Contents

Appendices

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HEYNE TILLETT STEEL

1. Introduction

Heyne Tillett Steel Limited has been appointed by Channing Junior School to consider the construction aspects and impact of the proposed subterranean development, in support of a planning application to the London Borough of Camden (LBC). The proposed development includes the construction of a standalone single storey basement to provide changing rooms and ancillary spaces in the southern end of the site and a further single storey basement which extends beneath the existing building to provide additional classrooms and a drama studio.

This Basement Impact Assessment (BIA) has been prepared by Heyne Tillett Steel in conjunction with GEA and in line with the Camden Planning Guidance CPG4 - Basement and Lightwells, along with section DP27 - Basement and Lightwells of Camden's Development Policies 2015 and supplementary reference documentation within these documents. This report provides specific details of each stage of the basement impact process as well as information on excavation, temporary works and construction techniques, including details of the potential impact of the subterranean development on the existing and neighbouring structures, based on the specific site characteristics, geology and hydrogeology.

In support of the BIA, a Geotechnical Report has been prepared by Geotechnical and Environment Associates Ltd (GEA). This is contained within Appendix D. GEA's report considers the geotechnical, hydrological and hydrogeological aspects of the structural scheme. It also summarises the 5 stages required for any BIA within Camden, these being Screening, Scoping, Site Investigation and Study, Basement Impact Assessment and Review and Decision Making. A report into the expected Ground Movement is also included within their report.

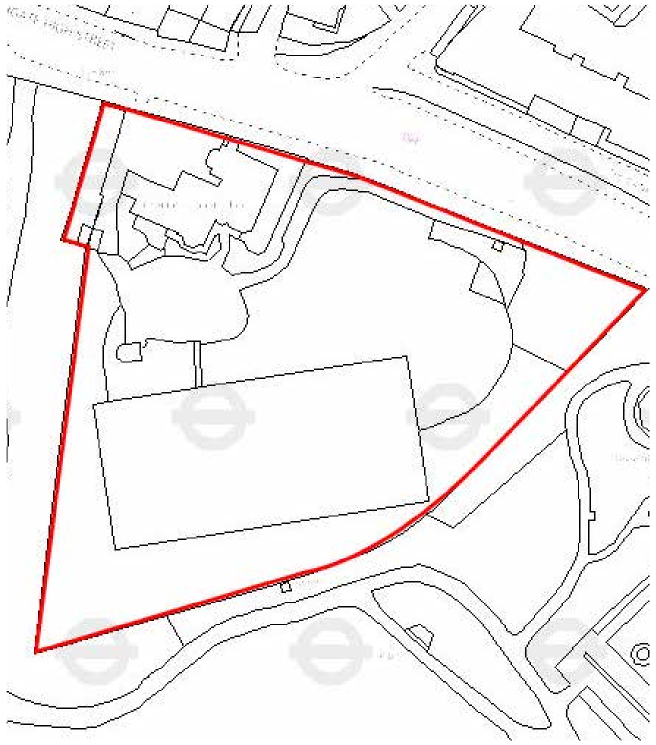
This structural engineering and geotechnical report has been organised in a format and sequence which best follows the previously highlighted 5 stages of any BIA in Camden, along with the engineering matters being discussed. A summary of each stage is given below including a corresponding reference location within the report.

The remainder of this document will discuss the existing conditions on site along with proposals in line with GEA's report and includes the previous highlighted sections above.

Camden CPG4 Stage	**Response and/or Reference Location**
1. Screening	
1.1. Subterranean Screening Assessment	*GEA Report Section 3.1.1*
1.2. Stability Screening Assessment	*GEA Report Section 3.1.2*
1.3. Surface Flow and Flooding Screening Assessment	*GEA Report Section 3.1.3*
2.0 Scoping	*Summary of Potential Impacts provided with GEA Report Section 4.1 and investigation of these potential impacts detailed in GEA Report Section 9.0*
3.0 Site Investigation and Study	*GEA Report Section 4.0*
4.0 Impact Assessment	*GEA Report Section 9.1.3 and Sections 8 of HTS Report*
5.0 Review and Decision Making	*Audit Review Undertaken by LB Camden*

Camden CPG4 Stages

Archive Photographs - Fairseat House, North East and South West Elevations c.1911



Site Location Plan

2 Existing Conditions

2.1 The Site

The site is triangular on plan, measuring approximately 123m x 158m x 122m as the crow flies, and is located just south of Highgate High Street in the London Borough of Camden.

The site topography slopes from the entrance on Highgate High Street down towards the surrounding Waterlow Park in both easterly and southerly directions.

The site is essentially split into three levels ranging from approximately 118m AOD to 111m AOD. The ground floor level of the school is located at approximately 117m AOD, the lower ground floor and playground levels are at approximately 114.27m AOD to 113.59m AOD and the tennis courts are located on the lowest level at approximately 110.40m AOD. The site slopes generally from north to south over a distance of approximately 106m, with an overall slope angle of 10 degrees. The site also slopes from west to east at a similar angle of 10 degrees over a distance of approximately 110m.

The school is set within extensive landscaped grounds. Tennis courts, a temporary building used for sports facilities and a number of portacabins occupy the southern end of the site. A relatively steep grass bank is located just north of the tennis courts. A tarmac playground area is located just south of the main school building and an access road is located along the western elevation of the main school building leading from the entrance on Highgate High Street to the eastern corner of the site, where a car park is situated.

A masonry retaining wall separates an existing terrace area at ground floor level from the landscaped gardens and playground areas along the eastern elevation of the main school building. A masonry wall also forms the northern boundary of the site, separating the school from Highgate High Street.

A number of trees are located within the landscaped gardens. The significance of these trees and their associated root protection zones is discussed within the Arboricultural Impact Assessment Report. This is contained within Appendix H.

2.2 Existing Building

The main school building is located in the northern end of the site, just south of Highgate High Street. The original building, also known as 'Fairseat House', is believed to have been constructed during the 1870s and was partially demolished in the early 1900s to allow for the widening of Highgate High Street / Highgate Hill. The building was partially reconstructed as required; the interface between the original structure and this later addition is clearly visible on site due to the colour variation between construction materials.

A detached rectangular shaped building, referred to as the stable block, is located to the west of the main school building. This 2 storey structure appears to be of loadbearing masonry construction but is excluded from the proposed development.

The main school building comprises 3 storeys overlying a single storey basement (lower ground floor), which only occupies approximately half the footprint of the building above. Due to the site topography, a level threshold exists at the interface between the single storey basement and the playground at the rear.

The existing structure comprises a series of loadbearing solid masonry walls supporting timber joists with lath and plaster ceilings typically. Ground floor slabs appear to be of ground bearing concrete construction or suspended timber joists spanning between solid masonry sleeper walls. The existing structure appears to be in reasonable condition where inspected.

Lateral stability appears to be provided by a combination of the main external masonry walls and internal spine walls in combination with the diaphragm action of the floor structures.

A series of structural alterations have been undertaken over the course of the building's life, however the full extent of these is unknown. A number of steel downstand beams were exposed during the intrusive investigations. These are believed to have been installed for various reasons including the following:-

- To allow for the demolition of existing internal loadbearing masonry walls
- To allow for the demolition of existing masonry chimneys
- To resupport timber floor structures that were locally demolished and reinstated due to poor condition

Our knowledge of the existing structure is based on visual site inspections and limited intrusive investigations due to access and programme constraints. A series of intrusive investigations will be required in the next stage of design to verify the existing structure in specific locations once the school is vacant.

Isometric View of Existing Structure looking North

View of South West Elevation and Feature Stair

View of Existing Masonry Retaining Wall, East Elevation

2.3 Existing Ground Conditions

A geotechnical desktop study and a full suite of site investigations have been undertaken by GEA to form the basis of their BIA. The scope of investigations included the following:-

- 3 no. cable percussion boreholes, 2 no. to depths of 12.00m and 1 no. advanced to a depth of 17.45m
- 4 no. open-drive sampler boreholes, advanced to a maximum depth of 6.00m, by means of a Premier rig to provide additional coverage of the site
- 5 no. window sampler boreholes advanced to a maximum depth of 3.50m, using hand held equipment in less accessible areas
- Installation of 6 no. groundwater monitoring standpipes to depths of between 3.00m and 8.00m, and subsequent groundwater monitoring visits
- Falling head tests carried out in 2 no. standpipes to determine the permeability of the underlying natural soils
- 9 no. hand dug trial pits excavated to depth of between 0.50m and 1.30m to determine the configuration of the foundations of the existing building and retaining wall
- Laboratory testing of selected soil samples for geotechnical purposes and for the presence of contamination

These investigations were required to determine the existing subsoil conditions and associated groundwater levels. A summary of the typical ground conditions are as follows:-

0.0 - 0.32 / 2.90m bgl	Made Ground / Topsoil Brown clayey gravelly sand, brown silty sandy clay or dark greyish brown sandy gravel with extraneous fragments of brick, concrete and ash
0.32 / 2.90 - 3.25/ 5.60m bgl	Bagshot Formation Sand with varying quantities of flint gravel, rare cobbles with rare pockets of grey clay to reddish brown medium to course with fragments of cemented sandstone and rounded flited gravel
3.25 / 5.60 - 11.55 / 12.20m bgl	Claygate Member Light brown silty fine sand to soft or firm brown mottled pale grey and orange-brown silty clay
11.55 / 12.20 to 17.45m bgl	Claygate Member Stiff high strength dark grey silty clay

A series of trial pits were also undertaken at lower ground and ground floors respectively to establish the construction details of existing footings and their founding levels.

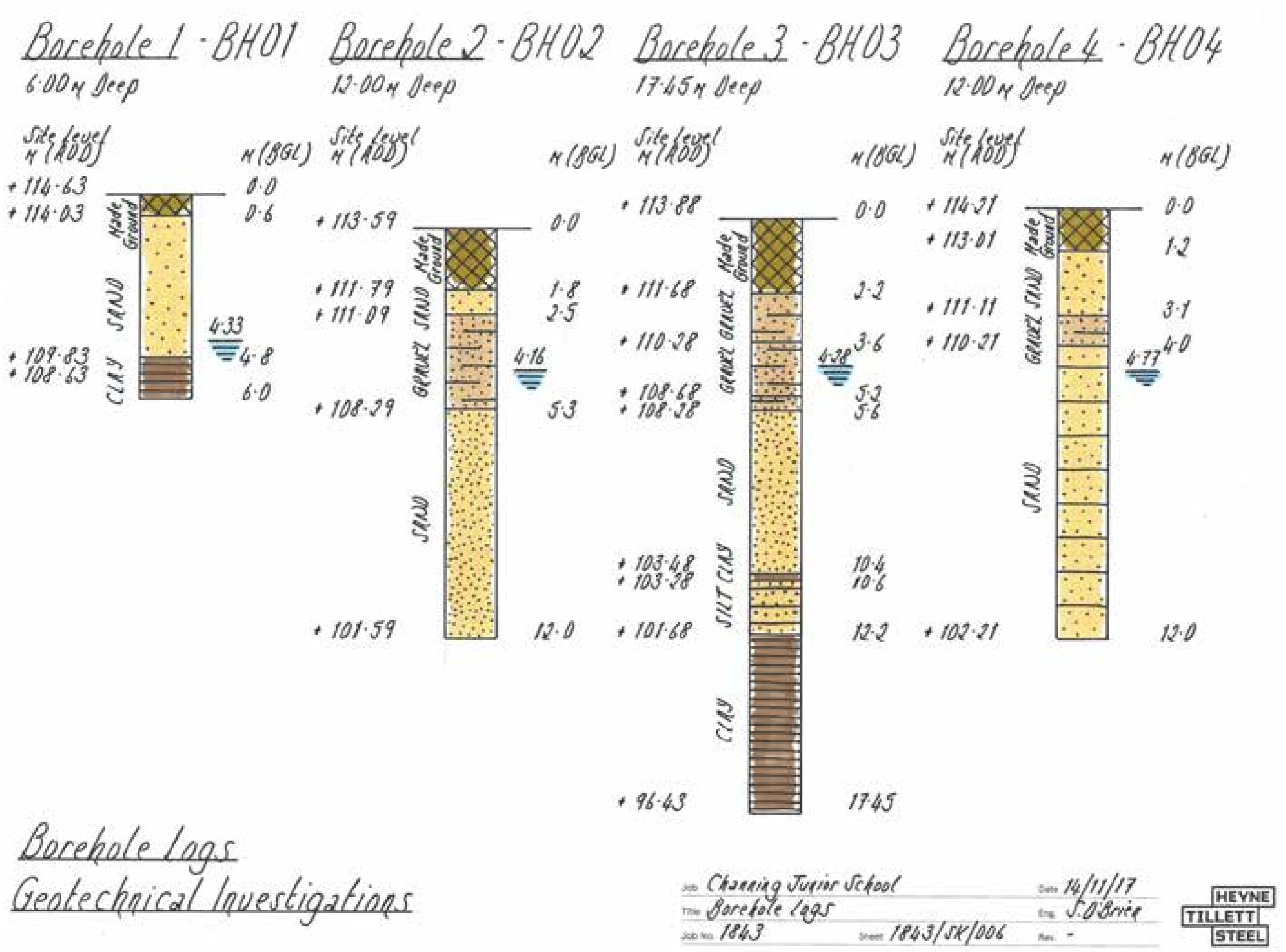
Groundwater levels are discussed in detail in section 2.6. In summary, groundwater was encountered at approximately 4-5m below ground level close to the base of the Bagshot Formation. This was verified in all investigation locations.

Please refer to GEA's report in Appendix D for more details including borehole and trial pit logs.

2.4 Existing Foundations

Existing loadbearing masonry walls appear to be founded on corbelled footings overlying concrete strip footings of varying depths. The concrete strip footings bear onto the firm silty sandy Bagshot Formation layer of the ground strata typically.

Site Photographs - Trial Pits, Main School Building



Borehole Logs

2.5 Existing Drainage

A Thames Water asset location search indicates that the site is served by a combined sewer, which runs in a southerly direction beneath Highgate High Street.

A below ground drainage CCTV survey has also been carried out by Spaflow and indicates that there are 2 no. separate below ground drainage systems on site, which discharge into the combined sewer from separate outfalls. Both systems are combined as they receive connections from foul and surface water drainage and comprise of a combination of gravity fed and pumped drainage to serve the lower ground floor.

All rainwater drainage from the temporary sports hall and associated buildings discharges to the ground.

The drainage systems on site were comparatively limited given that a majority of the surface area drains off downhill onto the sports field.

Please refer to Appendices E and F for more details including the below ground drainage CCTV survey report by Spaflow.

2.6 Existing Hydrology and Hydrogeology

GEA have undertaken an assessment of the existing site hydrogeology, which is summarised as follows:-

Both the Bagshot Formation and Claygate Member are classified as a Secondary 'A' Aquifers meaning they have permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers as defined by the Environment Agency (EA). The London Clay Formation is classified as unproductive strata with soils that have a low permeability and negligible significance to local water supply, as defined by the EA.

The site is not located within a designated Groundwater Source Protection Zone (SPZs) and there are no Environment Agency registered water abstraction points within 1km of the site. The nearest surface water feature is Upper Pond within Waterlow Park, located close to the southern boundary of the school grounds, at a level of between 111m AOD to 110m AOD. Another pond is located in the park known as Middle Pond located at an elevation of between 96m AOD and 91m AOD. A third pond is present in the park, known as Lower Pond.

The site lies outside the catchment of the Hampstead Heath chain of ponds.

Groundwater is likely to be present within the Bagshot Formation and the Claygate Member. Spring lines are present at the interface of the Bagshot Formation and the Claygate Member, and to a much lesser extent at a lower level at the boundary between the Claygate Member and the underlying essentially impermeable London Clay. These springs have been the source of a number of London's 'lost rivers', notably the Fleet, Westbourne and Tyburn, which all rose on Hampstead Heath.

Reference to the Lost Rivers of London indicates that a headwater of the eastern branch of the River Fleet flows from springs that rise in Waterlow Park to the south of the tennis courts in the park, close to Swain's Lane, located approximately 100m to the southwest of the site. The river flows in a south-easterly direction from that point.

Groundwater was encountered in the aforementioned ground investigation at Channing Upper School during drilling within the made ground, Bagshot Formation and Claygate Member at depths of between 2.0m and 8.0m.

The increase in hardstanding as a result of the proposals is minimal and rain water will be able to infiltrate into the ground beneath the site to the extensive areas of soft landscaping.

The site is not at risk of flooding from rivers or sea, or by reservoirs as defined by the Environment Agency.

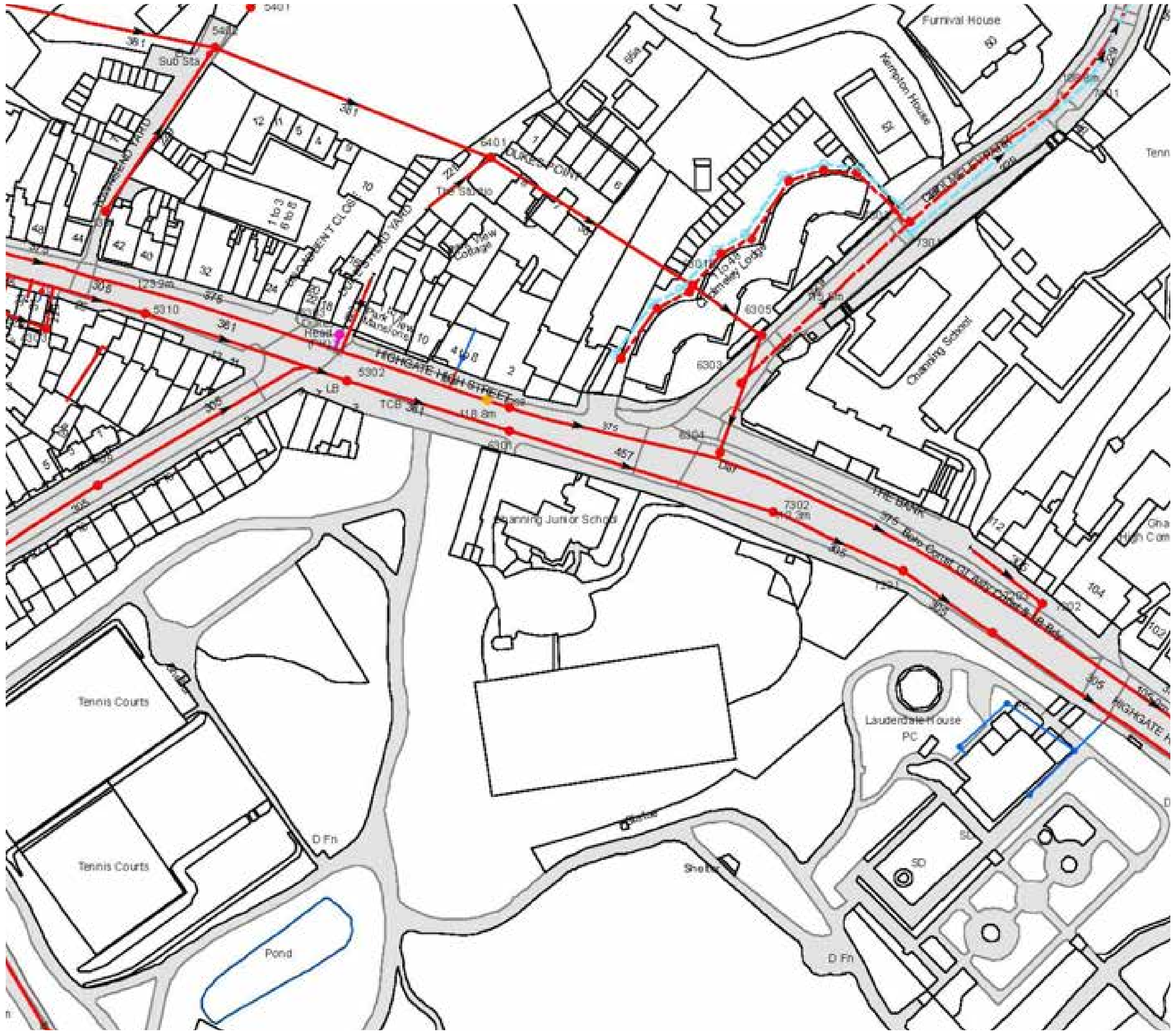
2.7 Party Walls

The main school building is detached and therefore there are no party walls for consideration.

2.8 Buried Infrastructure

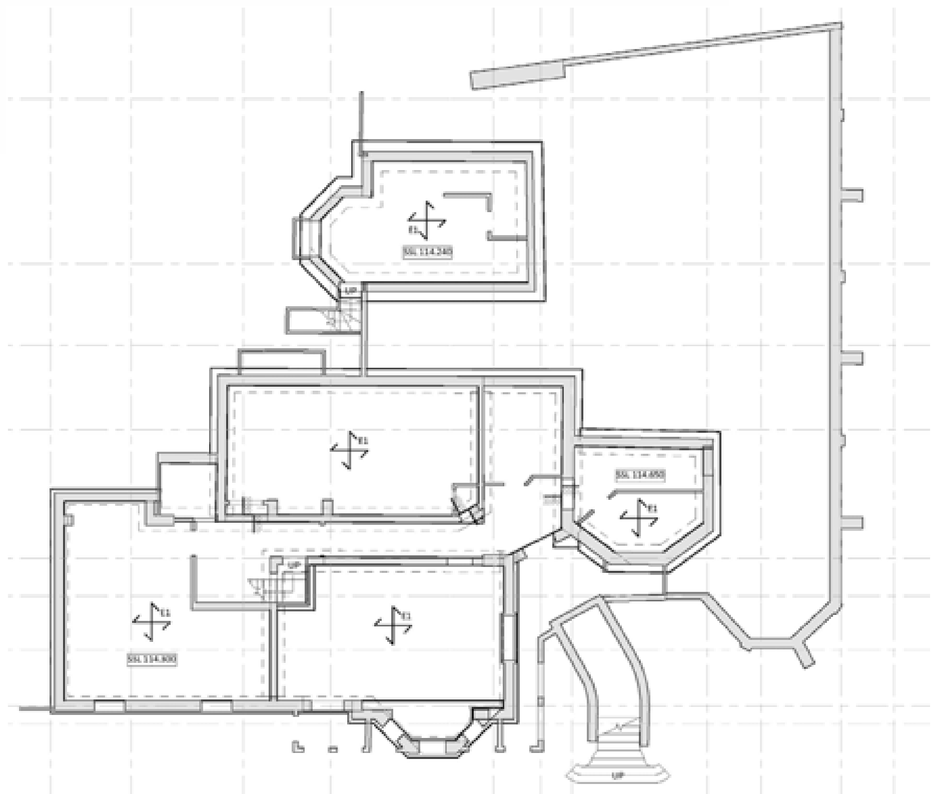
London Underground, Crossrail, Network Rail and Mail Rail development maps have been reviewed in terms of their proximity to the proposed development.

These assets are not considered to have any implications on the proposed development.



Thames Water Asset Location Plan

Longitudinal Isometric Section through Existing Structure



Existing Structural GA - Lower Ground Floor

3. Basement Impact Assessment

3.1 Stage 1 - Screening

The London Borough of Camden guidance suggests that any development that includes a basement should be screened to determine whether or not a full Basement Impact Assessment (BIA) is required.

A screening assessment toolkit is included in the ARUP document and for the basis of section 3.0 of GEA's report. This forms the basis of the next 3 stages of any BIA and continues accordingly.

3.2 Stage 2 - Scoping / Stage 3 - SI and Study

As noted within section 4.1 of GEA's report, there are a number of scoping points that have potential impacts and require further assessment by site investigation.

GEA have provided the design of the site investigation to correctly assess these scoping points and have concluded each point within section 9.0.

To summarise both of these stages, a table containing the potential impacts, consequences and conclusions of the site investigations is summarised below.

3.3 Stage 4 - Impact Assessment

As noted in the executive summary of their report, the conclusions of GEA's BIA are as follows:

The BIA has not indicated any concerns with regard to the effects of the proposed basement on the site and surrounding area. It has been concluded that the impacts identified can be mitigated by appropriate design and standard construction practice. The ground movement analysis and building damage assessment have indicated that the predicted damage to the adjoining and nearby structures would generally be Category 0 (Negligible), with a limited number of segments of 'Very Slight' damage. The result falls within acceptable limits, although monitoring is recommended to ensure that no excessive movements occur that would lead to damage in excess of these limits.

Potential Impact	Consequence	Site Investigation Conclusions
The site is within 100 m of a pond and spring lines. The lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) is close to or lower than, the mean water level in local pond or spring line and the pavilion excavation may extend beneath the water table.	The pavilion excavation may affect the groundwater flow regime. Flow from a spring if diverted or restricted could affect flow elsewhere. Changes in flow to the ponds could affect water quality.	The proposed 3.10 m deep excavation for the pavilion will have a formation level within the Bagshot Formation, close to or below the groundwater table. There is the potential for the pavilion to locally affect the groundwater regime and groundwater flows will be diverted around the structure.
The proposed basement development will result in a change in the proportion of hard surfaced / paved areas	The proportional increase in hardstanding could potentially reduce rates of recharge, reducing groundwater flow to a nearby watercourse. The increase could also increase rates of runoff, exacerbating flood risk.	The proposed development for the site will marginally increase the amount of hardstanding. Consideration may need to be given to permeable paving to mitigate a potential loss of groundwater recharge.
The existing site and surrounding area includes slopes, natural or manmade, greater than 7°. The site is within a wider hillside setting in which the general slope is greater than 7°	The proposed development has the potential to alter the existing slope profile which may lead to local instabilities. Low permeability clay layers within the Bagshot Formation may lead to perched water tables which can affect slope stability.	According to the slope angle map produced by Arup as part of the Camden geological, hydrogeological and hydrological study, the site is not located within a wider hillside setting in which the general slope is greater than 7°. The proposed basement excavation will cut into a steep bank to the north of the tennis courts. On the basis of a visual assessment of the site, no evidence of the slopes having suffered from movement was found.Further, the site sections indicate that the depth of the new pavilion structure to be constructed in the steepest slope will be such that greater stability will be provided by the permanent concrete retaining walls through the redevelopment than at present. In the temporary condition the slope will be supported with sheet piles. The proposed excavation for the pavilion is not therefore considered to be a cause for concern regarding slope stability issues.
The site is in an area that could be affected by seasonal shrinks well where clays are present. Trees may be felled.	Where foundations are affected by tree roots and clay soils are present this could lead to damaging differential movement. Heave of any clay soils resulting in structural damage to the buildings.	The site is underlain predominantly by granular soils of the Bagshot Formation and removal of trees is unlikely to cause heave of such soils. The Bagshot Formation is unlikely to be of volume change potential given the sandy nature of the soil, confirmed by particle size distribution tests.
Site is within 5 m of a highway or pedestrian right of way.	Excavation may result in structural damage to the road or footway.	The investigation has not indicated any specific problems, such as weak or unstable ground, voids or a high water table that would make working within 5 m of public infrastructure particularly problematic at this site. The pavilion excavation is located in excess of 5 m from Highgate High Street, but the eastern extension is located within 5 m. Careful workmanship will be undertaken to ensure no movements. This will be modelled in the GMA.
Founding depths relative to neighbours.	N/A	The site is currently occupied by a detached building. Where required the foundations of Fairseat House will be underpinned to ensure its stability. The ground movement analysis and building damage assessment have indicated that the predicted damage to the adjoining and nearby structures would generally be Category 0 (Negligible), with a limited number of segments of 'Very Slight' damage. The result falls within acceptable limits.
The site is underlain by a Secondary 'A' Aquifer.	The site is underlain by the Bagshot Formation, which is classified as a Secondary 'A' Aquifer. This has the potential of being able to support local water supplies as well as forming an important source of base flow for local rivers. There is the potential for the hydrogeological setting to be affected by a basement development.	Both the Bagshot Formation and Claygate Member are classified as Secondary 'A' Aquifers.

4. Proposed Development

4.1 Proposed Development

The proposed development includes the following structural proposals:-

- Construction of a single storey extension to provide a column-free hall / dining room at lower ground floor and connection to the south elevation of the existing building (Hall / Dining Room)
- Construction of a single storey extension to provide additional classrooms and a drama studio at lower ground floor and connection to the east elevation of the existing building (East Extension)
- Underpinning the existing building walls to allow for the construction of the extensions
- Localised demolition of existing internal walls and perimeter walls at lower ground floor to allow for access into the new spaces and associated structural works
- Construction of a single storey pavilion adjacent to the existing tennis courts to provide changing rooms (Pavilion)
- Play areas are proposed to the roofs of all new structures

A set of existing, demolition and proposed structural drawings are contained within Appendix C.

4.2 Proposed Substructure

East Extension

This extension will be formed using a combination of reinforced concrete retaining walls and underpinning existing footings to loadbearing masonry walls. Internal walls have been set out to align with the existing loadbearing masonry walls above at ground floor where possible to allow for sequential underpinning. This allows for a more efficient structural solution and simpler sequence of construction.

Reinforced concrete underpins will typically be in the region of 2.3-2.6m deep, extending from the underside of existing concrete strip foundations to the Bagshot Formation strata at +113.850m AOD. The allowable bearing pressure at this level will be in the region of 100kN/m^2.

The sequence of underpinning is to be undertaken in line with Figure 19 from the ARUP Guide 'Camden Geological, Hydrogeological and Hydrological Study' i.e. 1-3-5-2-4 sequence. The underpins will be a maximum of 1m wide and are likely to be installed in one stage, however this is subject to confirmation by the contractor.

The reinforced concrete retaining wall along the northern elevation of this extension will be formed using a similar 1-3-5-2-4 sequence but without the limitation of maintaining the existing wall lines above. The traditional method of forming RC retaining walls cannot be undertaken in this location due to the existing boundary wall and Highgate High Street beyond. The design of this retaining wall will account for the surcharge effects from the foundation to this boundary wall. Since the level of the foundation is unknown, this force will be assumed to act at existing ground level in this location +117.000m AOD. This is a conservative approach.

