# ATHLONE HOUSE, HAMPSTEAD LANE,

# LONDON N6 4RU

## STRUCTURAL ENGINEER'S

## CONSTRUCTION SEQUENCE METHODOLOGY FOR PLANNING

engineersHRW
incorporating Jane Wernick Associates

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## 1.0 Non-Technical Executive Summary

EngineersHRW have been appointed by Virtus Real Estate, to provide structural engineering design services for the proposed refurbishment and extension of Athlone House, Hampstead Lane, London N6 4RU. This report reviews the impact of the proposed basement on the existing building, nearby buildings and other infrastructure in order to safeguard their stability. Further parts of the report examine ground hydrology, drainage, flooding, trees and construction.

This report has been prepared in compliance with the London Borough of Camden's planning requirements for DP27 Basements and lightwells and CPG 4 Basements and lightwells. It includes this Construction Sequence Methodology signed off by a Chartered Structural Engineer (MIStructE) and includes proposals for temporary supports and sequence of construction.

The proposed work involves the restoration of the existing building and a single storey extension on the North side of the building with a basement for services distribution and a swimming pool at ground floor. As outlined in the structural inspection report by Mann Williams, the previous works to the building have left several scars which will be carefully repaired and the extension will be blended into the existing fabric as part of a sustainable evolution of the building. The stability of the existing structure will not be changed. The new extension will have a braced steel frame which is tied to the new masonry section which will have several stabilising masonry walls.

The site has been covered by several investigations and the ground conditions are well understood. There is Made Ground up to 1.8m thickness, underlain by Claygate Member to 20m (the maximum drilling depth). The existing foundations are masonry corbelled footings on a loose concrete mix. In the basement, the founding depth is generally 0.9m below the internal floor level while the ground floor foundations are 1.1m to 1.6m below ground level. The historical usage of the site would suggest that there are no sources of contamination of the site.

Monitoring of the boreholes over a 5-year period has found the water level to be stable between 9.02m and 10.21m below ground level. The proposed basement level will be the same as the existing basement level, which is more than 5m above the highest recorded water level. The conclusion of the basement impact assessment by Geotechnical & Environmental Associates, was that the proposed single storey basement will not have an impact on the hydrological or hydrogeological setting, as the basement will not intercept the groundwater.

Most of the trees are located away from likely areas affected by the demolition and construction works and those nearby will be protected as detailed in the tree protection plan.

As noted in the flood risk assessment by Infrastruct, the Environment Agency indicative Flood Map for Planning shows that the proposed development site is located in Flood Zone 1 which is classified as land at low risk of flooding. The proposed surface water drainage system will use the existing system and improve it by introducing a storage tank to control the rate of flow of water from the site.

The proposed basement and method of construction are of a fairly typical form. When the soil is excavated, the soil at the base of that excavation will expand due to being unloaded. The ground movement analysis from GEA, indicates that in the short-term the soil will expand by 10 mm at the centre of the excavation, reducing to around 5 mm at the edges. The impact of these movements on the existing building have been found to be within Burland Category 0 (negligible) and have nominal impact on the proposed extension. All other buildings are more than 30m away from the proposed basement and will be unaffected.

It is proposed that the existing non-original two storey side extension to the existing building is carefully demolished and the openings propped. The site of the extension is to be levelled and the basement to be excavated with the sides battered to a safe angle, as recommended by Geotechnical Consultants. A reinforced concrete slab, walls and new foundations will be cast before backfilling the excavation. This will provide a stable foundation for the superstructure to be constructed on.

## 2.0 Introduction

2.1.1 This Construction Sequence Methodology (CSM) for planning has been prepared for and on behalf of our client, based on the planning proposals by SHH Architects (drawing references listed in section 0). It is for the use of the client, the client's professional advisers and London Borough of Camden (LBC) and is for their use only. The report should not be used for any purposes other than for which it was considered. The report should be read in conjunction with Engineers HRW Structural Drawings (drawing references listed in 10.2.1) and Basement Impact Assessment (BIA) by GEA (report references listed in 10.3).

