii) serviceability and function, and (iii) stability. Burland Scale categories 0, 1, and 2 refer to (i) aesthetic damage, category 3 and 4 relate to (ii) serviceability and function, and 5 represents damage which relates to stability."*

The truth is that, as pointed out earlier in this report, the GMA does acknowledge the limitations of the Burland approach (section 5.9) and indeed does consider other criteria for the assessment of the church tower where it was found to be impossible to apply the Burland methodology.

The fact that the Church has suffered serious amounts of movement and cracking in the past does not diminish the usefulness of applying rigorous criteria to limit additional future movement caused by the neighbouring development to Category 0. This assessment of damage risk (para 26) is therefore not "meaningless" as is suggested by the Sts experts. Whatever has happened in the past, geotechnical engineers need to identify and mitigate those future movements that can be expected to occur due to stress changes in the soil as a result of the proposed development. This appears to be exactly what has been done, using the Plaxis modelling.

5.2.3 **Part 3 Review of issues revealed by BH 213**

The StS experts claim (para 27) that "*the groundwater heads in BH103 strongly suggested the presence of a hydrogeological boundary upstream (i.e. essentially uphill) of its location and probably between BH103 and BH102*". We disagree and do not reach this conclusion. We believe that the evidence points to a limited and variable permeability of the soils and concur with the opinion of the applicant's first groundwater expert ESI:

> *"It is probable that following periods of rainfall water infiltrates the Made Ground / Head deposits and then sits or moves above the underlying low permeability London Clay Formation."*

and also agree with the applicant's second groundwater expert OGI's concept of

> *"…a two-layer system, with the higher permeability combined Made Ground, Head Deposits and zone of Affected London Clay, overlying a less permeable layer of unaffected London Clay".*

The StS experts claim that BH213 encountered a surprising number of distinct and discrete zones of polished shear surfaces (para 28) and point to this (para29) as a *"remarkable and clearly local occurrence".* However, our experience is that the polished surfaces, visible on the photographs of the split cores taken from this borehole, are typical features of the London Clay, and would likely have been logged in any borehole subjected to the same unusual level of scrutiny as this one. It should be noted that the borehole was constructed by special rotary techniques specifically to allow this level of scrutiny.

In other words, the occurrence of these heavily fissured zones is considered normal and not to be a special feature of the ground in that particular borehole.

The StS experts then proceed (para 29) to hypothesise that a form of periglacial valley bulging has occurred and that excavation for a basement to the original General Hospital in about 1901 caused a slope failure (para 31). Neither of these hypotheses are considered necessary to explain the reported findings of BH213.

Finally, the StS experts allege (para 33) that no proper Conceptual Model for the ground that has been written by an experienced engineering geologist. On the contrary, we find that the following five Chartered Geologists have now contributed in one way or another to the geological assessment of the scheme.

• Opher Tolkovsky	BSc, MSc, DIC, FGS,	**CGeol** (Soil Consultants)
• Stuart Wagstaff	BSc, MSc, FGS, RoGEP	**CGeol** (Soil Consultants)
• John Bartley	BSc, MSc, FGS,	**CGeol** (Soil Consultants)
• Joseph Gomme	BA MSc	**CGeol** (esi)
• Elizabeth Brown	BSc MSc FGS	**CGeol** (Campbell Reith)

5.2.4 **Part 4 Management of groundwater**

The StS experts state (para 35) that drainage of the London Clay is a major feature of the design of the new development claim that and express concern that chemical deposition from dissolved solids in the clay will clog the system over time. On the contrary, OGI, the applicant's groundwater experts, advise that band drains are routinely installed successfully with groundwater drainage systems exceeding the design life of the building.

We consider that there is actually no essential requirement in this case to drain the London Clay by means of band drains and that clogging of these is thus not an issue, so long as there is a means to prevent any excessive pore water pressures acting on the piled retaining wall. This is being achieved through vertical drainage.

The GMA section 5.10 explains that the stability of the slopes remains unaffected by the negligible changes in groundwater that are predicted to potentially occur as a result of the development.

The StS experts state (para 36) that the proposed installation of a land drain to 0.75m depth would cause groundwater to rise by 1.25m. However, this is a gravity-defying non-sequitur. Groundwater levels would only rise up in the area of the tower if the existing drainage conditions in that area were somehow altered.

If the retaining wall drainage was omitted so that drainage was impounded there would conceivably be a rise in local groundwater levels behind the wall. That situation has been modelled.