Steel columns along the eastern elevation of this extension will be founded on pad foundations, 1.5m x 1.5m x 0.35m deep typically. The pads will bypass the made ground / topsoil in this location, bearing directly onto the Bagshot Formation.

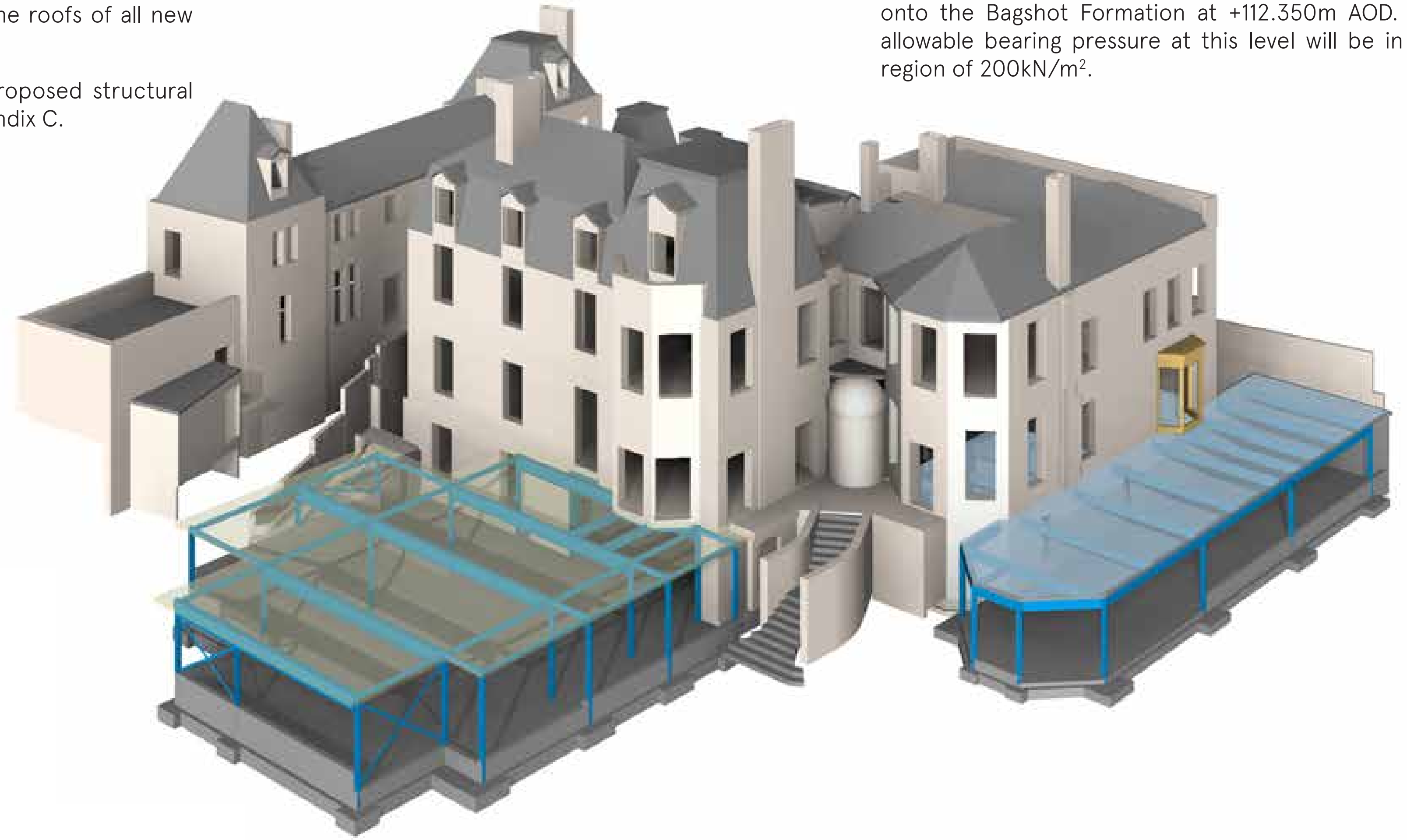
In one location, an existing loadbearing masonry wall at lower ground floor is proposed to be demolished to suit the architectural layout. A new steel beam will be installed at high level lower ground floor i.e. ground floor to support the wall above. This beam will span between a new steel column at one end and bear onto a mass concrete padstone within an existing masonry pier at the other end. The new steel column will be founded on a reasonably large 2m deep pad foundation, bearing onto the Bagshot Formation at +112.350m AOD. The allowable bearing pressure at this level will be in the region of 200kN/m^2.

A number of reinforced concrete upstands are required along the eastern elevation of the extension due to the sloping site topography. These will act as short retaining walls, extending from ground beams spanning between pad foundations.

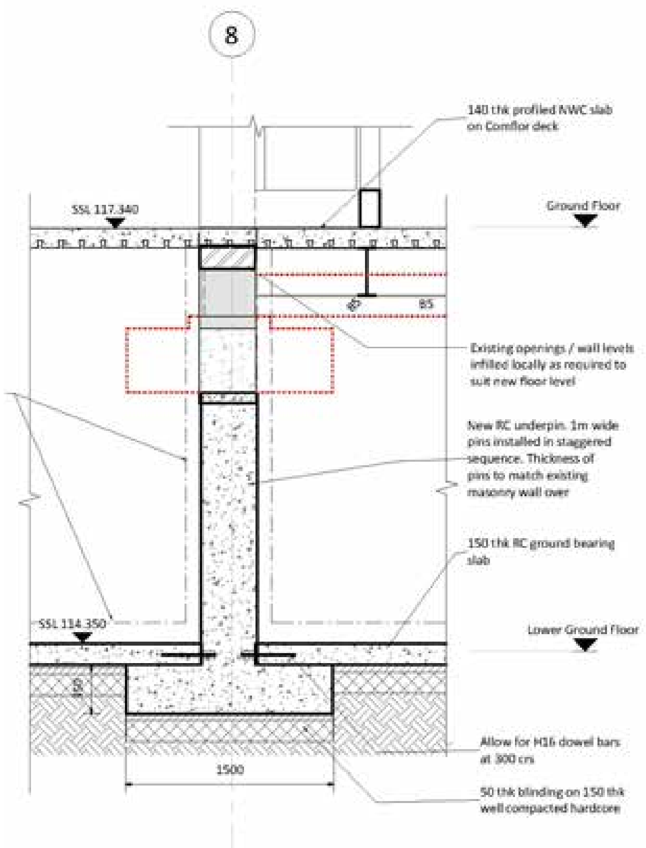
The internal slab at lower ground floor level will be of reinforced concrete ground bearing construction. The slab will be cast over blinding and well compacted hardcore overlying the Bagshot Formation. The Bagshot Formation is unlikely to be susceptible to shrink / swell, given the predominantly granular nature of the soils encountered on site.

In terms of waterproofing the basement, a cost exercise is required to determine the most cost effective first layer of waterproofing. The two viable options include upgrading the current reinforced concrete with a water resistant concrete (WRC) or externally tanking the RC retaining wall and pins between their back / external face and ground. The internal face of the RC retaining wall and pins will be lined with a drained cavity to provide a second layer of waterproofing as required for a Grade 3 habitable space in accordance with BS 8102.

The ground bearing slab will similarly be of WRC construction or externally tanked. The internal drained cavity will extend across the footprint of the extension and discharge into localised gullies, which will connect into the main below ground drainage system.



Isometric View of Proposed Structure looking North



Typical RC Underpin Section Detail

Hall / Dining Room

This extension will be founded on a series of shallow pad foundations typically.

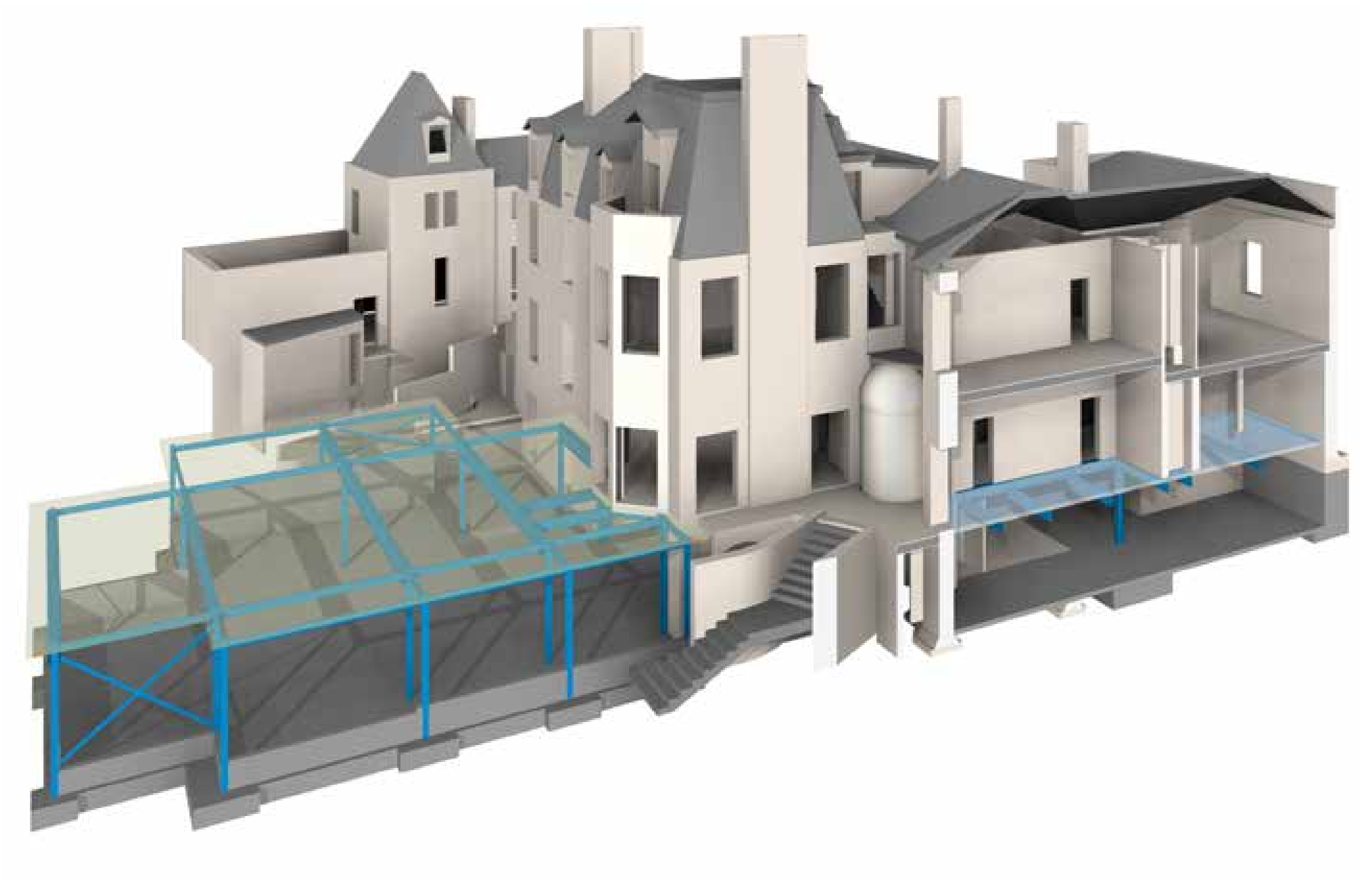
Boreholes 1 and 10 were undertaken within the footprint of this extension, just south of the main school building. Made ground was found to extend to depths of 0.32m (+114.18m AOD) and 1.60m (112.54m AOD) respectively.

The lower ground floor slab will be of reinforced concrete suspended construction due to the extent of made ground encountered within the footprint of the extension.

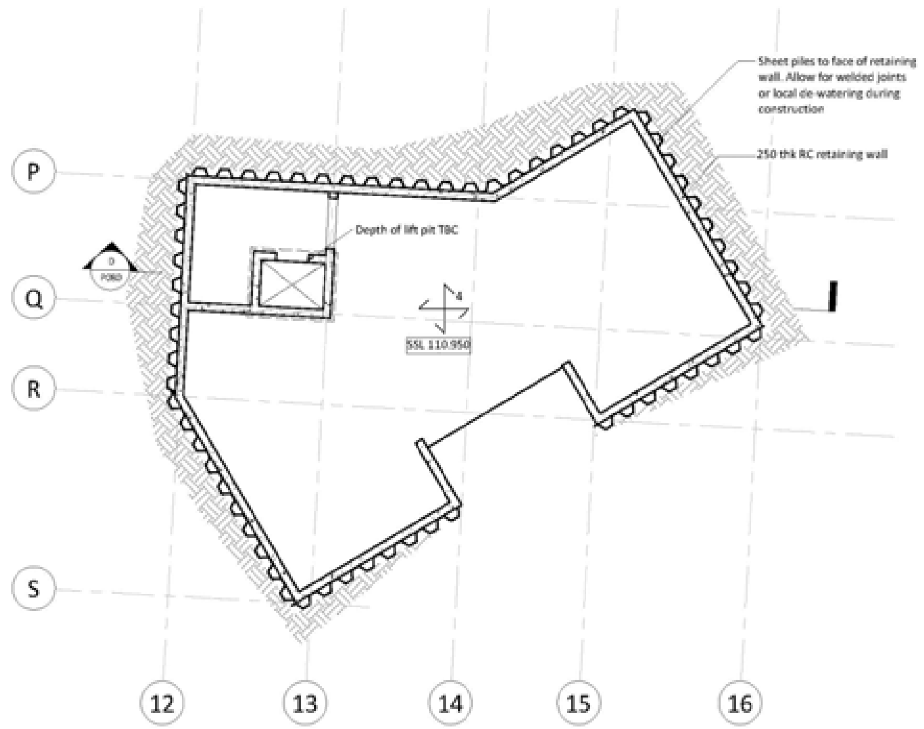
For the same reason, pad foundations will be 0.75m deep typically, bypassing the made ground / top soil and bearing directly onto the Bagshot Formation below. Bearing pressures have been limited to 100kN/m^2.

As per the east extension, a number of reinforced concrete upstands of varying depths are required to the perimeter of the extension due to the sloping site topography. These will act as short retaining walls, extending from ground beams spanning between pad foundations.

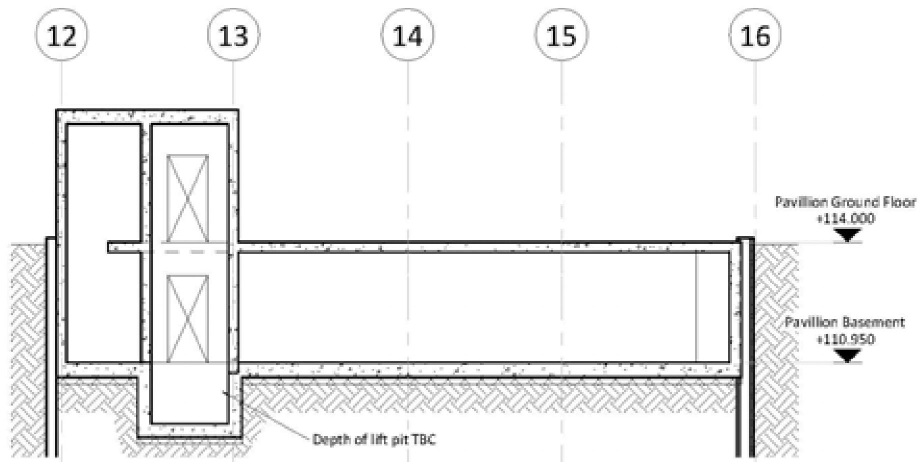
Although the groundwater table is present close to the base of the Bagshot Formation (approximately +110.00m AOD), the suspended slab will be externally tanked and an internal drained cavity will extend across the footprint of the extension as a secondary type of protection.



Longitudinal Isometric Section through Proposed Structure - Hall / Dining Room



Proposed Structural GA - Lower Ground Floor, Pavilion



Section through Proposed Pavilion

Pavilion

The pavilion structure will comprise a reinforced concrete box, with 250mm thick retaining walls to the perimeter supporting a suspended reinforced concrete flat slab at ground floor level. The suspended slab will act as a prop to the walls.

Reinforced concrete retaining walls will typically be 3.4m deep, extending from the existing ground level into the clayey gravelly sand of the Bagshot Formation strata at +110.60m AOD. This level is in fact close to the boundary of the Bagshot Formation and Claygate Member. Due to the sloping site topography, the retained height at the rear of the pavilion (i.e. north) will be greater than that at the front. As a result, the retaining walls have been checked for sliding.

A 350mm thick reinforced concrete raft foundation will occupy the footprint of the pavilion. The raft has been designed for heave movement, although this is expected to be minimal, and hydrostatic pressures associated with the groundwater at this level. The raft foundation will impose a bearing pressure of 25kN/m^2. A buoyancy check has been undertaken to verify that tension piles are not required to anchor the single storey structure.

Given that the formation level of the pavilion will extend close to or below the groundwater table, the method of construction requires careful consideration. We are proposing that steel sheet piles are installed on the sides and upslope face of the pavilion to support the ground in the temporary condition until the permanent reinforced concrete retaining walls are constructed. These sheet piles have the added benefit of preventing groundwater inflows from perched water tables and any infiltrating precipitation.

However, consideration needs to be given to noise and the impacts of vibration on the main school building. A bored pile wall may be a more appropriate solution subject to further guidance from a contractor.

As per the east extension, the pavilion must be adequately protected again water ingress. A cost exercise is required to determine the most cost effective first layer of waterproofing. The two viable options include upgrading the current reinforced concrete with a water resistant concrete (WRC) or externally tanking the RC retaining walls. The internal face of the RC retaining walls will be lined with a drained cavity to provide a second layer of waterproofing.

The raft foundation will similarly be of WRC construction or externally tanked. The internal drained cavity will extend across the footprint of the pavilion and discharge into localised gullies and chambers, where it will be pumped up to ground level.

4.3 Proposed Superstructure

East Extension

The superstructure will comprise a lightweight steel frame supporting composite normal weight concrete (NWC) slabs on profiled metal decking at roof level.

The overall slab depth and material properties of the concrete have been dictated by the dynamics performance of the roof structure, which will serve as a playground. Essentially a stiffer structure is required to minimise the anticipated frequencies for the end user.

It is also worth noting that the existing suspended timber floor structure at ground floor (within the main school building) will need to be partially demolished to allow for the sequential underpinning of the existing loadbearing masonry walls. The floor structure will be reinstated with NWC slabs on profiled metal decking spanning between long span steel beams. New steel beams will be cast into pockets in the reinforced concrete underpins.

Hall / Dining Room

The column free hall / dining room will comprise a lightweight steel frame supporting exposed CLT panels. The exposed CLT will provide an aesthetic in keeping with the recently refurbished senior school.

A series of services penetrations are required within the web of these steel beams. The specific number, sizes and setting out of these penetrations will be determined in the next stage of design.

The depth of typical long span steel beams (approximately 10m) has been dictated by dynamics as per the east extension.

Pavilion

A 250mm thick suspended reinforced concrete flat slab spans between perimeter retaining walls.

The roof slab has been designed to act as playground and to withstand vehicular loading to maintain the access route from Highgate High Street to the existing car park in south-eastern corner of site.

4.4 Stability

East Extension

Lateral stability is provided by a combination of deep reinforced concrete underpins and steel portal frames in the longitudinal direction. Portal frames are also provided in the transverse direction in alternate structural bays.

Lateral loads are resisted by the combined rigid action of the whole structural steel frame. Resistance is achieved by the inclusion of moment connections at beam / column junctions. Column bases are considered to be pinned to reduce pad foundation sizes.

Hall / Dining Room

Lateral stability is provided by vertical steel bracing in the longitudinal direction and a combination of vertical steel bracing and steel box frames in the transverse direction.

The CLT panels transfer loads back to the vertical steel bracing. These loads are resolved into the ground via shallow foundations in bearing.

Pavilion

The pavilion obtains it's stability from the roof slab acting as a stiff diaphragm transferring minimal lateral loads into the stiff reinforced concrete retaining walls.

4.5 Disproportionate Collapse

All single storey extensions will be designed for disproportionate collapse in accordance with the Building Regulations and the current material codes and standards.

The pavilion and hall / dining room are classified as Class 2A structures in Approved Document A (Part A3) of the Building Regulations, whereas the east extension is classified as a Class 2B structure.

The proposed structures will be framed and detailed to provide both horizontal and vertical 'ties' in accordance with the relevant material codes of practice.

4.6 Hydrogeology

The assessment of hydrogeology is covered within GEA's report and is summarised as follows:-

The investigation has indicated that the site is directly underlain by the Bagshot Formation, with the Claygate Member present at depth. Both strata are classified as Secondary 'A' Aquifers.

Monitored groundwater levels in October and November are about 1m beneath the proposed pavilion excavation, however early spring groundwater levels are likely to be higher. The measured groundwater table is close to the proposed excavation depth for the pavilion. There will be adequate space for water to flow around the structure, given its size relative to the size of the site and the absence of neighbouring basement structures, such that there will not be an impact on any groundwater flow.

On the basis of all of the above, it is still concluded that the proposed development will not have an impact on the hydrogeological setting.

Proposed Structural GA - Ground Floor, East Extension and Hall / Dining Room

5. Temporary Works and Sequence of Construction

5.1 Site Set Up - Phases 1 and 2

It is noted that LB Camden require the contractor and subcontractors to be members of the Considerate Contractors Scheme. If approved, this will be a condition of all the tendering contractors and subcontractors for the projects.

Access is only available from Highgate High Street so it is assumed that all deliveries, removals and access for operatives will be made from here. Please refer to the Construction Management Plan by CURO in Appendix G for more details.

Existing services to be terminated and diverted as required.

Site hoarding will be erected as required for both phases of construction.

5.2 Phase 1 - Hall / Dining Room & Pavilion

5.2.1 Temporary Sheet Piling

- Steel sheet piles to be installed on the sides and upslope face of proposed structure
- Sheet piles to be designed as cantilevers to eliminate the requirement for temporary inclined props and walings
- Allow for welded joints between sheet piles or alternative method of groundwater control subject to contractor's input

5.2.2 Excavation

- Excavate down to formation level of the raft foundation
- Allow for local dewatering as required

5.2.3 Construction of RC Raft Foundation and Superstructure

- Cast raft foundation using water resistant concrete (WRC)
- Cast RC retaining walls and lift shaft walls using water resistant concrete (WRC)
- Cast ground floor / roof slab

The construction of the hall / dining room has been omitted from the sequence of construction as it is not technically a subterranean structure. The sequence of construction is relatively straightforward and will follow on from the completion of the pavilion.

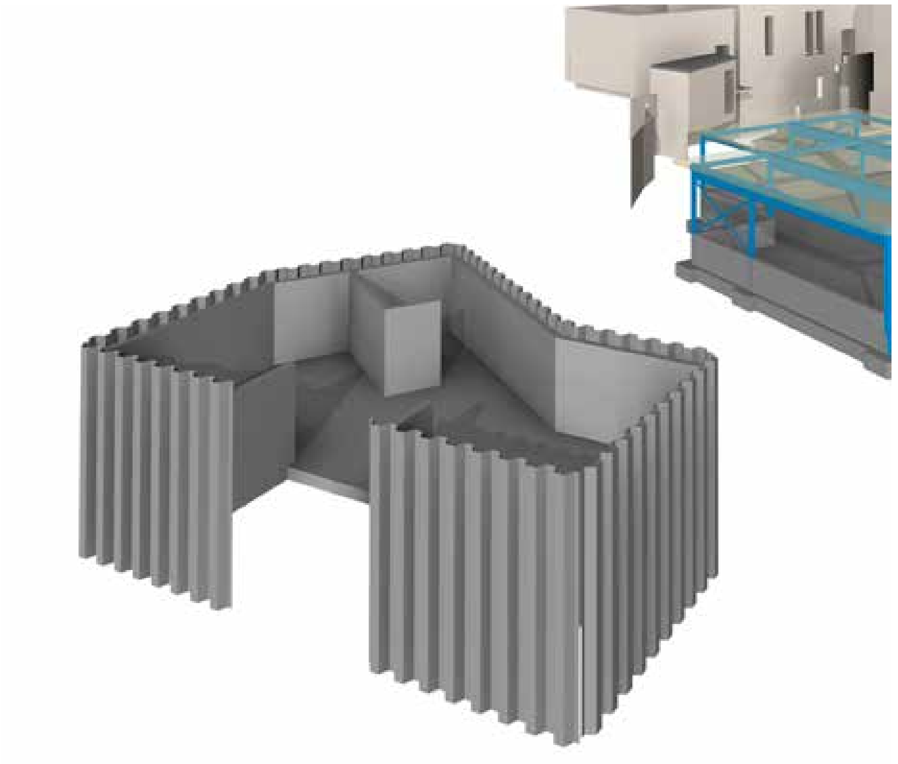
5.3 Phase 2 - East Extension

5.3.1 Demolition of Existing Suspended Timber Floor Structure, Main School Building

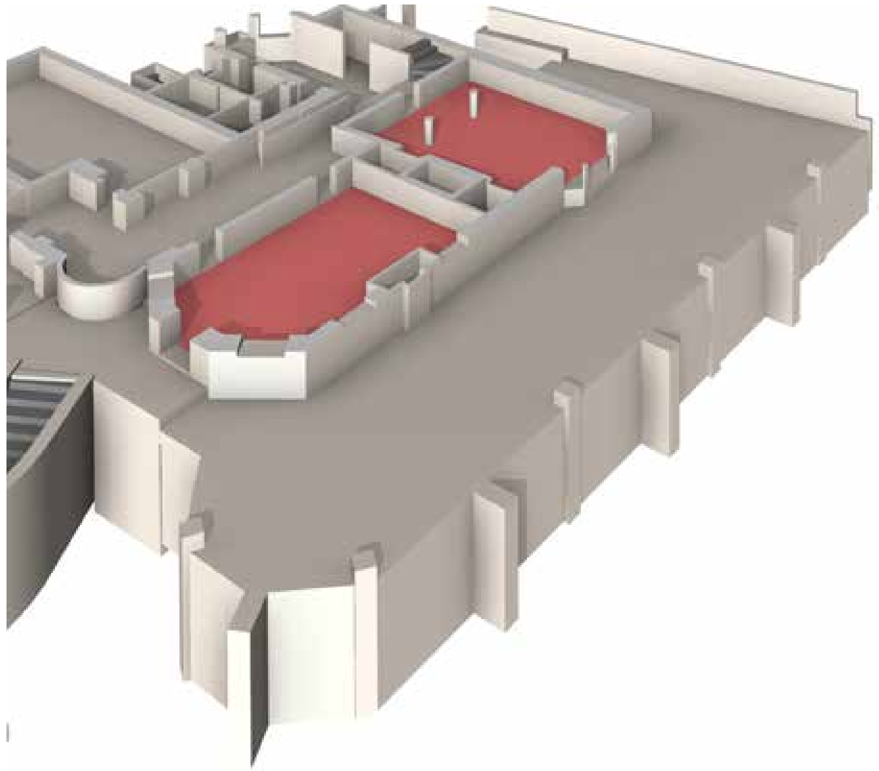
- Locally demolish existing suspended timber floor structure at ground floor and internal sleeper wall structures
- Undertake reduced level dig to expose the corbel of existing footings to loadbearing masonry walls that are to be underpinned

5.3.2 Underpinning of Existing Masonry Walls, Main School Building

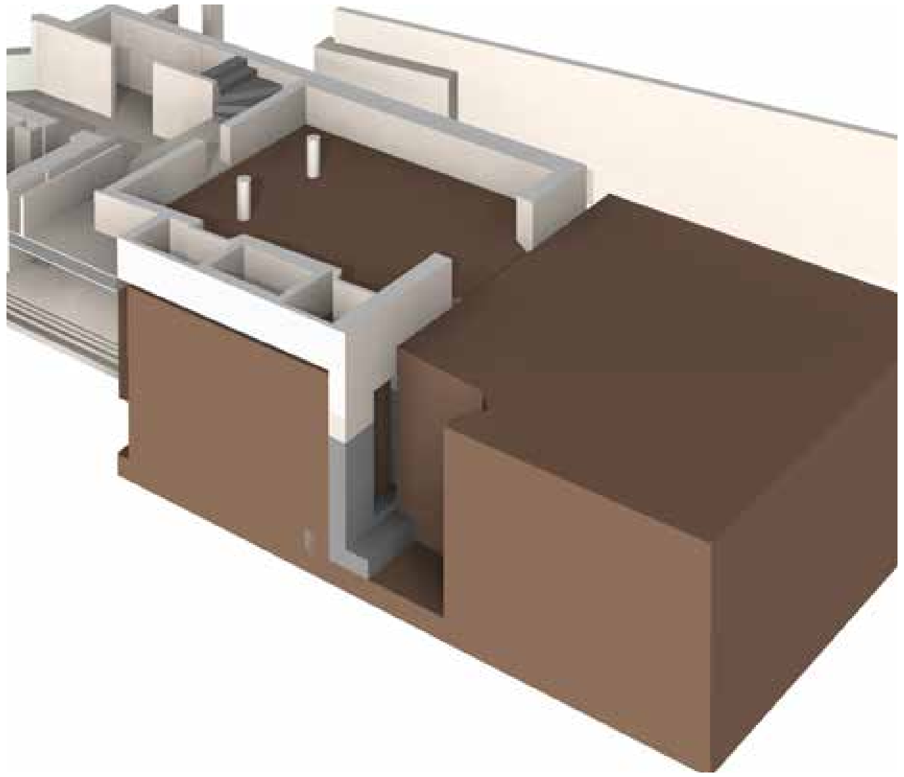
- All excavations for underpins are to be constructed in an agreed sequence, to be a maximum of 1m wide
- Sequence is to ensure that no two adjacent pins are cast within 48 hours of one another
- Typically the underpins are to be cast in a 1-3-5-2-4 sequence and in line with Figure 19 from the ARUP Guide 'Camden Geological, Hydrogeological and Hydrological Study'
- Underpin bases are to extend to the Bagshot Formation strata at +113.850m AOD. Proprietary side shutter will be used to provide protection to operatives and retain stability of ground
- Dry-pack to be installed tight between top of pins and underside of existing walls at least 24 hours after casting. Back fill excavations to top of reduced level dig
- It may be necessary to provide some limited groundwater control during the works. However sufficient testing and investigation will need to be conducted to ensure the stability of the existing and nearby structures are not compromised by this process