2.1.2 Engineers HRW have been asked to consider the structural issues surrounding the proposed construction works to support the planning application. The firm is based in London and have successfully produced designs for more than 100 basement schemes many in LBC.

2.1.3 This report has been prepared in compliance with LBC Planning requirements for DP27 Basements and lightwells and CPG 4 Basements and lightwells. It includes this Construction Sequence Methodology signed off by a Chartered Structural Engineer (MIStructE) and includes proposals for temporary supports and sequence of construction.

## 3.0 Description of Proposed Development

3.1.1 The proposal comprises the sensitive repair and restoration of the existing building. As part of the restoration to the North side of the existing building, a new single storey extension will be built with a new swimming pool and basement structure to the same level as the existing basement.

The existing building is not listed and there are no neighbouring buildings that would be impacted by the proposed basement development. Due to the local historical significance of the existing building and to protect it appropriately during construction, the existing building has been treated as an adjacent building to the proposed swimming pool basement construction and a full ground movement analysis (GMA) has been undertaken.

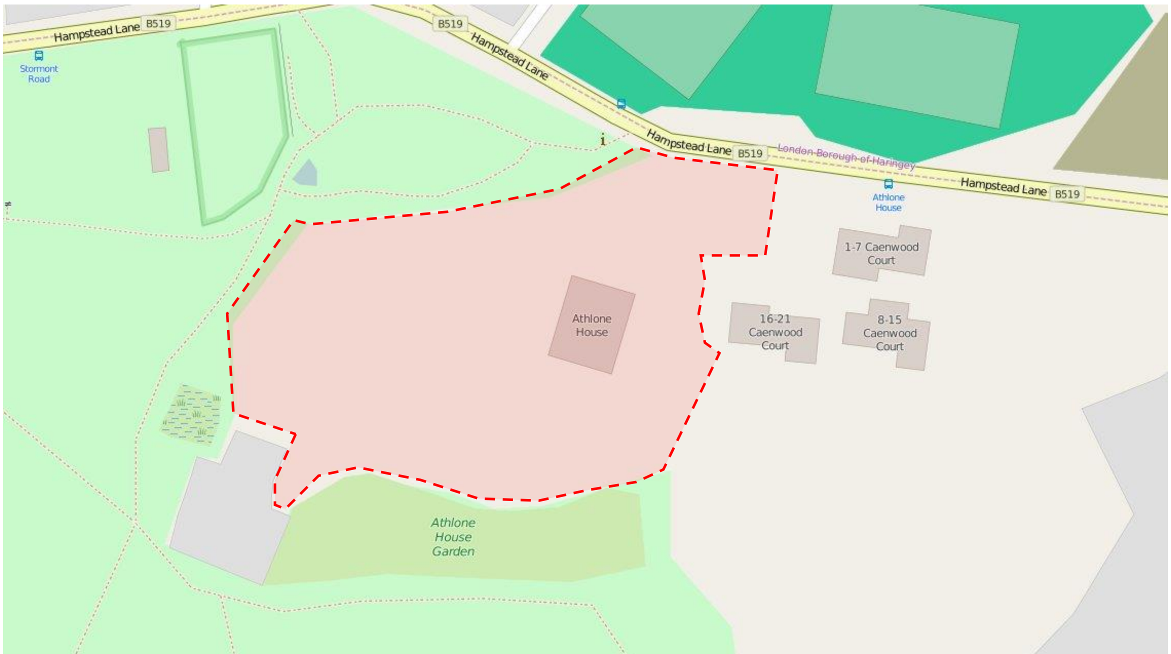


**Figure 1 – Site Location Plan with Boundary Shown in Red © OpenStreetMap contributors**

## 4.0 Relevant Planning Background

Planning applications have been in discussion for the site since 2003 when the Caenwood Court buildings were constructed.