The purpose of including the additional near surface collector drain in the design is understood to have been primarily to provide additional assurance to intercept and divert any near surface water flow during storm conditions, not to deal with groundwater.

The StS experts finally state (para37) that without a range of seasonal water level measurements there is no basis for predicting future movements. This is a fallacy since a good knowledge of past water levels would only contribute confidence to a model where the future conditions were unchanged and it would not help to understand the effects of future construction. Good engineering enables the configuration of water in the ground to be maintained at predictable levels in the future, so that the new development is "invisible" to the local hydrogeology.

5.2.5 **Part 5. Baseline values for the ground and its groundwater at construction time zero**

The StS experts state (para 38 & 39) that the ground model cannot be verified. However, the Plaxis modelling tool is now some 25 years old, having emerged from academia as a commercial ground in 1993. It is well known and is considered reliable.

The accusation by the StS experts that the model *"workings contain some unknown mixture of real and conservative values for strength, stiffness and permeability"* is unjustified. The DBCP includes a Geotechnical Design Report that discusses at length the selection of appropriate soil parameters for this project and the parameters used in the GMA are clearly set out.

The StS experts claim (para 40 et seq) that there is insufficient knowledge of the historical variation over time of ground water levels in the ground in which the footings for the church and its hall are founded for the development to proceed. They claim that this is required in order to judge how any change detected by instrumentation should be interpreted. This is not so. The design of the new development has incorporated specific drainage provisions, and there is not understood to be any planned redesign of these. In the event that a significant variation in the pore water pressures occurred that did not accord with the expected effects of these provision, the ensuing assessment would more likely look to the adequacy of their construction rather than past measurements of water levels.

Similar considerations apply to the vibrating wire piezometers (para 42) and to the inclinometers that have been installed (para 43). It is not essential to know their background behaviour for their information to be used. Indeed, it might be something of an optimist who claimed to have established the range of background behaviour after 1, 5 or even 10 years.

The monitoring and contingency plan that was provided in the DBCP was criticised and has now been revised by means of an addendum submission to the DBCP. While (para 44) the StS experts identified that inadequate preparation had been made for designing appropriate responses to given monitoring outputs in the previous DBCP, they have yet to comment on the revised proposals.

5.2.6 **Part 6. Matters considered Open and Closed**

The StS experts state that the S106 Q+A Master Document that is presented in Appendix P of the DBCP is confusing because they consider that some issues stated as having been closed have not been closed.

The document was understood to have been presented as supporting information to the effect that there had been due consultation with local parties and that the applicant had sought to address any issues raised as required by Sub-Clauses (v) (b), (c) and (d) of the S106.

Contrary to the actual S106 requirements, which are for a statement summarising all representations received by the Owner pursuant to the consultation with local interested parties and evidence that the Owner has sought to address any issues raised, the StS experts seem to imply (para 46) that items on the register could only be closed out on their say so rather than on the consideration of the documents owners and cite the fact that they have been closed out as

> *"further evidence that Campbell Reith have not done the job they were engaged to do."*

If the above statement was not intended to be of a somewhat inflammatory nature it is all the more difficult to accept the next assertion by the StS Experts that

> *"This situation will not improve without a change in the management structure for this job and the appointment of a senior engineer to take overall charge of what's going on with this basement."*

The appointment of Elizabeth Brown of Campbell Reith as Certifying Engineer required her to review the submission and to provide a report to the Council confirming that

- the DBCP has been formulated in strict accordance with the terms of the S106 Agreement and
- the DBCP has appropriately and correctly incorporated the provisions of sub-clauses (1) to (7) inclusive of the S106 agreement and
- the DBCP is sufficient to demonstrate that the Development can be constructed safely in light of the ground and water conditions and will control ground movements such that impact on the Neighbouring Properties is limited to "category 0 (negligible)" in accordance with the Burland Scale.

The required report was issued on 12th October 2017

The S106 Q+A Master Document lists some 400 issues. The StS experts have referred to about 35 specific issues that were raised by themselves. In each case the issues are indicated to have been addressed by various individual named firms of the applicant's team and the reason(s) for closing out the issues are stated in red. To be fair the final column does clearly detail where the StS experts have responded and indicated that they are not satisfied.

The S106 Q+A Master Document is thus not in any way misrepresenting the position of the StS experts as they suggest (paras 47 & 48).

Overall, and as an indication of the scale to which they may have become misled, it may be noted that they conclude that Professor David Potts of Imperial College should be asked for an opinion as a senior engineer with experienced engineering oversight at the highest level.