Construction of RC Raft Foundation and Superstructure



Demolition of Existing Suspended Timber Floor Structure, Main School Building



Underpinning of Existing Masonry Walls, Main School Building

5.3.3 Construction of RC Retaining Wall, Northern Elevation

- RC retaining wall along the northern elevation of the extension is to be formed using the same 1-3-5-2-4 sequence but without the limitation of maintaining the existing wall lines above
- Each section of the wall should be a maximum of 1m wide
- RC toe to sections of wall to extend to same depth as recently constructed RC underpins

5.3.4 Demolition of Existing Retaining Wall and Excavation

- Excavate down to formation level of RC underpins, toes and pad foundations across entire footprint of extension
- Allow for temporary propping to the head of RC underpins where required. Pins are designed as permanently propped. Temporary works design by others
- Demolish existing masonry retaining wall, which separates an existing terrace area at ground floor level from the landscaped gardens and playground areas along the eastern elevation of the main school building

5.3.5 Installation of Steel Column and Pad Foundation

- Cast RC pad foundation to proposed steel column within centre of extension
- Install corresponding steel column

5.3.6 Installation of Steel Transfer Beam at High Level Lower Ground Floor i.e. Ground Floor

- Install series of needle beams at high level lower ground floor along length of existing masonry wall to be demolished. Ensure needle beams are adequately supported at both ends on acro props or similar
- Locally demolish existing masonry wall down to existing structural slab level
- Install steel transfer beam to support retained masonry wall above. Steel transfer beam to span between recently installed steel column at one end and bear onto a mass concrete padstone within an existing masonry pier at the other end

5.3.7 Localise Demolition of Existing Ground Bearing Slab at Lower Ground Floor

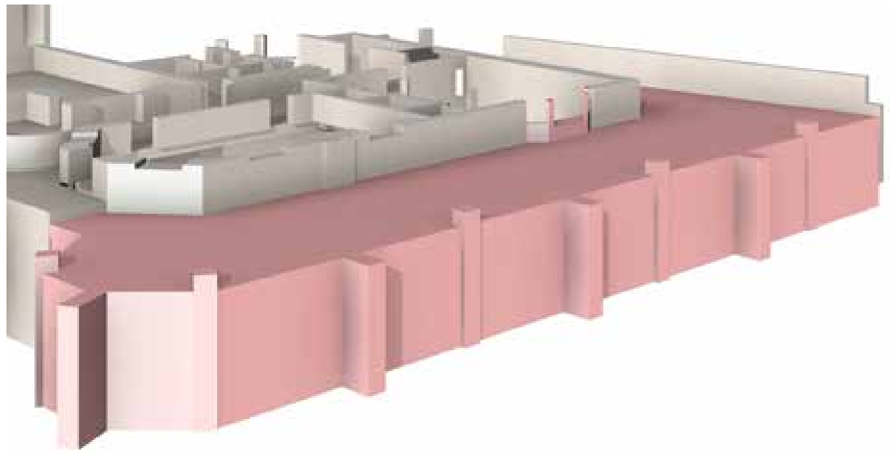
- Locally demolish existing ground bearing slab within the store / IT room at lower ground floor

5.3.8 Construction of Pad Foundations / RC Slab

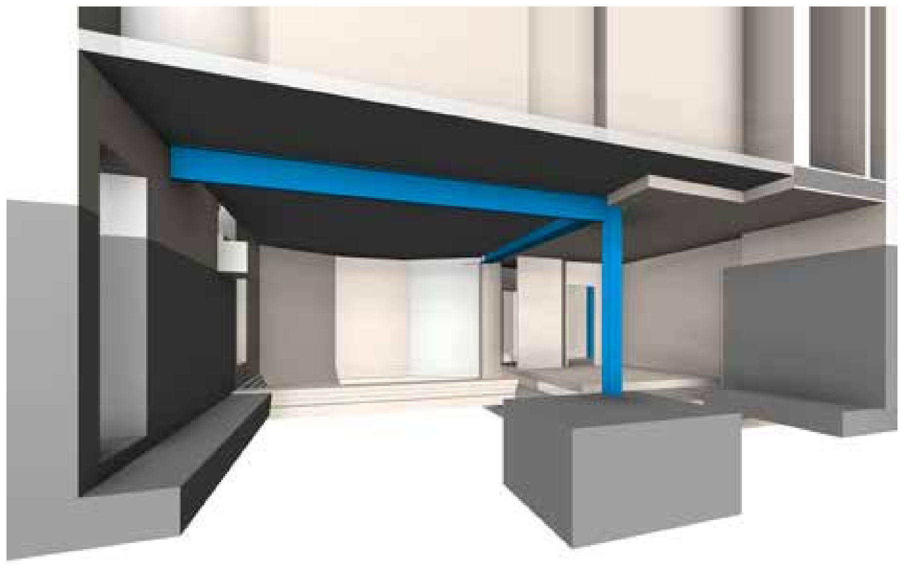
- Cast RC pad foundations to all remaining steel columns
- Cast RC ground bearing slab to entire footprint of extension, dowelling into existing RC underpins and retaining walls as required

5.3.9 Construction of Steel Frame and NWC Slabs on Profiled Metal Decking

- Erect steel frame, with new steel beams bearing onto mass concrete padstones within the depth of existing loadbearing masonry walls
- Install profiled metal decking and pour NWC as required



Demolition of Existing Retaining Wall and Excavation



Installation of Steel Column and Pad Foundation

Construction of Pad Foundations / RC Slab

6. Summary of Impact Assessment

6.1 Predicted Movements

GEA have undertaken a ground movement assessment to determine the likely movements arising from the proposed basement excavation. The results of this analysis have been used to predict the effect of these movements on surrounding structures.

The conclusions of the ground movement assessment are summarised as follows:-

The analysis has concluded that the predicted damage to the adjoining and nearby structures would generally be Category 0 (Negligible), with a limited number of segments of Category 0 (Very Slight) damage. It is, however, important to bear in mind that the results provide a conservative estimate of the behaviour of each of the sensitive structures and that in reality the predicted movements are unlikely to be fully realised. It is therefore considered that the maximum damage is unlikely to exceed Category 0 (Negligible).

Current guidance produced by the London Borough of Camden indicates that the risk of damage to neighbouring properties should be no greater than Category 1 (Very Slight). On this basis, the predicted damage that would inevitably occur as a result of the proposed development falls within acceptable limits, although monitoring is recommended to ensure that no excessive movements occur that would lead to damage in excess of these limits.

The separate phases of work, including underpinning and subsequent excavation of the proposed basement, will in practice be separated by a number of weeks. This will provide an opportunity for the ground movements during and immediately after installation of the retaining walls to be measured and the data acquired can be fed back into the design and compared with the predicted values. Such a comparison will allow the ground model to be reviewed and the predicted wall movements to be reassessed prior to the main excavation taking place so that propping arrangements can be adjusted if required.

Please refer to GEA's report in Appendix D for full details of the ground movement assessment.

Appendix A

Design Criteria and Outline Specification

Design Criteria and Outline Specification

1.1 Design Criteria

1.1.1 Deflections

The deflections of the new structure will be designed to meet the following criteria:

Concrete Elements (in-situ and precast):-

Vertical deflection of floor slabs will be limited to:

- Deflections under total loads:
  - Continuous = [span / 250]
  - Cantilevers = [span / 125]
- Deflections under live loads:
  - Internal = [span / 360]*
  - Perimeter = [span / 500]*
  - Cantilevers = [span / 175]*

*or 20mm whichever is the lesser

- Differential deflection between any two floors = +20mm

Steelwork Elements:-

- Vertical deflection of beams will be limited to:
-
- Deflections under total load:
  - Simply supported = [span / 250]
  - Cantilever = [span / 125]
- deflections under live loads:
  - Simply supported = [span / 360]*
  - Cantilever = [span / 180]*
  - Perimeter = [span / 500]*

*or 20mm whichever is the lesser

All cladding, finishes and services must be designed and detailed to accommodate the worst combination of these.

1.1.2 Movements

The overall size and form of the single storey extensions are such that it will not be necessary to introduce movement joints within the primary structure.

1.1.3 Durability

Long term durability of the concrete structure will be achieved by providing adequate cover to reinforcement as recommended in BS EN 1991-1. Corrosion protection of the steel structure will be achieved by a suitable paint system which provides a life to first major maintenance of 10 to 15 years.

1.1.4 Fire Protection

It is assumed that the fire rating for the structures to all single storey extensions will be 60 minutes, although this is subject to confirmation from the fire consultant. Fire protection to new reinforced concrete structure will be achieved by providing cover to the reinforcement and minimum concrete section sizes as recommended in BS EN 1992-1. Fire protection to steelwork elements is to be determined by the architect. This may take the form of spray applied systems, fire boarding or intumescent paints.

1.1.5 Tolerances

The frames will be constructed to be within the tolerances set down in the technical specifications and the recommendations of BS EN 13670:2009. All finishes, cladding, services, internal partitions are required to be detailed to accommodate the worst combination of these.

1.1.6 Structural Robustness

All extensions will be designed in accordance with the relevant design standards to satisfy the requirements for robustness. The pavilion and hall / dining room are classified as Class 2A structures, whereas the east extension is classified as a Class 2B structure according to the Building Regulations.

1.2 General

The following design elements should be in accordance with the architect's details:

- Water and damp proofing
- Setting out
- Fire protection
- Floor separation and acoustic isolation
- External works
- Landscaping
- Finishes
- Internal partitions

1.2.2 Concrete

The concrete grades to be used are as follows:

- Blinding, GEN1
- Mass concrete, GEN3
- In-situ, RC40
- Foundations, FND2

All formed surfaces to be Type A (basic) finish in accordance with BS EN 13670:2009. Tops of ground beams and floor slabs to be uniformly levelled and tamped to type 1u finish, subject to agreement with flooring manufacturer.

1.2.3 Steelwork

All steelwork to be Grade S355, to BS EN 10025 and in accordance with BS5950. All hollow sections to be grade S355 Corus Celsius.

All connections to have minimum 2no. M16 bolts, with minimum 6mm leg length continuous fillet welds, unless specifically noted.

All steelwork to be blast cleaned to SA2.5. Internal steelwork painted with 75 µm of zinc phosphate primer, 75 µm sealant. External / perimeter steelwork to be galvanised to 85 µm.

1.2.4 Timber

All timber members are to be grade C24 to BS 5628 unless noted otherwise. Timber to be pressure impregnated with preservative and cut ends brush treated.

Lateral restraint straps for floors are to be a minimum of 900m long x 30mm x 5mm galvanised MS straps at 1200mm centres with 150mm bobend.

1.2.5 Temporary Works

The contractor is responsible for the design, installation and maintenance of all necessary temporary works to ensure the strength and stability of the building and surrounding buildings throughout the construction process.

1.3 Design Parameters

1.3.1 Codes of Practice

Eurocodes:
BS EN 1990 - Eurocode 0 - Basis of Structural Design
BS EN 1991 - Eurocode 1 - Actions on Structures
BS EN 1992 - Eurocode 2 - Design of Concrete Structures
BS EN 1993 - Eurocode 3 - Design of Steel Structures
BS EN 1995 - Eurocode 5 - Design of Timber Structures
BS EN 1996 - Eurocode 6 - Design of Masonry Structures
BS EN 1997 - Eurocode 7 - Geotechnical Design

Building Regulations 2010:

Approved Document A – Structure (2013 edition)
Approved Document H – Drainage & Waste Disposal (2010 edition)

1.3.2 Design Loadings

Imposed Loadings [kN/m^2]:

Ground Floor / Roof		
ALL Buildings	Playground	5.00 kN/m^2
Lower Ground Floor / Basement		
East Extension	Classrooms	3.00 kN/m^2
Hall / Dining Room	Hall	5.00 kN/m^2
Pavilion	WCs	2.00 kN/m^2 + 1.00kN/m^2 (Partitions)

Appendix B

Structural Drawings

HEYNE TILLETT STEEL

100mm @ A1 (50mm @ A3)

1 This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

2 Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm long

NOTE:
All existing details shown are based on archive drawings and limited opening up works. Assumptions have been made regarding existing construction. Materials, construction, framing and spans of existing slabs and walls to be confirmed during enabling works.

Existing Column Schedule

Existing Beam Schedule

Existing legend

E	Existing RC floor as indicated on drawing
e	Existing timber joists, dimensions, crs and span as indicated on drawing.
	Existing structural walls
— — —	Existing structure below
	Existing padstone, TBC on site

Floor Schedule

Existing Floor	Ex

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Preliminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

hts.uk.com

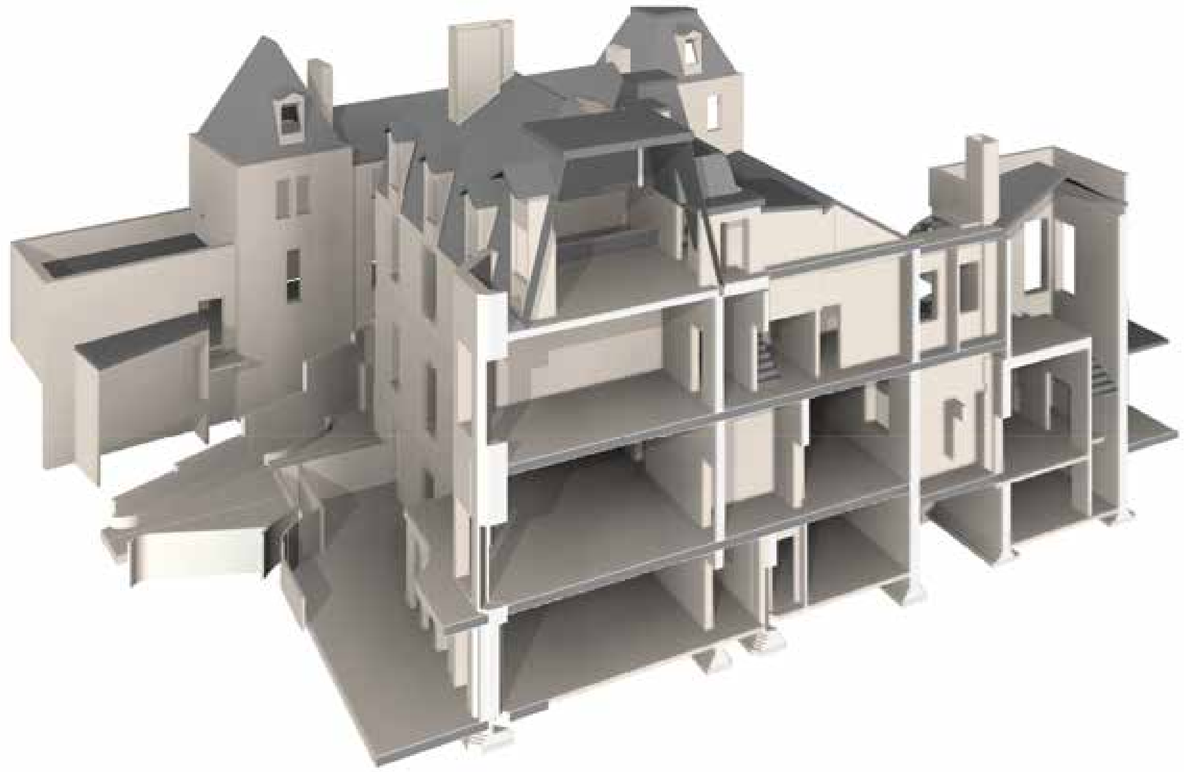
Job Name
Channing Junior School
N6 5JR

Drawing Title
Existing
Overall View

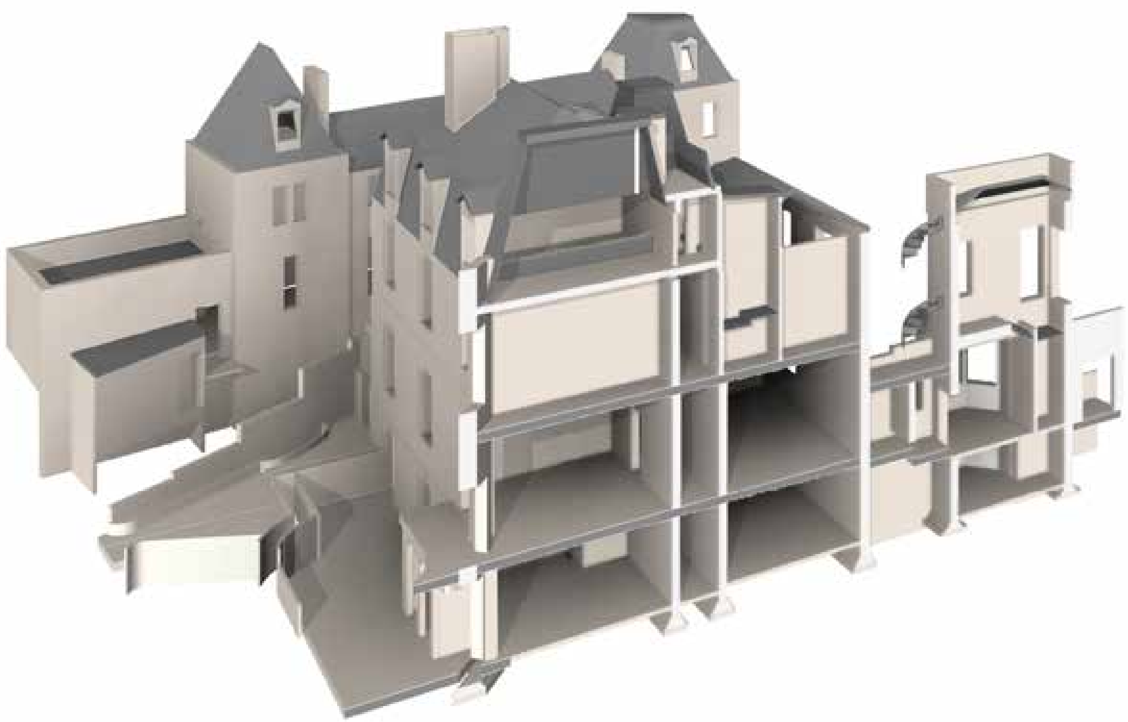
Purpose of Issue **Preliminary** Scale at A1

Drg No 1843/E005 Rev P1

DWG **Existing Section 1**



DWG **Existing Section 3**



DWG **Existing Section 2**

DWG **Existing Section 4**

100mm @ A1 (50mm @ A3)

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Existing Column Schedule

Existing Beam Schedule

Existing legend

E	Existing RC floor as indicated on drawing
e	Existing timber joists, dimensions, crs and span as indicated on drawing.
	Existing structural walls
— — — —	Existing structure below
	Existing padstone, TBC on site

Floor Schedule

Existing Floor	Ex

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

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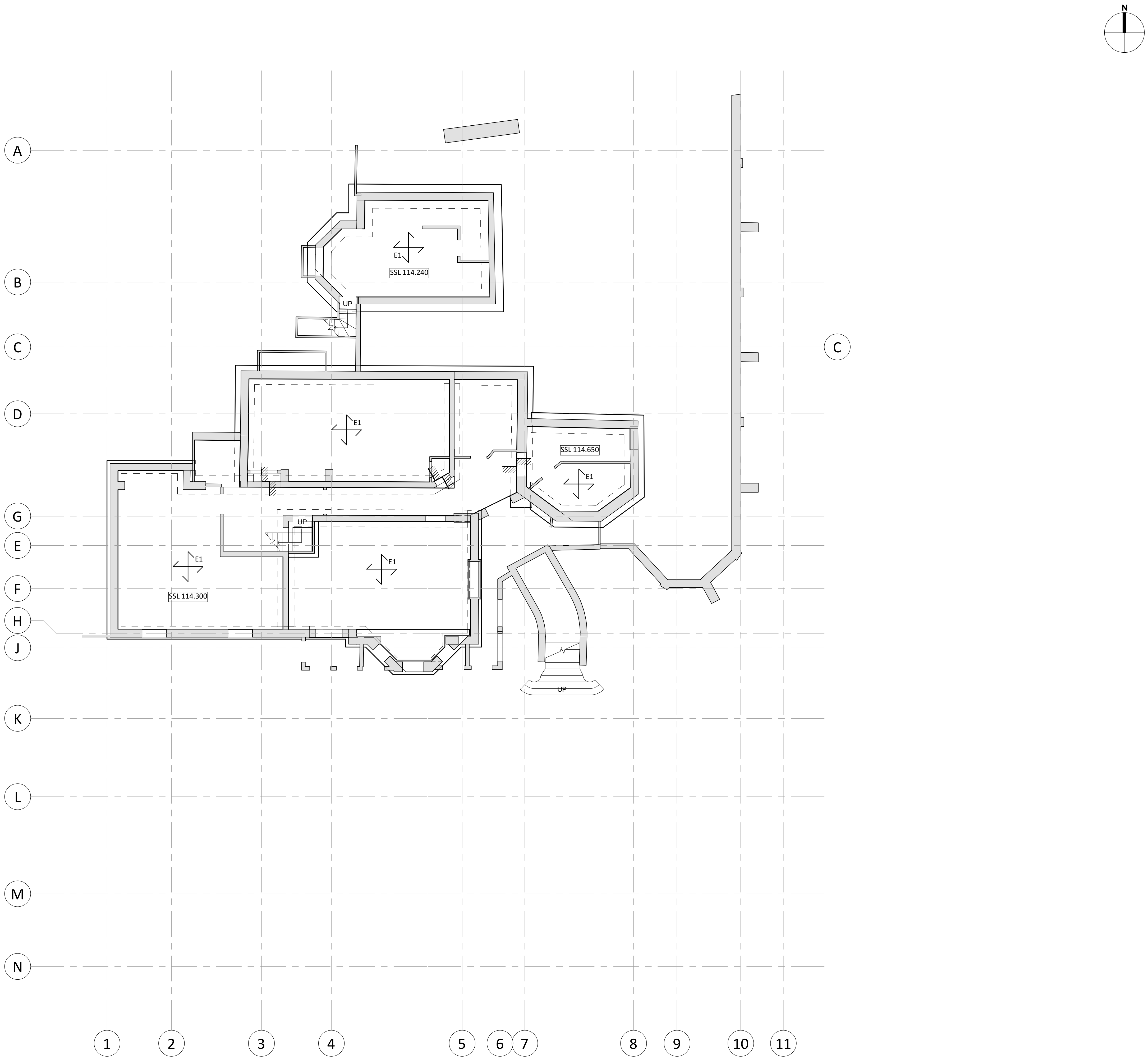
Job Name
Channing Junior School
N6 5JR

Drawing Title
Existing
Overall Sections

Purpose of Issue **Preliminary** Scale at A1

Drg No **1843/E006** Rev **P1**



100mm @ A1 (50mm @ A3)

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Existing Column Schedule

Existing Beam Schedule

Existing legend

E	Existing RC floor as indicated on drawing
e	Existing timber joists, dimensions, crs and span as indicated on drawing.
	Existing structural walls
	Existing structure below
	Existing padstone, TBC on site

Floor Schedule

Existing Floor	Ex
E1	Existing ground bearing RC slab, 150mm thk typically
E2	Existing suspended timber floor. Size and spacing of joists varies

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Preliminary Issue

HEYNE TILLETT STEEL
STRUCTURAL ENGINEERS
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Job Name
Channing Junior School N6 5JR

Drawing Title
Existing Lower Ground Floor Plan

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

Drg No **1843/E090** Rev **P1**

100mm @ A1 (50mm @ A3)

1. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
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NOTE:
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Existing Column Schedule

Existing Beam Schedule

Existing legend

E	Existing RC floor as indicated on drawing
e	Existing timber joists, dimensions, crs and span as indicated on drawing.
	Existing structural walls
	Existing structure below
	Existing padstone, TBC on site

Floor Schedule

Existing Floor	Ex
E1	Existing ground bearing RC slab, 150mm thk typically
E2	Existing suspended timber floor. Size and spacing of joists varies

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Preliminary Issue

HEYNE TILLETT STEEL
STRUCTURAL ENGINEERS
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Job Name
Channing Junior School N6 5JR

Drawing Title
Existing Ground Floor Plan

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

Drg No **1843/E100** Rev **P1**

100mm @ A1 (50mm @ A3)

1. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
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Existing Column Schedule

Existing Beam Schedule

Existing legend

E	Existing RC floor as indicated on drawing
e	Existing timber joists, dimensions, crs and span as indicated on drawing.
	Existing structural walls
	Existing structure below
	Existing padstone, TBC on site

Floor Schedule

Existing Floor	Ex
E1	Existing ground bearing RC slab, 150mm thk typically
E2	Existing suspended timber floor. Size and spacing of joists varies

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Preliminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

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Job Name
Channing Junior School N6 5JR

Drawing Title
Existing First Floor Plan

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

Drg No **1843/E110** Rev **P1**

100mm @ A1 (50mm @ A3)

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NOTE:
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Existing Column Schedule

Existing Beam Schedule

Existing legend

E	Existing RC floor as indicated on drawing
e	Existing timber joists, dimensions, crs and span as indicated on drawing.
	Existing structural walls
	Existing structure below
	Existing padstone, TBC on site

Floor Schedule

Existing Floor	Ex
E1	Existing ground bearing RC slab, 150mm thk typically
E2	Existing suspended timber floor. Size and spacing of joists varies

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Preliminary Issue

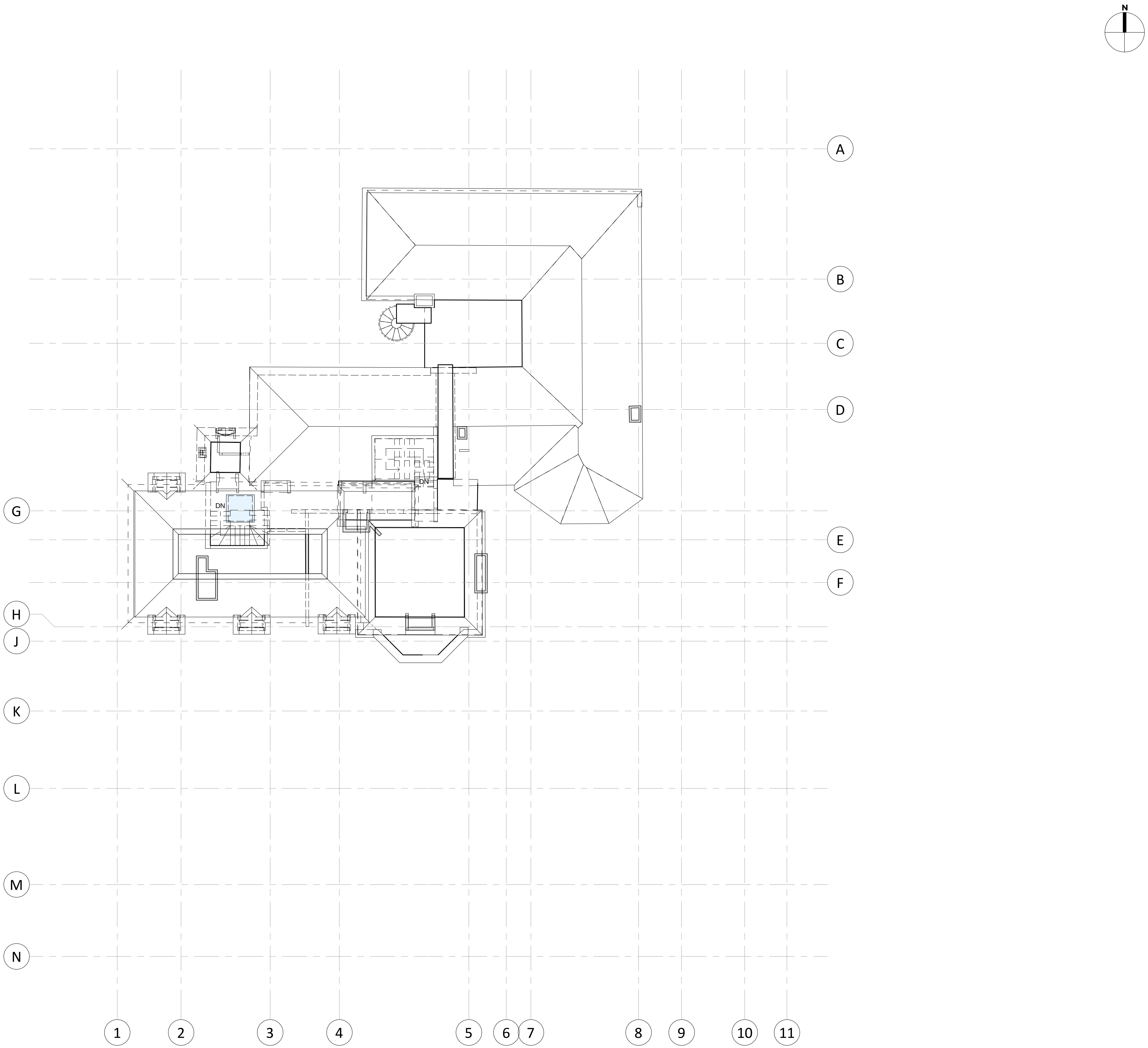
HEYNE TILLETT STEEL
STRUCTURAL ENGINEERS
hts.uk.com

Job Name
Channing Junior School
N6 5JR

Drawing Title
Existing Second Floor Plan

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

Drg No **1843/E120** Rev **P1**



100mm @ A1 (50mm @ A3)

1. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm long

NOTE:
All existing details shown are based on archive drawings and limited opening up works. Assumptions have been made regarding existing construction. Materials, construction, framing and spans of existing slabs and walls to be confirmed during enabling works.