The recent application 2013/7242/P proposed to demolish the existing structure and build a new structure on the site of the old one. There was an appeal following the refusal of the application and as part of the appeal process there were several specific areas noted as agreed items, these include:

- Hydrology
- Biodiversity
- Affordable Housing
- Sustainability
- Amenity of neighbors
- Transport

The 'agreed item' relevant to this report is the hydrology. It was agreed that a proposed basement 7m below ground level (bgl) would not have a negative impact on the hydrology on the site. The new proposed depth is less than 7m bgl, it is at the same level as the existing basement 3.2m bgl and is an improvement on the previous proposal.

## 5.0 Site Information

The site is situated in the Highgate Village Conservation Area of the London Borough of Camden (LBC).

The site is located on Hampstead Lane with Hampstead Heath on the South and West sides and 3 blocks of residential buildings to the East. The current site access is from Hampstead Lane. The site is roughly rectangular and it is maximum 190m long x max 230m wide. It occupies an area of approximately 2.88 hectares.

The site is at the crest of the hill at an average level of 112.9 AOD and the ground level steps down along the site from a high level circa 13.2m at the front and East side of the property to the lower level circa 12.0m at the rear and West side of the existing building. The desk study has not found any tunnels or other underground infrastructure in the vicinity of the site.

### 5.1 Existing Building

From historical map evidence, the present detached property was built in 1871, originally a residential building that was later used as a hospital. As part of this change of use, a number of additional buildings were added and demolished leaving an area of hardstanding to the North of the building.

The existing property is a 4-storey detached former manor house, located at the East of the site. With the exception of the building and the hardstanding to the North of it, the site is generally soft landscaped gardens.

The existing structure appears to be traditionally constructed with load-bearing solid brickwork walls on brick corbel footings on mass concrete. Internally it has timber floors and roofs, with some original steel beams and more recent timber and brickwork partitions. The basement has load-bearing masonry walls on brick corbel footings on mass concrete with a mass concrete floor.

For a full structural assessment of the existing building and proposed interventions see Structural Interventions Report in Appendix C and the Structural Inspection Report in Appendix D

**Figure 2 East View of Existing Building**

## 5.2 Neighbouring Buildings

There are no buildings within 30m of the site which is outside of the influence zone of the proposed works as stated in the Basement Impact Assessment (BIA) in Appendix A.

The existing building has been treated as a neighbouring building to the proposed swimming pool basement construction as part of the BIA by GEA, the GMA by GEA and this CSM. This is one of the reasons the BIA has gone further than the screening stage.

## 5.3 Geology

The site investigation carried out by GEA, qualified site investigation consultants, revealed that ground conditions are generally consistent with the geological records and known history of the area. The ground comprises of Made Ground up to 1.8m thickness, underlain by the Claygate Member to 20m (the maximum drilling depth).

The ground conditions are summarised as follows:

- Made ground extends to depths of between 0.80m bgl (111.65m OD) and 1.80m bgl (110.45m OD), in the lawn areas surrounding the house, made ground extended to a maximum depth of 0.40m bgl (109.01m OD). It generally comprises brown clayey silt with rootlets, gravel, brick, concrete, coal and timber fragments;
- The upper Claygate Member initially comprises firm becoming stiff medium to high strength brown and orange-brown mottled grey silty very sandy clay with pockets of clayey fine sand and sandy silt, which extends to depths of 6.00m bgl (106.25m OD) and 7.30m bgl (105.34m OD);
- This is underlain by a middle Claygate member of stiff brownish grey silty sandy clay with partings and pockets of pale grey silt to depths of 7.30m bgl (104.95m OD) and 9.00m bgl (103.64m OD), which sits on stiff high strength dark grey silty clay to clayey silt is present to depths of 12.00m bgl (101.44m OD) and 15.00m bgl (97.25m OD);
- The lowest Claygate Member is very stiff high strength to very high strength dark grey silty, locally sandy, clay with traces of selenite, which was proved to the maximum depth investigated, of 20.00m bgl (92.64m OD).