Professor Potts is a Senior Consultant at GCG and holds the GCG sponsored chair as Professor of Geotechnical Engineering at Imperial College. It is a matter of record that his firm GCG have already provided an opinion on the potential impact of the proposed Pears development on St Stephen's Church and have already concluded, without the need for any more detailed modelling than that undertaken in January 2015, that the "damage to the church resulting from construction of the Pears Building should not exceed damage category 0 (negligible)".

Some rather emotive language has perhaps been used to accentuate the various arguments that the StS experts have presented. In the interests of attempting to provide a balanced background against which the non-technical reader may form an opinion about the church some reminder of the church context is perhaps warranted as follows.

1. The church is documented as having suffered serious movement in 1896, 1898, 1901, 1903, 1960, 1969, 1970 and 1972.
2. The northern line tube was reportedly tunnelled close to or beneath the west end of the church in around 1902.
3. The Royal Free Hospital was constructed in around 1969.
4. The church was underpinned in 2002-2009 and the existing church basement was formed.

Overall, prior to the recent stabilisation by underpinning, there was a pattern of historical movement that pointed towards significant subsidence and cracking of the more western end of the church, commencing in the 19th Century and continuing throughout the 20th Century.

5.3 Report by Stephenson Davenport Structural Associates Ltd. (9/11/17)

This is a thirty-two page document prepared by Ian Stephenson for St Stephens. The principal issue raised are discussed below.

The report criticise the DBCP as having been prepared as a response to the requirements of the section 106 requirements, and yet that is precisely what was required.

The report calls for more detailed information on the structural loading take downs used to size the piles, lift cores, pile caps, columns, etc. This information would only be required if an actual re-calculation of the design was required.

The report claims that details of appointments were not provided. The S106 requires details of the appointment of the Basement Design Engineer and of the Certifying Engineer and these details were provided.

The report questions the safe construction of the piling mat using vibratory compaction. This is normal practice and the contractor is expected to control the level of any ground induced vibration using the ground borne vibration monitoring that is planned.

The report states that a very crude approach has been used in assembling the ground model, that the outcomes are not realistic and that it is highly unlikely that the structures will comply with Burland Category 0 during and after the works are completed. It would seem that in these comments this report is merely mirroring the comments made by the StS experts, addressed in the previous section

Again, as with the report by the StS experts, this report claims that the Q and A spread sheet in Appendix P gives a false impression of the real situation. Again, this issue has been addressed in the previous section.

5.4 Report by Stephenson Davenport Structural Associates Ltd. (8/11/17)

This is a twenty-four page document prepared by Ian Stephenson for Pond Street properties. However, the report does not appear to raise any issues other than those raised either in the above report or in the below letter.

5.5 Letter from Stephenson Davenport Structural Associates Ltd

This a letter by Ian Stephenson criticising the monitoring system that has been put in place on certain properties on Pond Street for being restricted to the front facades of these properties and demanding a more robust monitoring, communication and contingency plan. The letter was written prior to the revised plan.

5.6 Letter from drk planning, dated 13th November 2017

This is a letter from Derek Kent that appears to mirror the comments already made by both Stephenson Davenport and by the StS experts and as such does not appear to merit individual scrutiny.

5.7 Email from Jeffrey Gold, dated 6th December 2017

This is a letter from the chair of the Hampstead Green Neighbourhood Group (HGNG) claiming that the previous version of this review did not provide sufficient evaluation of the DBCP submission and did not refer to the reports of the StS experts.

To clarify, the brief was to independently assess whether the DBCP meets the S106 requirements and to identify any issues or areas where it is considered that the applicants have not met the requirements. It is strictly speaking not necessary to evaluate or explain for each clause of the S106 by how much the submission surpassed or failed to meet the S106 requirement and in most cases it is simply a matter of stating whether or not some very tangible task has been completed.

The brief is not to reproduce the assessments or calculations but to attempt to identify any aspects of the assessment, design, methodology or outcomes that do not appear to accord with expectations in the light of the S106 requirements and for any such aspects to identify as far as is possible what additional measures should be reasonably considered necessary in order to meet the S106 requirements.

The brief has since been extended to include consideration of the representations by objectors.

6. Conclusion

It is considered that the DBCP meets the requirements of the S106 agreement, and that it has been reasonably demonstrated that the Development can be constructed safely in the light of the ground and water conditions and that ground movements can be controlled such that impact on the Neighbouring Properties is limited to “category 0 (negligible)” in accordance with The Burland Scale.