Existing Column Schedule

Existing Beam Schedule

Existing legend

E	Existing RC floor as indicated on drawing
e	Existing timber joists, dimensions, crs and span as indicated on drawing.
	Existing structural walls
	Existing structure below
	Existing padstone, TBC on site

Floor Schedule

Existing Floor	Ex
E1	Existing ground bearing RC slab, 150mm thk typically
E2	Existing suspended timber floor. Size and spacing of joists varies

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Preliminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

hts.uk.com

Job Name
Channing Junior School
N6 5JR

Drawing Title
Existing Third Floor Plan

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

Drg No **1843/E130** Rev **P1**

100mm @ A1 (50mm @ A3)

1 This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

2 Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm long

3 All demolition drawings are to be read in conjunction with proposed plans

4 Assume all edges of RC are to be disc-cut UNO
Where edges of slab are to be demolished, floors are to be disc cut to face of nearest beam if applicable.

5 Care to be taken not to cut / adversely affect existing retained beams / columns while demolition is taking place. Contractor to undertake careful exploratory works and submit appropriate method statement to ensure retained structure is not damaged undertaking areas of demolition

6 Treat all cut concrete faces with Ronabond concrete repair system by Ronacrete, or similar concrete repair system

7 Temporary bracing required prior to demolition of existing stability cores and until the new stability structure is in placeprior to construction of new stability structure. Contractor to submit full temporary works and sequencing proposal to the CA for review prior to commencing work

8 The foundations of the existing structure must not be undermined. Upon exposing the retained structures the contractor should identify if any proposed excavation levels are deeper than the existing founding levels and notify the engineer accordingly

The existing structural information shown on these drawings is based on visual inspection of the building, limited opening up works and relevant archive information. All details of the existing construction are subject to confirmation by the Contractor during the works on site. No materials are to be ordered until the relevant details and conditions are confirmed by the Contractor on site. Should the contractor discover any discrepancies between the assumed existing structure and what is found on site they should notify the engineer immediately, and await further instruction

Demolition legend

	Area of floor to be demolished
	Beam demolished / removed
	Column demolished / removed
	RC / Masonry wall demolished

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

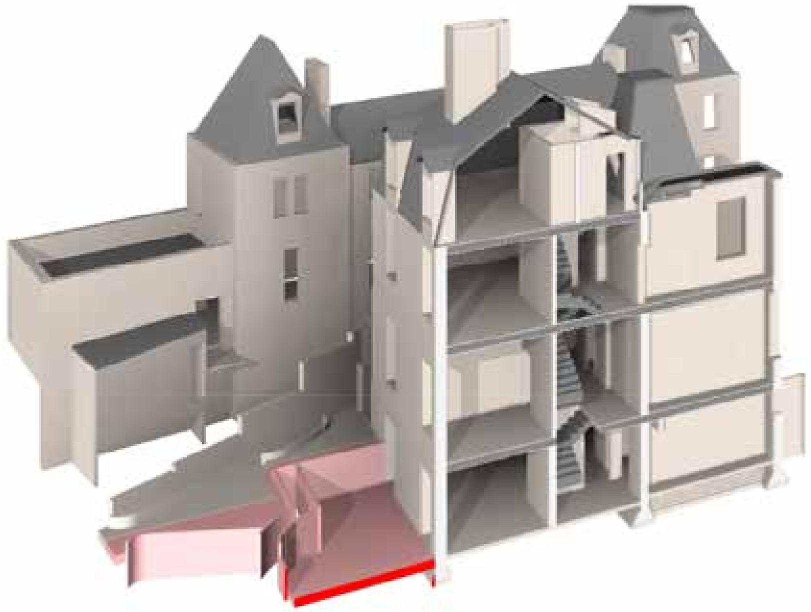
HEYNE TILLETT STEEL
STRUCTURAL ENGINEERS
hts.uk.com

Job Name
Channing Junior School N6 5JR

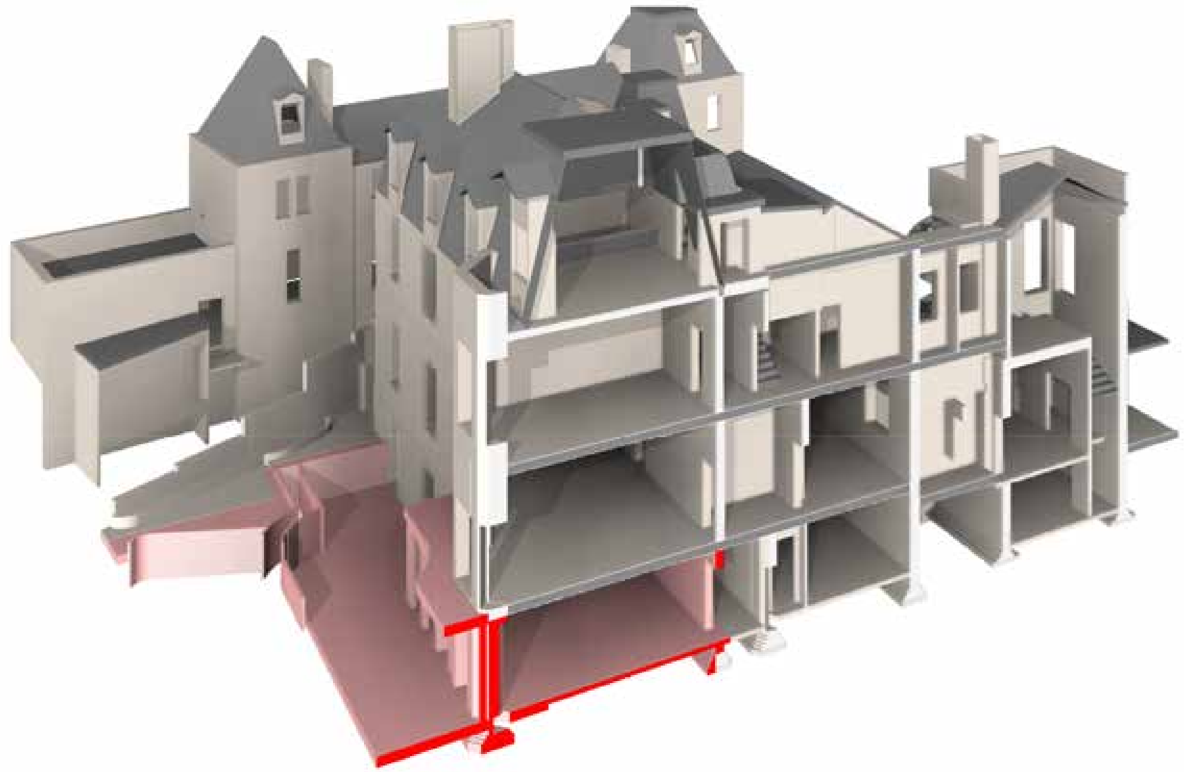
Drawing Title
Demolition Overall Sections

Purpose of Issue **Preliminary** Scale at A1

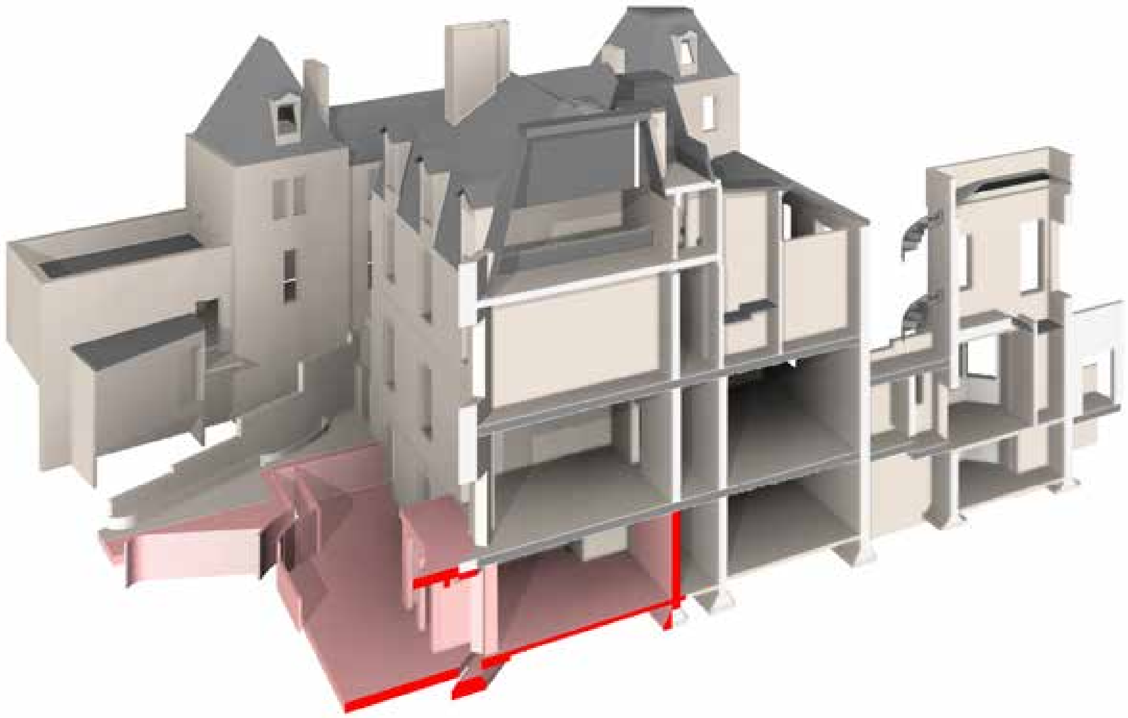
Drg No **1843/D005** Rev **P1**



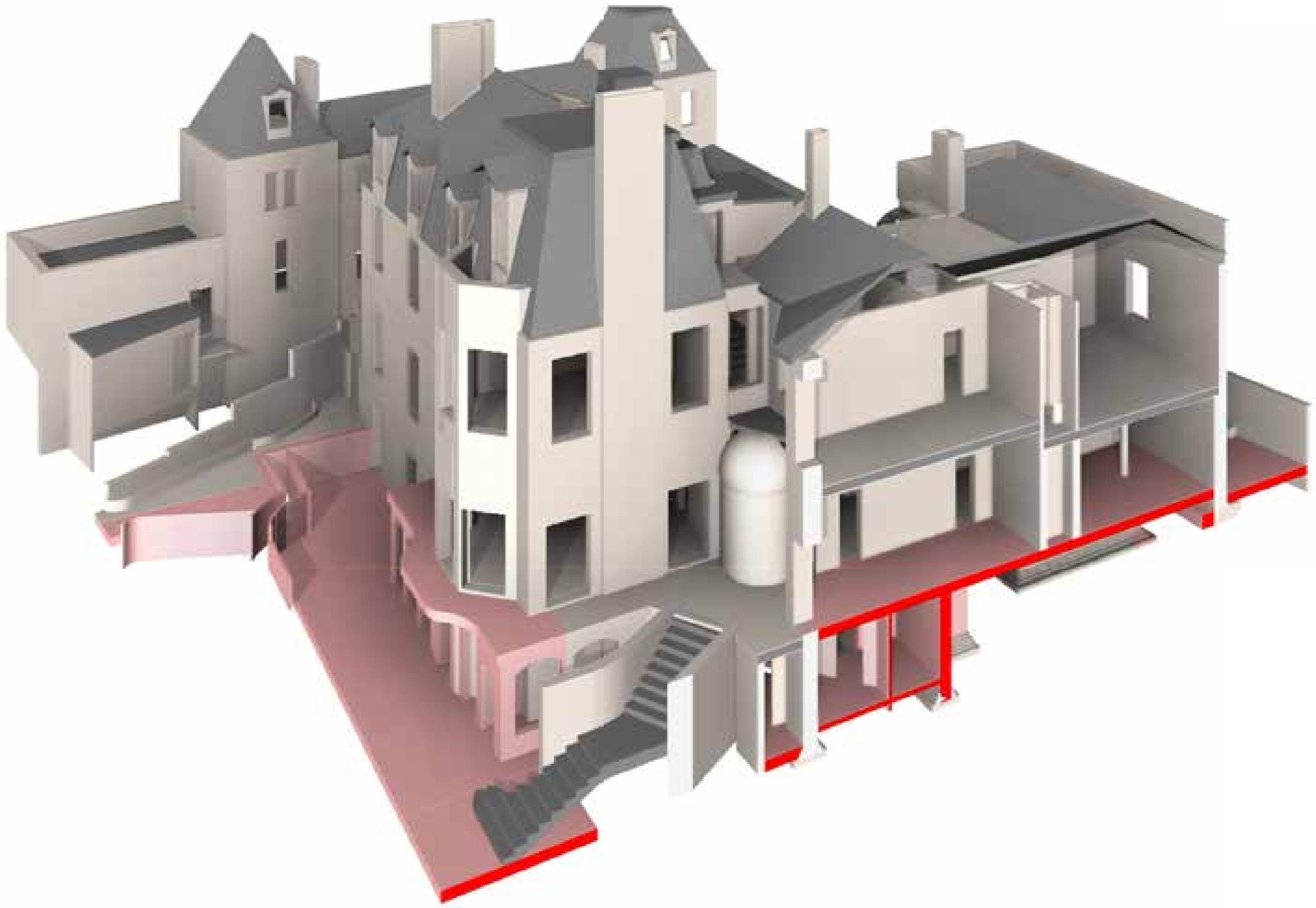
Demolition Section 1



Demolition Section 3



Demolition Section 2



Demolition Section 4

100mm @ A1 (50mm @ A3)

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7 Temporary bracing required prior to demolition of existing stability cores and until the new stability structure is in placeprior to construction of new stability structure. Contractor to submit full temporary works and sequencing proposal to the CA for review prior to commencing work

8 The foundations of the existing structure must not be undermined. Upon exposing the retained structures the contractor should identify if any proposed excavation levels are deeper than the existing founding levels and notify the engineer accordingly

The existing structural information shown on these drawings is based on visual inspection of the building, limited opening up works and relevant archive information. All details of the existing construction are subject to confirmation by the Contractor during the works on site. No materials are to be ordered until the relevant details and conditions are confirmed by the Contractor on site. Should the contractor discover any discrepancies between the assumed existing structure and what is found on site they should notify the engineer immediately, and await further instruction

Demolition legend

	Area of floor to be demolished
	Beam demolished / removed
	Column demolished / removed
	RC / Masonry wall demolished

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

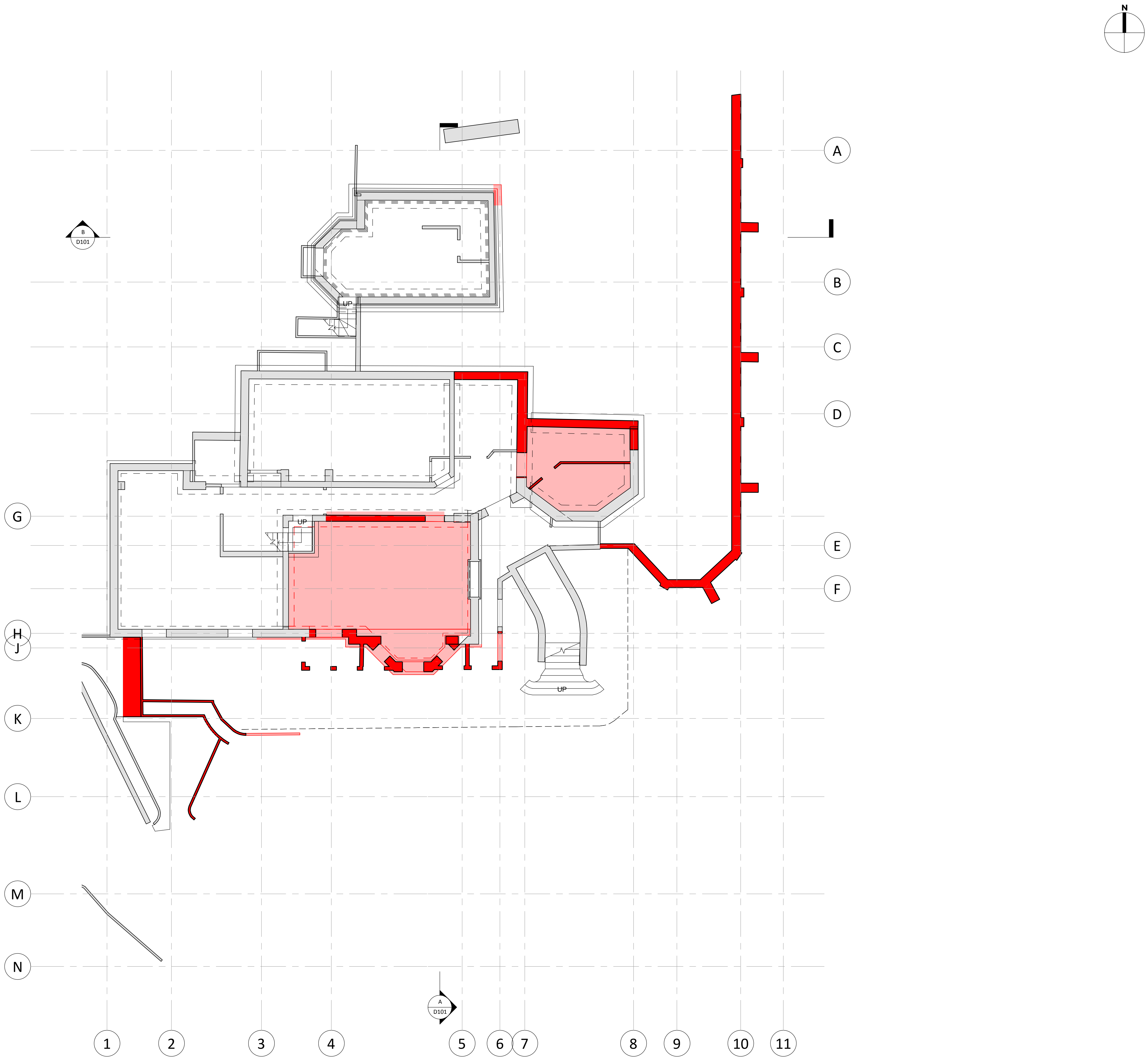
HEYNE TILLETT STEEL
STRUCTURAL ENGINEERS
hts.uk.com

Job Name
Channing Junior School
N6 5JR

Drawing Title
Demolition
Overall Sections

Purpose of Issue **Preliminary** Scale at A1

Drg No **1843/D006** Rev **P1**



100mm @ A1 (50mm @ A3)

1 This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

2 Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm long

3 All demolition drawings are to be read in conjunction with proposed plans

4 Assume all edges of RC are to be disc-cut UNO Where edges of slab are to be demolished, floors are to be disc cut to face of nearest beam if applicable.

5 Care to be taken not to cut / adversely affect existing retained beams / columns while demolition is taking place. Contractor to undertake careful exploratory works and submit appropriate method statement to ensure retained structure is not damaged undertaking areas of demolition

6 Treat all cut concrete faces with Ronabond concrete repair system by Ronacrete, or similar concrete repair system

7 Temporary bracing required prior to demolition of existing stability cores and until the new stability structure is in placeprior to construction of new stability structure. Contractor to submit full temporary works and sequencing proposal to the CA for review prior to commencing work

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Demolition legend

(pink fill)	Area of floor to be demolished
(red dash line)	Beam demolished / removed
(red I symbol)	Column demolished / removed
(thick red line)	RC / Masonry wall demolished

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

hts.uk.com

Job Name

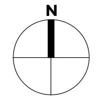
Channing Junior School N6 5JR

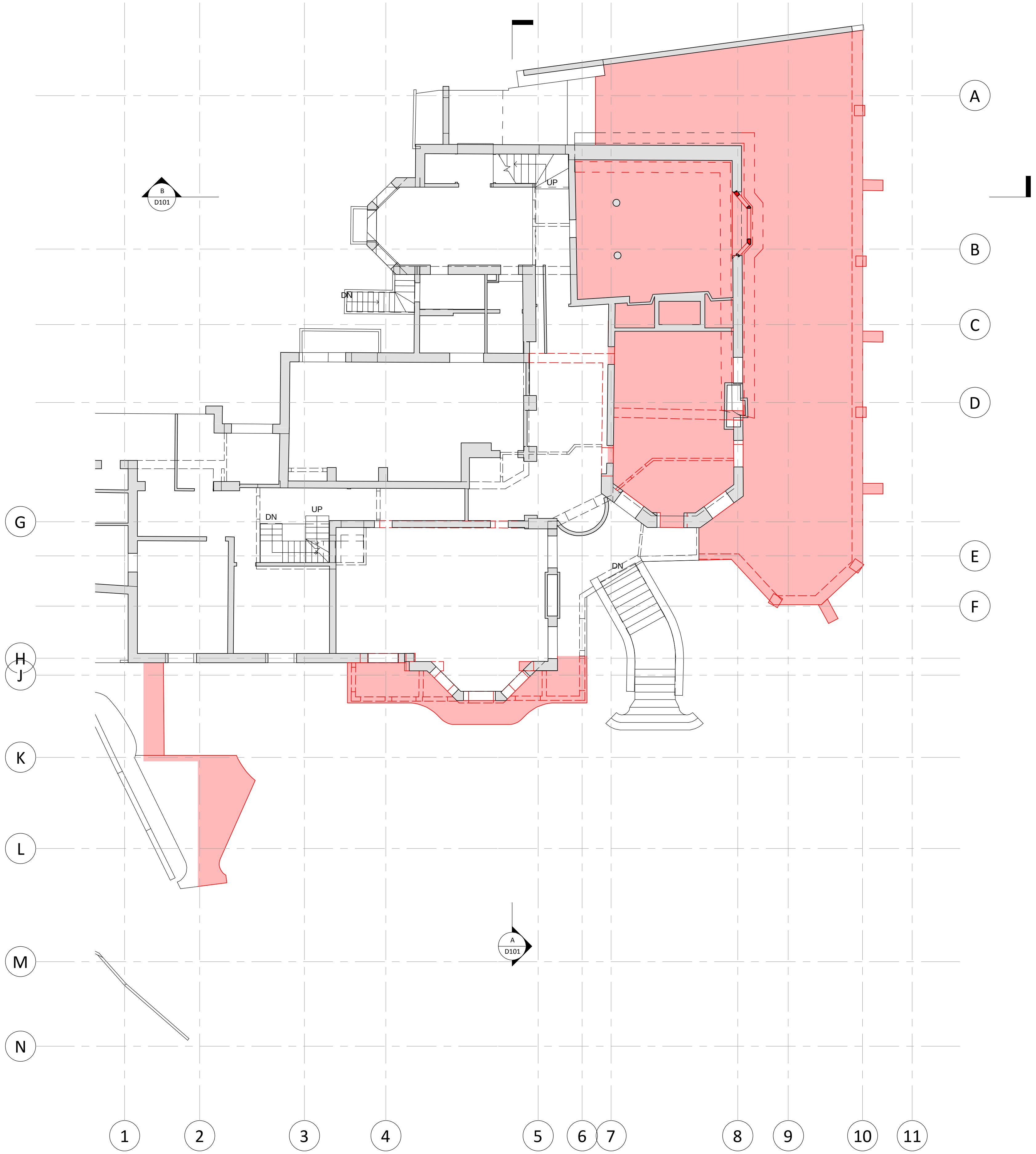
Drawing Title

Demolition Lower Ground Floor Plan

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

Drg No **1843/D090** Rev **P1**





100mm @ A1 (50mm @ A3)

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3 All demolition drawings are to be read in conjunction with proposed plans

4 Assume all edges of RC are to be disc-cut UNO Where edges of slab are to be demolished, floors are to be disc cut to face of nearest beam if applicable.

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6 Treat all cut concrete faces with Ronabond concrete repair system by Ronacrete, or similar concrete repair system

7 Temporary bracing required prior to demolition of existing stability cores and until the new stability structure is in placeprior to construction of new stability structure. Contractor to submit full temporary works and sequencing proposal to the CA for review prior to commencing work

8 The foundations of the existing structure must not be undermined. Upon exposing the retained structures the contractor should identify if any proposed excavation levels are deeper than the existing founding levels and notify the engineer accordingly

The existing structural information shown on these drawings is based on visual inspection of the building, limited opening up works and relevant archive information. All details of the existing construction are subject to confirmation by the Contractor during the works on site. No materials are to be ordered until the relevant details and conditions are confirmed by the Contractor on site. Should the contractor discover any discrepancies between the assumed existing structure and what is found on site they should notify the engineer immediately, and await further instruction

Demolition legend

	Area of floor to be demolished
	Beam demolished / removed
	Column demolished / removed
	RC / Masonry wall demolished

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

hts.uk.com

Job Name
Channing Junior School N6 5JR

Drawing Title
Demolition Ground Floor Plan

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

Drg No **1843/D100** Rev **P1**

100mm @ A1 (50mm @ A3)

1 This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

2 Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm long

3 All demolition drawings are to be read in conjunction with proposed plans

4 Assume all edges of RC are to be disc-cut UNO Where edges of slab are to be demolished, floors are to be disc cut to face of nearest beam if applicable.

5 Care to be taken not to cut / adversely affect existing retained beams / columns while demolition is taking place. Contractor to undertake careful exploratory works and submit appropriate method statement to ensure retained structure is not damaged undertaking areas of demolition

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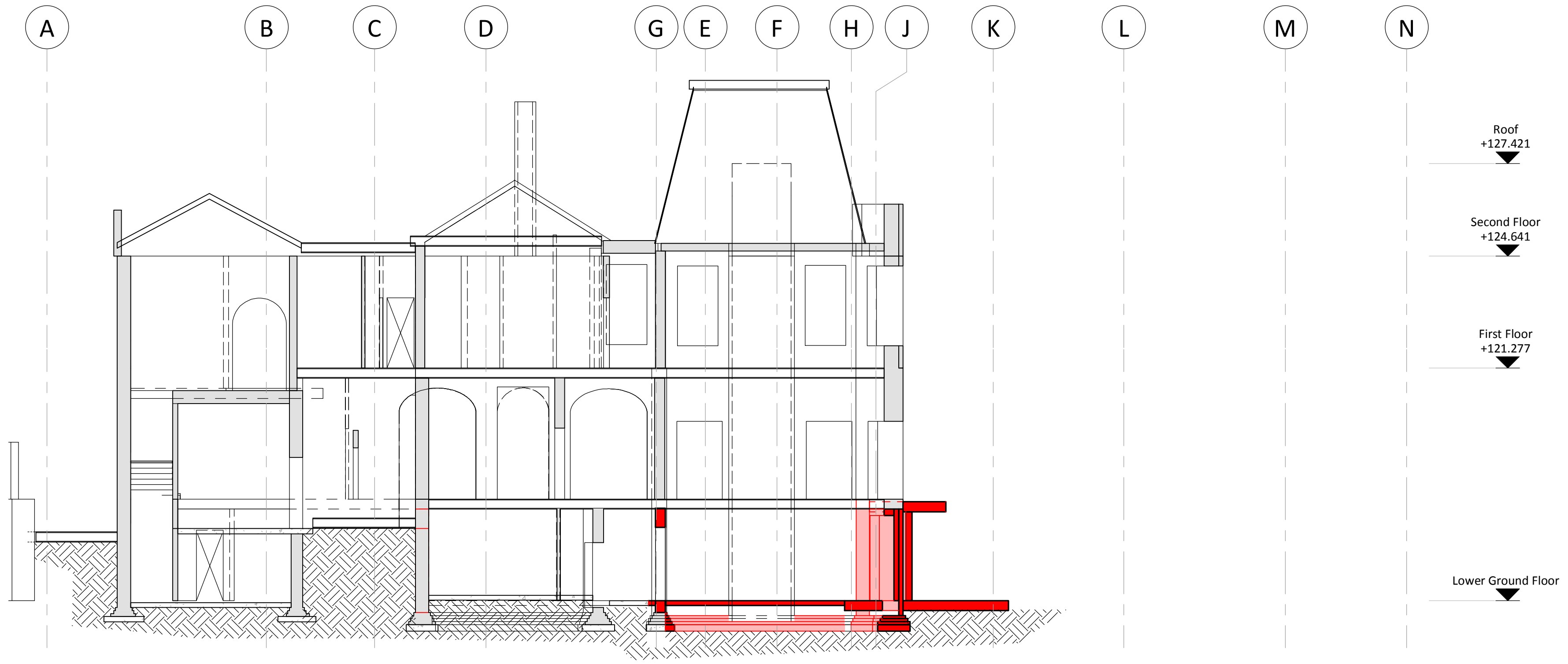
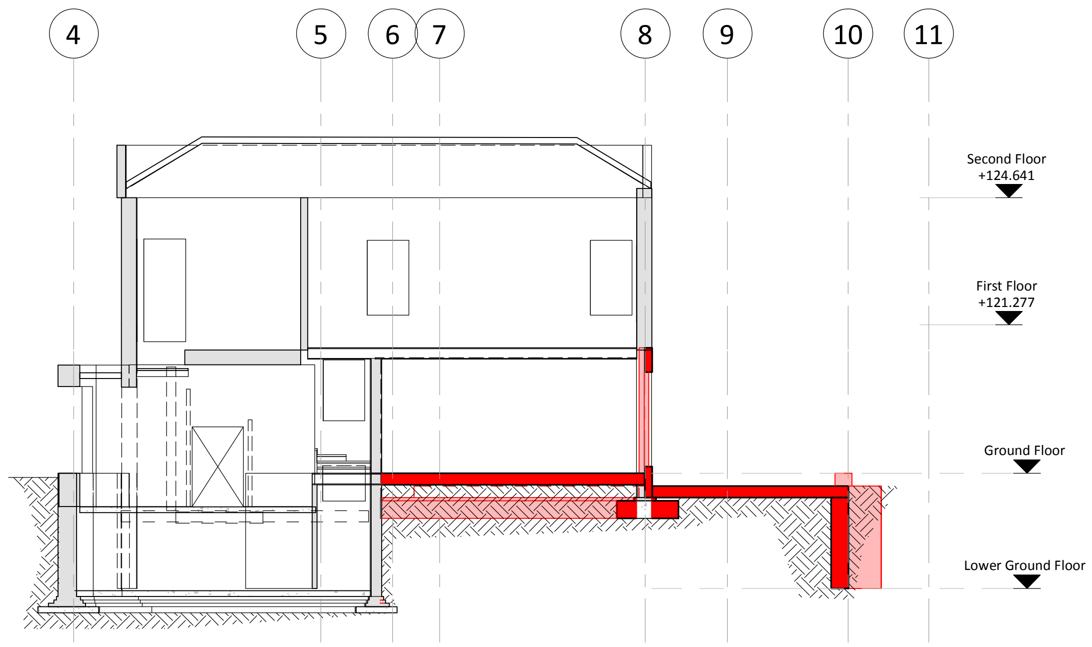