### 5.3.1 Soil Contamination

The site investigation contamination analyses have not indicated any elevated concentrations of the tested contaminants.

The historical usage of the site would suggest that there are no sources of contamination on the site.

## 5.4 Groundwater

As part of the site investigation carried out by GEA, the groundwater was encountered within the boreholes 101 and 103, at depths of 12.10m (101.43m OD) and 12.50m (99.75m OD). Ground water was not found within any of the trail pits. Monitoring of these boreholes over a 5-year period has found the water level to be stable between 9.02m bgl (104.42m OD) and 10.21m bgl (101.99m OD), with full records available in the GEA BIA Report in Appendix A.

### 5.4.1 Risks to Groundwater

The conclusion of the BIA by GEA, was that the proposed single storey basement will not have an impact on the hydrological or hydrogeological setting, as the basement will not intercept the groundwater. The existing basement level is 109.55m OD, the proposed basement level is also 109.55m OD, which is more than 5m above the highest recorded water level.

GEA do not expect groundwater to be encountered within the basement excavation. Given the space around the proposed excavations, the basement will be constructed within an open cut excavation, with the sites battered to a safe angle. Unsupported sides should be protected during periods of rainfall and from run-off from construction operations until the retaining walls have been installed.

## 5.5 Hydrology

A Flood Risk Assessment (FRA) has been undertaken by Infrastruct and included with this report in Appendix F. The assessment revealed that the development is not at risk from flooding from fluvial sources, surface flooding, rising ground water or sewer surcharging.

### 5.5.1 Proposed Surface Water Drainage

As described in the FRA, the existing system takes part of the surface water runoff from the main building through an existing connection to the ornamental pond which has an existing connection to the adjacent watercourse which runs South into the Hampstead Heath ponds.

The proposed drainage system will reuse the existing system with the addition of an attenuation tanked storage to maintain a controlled and regular flow to the offsite watercourse avoiding significant peak rate discharges. The existing system will be fully surveyed and local repairs will be made where necessary.

The attenuation tank is part of a typical sustainable urban drainage system (SuDs) technique to control the quantity and quality of surface water runoff. The SuDs scheme consists of a tanked storage system with an attenuated discharge rate. The attenuated discharge will be provided by a flow control device and will limit the discharge to the greenfield runoff rate. Tanked cellular storage is proposed to accommodate the peak storm event for a 1 in 100 year storm with an allowance of 30% for climate change. The cellular storage will be accommodated under the existing tennis court. The attenuated discharge from the cellular storage will outfall into the existing pond/lake. This will even out the current unrestricted discharge which outfalls storm volumes directly into the pond.

New shallow swales will be provided alongside the access roads to take surface runoff from them. The swale will provide water treatment as well as accommodating storm loads. The hard standing serving the lodges and entrance will be constructed from tanked permeable paving to address quantity of runoff and water quality. The surface water drainage is shown on drawing number Drainage Strategy 1480/DR/50.

#### 5.5.2 Proposed Foul Drainage

From the FRA, the existing building drainage is served by a private gravity system discharging into the Thames Water public sewer in Hampstead Lane.

It is proposed that the new foul drainage will utilise the existing gravity drainage connection and will be repaired where necessary. A CCTV survey is proposed at the next stage to establish the extent of the repairs. The depth of the connection should mean that pumping of the basement is not necessary, however, this will be confirmed in the detailed design stage. As is typical, an anti- back flow valve will be installed to prevent surcharge of the main sewer flowing back into the property should such an event occur. Thames Water records do not show any such events occurring but installation of the valve is a normal precautionary measure.

The proposed BBQ pavilion is remote and at a lower level from the main building so will require a package pumping station to pump effluent to the higher level gravity drainage system serving the main building. The foul drainage is shown on Drainage Strategy drawing number 1480/DR/50.