DWG D090 **Section A-A**
1 : 100



DWG D090 **Section B-B**
1 : 100

Demolition legend

	Area of floor to be demolished
	Beam demolished / removed
	Column demolished / removed
	RC / Masonry wall demolished

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

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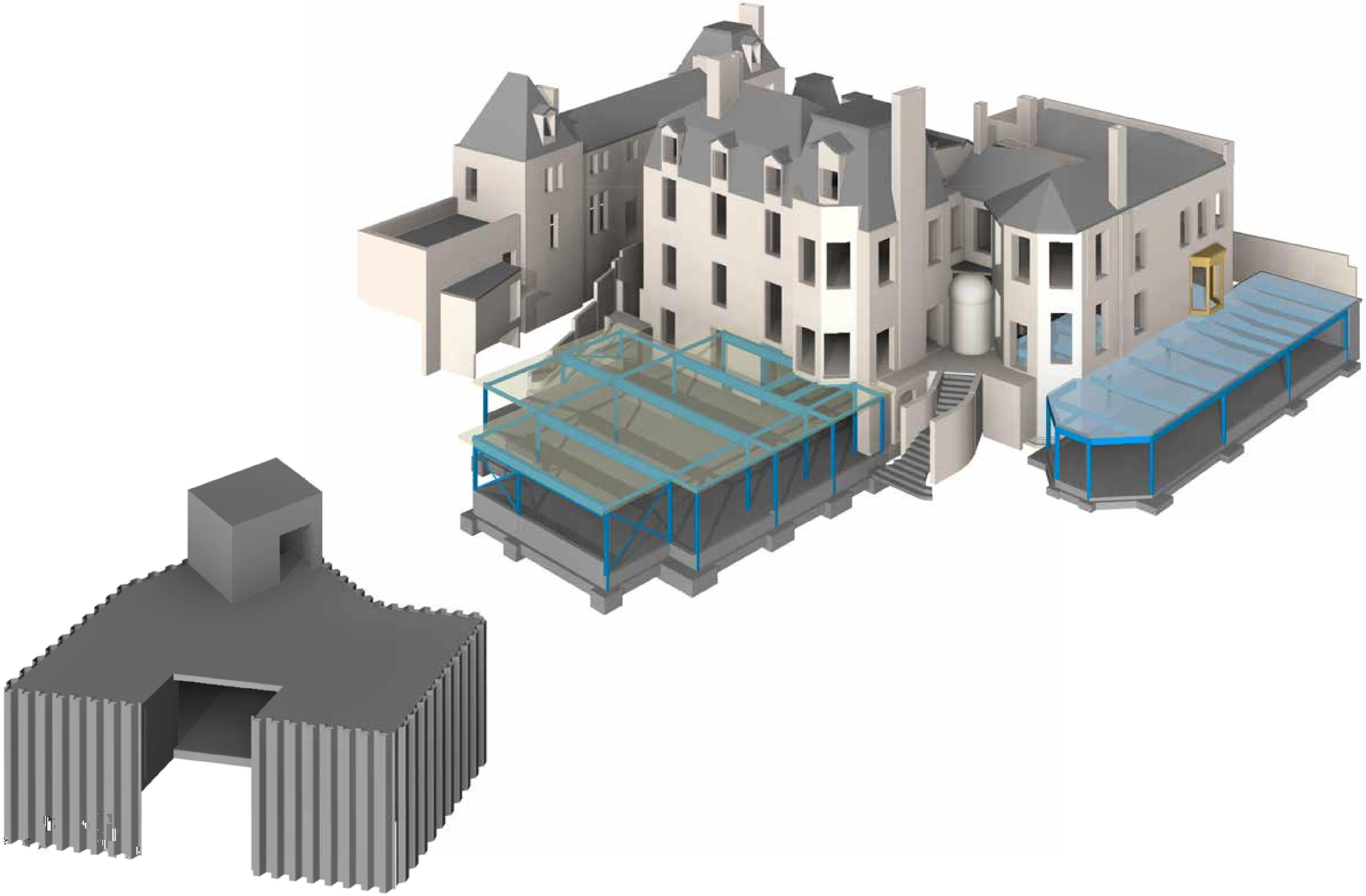
Job Name
Channing Junior School
N6 5JR

Drawing Title
Demolition
Overall Sections

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

Drg No **1843/D101** Rev **P1**



100mm @ A1 (50mm @ A3)

1. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm

Column Schedule

C1	152x152x37 UC	C2	203x203x100 UC

Beam Schedule

B1	200x100x10 RHS	B8	203x203x86 UC
B2	350x150x10 RHS	B9	500x300x12.5 RHS
B3	203x102x23 UB	BR1	100 x 10 MS plate cross-brace
B5	356x127x33 UB	EA1	100x100x10 EA fixed to perimeter
B6	533x210x92 UB		
B7	305x305x158 UC		

Floor Schedule

Concrete Floor X	Profiled deck X	Timber Floor X	Glass Floor X

1	150 thk RCground bearing slab
2	140 thk profiled NWC slab on TATA Comflor 60 1.0 mm gauge deck with 1 layer A193 mesh top. 19mm dia shear studs welded to top flange at 300 crs
3	150 thk CLT panels (5s150TL)
4	350 thk RC slab
5	250 thk RC slab

Legend

	Proposed RC structure
	Proposed WRC structure
	Proposed Steel Framing
PSx	PS1 - 450lg x 215wd x 150dp MC padstone PS1 - 600lg x 215wd x 215dp MC padstone
ST	Connection Strengthening
C	Crank
S	Splice
M	Moment connection
TB	Thermal Break
B1 [25mm]	Pre-camber
BR	Break in beam

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

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Job Name

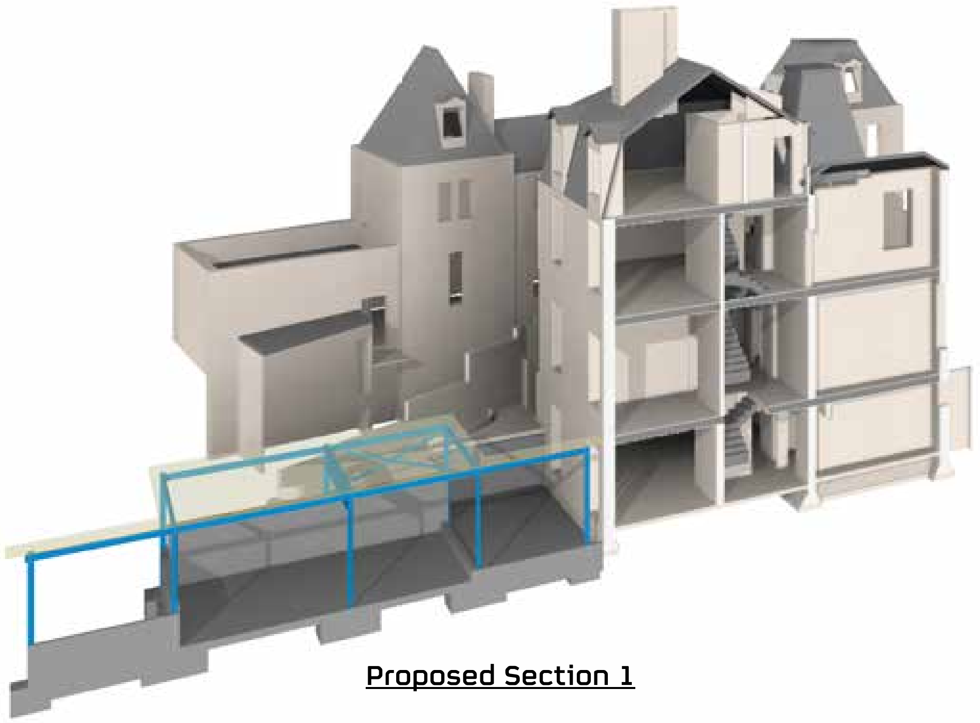
Channing Junior School N6 5JR

Drawing Title

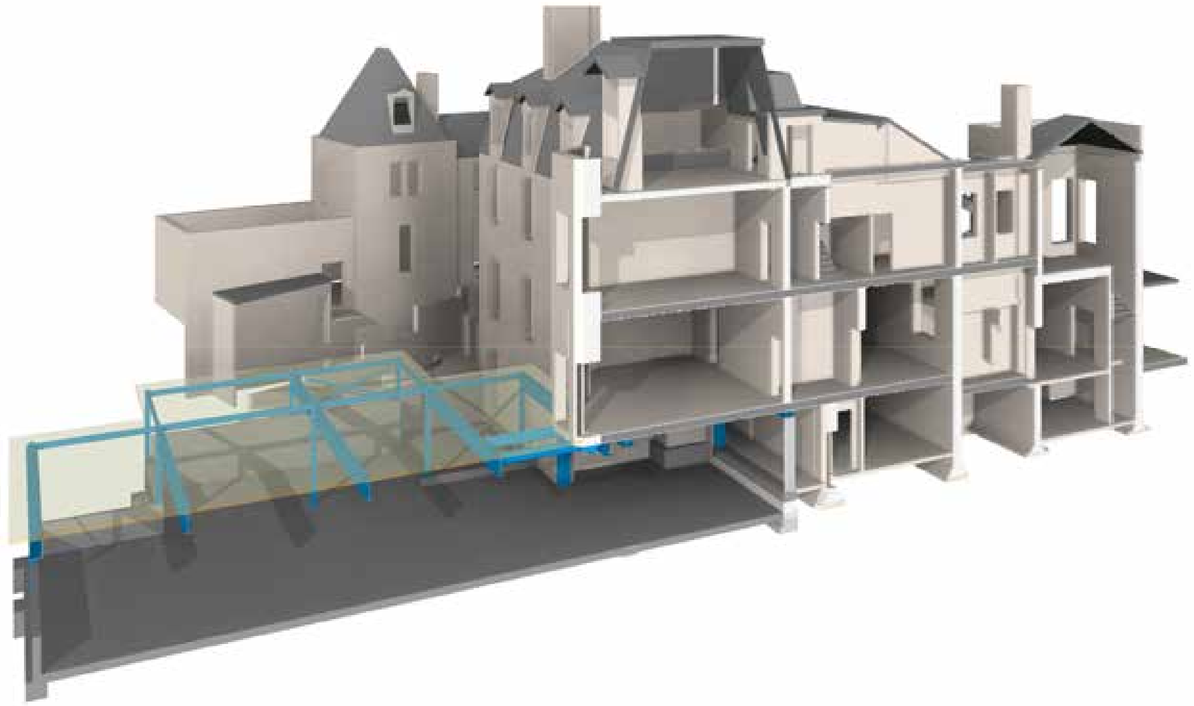
Proposed Overall View

Purpose of Issue **Preliminary** Scale at A1

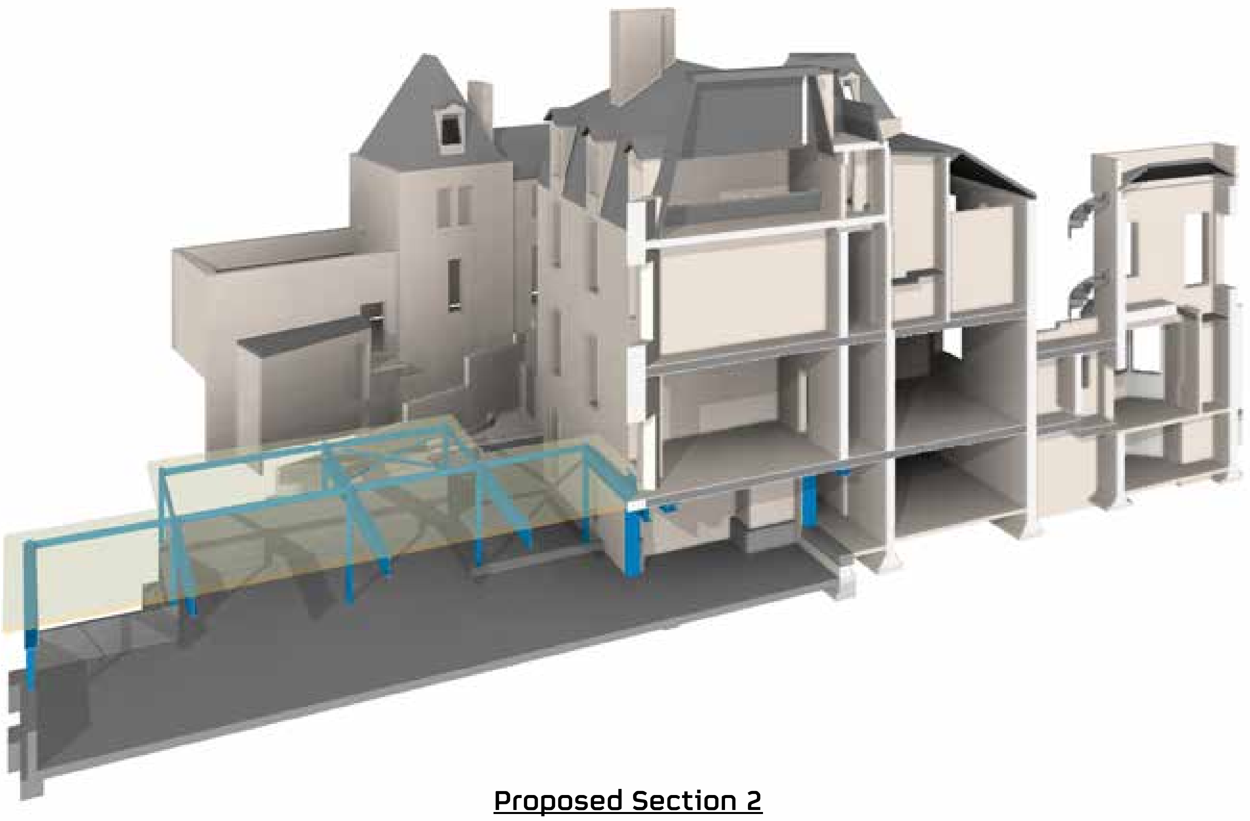
Drg No **1843/P005** Rev **P1**



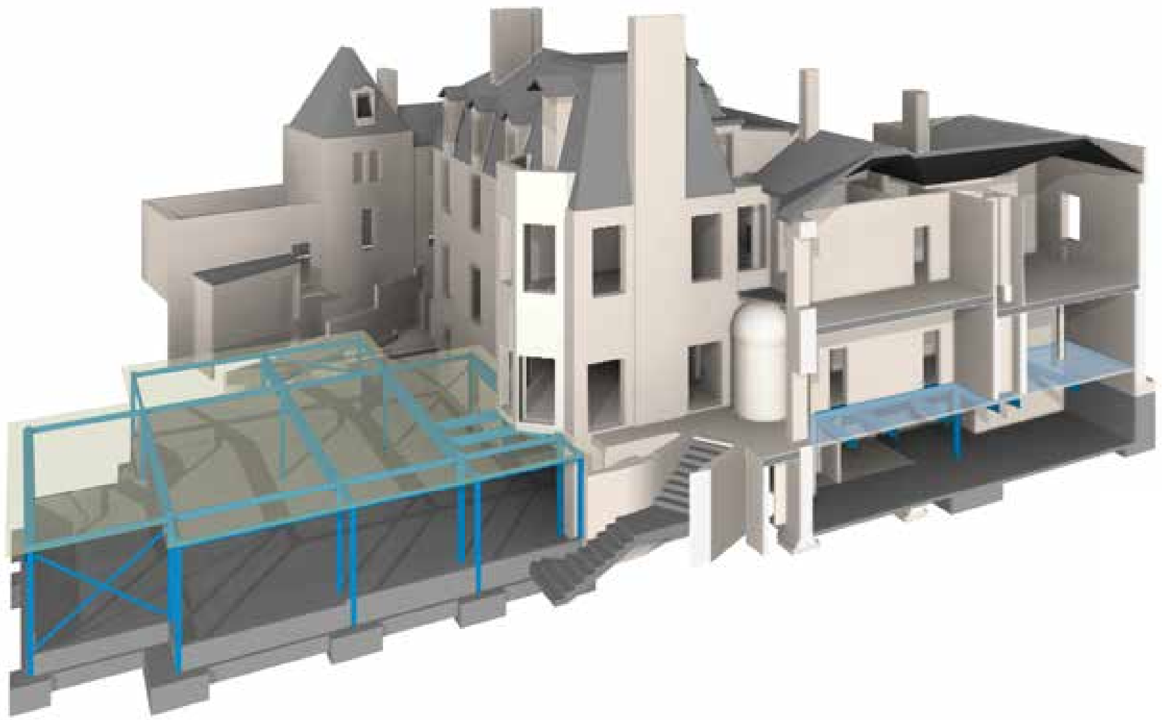
Proposed Section 1



Proposed Section 3



Proposed Section 2



Proposed Section 4

100mm @ A1 (50mm @ A3)

1 This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

2 Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm

Column Schedule

C1	152x152x37 UC	C2	203x203x100 UC

Beam Schedule

B1	200x100x10 RHS	B8	203x203x86 UC
B2	350x150x10 RHS	B9	500x300x12.5 RHS
B3	203x102x23 UB	BR1	100 x 10 MS plate cross-brace
B5	356x127x33 UB	EA1	100x100x10 EA fixed to perimeter
B6	533x210x92 UB		
B7	305x305x158 UC		

Floor Schedule

Concrete Floor X	Profiled deck X	Timber Floor X	Glass Floor X

1	150 thk RCground bearing slab
2	140 thk profiled NWC slab on TATA Comflor 60 1.0 mm gauge deck with 1 layer A193 mesh top. 19mm dia shear studs welded to top flange at 300 crs
3	150 thk CLT panels (5s150TL)
4	350 thk RC slab
5	250 thk RC slab

Legend

- Proposed RC structure
- Proposed WRC structure
- Proposed Steel Framing
- PSx — PS1 - 450lg x 215wd x 150dp MC padstone; PS1 - 600lg x 215wd x 215dp MC padstone
- ST — Connection Strengthening
- C — Crank
- S — Splice
- M — Moment connection
- TB — Thermal Break
- B1 [25mm] — Pre-camber
- BR — Break in beam

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

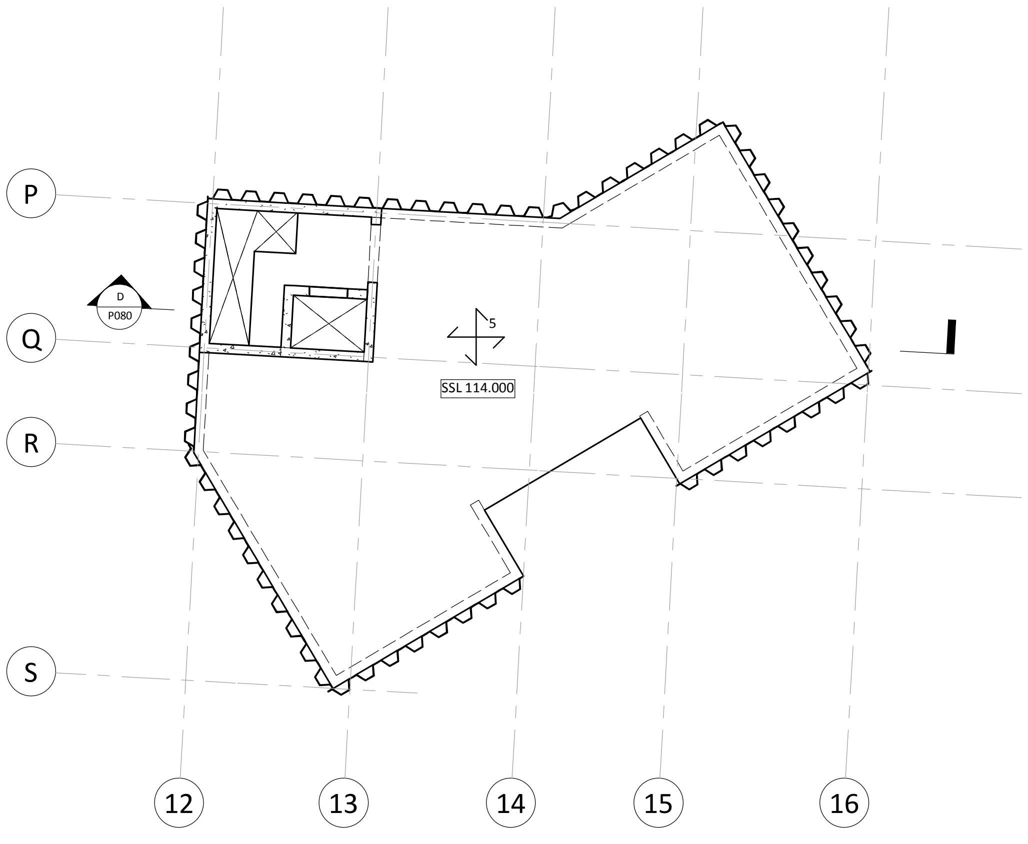
hts.uk.com

Job Name
Channing Junior School
N6 5JR

Drawing Title
Proposed Overall Sections

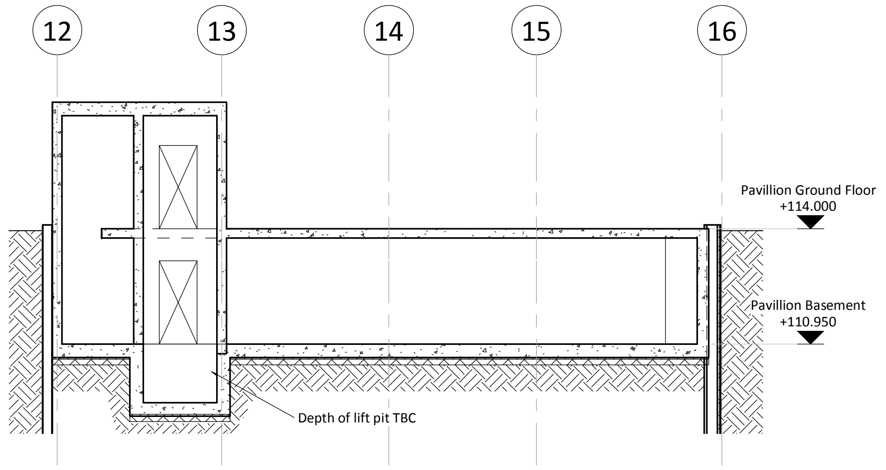
Purpose of Issue **Preliminary** Scale at A1

Drg No **1843/P006** Rev **P1**



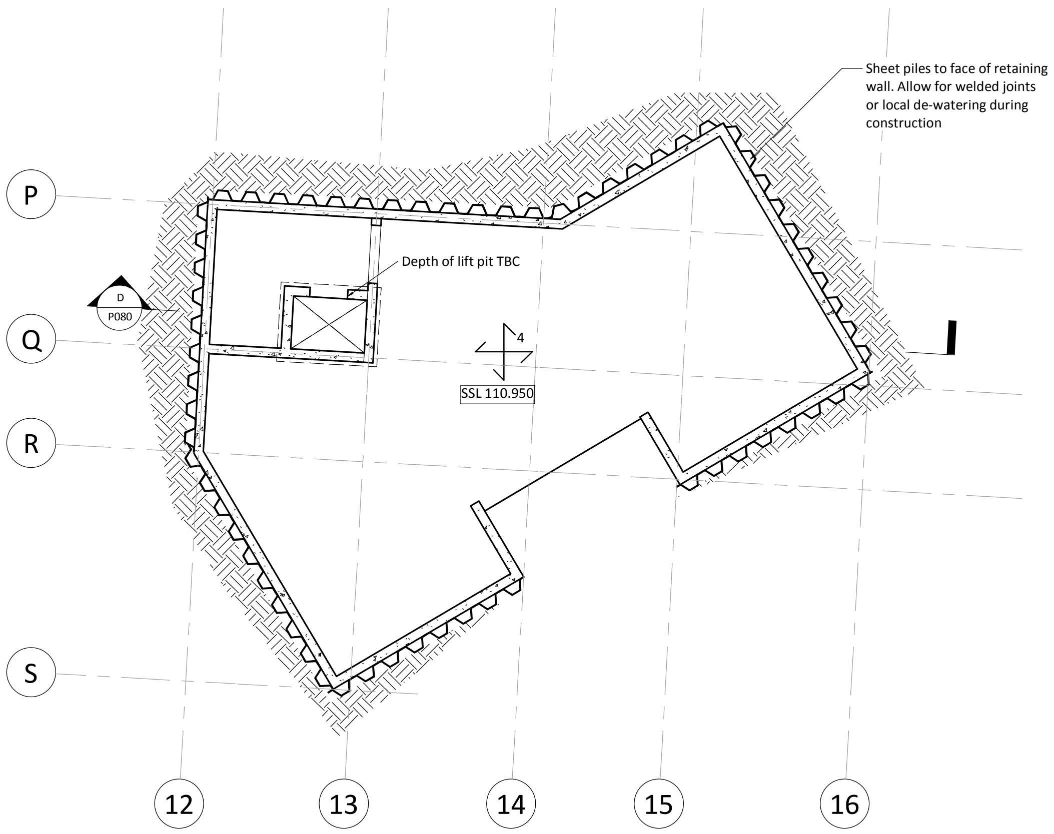
Pavillion Basement Ground Floor

1 : 100

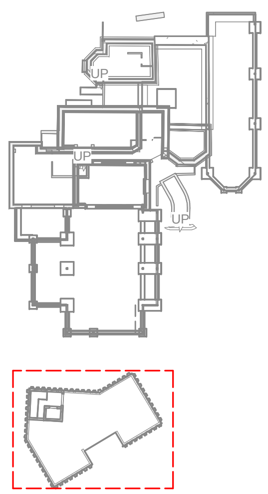


DWG P080 **Section D-D**

1 : 100



Pavillion Basement



KEY PLAN

100mm @ A1 (50mm @ A3)

1. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm

Column Schedule

C1	152x152x37 UC	C2	203x203x100 UC

Beam Schedule

B1	200x100x10 RHS	B8	203x203x86 UC
B2	350x150x10 RHS	B9	500x300x12.5 RHS
B3	203x102x23 UB	BR1	100 x 10 MS plate cross-brace
B5	356x127x33 UB	EA1	100x100x10 EA fixed to perimeter
B6	533x210x92 UB		
B7	305x305x158 UC		

Floor Schedule

Concrete Floor	Profiled deck	Timber Floor	Glass Floor

1	150 thk RCground bearing slab
2	140 thk profiled NWC slab on TATA Comflor 60 1.0 mm gauge deck with 1 layer A193 mesh top. 19mm dia shear studs welded to top flange at 300 crs
3	150 thk CLT panels (5s150TL)
4	350 thk RC slab
5	250 thk RC slab

Legend

	Proposed RC structure
	Proposed WRC structure
	Proposed Steel Framing
PSx	PS1 - 450lg x 215wd x 150dp MC padstone PS1 - 600lg x 215wd x 215dp MC padstone
ST	Connection Strengthening
C	Crank
S	Splice
M	Moment connection
TB	Thermal Break
B1 [25mm]	Pre-camber
BR	Break in beam

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

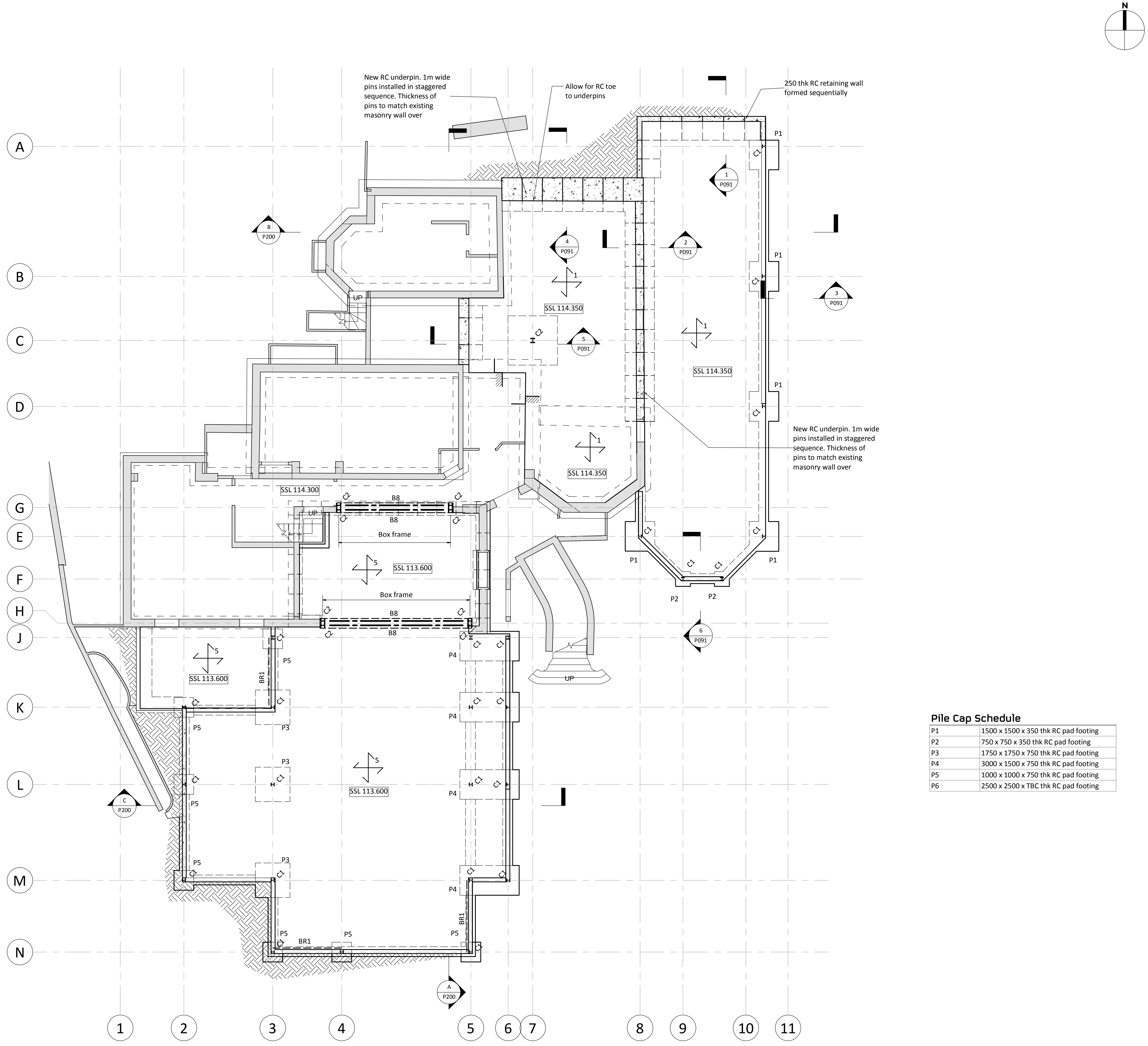
hts.uk.com

Job Name
Channing Junior School
N6 5JR

Drawing Title
Proposed Lower Ground Floor Plan

Purpose of Issue **Preliminary** Scale at A1 **As indicated**

Drg No **1843/P080** Rev **P1**



1. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
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Column Schedule