#### 5.5.3 Risks to Surface Water Flooding and SuDs

As noted in FRA the Environment Agency indicative Flood Map for Planning shows that the proposed development site is located in flood zone 1 which is classified as land at low risk of flooding.

The proposed surface water drainage system will improve on the existing system by introducing a SuDs attenuation storage to control the flow of water from the site.

### 5.6 Trees

An Arboricultural Report was prepared by Catherine Bickmore Associates Ltd the arboricultural consultants. It is proposed that trees near works are protected, design and construction will follow the recommendations in the preliminary tree protection plan covering the demolition and construction period for the works.

#### 5.6.1 Tree Removal

It is not proposed that any trees near the existing building or proposed extension are removed.

## 6.0 Proposed Structural Works

### 6.1 Introduction

The proposed development of the site involves the careful restoration of the existing main building. Internally this consists of removing the lightweight partitions and infilling openings which were added later when it was used as a hospital. Internal existing features such as the grand stair, the original ceilings and cornicing details will be retained. Access will be improved with the addition of new staircases and sensitively added new openings. Externally, the gable end brickwork and the tower parapets will be returned to their 1880’s appearance.

The proposal includes the construction of a new single storey extension to the North of the site in the area of the hardstanding which has been previously built on, both when it was private residence and during the later works for the hospital. As part of the new extension, a swimming pool will be built down to the same level as the existing basement. Refer to the Structural Interventions Report in Appendix C for further information on the structural works.

### 6.2 Removal of the Non-original North-West Extension

It is proposed to carefully remove the non-original North-West extension and reopen the internal space both built during its later use as a hospital. All demolition works will be carried out in accordance with BS 6187 ‘Code of practice for demolition’ and an appropriately skilled and experienced contractor is to be appointed. The works are to be carefully sequenced and undertaken and the contractor is to provide full temporary works and supervision by a temporary works coordinator to ensure that the stability of the remaining structure is maintained at all times.

### 6.3 Proposed Swimming Pool Basement

6.3.1 The new swimming pool “basement” structure is to consist of reinforced concrete perimeter walls with a ground bearing reinforced concrete raft slab.

6.3.2 The excavation is to be 3.25m below the existing garden ground levels to a level in line with the existing basement. Given the space available around the proposed swimming pool, it is proposed to make an open cut excavation with the sides battered to a safe angle outlined in the BIA from GEA.

6.3.3 Groundwater was found at a depth of more than 12m below ground level in the monitoring standpipes placed in Borehole 1 and Borehole 3, 5.0m below the proposed basement level and highest recorded water level monitored over a 5-year period. Therefore, groundwater is not expected to be encountered within the basement excavation and neither would the extent of any seasonal variations be of such a magnitude that the groundwater table would rise to the level of the proposed basement structure. Care will be taken to protect the sides of any unsupported cut slopes during periods of rainfall and any run-off from construction operations until the retaining walls have been installed.

6.3.4 The concrete structure will be designed to BS8110 with full top and bottom reinforcement to all sections. The concrete in itself is not a watertight / waterproof construction and in order to achieve a Grade 3 ‘habitable’ basement in accordance with BS8102 a combination of external tanking system with internal drained cavity system will be provided.

### 6.4 Land Stability

6.4.1 The battered back excavation is the suggested method for the basement excavation from the BIA from GEA, with the slope at 1 (vertical) to 2 (horizontal). The excavation will be made largely in stiff clay. From the GMA the ground movements will be limited to 10mm, and is covered in more detail in 7.0.

6.4.2 The proposed reinforced concrete basement structure is classified as a "robust" structure and any accidental lateral loading applied to the new basement structure can be resisted by the RC structure.

### 6.5 Superstructure

The proposed extension superstructure will be a braced steel structure in the North-Western swimming pool area. In the North-Eastern area of the extension, load bearing masonry will be used on strip footings with reinforced concrete slabs. Between the two spaces is a service yard, which will have ground bearing paving stones.