C1	152x152x37 UC	C2	203x203x100 UC

Beam Schedule

B1	200x100x10 RHS	B8	203x203x86 UC
B2	350x150x10 RHS	B9	500x300x12.5 RHS
B3	203x102x23 UB	BR1	100 x 10 MS plate cross-brace
B5	356x127x33 UB	EA1	100x100x10 EA fixed to perimeter
B6	533x210x92 UB		
B7	305x305x158 UC		

Floor Schedule

Concrete Floor X	Profiled deck X	Timber Floor X	Glass Floor X

1	150 thk RCground bearing slab
2	140 thk profiled NWC slab on TATA Comflor 60 1.0 mm gauge deck with 1 layer A193 mesh top. 19mm dia shear studs welded to top flange at 300 crs
3	150 thk CLT panels (5s150TL)
4	350 thk RC slab
5	250 thk RC slab

Legend

	Proposed RC structure
	Proposed WRC structure
	Proposed Steel Framing
PSx	PS1 - 450lg x 215wd x 150dp MC padstone PS1 - 600lg x 215wd x 215dp MC padstone
ST	Connection Strengthening
C	Crank
S	Splice
M	Moment connection
TB	Thermal Break
B1 [25mm]	Pre-camber
BR	Break in beam

Pile Cap Schedule

P1	1500 x 1500 x 350 thk RC pad footing
P2	750 x 750 x 350 thk RC pad footing
P3	1750 x 1750 x 750 thk RC pad footing
P4	3000 x 1500 x 750 thk RC pad footing
P5	1000 x 1000 x 750 thk RC pad footing
P6	2500 x 2500 x TBC thk RC pad footing

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

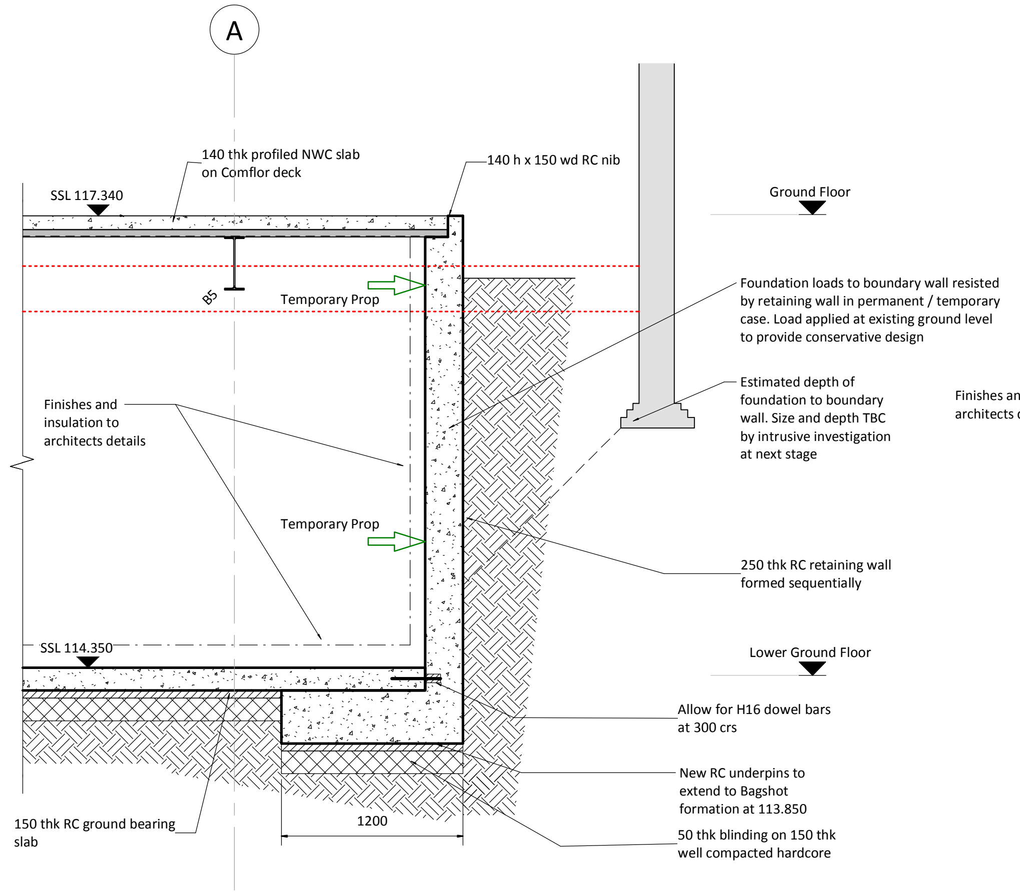
hts.uk.com

Job Name
Channing Junior School N6 5JR

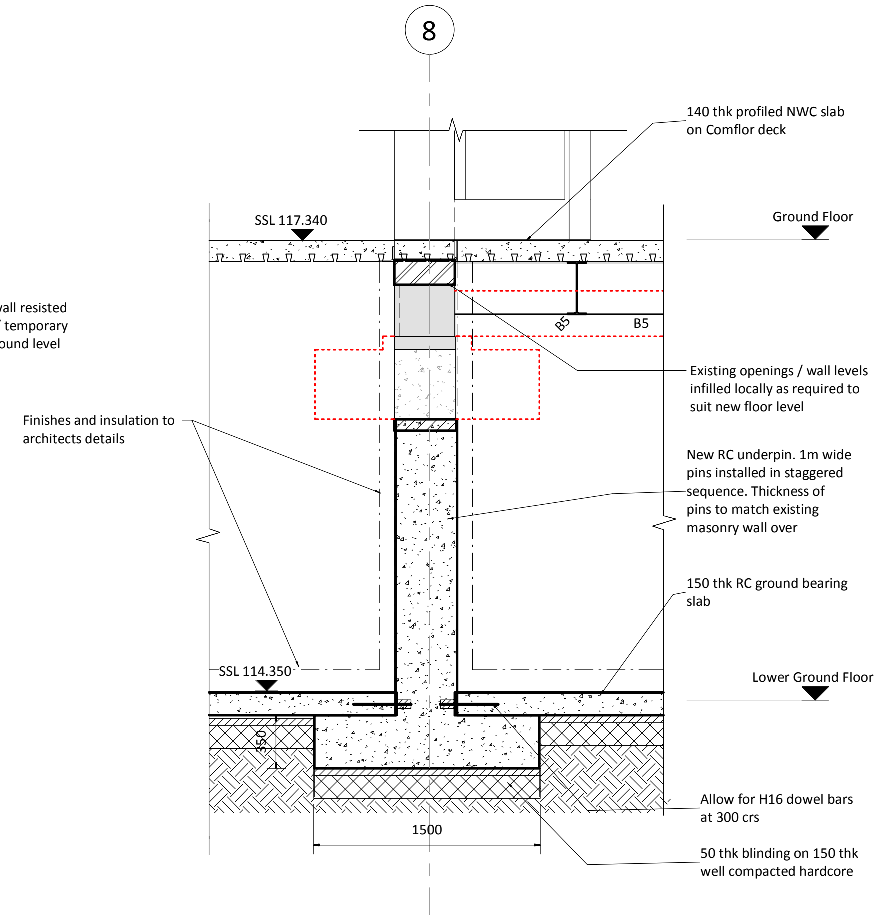
Drawing Title
Proposed Lower Ground Floor Plan

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

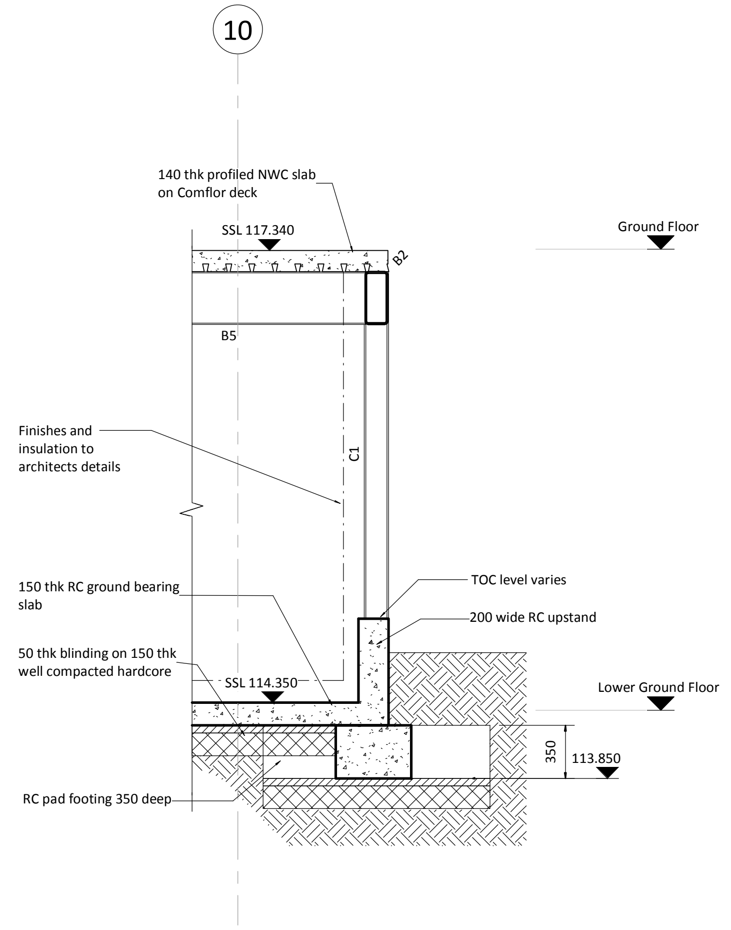
Drg No **1843/P090** Rev **P1**



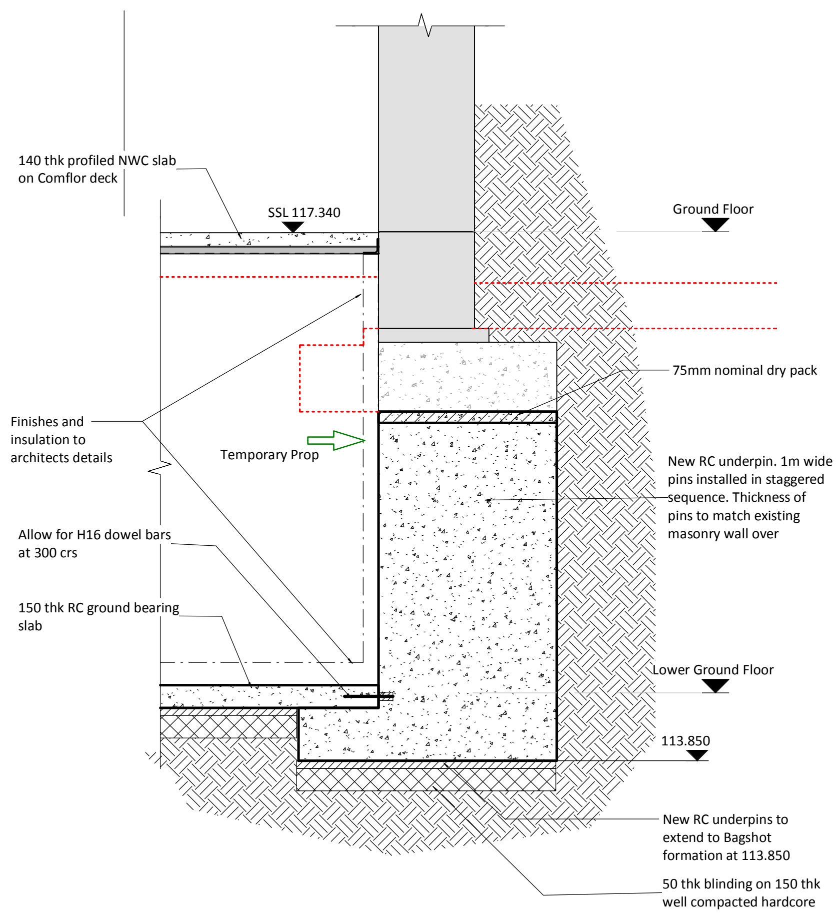
DWG P090 **Section 1-1**
1 : 25



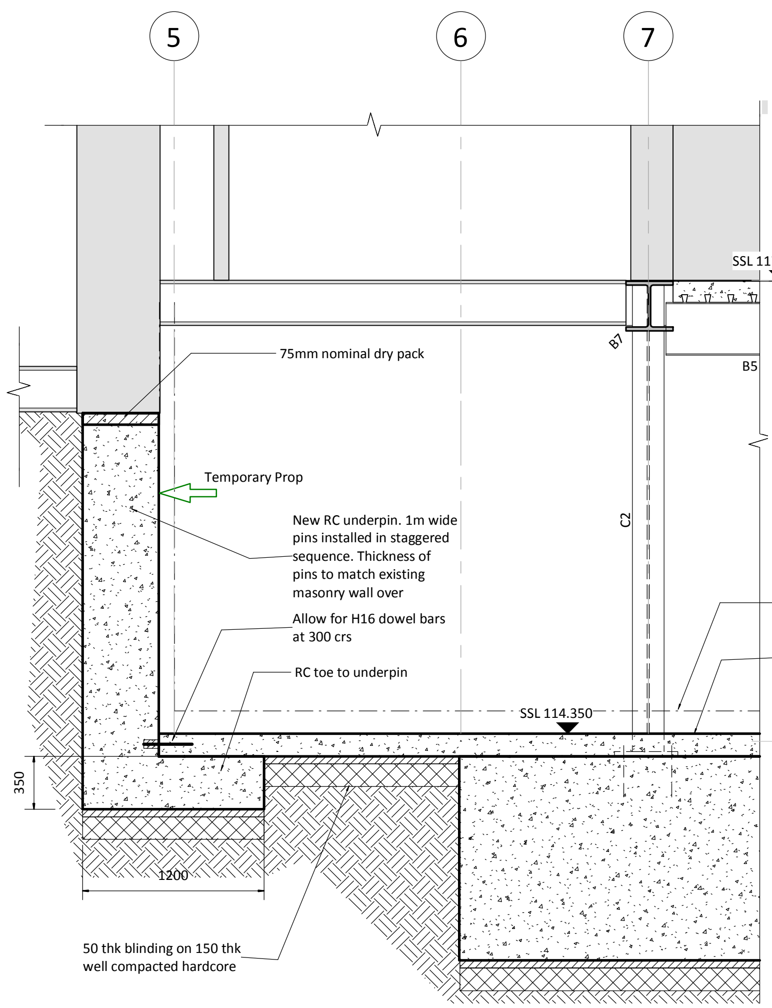
DWG P090 **Section 2-2**
1 : 25



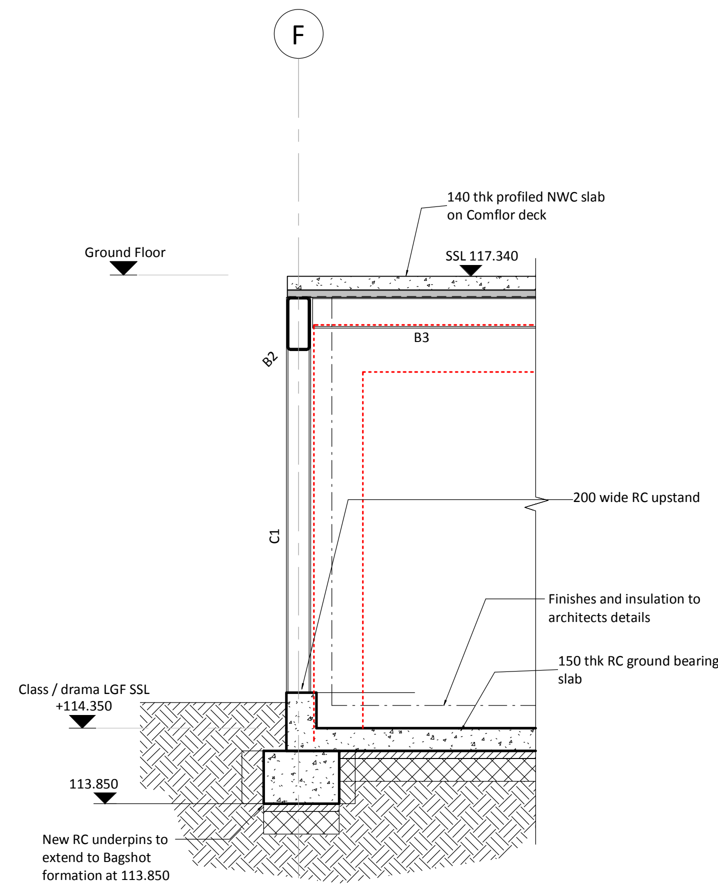
DWG P090 **Section 3-3**
1 : 25



DWG P090 **Section 4-4**
1 : 25



DWG P090 **Section 5-5**
1 : 25



DWG P090 **Section 6-6**
1 : 25

100mm @ A1 (50mm @ A3)

1. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm

Column Schedule

C1	152x152x37 UC	C2	203x203x100 UC

Beam Schedule

B1	200x100x10 RHS	B8	203x203x86 UC
B2	350x150x10 RHS	B9	500x300x12.5 RHS
B3	203x102x23 UB	BR1	100 x 10 MS plate cross-brace
B5	356x127x33 UB		
B6	533x210x92 UB	EA1	100x100x10 EA fixed to perimeter
B7	305x305x158 UC		

Floor Schedule

Concrete Floor X	Profiled deck X	Timber Floor X	Glass Floor X
1	150 thk RCground bearing slab		
2	140 thk profiled NWC slab on TATA Comflor 60 1.0 mm gauge deck with 1 layer A193 mesh top. 19mm dia shear studs welded to top flange at 300 crs		
3	150 thk CLT panels (5s150TL)		
4	350 thk RC slab		
5	250 thk RC slab		

Legend

	Proposed RC structure
	Proposed WRC structure
	Proposed Steel Framing
PSx	PS1 - 450lg x 215wd x 150dp MC padstone PS1 - 600lg x 215wd x 215dp MC padstone
ST	Connection Strengthening
C	Crank
S	Splice
M	Moment connection
TB	Thermal Break
B1 [25mm]	Pre-camber
BR	Break in beam

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Preliminary Issue

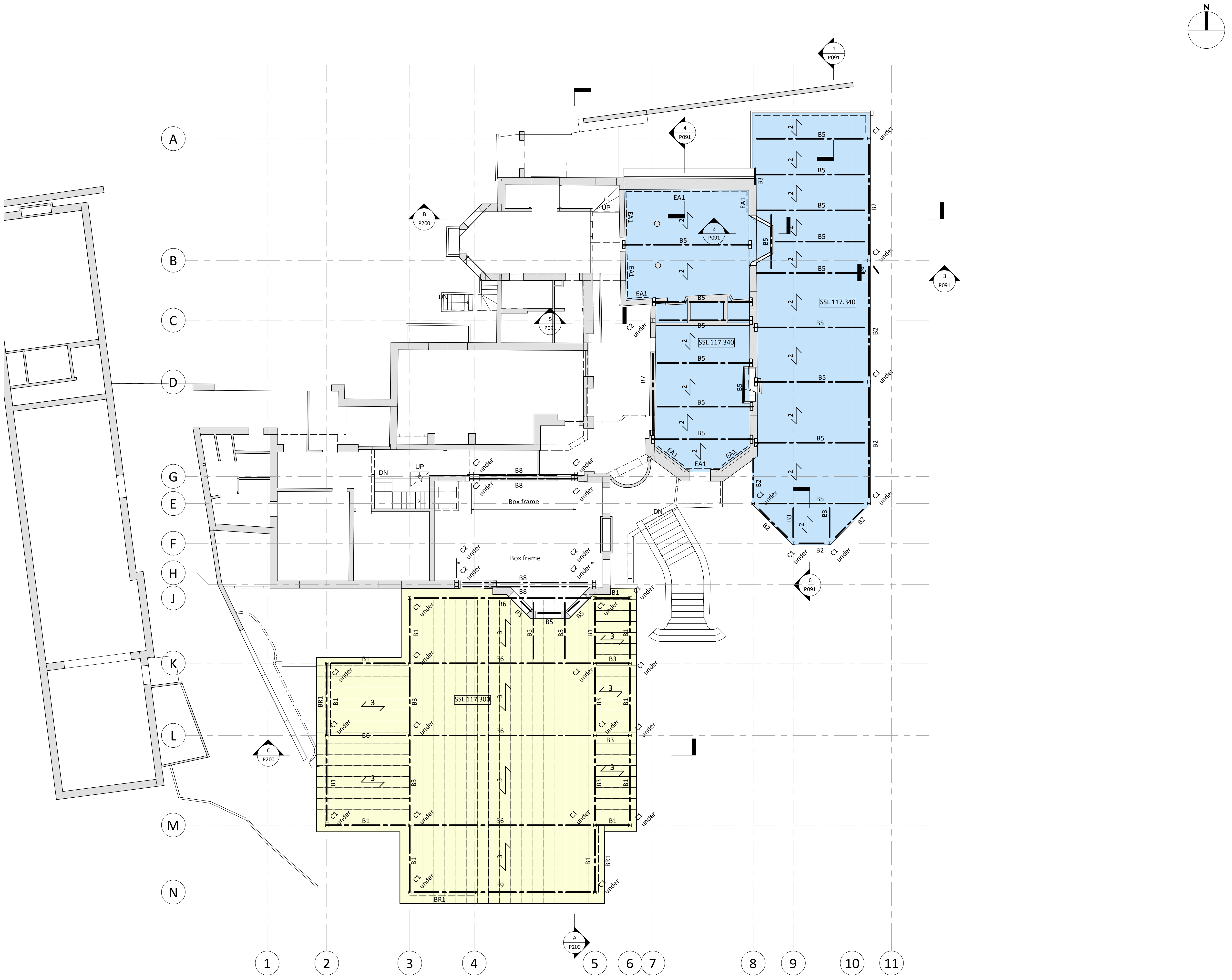
HEYNE TILLETT STEEL
STRUCTURAL ENGINEERS
hts.uk.com

Job Name
Channing Junior School N6 5JR

Drawing Title
Proposed Lower Ground Floor Details

Purpose of Issue **Preliminary** Scale at A1 **1 : 25**

Drg No **1843/P091** Rev **P1**



100mm @ A1 (50mm @ A3)

1 This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

2 Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm

Column Schedule

C1	152x152x37 UC	C2	203x203x100 UC

Beam Schedule

B1	200x100x10 RHS	B8	203x203x86 UC
B2	350x150x10 RHS	B9	500x300x12.5 RHS
B3	203x102x23 UB	BR1	100 x 10 MS plate cross-brace
B5	356x127x33 UB	EA1	100x100x10 EA fixed to perimeter
B6	533x210x92 UB		
B7	305x305x158 UC		

Floor Schedule

Concrete Floor X	Profiled deck X	Timber Floor X	Glass Floor X

1	150 thk RCground bearing slab
2	140 thk profiled NWC slab on TATA Comflor 60 1.0 mm gauge deck with 1 layer A193 mesh top. 19mm dia shear studs welded to top flange at 300 crs
3	150 thk CLT panels (5s150TL)
4	350 thk RC slab
5	250 thk RC slab

Legend

	Proposed RC structure
	Proposed WRC structure
	Proposed Steel Framing
PSx	PS1 - 450lg x 215wd x 150dp MC padstone PS1 - 600lg x 215wd x 215dp MC padstone

ST	Connection Strengthening	C	Crank
M	Moment connection	S	Splice
B1 [25mm]	Pre-camber	TB	Thermal Break
		BR	Break in beam

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Preliminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

hts.uk.com

Job Name

Channing Junior School N6 5JR

Drawing Title

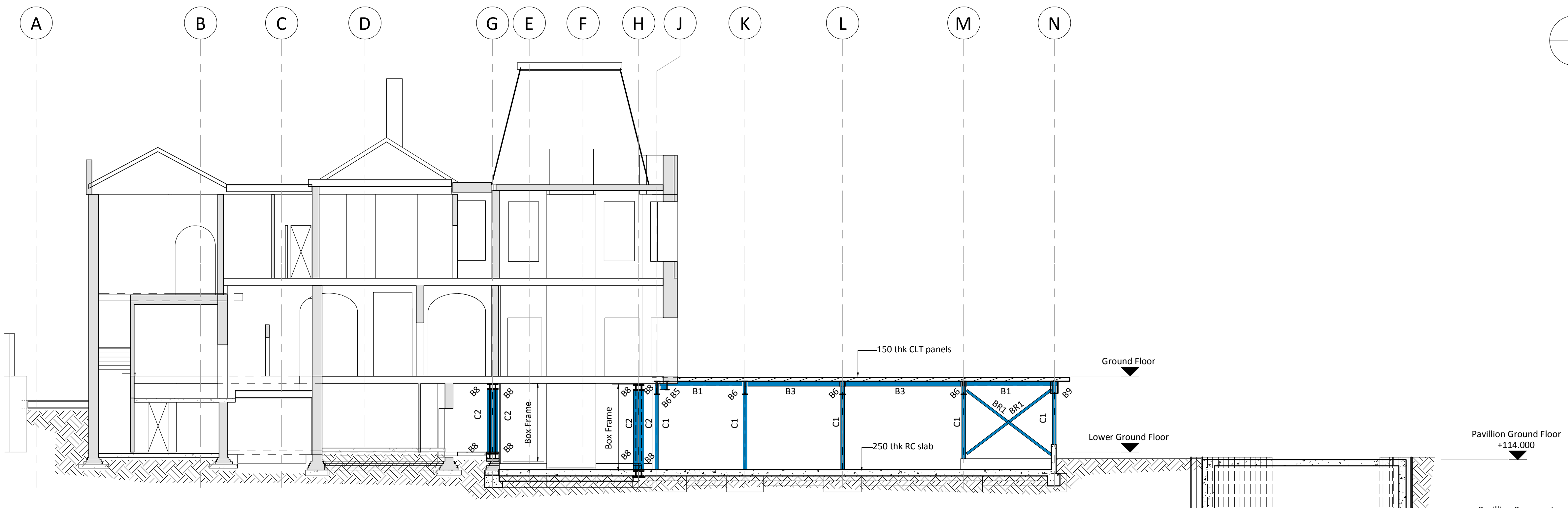
Proposed Ground Floor Plan

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

Drg No **1843/P100** Rev **P1**

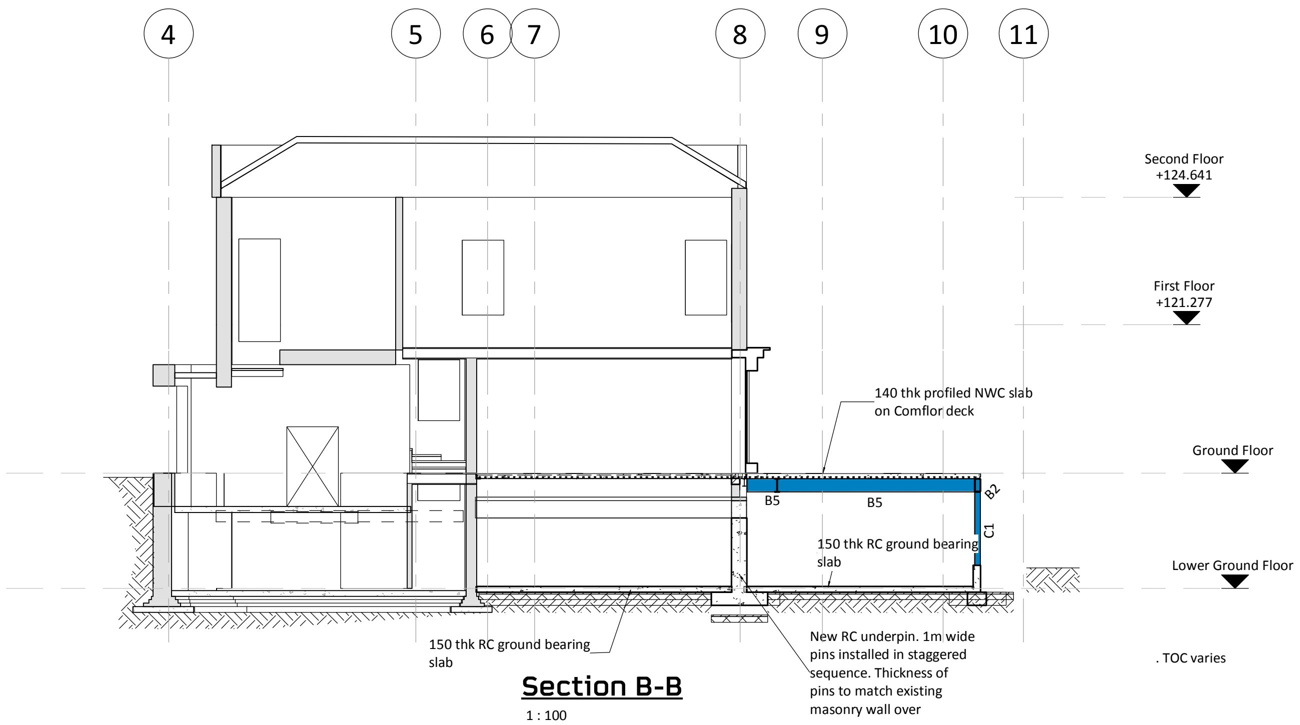
100mm @ A1 (50mm @ A3)

1. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm



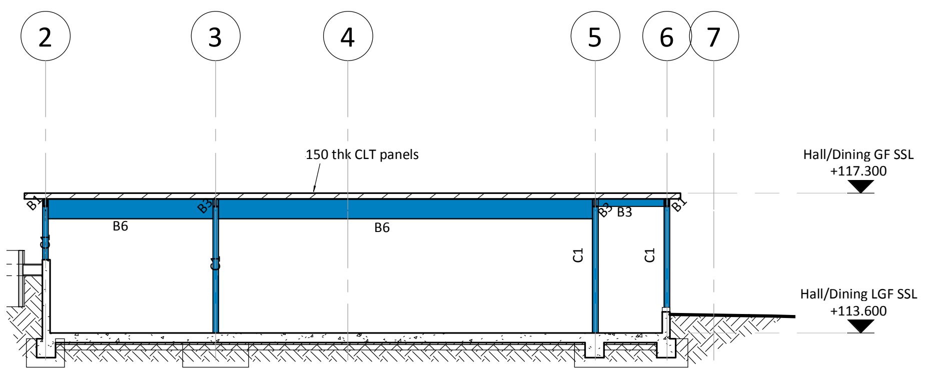
Section A-A

1 : 100



Section B-B

1 : 100



Section C-C

1 : 100

Column Schedule

C1	152x152x37 UC	C2	203x203x100 UC

Beam Schedule

B1	200x100x10 RHS	B8	203x203x86 UC
B2	350x150x10 RHS	B9	500x300x12.5 RHS
B3	203x102x23 UB	BR1	100 x 10 MS plate cross-brace
B5	356x127x33 UB	EA1	100x100x10 EA fixed to perimeter
B6	533x210x92 UB		
B7	305x305x158 UC		

Floor Schedule

Concrete Floor X	Profiled deck X	Timber Floor X	Glass Floor X

1	150 thk RCground bearing slab
2	140 thk profiled NWC slab on TATA Comflor 60 1.0 mm gauge deck with 1 layer A193 mesh top. 19mm dia shear studs welded to top flange at 300 crs
3	150 thk CLT panels (5s150TL)
4	350 thk RC slab
5	250 thk RC slab

Legend

	Proposed RC structure
	Proposed WRC structure
	Proposed Steel Framing
PSx	PS1 - 450lg x 215wd x 150dp MC padstone PS1 - 600lg x 215wd x 215dp MC padstone

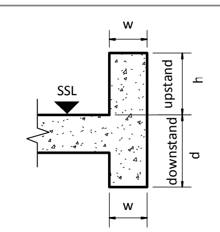
ST Connection Strengthening — C Crank

S Splice

M Moment connection — TB Thermal Break

B1 [25mm] Pre-camber — BR Break in beam

Typical Beam Notation



Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

hts.uk.com

Job Name

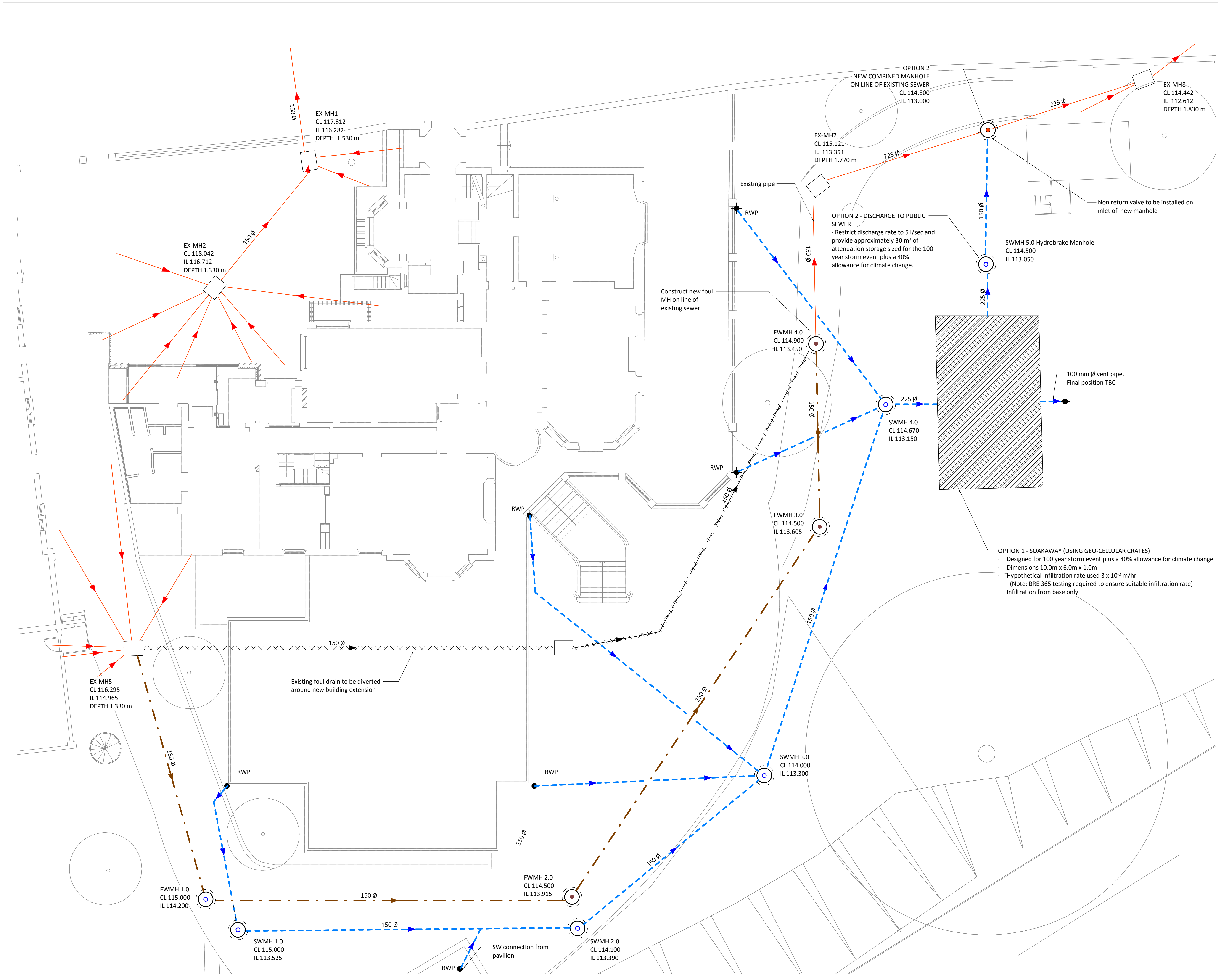
Channing Junior School N6 5JR

Drawing Title

Proposed Overall Sections

Purpose of Issue **Preliminary** Scale at A1 **1 : 100**

Drg No **1843/P200** Rev **P1**



100mm @ A1 (50mm @ A3)

1 This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

3 Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm

3 Abbreviations:-

CL	- Cover Level
IL	- Invert Level
MH	- Manhole
OD	- Outer Diameter
RWP	- Rainwater Pipe
SVP	- Soil Vent Pipe

4 All pipework to be 100 Ø unless noted otherwise

5 The contractor is to execute all repair works and recommendations associated with drainage to be retained and reused outlined in the CCTV report by Spaflow, dated November 2017

Drainage Key

- Proposed SW drain run
- Proposed FW drain run
- Proposed CW drain run
- Proposed Pumped Rising Main
- Existing SW drain run
- Existing FW drain run
- Existing CW drain run
- Existing Pumped Rising Main
- Public sewer
- Unspecified drain run
- Proposed Channel Drain
- Redundant drain run
- RWP Proposed / Existing Rain Water Pipe
- SVP Proposed / Existing Soil Vent Pipe
- RE Proposed / Existing Rodding Eye
- DP Proposed / Existing Drainage Point
- SS Proposed / Existing Stub Stack
- G Proposed / Existing Gully
- Proposed SW Manhole
- Proposed FW Manhole
- Proposed CW Manhole
- Proposed Public Sewer Manhole
- Existing Manhole

Rev	Date	By	Eng	Amendments
P1	15.12.17	SLS	SOB	Prelimiminary Issue

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

hts.uk.com

Job Name

Channing Junior School N6 5JR

Drawing Title

Drainage Sheet

Purpose of Issue **Preliminary** Scale at A1 **As indicated**

Drg No **1843/DR010** Rev **P1**

Appendix C

External and Internal Site Photographs

External Site Photographs

Internal Site Photographs

Appendix D

Site Investigation Report - GEA

HEYNE TILLETT STEEL

SITE INVESTIGATION & BASEMENT IMPACT ASSESSMENT REPORT

Channing Junior School
Highgate High Street,
London N6

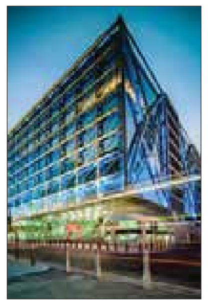
Client: Channing Junior School

Engineer: Heyne Tillett Steel

J17268

December 2017



GEA

Document Control

Project title	Channing Junior School, Highgate High Street, London, N6 5JR	**Project ref**	J17268
Report prepared by	Hannah Dashfield BEng FGS Geotechnical Engineer		
With input from	Martin Cooper BEng CEng MICE FGS Technical Director		
	John Evans MSc FGS CGeol Consultant Hydrogeologist		
	Rupert Evans MSc CEnv CWEM MCIWEM AIEMA Consultant Hydrologist		
Report checked and approved for issue by	Steve Branch BSc MSc CGeol FGS FRGS Managing Director		

Issue No	Status	Amendment Details	Date	Approved for Issue
1	Draft		1 December 2017	
2	Final	GMA appended	12 December 2017	SB

This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.

✓	Hertfordshire	tel 01727 824666 mail@gea-ltd.co.uk
	Nottinghamshire	tel 01509 674888 midlands@gea-ltd.co.uk

This report is intended as a Ground Investigation Report (GIR) as defined in BS EN1997-2, unless specifically noted otherwise. The report is not a Geotechnical Design Report (GDR) as defined in EN1997-2 and recommendations made within this report are for guidance only.

CONTENTS

EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Heyne Tillett Steel, on behalf of Channing Junior School, with respect to the construction of single storey extensions along the eastern and southern elevations of the existing school building at lower ground floor level, in addition to a 3.10 m deep excavation (110.95 m OD) beneath the existing playground for a new pavilion building. The purpose of the investigation has been to research the history of the site with respect to possible contaminative uses, to determine the ground conditions and hydrogeology, to assess the extent of any contamination and to provide information to assist with the design of suitable foundations and retaining walls for the proposed extensions and subterranean structures. The report also includes information required to comply with London Borough of Camden (LBC) Draft Planning Guidance CPG4, relating to the requirement for a Basement Impact Assessment (BIA). A ground movement assessment has been completed to provide an indication of the likely impact of the proposed development on surrounding structures, and the findings are included in the appendix (J17268A report issue 1, dated 11 December 2017). .

SITE HISTORY

The existing building of Fairseat is understood to have been remodelled in 1867 and was in use as a private house until the school occupied the site in 1926; as such the site is not considered to have a contaminative history. A preliminary UXO risk assessment has been completed by First Line Defence (ref EP5503-00, dated 13 October 2017) and concluded that no further action is required in this respect.

GROUND CONDITIONS

The investigation has generally encountered the expected ground conditions in that, beneath a moderate to significant thickness of made ground, extending to depths of between 0.32 m and 2.90 m (115.49 m OD and 110.20 m OD), the Bagshot Formation overlies the Claygate Member, proved to the maximum depth investigated of 17.45 m. The Bagshot Formation generally comprises fine to coarse sand with varying quantities of flint gravel and nodules of sandstone. This stratum has been interpreted to extend to depths of between 3.25 m and 5.60 m (111.25 m OD and 108.40 m OD). The Claygate Member generally comprises light brown silty fine sand, extending to depths of 11.55 m (102.10 m OD) and 12.20 m (101.80 m OD), although an upper horizon of clay was noted locally. At depth, the Claygate Member becomes stiff locally firm dark grey silty clay, and was proved to the maximum depth investigated of 17.45 m (96.55 m OD). Groundwater was encountered during drilling at depths of 4.00 m, 5.10 m and 15.50 m and subsequent monitoring of the installed standpipes has measured water at depths of 3.89 m and 4.80 m (110.56 m OD and 109.15 m OD).

The contamination test results indicate elevated concentrations of lead and arsenic above the generic screening values for a residential end use.

RECOMMENDATIONS

All new foundations will need to bypass the made ground and it should be possible to adopt strip or pad foundations bearing within the Bagshot Formation, above the groundwater table for the eastern and southern extensions. The pavilion will extend close to or below the groundwater table and careful consideration will need to be given to the support of the excavation within predominantly granular soils. Support of the excavation using sheet piles may be appropriate. Remedial measures are not deemed to be required to protect end users.

BASEMENT IMPACT ASSESSMENT

There will be adequate space for water to flow around the structure, given its size relative to the size of the site and the absence of neighbouring basement structures, such that there should not be any significant impact on groundwater flow. The BIA has not indicated any concerns with regard to the effects of the proposed basement on the site and surrounding area. It has been concluded that the impacts identified can be mitigated by appropriate design and standard construction practice. The ground movement analysis and building damage assessment have indicated that the predicted damage to the adjoining and nearby structures would generally be Category 0 (Negligible), with a limited number of segments of ‘Very Slight’ damage. The result falls within acceptable limits, although monitoring is recommended to ensure that no excessive movements occur that would lead to damage in excess of these limits.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

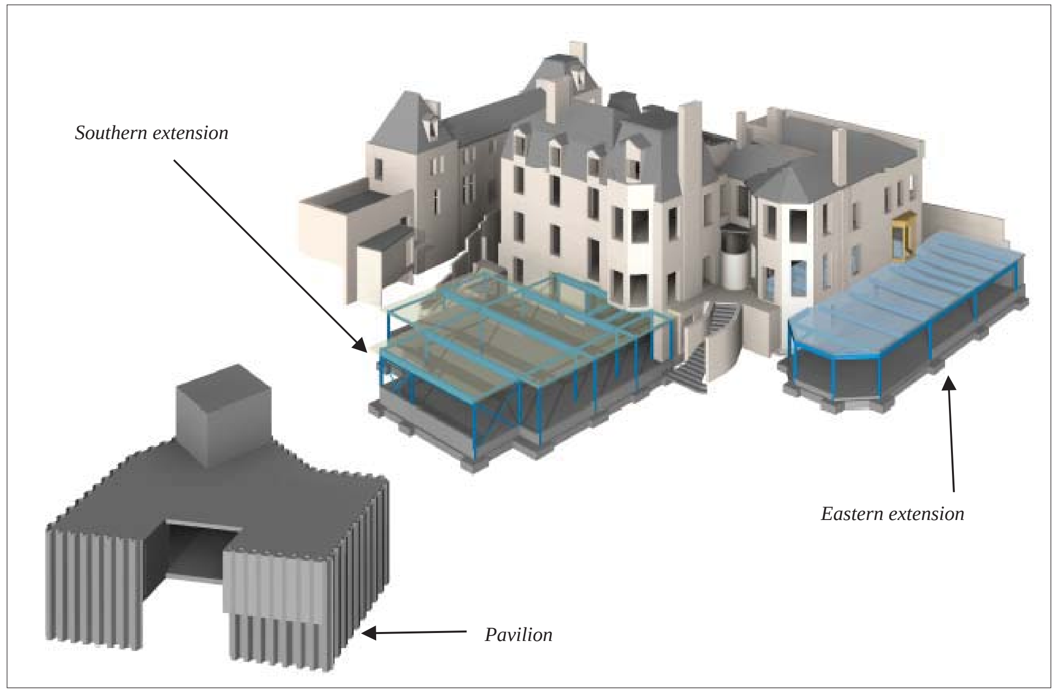
1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) has been commissioned by Heyne Tillett Steel, on behalf of Channing Junior School, to carry out a desk study and ground investigation at Channing Junior School, Highgate High Street, London N6 5JR. This report also forms part of a Basement Impact Assessment (BIA), which has been carried out in accordance with guidelines from the London Borough of Camden in support of a planning application.

A ground movement analysis and building damage assessment has been completed and report is included in the appendix (J17268A report issue 1, dated 11 December 2017).

1.1 Proposed Development

It is proposed to construct lower ground floor extensions along the eastern and southern elevations of the existing school building, in addition to a 3.10 m deep excavation beneath the existing playground for a new pavilion building, extending to a level of roughly 110.95 m OD.



The southern extension will be an irregular shaped rectangle, measuring approximately 17.55 m by 13 m in maximum dimensions to provide a dining hall and kitchen. This extension will extend to a depth of approximately 1 m below the existing playground level, which is located at a level of about 113.60 m OD. It will be a single storey structure with a play area above and extend about 16.7 m laterally from the rear elevation of the existing lower ground floor.

The eastern extension will include excavating 3 m of soil from beneath the terrace level to create a drama studio, classroom and enlarged toilets. The excavation will extend to a level of approximately 114.35 m OD.

The pavilion will provide changing rooms and will involve an excavation up to 3.10 m deep constructed partly under the playground and partly into the grass bank located to the north of the tennis courts. At playground level, a lift and stairs will be located on the upper level and at the lower level an entrance will be set within the grass bank.

This report is specific to the proposed development and the advice herein should be reviewed if the proposals are amended.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- to check the history of the site and surrounding areas with respect to previous contaminative uses;
- to assess the risk from unexploded ordnance (UXO);
- to determine the ground conditions and their engineering properties;
- to determine the configuration of existing foundations;
- to assess the impact of the proposed basement on the local hydrogeology, hydrology and stability of the surrounding natural and built environment;
- to provide advice with respect to the design of suitable foundations and retaining walls;
- to assess the ground movements caused by excavation of the proposed subterranean structures and the level of damage to the surrounding structures;
- to provide an indication of the degree of soil contamination present; and
- to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

1.3 Scope of Work

In order to meet the above objectives, a desk study was carried out, followed by a ground investigation. The desk study comprised:

- a review of historical Ordnance Survey (OS) maps and environmental searches sourced from the Envirocheck database;
- a review of readily available geology maps;
- a preliminary UXO risk assessment (ref EP5530-00, dated 13 October 2017) by 1st Line Defence, commissioned by GEA; and
- a walkover survey of the site carried out at the time of the fieldwork.

In the light of this desk study an intrusive ground investigation was carried out which comprised, in summary, the following activities:

- three cable percussion boreholes, two to a depth of 12.00 m and a single borehole advanced to a depth of 17.45 m;
- four open-drive sampler boreholes, advanced to a maximum depth of 6.00 m;
- five window sampler boreholes advanced to a maximum depth of 3.50 m;
- installation of six groundwater monitoring standpipes to depths of between 3.00 m and 8.00 m, and subsequent groundwater monitoring visits;
- falling head tests carried out in two standpipes to determine the permeability of the underlying natural soils;
- nine hand dug trial pits excavated to depths of between 0.50 m and 1.30 m to determine the configuration of the foundations of the existing building and retaining wall;
- laboratory testing of selected soil samples for geotechnical purposes and for the presence of contamination;
- a ground movement analysis and building damage assessment; and
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

The report includes a contaminated land assessment which has been undertaken in accordance with the methodology presented in Contaminated Land Report (CLR) 11[1] and involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment.

The exploratory methods adopted in this investigation have been selected on the basis of the constraints of the site including but not limited to access and space limitations, together with any budgetary or timing constraints. Where it has not been possible to reasonably use an EC7 compliant investigation technique a practical alternative has been adopted to obtain indicative soil parameters and any interpretation is based upon engineering experience, local precedent where applicable and relevant published information.

1.3.1 Basement Impact Assessment

The work carried out includes a Hydrological and Hydrogeological Assessment and Land Stability Assessment (also referred to as Slope Stability Assessment), all of which form part of the BIA procedure specified in the London Borough of Camden (LBC) Draft Planning Guidance CPG4[2] and their Guidance for Subterranean Development[3] prepared by Arup ('the Arup Report') in accordance with Policy A5 of the Camden Local Plan 2017. The aim of the

1 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004
2 London Borough of Camden Draft Planning Guidance CPG4 (November 2017) *Basements and lightwells*
3 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean development.* For London Borough of Camden November 2010

work is to provide information on surface water, groundwater and land stability and in particular to assess whether the development will affect neighbouring properties or groundwater movements and whether any identified impacts can be appropriately mitigated by the design of the development.

1.3.2 Qualifications

The land stability element of the Basement Impact Assessment (BIA) has been carried out by Martin Cooper, a BEng in Civil Engineering, a chartered engineer (CEng), member of the Institution of Civil Engineers (MICE), and Fellow of the Geological Society (FGS) who has over 25 years' specialist experience in ground engineering. The subterranean (groundwater) flow assessment has been carried out by John Evans, MSc in Hydrogeology, Chartered Geologist (CGeol) and Fellow of the Geological Society of London (FGS). The surface water and flooding assessment has been carried out by Rupert Evans, a hydrologist with more than ten years' consultancy experience in flood risk assessment, surface water drainage schemes and hydrology / hydraulic modelling. Rupert Evans is a Chartered Environmentalist, Chartered Water and Environmental Manager and a Member of CIWEM.

The assessments have been made in conjunction with Steve Branch, a BSc in Engineering Geology and Geotechnics, MSc in Geotechnical Engineering, a Chartered Geologist (CGeol) and Fellow of the Geological Society (FGS) with over 30 years' experience in geotechnical engineering and engineering geology.

All assessors meet the qualification requirements of the Council guidance.

1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

2.0 THE SITE

2.1 Site Description

The site is located in the London Borough of Camden, approximately 930 m to the northwest of Archway London Underground Station, and about 900 m south-southeast of Highgate London Underground Station. It is bounded by Highgate High Street to the north and is bordered to the east by Lauderdale House and to the south and west by Waterlow Park. The site may be additionally located by National Grid Reference 528640, 187310 and is shown on the map extract overleaf.

The site is currently occupied by Channing Junior School, an independent day school for girls. The main building is Fairseat which is set back from the main road and comprises an irregular shaped detached three-storey brick building with a lower ground floor and accommodation at roof level. To the west of this building is a detached rectangular shaped, two-storey brick building with roof accommodation, which also forms part of the school premises, referred to as the stable block. These buildings are understood to be listed.

A walkover of the site was carried out during the fieldwork and selected photographs are included overleaf. The local topography slopes down in both easterly and southerly directions and the site is essentially on three levels ranging from about 118 m OD to 111 m OD. The ground floor level of the school is located at approximately 117 m OD, the lower ground floor and playground levels are at roughly 114.27 m OD to 113.59 m OD and the tennis courts are located on the lowest level at about 110.40 m OD. The site slopes generally from north to south over a distance of about 106 m, with an overall slope angle of 10°, and from west to east also at about 10° over a distance of about 110 m.

Existing site layout, looking towards northwest

The school is set within extensive landscaped grounds with a large area for tennis courts, a temporary building used for sports facilities in the south of the site and a number of portacabins. A tarmac playground area is present to the south of the main school building and an access road is located along the western elevation of the main school building leading from Highgate High Street to the eastern corner of the site where a car park area is situated. Along the eastern elevation, a retaining wall 2.12 m high separates a terrace located at ground floor level from the landscaped gardens and playground areas. A grass bank is located to the north of the tennis courts with steps leading from the playground to the tennis courts. The northern boundary of the site is formed by a brick wall separating the school grounds from Highgate High Street.

Numerous mature and immature trees are present within the landscaped gardens located to the southeast of Fairseat House and along the eastern and southern perimeters of the site. Planted areas are located just to the southwest of Fairseat House in an area located between the access road and playground and on the lower level in front of the retaining wall of the terrace.

Main entrance to school

Car park at front of school.

Access road between Stable Block and Fairseat House, looking north

Southern elevation of Fairseat House

Fairseat House, looking northwest at BH3

Eastern elevation of Fairseat House

Sloping ground to east of the terrace

From tennis courts, looking northwest

Temporary building and portacabins on tennis courts and Premier rig set up over BH12

Tennis courts looking west

2.2 Site History

The site history has been researched by reference to internet sources and historical Ordnance Survey (OS) maps obtained from the Envirocheck.

The earliest map studied, dated 1870, show Highgate High Street laid out to the north and the site was already developed by a 'W' shaped building, named as Fairseat House and the stable block, with Lauderdale House located to the southeast of the site and landscaped gardens surrounding the two houses. On this map a pond was located 120 m to the southwest of the site and another pond was shown 160 m to the south-southeast.

Between 1870 and 1896 an overflow pond is shown to the southeast of the pond located to the south-southeast. On the 1896 map, the grounds to the south of Lauderdale House are annotated as Waterlow Park. At some time between 1896 and 1937 changes to the shape of the house took place. Reference to internet research[4] indicates that the east wing of Fairseat House was demolished in 1909 for the widening of the road. Tennis courts were constructed to the southwest of Fairseat House between 1915 and 1935.

On the 1952 map, a shelter is shown 240 m to the south of Fairseat House and a putting green is shown just to the north of the pond located to the southwest and a number of ruins are shown to the southwest and south-southwest of the site. An electrical works is labelled roughly 75 m to the northwest of the site. Between 1952 and 1967 tennis courts were constructed in the south of the site and the tennis courts were extended to five courts between

[4] http://www.british-history.ac.uk/vch/middx/vol6/pp122-135#highlight-first

1991 and 1992. The tennis courts and putting green to the southwest of the site had been reconfigured. According to the London Encyclopaedia, Lauderdale House was built in 1580 by Richard Martin for the residence of the Earl of Lauderdale. Lauderdale House was brought by Sir Sidney Waterlow 1st Baronet in 1871 and Waterlow made his home in Fairseat House, which is understood to be a Victorian mansion. Lauderdale House and its grounds were given by Waterlow to St Bartholomew's Hospital in 1872 for use as a convalescent home. In 1889 Waterlow gave the house and gardens to London City Council for a garden to the gardenless. It is understood that Fairseat House has been used as a school since 1926 and has remained essentially unchanged to the present day, although temporary classrooms were erected at the western end of the tennis court in the last couple of years.

2.3 Preliminary UXO Risk Assessment

A preliminary UXO risk assessment has been carried out by 1st Line Defence and their report (ref EP5503-00, dated 13 October 2017) is included in the appendix. The risk assessment has been carried out in accordance with the guidelines provided by CIRIA, which state that the likelihood of encountering and detonating unexploded ordnance (UXO) below a site should be assessed along with establishing the consequences that may arise. The first phase comprises a preliminary risk assessment, which should be undertaken at an early stage of the development planning. If such an assessment identifies a high level of risk then a detailed risk assessment should be carried out by a UXO specialist, which will identify an appropriate course of action with regard to risk mitigation.

The preliminary UXO risk assessment has indicated that the site was subject to one bombing incident in the form of an incendiary bomb shower in February 1941. Anecdotal records report that Channing School was badly damaged by a parachute mine during World War II. This is thought to be within the school grounds to the north of the site. The report concludes that no further action is required in regard to unexploded ordnance.

2.4 Other Information

A search of public registers and databases has been made via the Envirocheck database and relevant extracts from the search are appended. Full results of the search can be provided if required.

The desk study research indicated that there are no registered landfills, historic landfills, registered waste transfer sites, waste management facilities or recorded pollution incidents within 250 m of the site. There are three potentially infilled land (water) within 250 m of the site, located 158 m southeast, 205 m northeast and 215 m northeast of the site with infilling taking place by 1876 and 1896.

There are no discharge consents or fuel stations listed within 250 m of the site. There are 12 contemporary trade directory entries listed within 250 m of the site, including an active dry cleaners 73 m to the west and a garage 114 m to the northwest, but no contaminated land register entries or notices within 1 km of the site.

Reference to records compiled by the Health Protection Agency (formerly the National Radiological Protection Board) indicates that the site falls within an area where less than 1% of homes are affected by radon emissions and therefore radon protective measures will not be necessary.

The site is not located within a Nitrate Vulnerable Zone or any other sensitive land uses, although the site is located in the Highgate Conservation Area, Fairseat Metropolitan Open Land and is designated private open space within Waterlow Park, along with a site of nature

conservation importance by Natural England. The school building is also subject to an archaeological constraint.

There are no London Underground tunnels or Network Rail tunnels located within 50 m of the site. Copies of the services drawings obtained from BT, Cadent Gas, Thames Water and UK Power Networks is included in the appendix.

Discussions on site with the school's builder indicated that there is a well on site which has been covered over and is located in the area to the west of Borehole No 2.

2.5 Geology

The British Geological Survey (BGS) map of the area (Sheet 256), indicates that the site is underlain by the Bagshot Formation, overlying the Claygate Member of the London Clay Formation, which is in turn underlain by the London Clay Formation. The boundary between the Bagshot Formation and the Claygate Member is shown to outcrop approximately 20 m to 30 m to the south of the site of Fairseat House and the boundary of the Claygate Member and Bagshot Formation is roughly 160 m to the south. An extract from the BGS geology viewer is included below, indicating the location of the site with respect to the geological boundaries.