The existing basement will be opened up by replacing the existing vaults with a steel frame and a new concrete ceiling and steel staircases.

The lightweight partitions will be removed and openings will be made in the existing loadbearing brickwork with lintels and steel frames. Some additional steel staircases and steel lift cores will also be introduced. The existing retained façade and roof are to be carefully repaired, with the gable brickwork rebuilt to form the original Dutch gables and the castellation returned to the tower.

### 6.6 Superstructure Stability

Overall stability of the proposed structure is provided by the existing masonry walls and masonry extension. The steel frame is braced and connected to the masonry structure. The new superstructure frame will be designed with full horizontal ties for robustness and disproportionate collapse.

## 7.0 Control of Movement

The proposed basement scheme and method of construction are of a fairly typical and conservative form. The structural stability has been fully addressed and the Ground Movement Assessment (GMA) from Geotechnical and Environmental Associates (GEA) concludes that the potential damage to the existing building from the proposed excavation to be Category 0 and negligible.

### 7.1 Ground Movement Analysis

The nearest adjacent building is 30m away as stated in the GMA for the site. Due to the historic nature of the building, a GMA has been undertaken by GEA to assess any damage to the existing building.

The assessment examines the impact of movement caused by the basement scheme on the adjoining buildings and adjacent structures. Both the short term and long term conditions are assessed relating to the construction phase and the performance of the permanent works. The assessment uses both computer modelling and empirical methods and assesses any damage of the adjacent properties using the methodology set out in CIRIA Report C580. The calculated movements have been found to be within Burland Category 0 and negligible.

From the GMA, the results of the analysis indicate that the heave resulting from the excavation of the proposed basement will be up to 10 mm within the centre the excavation and reducing to approximate 5 mm toward the edges. These movements would be expected to be complete by the end of the excavation and construction period, although depending on the time-scales of the excavation and subsequent construction, these movements may not be fully realised. Taking into account the loads of the proposed extension, the analysis has shown that in the long term, the majority of the short-term movement will be recovered, with total heave movements at the centre of the excavation likely to actually be approximately 3 mm reducing to 1 mm at the edges. In the South-Eastern corner however, where the existing basement is present, up to 5 mm of settlement can be expected due to the limited unloading of this area coupled with the proposed loads.

It also indicates the likely impact of the proposed basement construction beyond the site boundaries. On the basis of the analysis, total vertical movements outside the proposed extension to the east are unlikely to exceed 1 mm of heave, whilst beyond the South-Eastern corner between 1 mm and 2 mm of settlement maybe expected to occur. These movements however occur within 2 m of the edge of the excavation and are therefore considered to be very small and will not have detrimental impact on any surrounding structures.

## 8.0 Temporary Works

The contractor will be responsible for the design, erection and maintenance of all temporary works in accordance with all relevant British Standards. The contractor will be contractually obligated to appoint a qualified temporary works engineer to provide adequate temporary works and supervision to ensure that the stability of the existing structure, excavations and surrounding structures are maintained at all times.

### 8.1 Submissions

The contractor will be required to submit full proposals, method statements and calculations to the engineer and all appropriate parties (party wall surveyors, etc.) for approval prior to the start of any works on site.

The contractor will also be required to appoint a Temporary Works Co-ordinator for the duration of the contract in accordance with the specification and BS 5975.

### 8.2 Monitoring

All items of temporary works and the existing building should be monitored in a manner and frequency commensurate with the construction activity taking place. As a minimum the monitoring should include a daily full visual survey of all temporary works and surrounding structures and a weekly measured survey using fixed survey points during the main basement works, subject to proposed construction sequence, etc.

## 9.0 Sequence of Construction Works

Construction methodology and temporary works assumed in the design for the proposed extension are as described below. These will be superseded by the contractor’s proposals.

1. The existing two storey side extension to the existing building is be carefully demolished with the openings pinned and needled.

2. The site of the extension is to be levelled and the basement to be excavated with the sides battered to a safe angle.

3. The ground bearing reinforced concrete slab will be cast on a prepared blinding surface with starter bars for the reinforced concrete walls

4. The reinforced concrete walls will be cast and the excavation backfilled against the walls which will act as vertical cantilevers.

5. A suspended concrete slab will be cast in the pool area.

6. Strip footings will be cast in the loadbearing masonry area of the extension under insitu reinforced concrete floors.

7. A suspended concrete slab will be cast on voidformer.

8. The steel frame and masonry structure will be constructed.

## 10.0 Design Information

### 10.1 Design Standards

- Building Regulations 2010 Edition
- BS EN 1990 Eurocode 0: Basis of Structural Design
- BS EN 1991 Eurocode 1: Actions on Structures
  - 1-1 General Actions – Densities, Self-weight, Imposed Loads for Buildings
  - 1-2 General Actions – Actions on Structures exposed to Fire
  - 1-3 General Actions – Snow Loads
  - 1-4 General Actions – Wind Loads
  - 1-7 General Actions – Accidental Actions
- BS EN 1992 Eurocode 2: Design of Concrete Structures
  - 1-1 General Rules and Rules for Buildings
  - 1-2 General Rules – Structural Fire Design
- BS EN 1993 Eurocode 3: Design of Steel Structures
  - 1-1 General Rules and Rules for Buildings
- BS EN 1995 Eurocode 5 Design of Timber Structures
  - 1-1 General Rules and Rules for Buildings
- BS EN 1996 Eurocode 6 Design of Masonry Structures
  - 1-1 General rules for reinforced and unreinforced masonry structures
- BS EN 1997 Eurocode 7: Geotechnical Design
  - 1-1 General Rules

Further detail about the design criteria used for the design is included in the Structural Interventions Report in Appendix C.

### 10.2 Drawings

10.2.1 engineersHRW drawings and sketches:

- Proposed Foundations
- Proposed Basement
- Proposed Ground Floor
- Proposed 1st Floor
- Proposed 2nd Floor
- Proposed 3rd Floor
- Proposed Roof

- Section A-A
- Section B-B
- Section C-C
- Section D-D
- Section E-E
- Proposed Drainage Plan

- Basement Construction Sequence

10.2.2 Architects Drawings:

- OS Location Plan
- Site Plan – Existing
- Site Plan – Proposed

- Basement – Existing
- Ground Floor – Existing
- First Floor – Existing
- Second Floor – Existing
- Third Floor – Existing
- Roof – Existing

- Basement – Demolition
- Ground Floor – Demolition
- First Floor – Demolition
- Second Floor – Demolition
- Third Floor – Demolition
- Roof – Demolition

- Basement – Proposed
- Ground Floor – Proposed
- First Floor – Proposed
- Second Floor – Proposed
- Third Floor – Proposed
- Roof – Proposed

- East Elevation – Existing/Demolition
- South Elevation – Existing/Demolition
- West Elevation – Existing/Demolition
- North Elevation – Existing/Demolition

- East Elevation – Proposed
- South Elevation – Proposed
- West Elevation – Proposed
- North Elevation – Proposed

- AA Long Section – Existing/Demolition
- BB Cross Section – Existing/Demolition
- CC Cross Section – Existing/Demolition
- DD Long Section – Existing/Demolition

- AA Long Section – Proposed
- BB Cross Section – Proposed
- CC Cross Section – Proposed
- DD Long Section – Proposed
- EE Cross Section – Proposed

## 10.3 Reports

- Basement Impact Assessment (BIA) and Ground Movement Analysis (GMA), GEA June 2016
- Structural Interventions Report, engineersHRW June 2016
- Structural Inspection Report, Mann Williams June 2016
- Flood Risk Assessment (FRA), Infrastruct June 2016
  Arboricultural Report, Catherine Bickmore Associates' June 2016