According to the British Geological Survey Lexicon[5], the Bagshot Formation is *"composed of pale yellow-brown to pale grey or white, locally orange or crimson, fine- to coarse-grained sand that is frequently micaceous and locally clayey, with sparse glauconite and sparse seams of gravel. The sands are commonly cross-bedded but some are laminated. Thin beds and lenses of laminated pale grey to white sandy or silty clay or clay ('pipe-clay') occur sporadically, becoming thicker towards the top of the formation."*

The Claygate Member "*comprises dark grey clays with sand laminae, passing up into thin alternations of clays, silts and fine-grained sand, with beds of bioturbated silt"*.

The London Clay Formation is described as "*bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. It commonly contains thin courses of carbonate concretions*

5 *http://www.bgs.ac.uk/lexicon*

('cementstone nodules') and disseminated pyrite. It also includes a few thin beds of shells and fine sand partings or pockets of sand, which commonly increase towards the base and towards the top of the formation."

The geology in this area is generally roughly horizontally bedded such that the boundary between the geological formations roughly follows the ground surface contour lines. The existing lower ground floor level is located at a level of approximately 114.30 m OD. The Bagshot Formation is expected to extend to a level of approximately 115 m OD to 110 m OD in this area and the Claygate Member to levels of between roughly 95 m OD to 90 m OD.

A borehole (BGS reference TQ28NE198) drilled by the BGS on Hampstead Lane roughly 2.3 km to the west of the site, generally referred to as the 'Hampstead Heath borehole', was advanced to a depth of 66.74 m (61.97 m OD) at National Grid Reference 526455, 186890. The borehole record indicates that the Bagshot Formation extended to a level of 109.71 m OD and the base of the Claygate Member was encountered at a level of 93.71 m OD. The Hampstead Heath borehole proved the London Clay to extend to a level of at least 61.97 m OD.

GEA has previously carried out a ground investigation at Channing Senior School located on the northern side of Highgate High Street, roughly 60 m to the north-northeast of the site. Below a 0.40 m to 5.60 m thickness of made ground, the Bagshot Formation was found to overlie the Claygate Member which was in turn underlain by London Clay. The Bagshot Formation generally comprised light brown, locally orange-brown and reddish brown, fine to coarse sand which was occasionally silty and gravelly and was possibly overlain by a downwash deposit on higher parts of the site, extending to depths of between 6.50 m and 6.80 m. The Claygate Member was found to comprise a variable sequence of orange-brown to brown and mottled grey silty very sandy clay and a very clayey silty sand which was proved to depths of between 12.70 m and 4.50 m. The London Clay Formation comprised firm becoming stiff grey silty fissured clay with occasional selenite crystals which graded into a silty sandy clay below a depth of 16.50 m and extended to the maximum depth investigated of 20.00 m.

2.6 Hydrology and Hydrogeology

Both the Bagshot Formation and Claygate Member are classified as a Secondary 'A' Aquifers meaning they have permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers as defined by the Environment Agency (EA). The London Clay Formation is classified as unproductive strata with soils that have a low permeability and negligible significance to local water supply, as defined by the EA.

The site is not located within a designated Groundwater Source Protection Zone (SPZs) and there are no Environment Agency registered water abstraction points within 1 km of the site. The nearest surface water feature is Upper Pond within Waterlow Park, located close to the southern boundary of the school grounds, at a level of between 111 m OD to 110 m OD. Another pond is located in the park known as Middle Pond located at an elevation of between 96 m OD and 91 m OD. A third pond is present in the park, known as Lower Pond.

The site lies outside the catchment of the Hampstead Heath chain of ponds.

Groundwater is likely to be present within the Bagshot Formation and the Claygate Member. Spring lines are present at the interface of the Bagshot Formation and the Claygate Member, and to a much lesser extent at a lower level at the boundary between the Claygate Member and the underlying essentially impermeable London Clay. These springs have been the source of a number of London's "lost" rivers, notably the Fleet, Westbourne and Tyburn, which all rose on Hampstead Heath.

Reference to the Lost Rivers of London[6] indicates that a headwater of the eastern branch of the River Fleet flows from springs that rise in Waterlow Park to the south of the tennis courts in the park, close to Swain's Lane, located approximately 100 m to the southwest of the site. The river flows in a southeasterly direction from that point.

Groundwater was encountered in the aforementioned ground investigation at Channing Upper School during drilling within the made ground, Bagshot Formation and Claygate Member at depths of between 2.0 m and 8.0 m.

The increase in hardstanding as a results of the proposals is minimal and rain water will be able to infiltrate into the ground beneath the site to the extensive areas of soft landscaping.

The site is not at risk of flooding from rivers or sea, or by reservoirs as defined by the Environment Agency.

2.7 Preliminary Risk Assessment

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a "suitable for use" approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

2.7.1 Source

The desk study research has indicated that the existing building of Fairseat House has been on the site for over 150 years, and was a private house, prior to the school being established on the site in 1926. The site is therefore not considered to have a contaminative history.

There are no historical or existing landfill sites within 250 m of the site, although there are three ponds located within 250 m of the site which were infilled prior to 1896. Given the age of the infilling, they do not represent a source of soil gas.

2.7.2 Receptor

Consideration is being given to the construction of three extensions within the vicinity of the main school. The use of the site as a school will not result in extensive exposure to the soil and being only part of the school the annual exposure period of pupils using the block would be relatively low and thus this proposed usage is considered to represent a relatively low sensitivity end-use.

Buried services are likely to come into contact with any contaminants present within the soils through which they pass and site workers are likely to come into direct contact with any contaminants present in the soil and through inhalation of vapours during excavation of the subterranean structure and construction of the extensions.

The site is underlain by a Secondary 'A' Aquifer and therefore groundwater and adjacent sites should be considered moderately sensitive receptors. The presence of an Unproductive Stratum beneath the secondary aquifers means that the chalk aquifer at depth represents a relatively low sensitivity receptor.

6 Nicholas Barton and Stephen Myers (2016) *London's Lost Rivers. Revised Edition.* Historical Publications Ltd

2.7.3 Pathway

The largely granular Bagshot Formation will allow the migration of any contaminated groundwater through the shallow soils to surrounding sites. The presence of negligibly permeable London Clay beneath the Claygate Member will however limit the potential for groundwater percolation into the underlying chalk, and thus a pathway is not considered likely to exist to the major aquifer.

Within the site, end users will be largely isolated from direct contact with any contaminants present within the made ground by the presence of the building and the extent of the hardstanding. However, in proposed areas of soft landscaping potential contaminant exposure pathways exist with respect to end users.

Except for the pathway of direct contact for site workers, no new pathways will be created by the extensions and services will come into contact with any contamination within the soils in which they are laid.

There is thus considered to be limited potential for a significant contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant beneath the new building and extent of any hardstanding and a moderate potential exists within any proposed soft landscaped areas.

2.7.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a LOW risk of there being a significant contaminant linkage at this site, which would result in a requirement for major remediation work. Furthermore, there is not considered to be a potential for hazardous soil gas to be present on or migrating towards the site, such that soil gas exclusion systems should not be required.

3.0 SCREENING

The London Borough of Camden guidance suggests that any development proposal that includes a subterranean basement should be screened to determine whether or not a full Basement Impact Assessment (BIA) required.

3.1 Screening Assessment

A number of screening tools are included in the Arup report and for the purposes of this report reference has been made to Appendix E which includes a series of questions within a screening flowchart for three categories; groundwater flow; land stability; and surface water flow. Responses to the questions are tabulated on the following pages.

3.2 Subterranean (groundwater) Screening Assessment

Question	Response for Channing Junior School
1a. Is the site located directly above an aquifer?	*Yes, the site is located above a Secondary 'A' Aquifer as designated by the EA.*
1b. Will the proposed basement extend beneath the water table surface?	*Possibly. The pavilion structure may extend close to or below the groundwater table in the Bagshot Formation.*
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	*Yes. The site is located roughly 100 m to the northeast of the headwaters of the River Fleet, which was fed by springlines that rise in Waterlow Park. It is understood that a well is present on site but not in use.*
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No. Figure 14 of the Arup report indicates that the site is not located within this catchment area.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	*Yes. The pavilion structure will be constructed within an area currently soft covered. The eastern and southern extensions will be located within areas currently hard-surfaced.*
5. As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	*Possibly. It is understood that SUDS are proposed.*
6. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than, the mean water level in any local pond or spring line?	*Possibly. A pond located in Waterlow Park known as Upper Pond is located at an elevation of between 111 m OD and 110 m OD and the proposed pavilion will have an SSL of 110.95 m OD.*

The above assessment has identified the following potential issues that need to be assessed:

Q1a The site is above a Secondary 'A' Aquifer.
Q1b The pavilion structure may extend beneath the water table.
Q2 The site is located within 100 m of a watercourse and a well is present on site.
Q4 There is likely to be an increase in hard surfaced areas.
Q5 More surface water may be discharged to the ground.
Q6 The pavilion may extend close to or lower than mean water level in the Upper Pond located in Waterlow Park.

3.3 Stability Screening Assessment

Question	Response for Channing Junior School
1. Does the existing site include slopes, natural or manmade, greater than 7°?	*Yes. The general angle of the slope is 10°.*
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	No. No re-profiling of the landscaping is proposed in the scheme.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	*Yes the site neighbours land with a general topography greater than 7°, but the site does not neighbour any cuttings.*
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	*Yes. With reference to the Arup report, the site is located in an area where slopes are more than 7° and in places greater than 10°.*
5. Is the London Clay the shallowest strata at the site?	No. The underlying soil is indicated as the Bagshot Formation
6. Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained?	*Possibly.*
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	*Possibly. Soils of the Bagshot Formation are predominantly granular soils and therefore non-shrinkable, although layers of clay may be present that may be prone to volume changes.*
8. Is the site within 100 m of a watercourse or potential spring line?	*Yes. The site is located roughly 100 m to the northeast of the headwaters of the River Fleet, which was fed by spring lines that rise in Waterlow Park. It is understood that a well is present on site but not in use.*
9. Is the site within an area of previously worked ground?	No. Historical maps do not indicate any evidence of worked ground at the site.

Question	Response for Channing Junior School
10a. Is the site within an aquifer?	*Yes. The site is located above a Secondary 'A' Aquifer as designated by the EA.*
10b. Will the proposed basement extend beneath the water table such that dewatering may be required during construction?	Possibly. Dewatering may be required during excavation of pavilion.
11. Is the site within 50 m of Hampstead Heath ponds?	No.
12. Is the site within 5 m of a highway or pedestrian right of way?	*Yes. The site is bounded by Highgate High Street.*
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	No. The pavilion structure will have foundations roughly 2 m deeper than the foundations of Fairseat House, but the structure will be detached.
14. Is the site over (or within the exclusion zone of) any tunnels, eg railway lines?	No.

The above assessment has identified the following potential issues that need to be assessed:

Q1 The site has a localised area with a slope greater than 7°
Q3 The general topography of the area is greater than 7°.
Q4 The site is located within a hillside setting with slopes greater than 7°
Q6 Trees may be felled as part of the development proposals.
Q7 The site may be affected by seasonal shrink-swell where clays are present.
Q8 The site is located within 100 m of a watercourse and a well is present on site.
Q10 The site is located directly above a Secondary 'A' Aquifer and dewatering may be required for pavilion.
Q12 The site is located within 5 m of a highway or pedestrian right of way.

3.4 Surface Flow and Flooding Screening Assessment

Question	Response for Channing Junior School
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No. Figure 14 of the Arup report confirms that the site is not located within this catchment area.
2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	No. Any additional surface water from the increase hardstanding area will be either attenuated and discharged into the Thames Water sewers or infiltrated to ensure the surface water flow regime will be unchanged. The pavilion will extend into parts of the site that are currently permeable. These parts will have less than 1 m depth of soil between the roof of the basement and ground surface despite the recommendations in para 2.16 of the CPG4. It is considered that the use of SUDS will mitigate any impact of not meeting the 1 m requirement.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	*Yes. A marginal increase will occur in the area of the pavilion, which is currently in part permeable (namely the steep bank).* *SUDS attenuation/infiltration will reduce the impact to acceptable levels.*

Question	Response for Channing Junior School
4. Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?	No. Any additional surface water from the increased hardstanding area will be either attenuated and discharged into the Thames Water sewers or infiltrated to ensure the surface water flow regime will be unchanged.
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No. The proposed basement and development is very unlikely to result in any changes to the quality of surface water being received by adjacent properties or downstream watercourses. It is proposed to allow for new SUDS measures to control how water is dealt with from additional hardstanding areas and it will be unpolluted roof water or low pollution hazard land uses draining from the site.
6. Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk of flooding, for example because the proposed basement is below the static water level or nearby surface water feature?	No. The findings of this BIA together with the Camden Flood Risk Management Strategy dated 2013, and Figures 3iii, 4e, 5a and 5b of the SFRA dated 2014, and Environment Agency online flood maps show that the site has a very low flooding risk from surface water, sewers, reservoirs (and other artificial sources) and fluvial/tidal watercourses. It is possible that the basement will be constructed within a perched water table and the recommendations outlined in the BIA with regards to water-proofing and tanking of the basement will reduce the risk to acceptable levels. In accordance with paragraph 5.11 of the CPG a positive pumped device will be installed in the basement in order to further protect the site from sewer flooding.

The above assessment has identified the following potential issues that need to be assessed:

Q3 There will be a marginal increase in the amount of hardstanding.

4.0 SCOPING AND SITE INVESTIGATION

The purpose of scoping is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified potential impact factors.

The potential impacts of the proposed development on surface flow, flooding and subterranean flow will need to be dealt with in separate assessments, such that the following section focuses on the potential impacts that may have an impact on slope stability.

4.1 Potential Impacts

The following potential impacts have been identified.

Potential Impact	Consequence
The site is underlain by a Secondary 'A' Aquifer.	The site is underlain by the Bagshot Formation, which is classified as a Secondary 'A' Aquifer. This has the potential of being able to support local water supplies as well as forming an important source of base flow for local rivers. There is the potential for the hydrogeological setting to be affected by a basement development.
The site is within 100 m of a pond and spring lines. . The lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) is close to or lower than, the mean water level in local pond or spring line and the pavilion excavation may extend beneath the water table.	The pavilion excavation may affect the groundwater flow regime. Flow from a spring if diverted or restricted could affect flow elsewhere. Changes in flow to the ponds could affect water quality.

Potential Impact	Consequence
The proposed basement development will result in a change in the proportion of hard surfaced / paved areas	The proportional increase in hardstanding could potentially reduce rates of recharge, reducing groundwater flow to a nearby watercourse. The increase could also increase rates of runoff, exacerbating flood risk.
The existing site and surrounding area includes slopes, natural or manmade, greater than 7°. The site is within a wider hillside setting in which the general slope is greater than 7°	The proposed development has the potential to alter the existing slope profile which may lead to local instabilities. Low permeability clay layers within the Bagshot Formation may lead to perched water tables which can affect slope stability.
The site is in an area that could be affected by seasonal shrink-swell where clays are present. Trees may be felled.	Where foundations are affected by tree roots and clay soils are present this could lead to damaging differential movement. Heave of any clay soils resulting in structural damage to the buildings.
Site is within 5 m of a highway or pedestrian right of way.	Excavation may result in structural damage to the road or footway.

These potential impacts have been investigated through the site investigation, as detailed in Section 10.

4.2 Exploratory Work

In order to meet the objectives described in Section 1.2 and to assess the potential impacts identified in the screening exercise of the BIA, three cable percussion boreholes were advanced to depths of 12.00 m and 17.45 m, by means of a cable percussion drilling rig. The 12 m deep boreholes were advanced in a single string of casing (150 mm diameter) and the deeper borehole was drilled with two strings of casing (200 mm and 150 mm diameter). In addition, a further four boreholes were drilled to depths of between 3.00 m and 6.00 m, using an open-drive percussive sampler (Premier rig) to provide additional coverage of the site. Standard Penetration Tests (SPTs) were carried out at regular intervals in the boreholes to provide quantitative data on the strength of soils encountered.

To provide additional coverage of the site in less accessible areas, five drive-in window sampler boreholes were advanced to depths of between 1.00 m and 3.50 m, using portable hand-held equipment.

A total of six groundwater monitoring standpipes were installed in six boreholes, with a single pipe installed to a depth of 3.00 m, two pipes to 5.00 m, two pipes to 6.00 m and a single pipe to a depth of 8.00 m. The standpipes have been monitored on a number of occasions to date, over a period of roughly three weeks.

Falling head tests were undertaken in two of the standpipes, one day after installation, to provide information on the permeability of the underlying natural soils.

Nine trial pits were manually excavated to provide information on the existing foundations of Fairseat House and the retaining wall of the terrace.

All of the above work was carried out under the supervision of a geotechnical engineer from GEA.

A selection of the samples recovered from the boreholes and trial pits was submitted to a soil mechanics laboratory for a programme of geotechnical testing and an analytical laboratory for a programme of contamination testing.

The borehole and trial pit records and results of the laboratory analyses are appended, together with a site plan indicating the exploratory positions. A topographical survey (unnamed drawing) has been provided by the consulting engineers and the ordnance datum (OD) levels for the boreholes and trial pits have been extrapolated from this drawing.

4.3 Sampling Strategy

The scope of the works was specified by the consulting engineers with input from GEA, in order to meet CPG4 requirements. The locations of the cable percussion boreholes and trial pits were specified by the consulting engineers. GEA selected the positions of the shallow boreholes and positioned all exploratory locations in accessible areas, whilst avoiding the areas of known services.

Originally, it was proposed to drill three 12 m deep boreholes and a single borehole to 25 m. However, in view of the presence of a drain run and numerous overhead cables at the front of the school, one of the 12 m deep boreholes was omitted from the scope of works.
It is understood that full-scale soakage testing is required in accordance with BRE 365 to allow for the design of permeable paving. This was not undertaken at the time of the site investigation due to the disturbance that trial pitting causes to the ground surface and was replaced by borehole soakage tests.

A total of 12 samples of made ground were subjected to analysis for a range of common industrial contaminants and contamination indicative parameters. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. The soil samples were selected to provide a general view of the chemical conditions of the soils that are likely to be involved in a human exposure. In addition, the 12 samples of made ground were screened for asbestos as a precautionary measure.

The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. Details of the MCERTs accreditation and test methods are included in the Appendix together with the analytical results.

A number of samples recovered from the boreholes and trial pits were submitted to a geotechnical laboratory for a programme of testing that included moisture content and Atterberg limit tests, Particle Size Distribution tests, undrained triaxial compression tests and soluble sulphate and pH level analysis.

5.0 GROUND CONDITIONS

On the basis of an inspection of the recovered soil, it has been interpreted that the investigation encountered a moderate to significant thickness of topsoil and or made ground, overlying the Bagshot Formation, underlain by the Claygate Member of the London Clay, proved to the maximum depth investigated, of 17.45 m (97.00 m OD).

5.1 Made Ground / Topsoil

The investigation indicated that the made ground extends to depths of between 0.32 m and 2.90 m (115.49 m OD and 110.20 m OD).

The made ground generally comprises brown clayey gravelly sand, brown silty sandy clay or dark greyish brown sandy gravel, with extraneous fragments of brick, concrete and ash.

Borehole Nos 1 and 10 were carried out within the footprint of the proposed southern extension on the playground and the made ground was found to extend to depths of 0.32 m (114.18 m OD) and 1.60 m (112.54 m OD), respectively.
Borehole Nos 5 and 8 were carried out within the footprint of the eastern extension and the made ground was found to extend to depths of 2.90 m (114.00 m OD) and 2.00 m (114.93 m OD), respectively. Borehole No 7 was carried out from the terrace in close proximity to the extension and the made ground extended to a depth of 1.50 m (115.49 m OD).

Borehole Nos 2 and 11 lie within the footprint of the pavilion and the made ground in this area extended to depths of 1.80 m (111.85 m OD) and 1.70 m (110.20 m OD).

Borehole Nos 3, 4, 9 and 12 were drilled outside the footprint of the new extension and found the made ground to extend to depths of 2.20 m (111.80 m OD), 1.20 m (113.01 m OD), 0.70 m (114.00 m OD), 1.85 m (111.45 m OD).
No visual or olfactory evidence of contamination was noted in the made ground, apart from the presence of extraneous material such as burnt coal and brick. A total of 12 samples of the made ground have tested for the presence of contamination as a precautionary measure and the results are presented in Section 5.5.

5.2 Bagshot Formation

The base of this formation is marked in the Hampstead area by a layer of coarse sand and rounded flint gravel, which was noted to be present in the deeper boreholes, so the base of the formation has been interpreted on the basis of an inspection of the recovered soil.

The Bagshot Formation was encountered to the full depth of Borehole Nos 5 and 7 to 12 and was found to extend to depths of between 3.25 m and 5.60 m (111.25 m OD and 108.40 m OD). It predominantly comprised sand with varying quantities of flint gravel, rare cobbles with rare pockets of grey clay. Towards the base of this stratum, reddish brown medium to coarse with fragments of cemented sandstone and rounded flint gravel was generally encountered; this layer was absent from Borehole No 2.

The Bagshot Formation was found to be thickest in Borehole No 3, but generally the base of this stratum was around 110 m OD, and there is a clear reduction in strength at this level.

Standard Penetration Tests (SPTs) indicate the Bagshot Formation to generally be in a medium dense state.

These soils were observed to be free of any visual or olfactory evidence of soil contamination.

5.3 Claygate Member

The Claygate Member generally comprised light brown silty fine sand, extending to depths of 11.55 m (102.10 m OD) and 12.20 m (101.80 m OD). Below this depth, stiff high strength dark grey silty clay was encountered, extending to the maximum depth investigated of 17.45 m (96.55 m OD). In Borehole No 3, dark greenish grey clay was encountered at a depth of 16.50 m (97.50 m OD).

In Borehole Nos 1, 3, 4, 6, the upper horizon of the Claygate Member comprised soft or firm brown mottled pale grey and orange-brown silty clay, which is considered to have been water softened.

SPTs indicate the fine sands of the Claygate Member to generally be in a medium dense state.

A triaxial test was undertaken on a single sample of clay of the Claygate Member and indicate an undrained shear strength of 83 kPa at a depth of 14.00 m from Borehole No 3.

Atterberg limit laboratory tests carried out on samples of the clay indicate it to be of moderate volume change potential.

These soils were observed to be free of any visual or olfactory evidence of soil contamination.

5.4 Groundwater

Groundwater was encountered during drilling in Borehole No 1 at a depth of 5.10 m and Borehole No 6 at 4.00 m. In Borehole No 3, a water strike was encountered in the Claygate Member at a depth of 15.50 m, rising to 11.00 m after 20 minutes.

Monitoring of the standpipes installed in the boreholes has been carried out on a number of occasions over a period of approximately three weeks, and the results are shown in the table below.

Date	Borehole No	Depth to water (m) [Level (m OD)]
23/10/2017	2	3.89 [109.76]
	4	4.77 [109.44]
24/10/2017	2	4.15 [109.50]
	4	4.78 [109.43]
25/10/2017	1	4.33 [110.17]
	2	4.16 [109.49]
	3	4.28 [109.72]
	4	4.77 [109.44]
	6	4.50 [109.15]
	12	DRY to 2.80 [110.50]
16/11/2017	1	4.36 [110.14]
	2	4.21 [109.44]
	3	Not monitored
	4	4.80 [109.41]
	6	Dry to 4.34 [109.31]
	12	Dry to 2.74 [110.56]

There is a groundwater table present close to the base of the Bagshot Formation.

On the basis of the levels in Borehole Nos 1, 3 and 4, groundwater is interpreted as flowing in a southwesterly direction across the site towards Waterlow Park.

5.5 Soil Contamination

The table below sets out the US95 values measured within 12 samples of made ground analysed; all concentrations are in mg/kg unless otherwise stated.

Determinant	Maximum concentration recorded (mg/kg)	Minimum concentration recorded (mg/kg)	Number of samples below detection limit	Normalised upper bound US_{95}
pH			-	-
Arsenic	48	8.2	NONE	23.47
Cadmium	<0.2	<0.2	ALL	0.2
Chromium	25	14	NONE	20.18
Lead	1200	42	NONE	466.7
Mercury	1.4	<0.3	Three	0.88
Selenium	<1.0	<1.0	ALL	1
Copper	94	15	NONE	45.09
Nickel	12	6.2	NONE	10.61
Zinc	120	21	NONE	76.1
Total Cyanide	2	<1	11	1.23
Total Phenols	<1.0	<1.0	ALL	1
Total PAH	4.06	<0.80	NINE	2.18
Sulphide	3.7	<1.0	10	1.68
Benzo(a)pyrene	0.41	<0.05	Eight	0.20
Naphthalene	0.31	<0.05	11	0.11
TPH – C8 – C10	<0.1	<0.1	ALL	0.1
TPH – C10 – C12	<2.0	<2.0	ALL	2
TPH – C12 – C16	5.3	<4.0	11	4.3
TPH – C16 – C21	27	<1.0	Seven	8.71
TPH – C21 – C35	250	<1.0	Seven	70.58
Total Organic Carbon %	3.3	0.3	NONE	1.61

5.5.1 Generic Quantitative Risk Assessment

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. Contaminants of

concern have values in excess of generic human health risk based guideline values which are either the CLEA[7] Soil Guideline Value where available, or Generic Screening Values calculated using the CLEA UK Version 1.06[8] software assuming a residential end use, with plant uptake or are based on the DEFRA Category 4 Screening values[9]. The key generic assumptions for this end use are as follows:

- that groundwater will not be a critical risk receptor;
- that the critical receptor for human health will be a young female child aged 0 to six years old;
- that young children will not have prolonged exposure to the site;
- that the exposure duration will be six years;
- that the critical exposure pathways will be direct soil and indoor dust ingestion, consumption of homegrown produce, consumption of soil adhering to homegrown produce, skin contact with soils and dust, and inhalation of dust and vapours; and
- that the building type equates to a two-storey small terraced house.

It is considered that these assumptions are acceptable for this generic assessment of this site, albeit conservative as no new pathways will be introduced.

The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

Where contaminant concentrations are measured at concentrations below the generic screening value it is considered that they pose an acceptable level of risk and thus further consideration of these contaminant concentrations is not required. However, where concentrations are measured in excess of these generic screening values there is considered to be a potential that they could pose an unacceptable risk and thus further action will be required which could include;

- additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;
- site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or
- soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

The contamination testing has revealed elevated concentrations of lead and arsenic. All of the other contaminants were found to be below their respective generic guideline values. In addition, the samples of made ground were screened for asbestos and no asbestos was

7 *Updated Technical Background to the CLEA Model (Science Report SC050021/SR3) Jan 2009* and Soil Guideline Value reports for specific contaminants; all DEFRA and Environment Agency.
8 Contaminated Land Exposure Assessment (CL|EA) Software Version 1.06 Environment Agency 2009
9 CL:AIRE (2013) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Final Project Report SP1010 and DEFRA (2014) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Policy Companion Document SP1010

detected within the sample tested. This assessment is based upon the potential for risk to human health, which at this site is considered to be the critical risk receptor.

The significance of the contamination results is considered further in Part 2 of the report.

5.6 Existing Foundations

Nine trial pits were excavated to expose the foundations of the existing building and retaining wall of the terrace.

The trial pits indicated that the southern elevation of Fairseat House is supported on three brick corbels over concrete founded at a depth of 1.35 m (113.05 m OD), which is assumed to be bearing on the Bagshot Formation, although this was not confirmed.

The eastern elevation of Fairseat House is supported on three brick corbels over concrete bearing on made ground at depths of 0.60 m (116.40 m OD) and 0.75 m (116.25 m OD). The retaining wall along the east of the terrace level is generally founded on the Bagshot Formation at depths of 0.60 m (114.10 m OD and 0.70 m (114.00 m OD) with the larger columns founded at a depth of 1.00 m (113.70 m OD).

The findings of the trial pits are summarised in the table below and trial pit records and photographs are included within the appendix.

Trial Pit No	Structure	Foundation Detail	Bearing Stratum
1	Eastern elevation of Fairseat	Three brick corbels over concrete Top: 0.16 m Base: 0.60 m Lateral projection 640 mm	MADE GROUND
1A	Northern elevation of Fairseat	Brick corbel over brick and concrete mix Top: 0.22 m Base: 0.75 m Lateral projection 500 mm	MADE GROUND
2	Retaining wall of terrace (A-A')'	Concrete Top: 0.20 m Base: 0.70 m Lateral projection 540 mm	Orange-brown gravelly SAND (Bagshot Formation)
	Column o retaining wall on terrace (B-B')	Concrete Top: 0.20 m Base: 1.00 m Lateral projection 300 mm	Orange-brown gravelly SAND (Bagshot Formation)
2A	Retaining wall of terrace	Brick over a brick and concrete mix Top: 0.20 m Base: 0.60 m Lateral projection 200 mm	MADE GROUND
3	Boiler Room (A-A')	Three brick corbels over concrete Top: 0.18 m above ground level Base: 0.20 m bgl Lateral projection 260 mm	Orange-brown gravelly SAND (Bagshot Formation)
	Boiler Room (B-B')	Three brick corbels over concrete Top: 0.17 m above ground level Base: 0.28 m bgl Lateral projection 390 mm	Orange-brown gravelly SAND (Bagshot Formation)
4	Internal column ((A-A')	Four brick corbels over concrete Top: 0.415 m Base: approximately 1.14 m Lateral projection: at least 600 mm	Not proved
	Internal column (B-B')	Four brick corbels over concrete Top: 0.40 m Base: approximately 1.14 m Lateral projection: at least 650 mm	Not proved
5	Internal classroom wall	Four brick corbels over concrete Top: 0.45 m Base: approximately 0.95 m Lateral projection: 350 mm	Orange-brown gravelly SAND (Bagshot Formation)
6	Southern elevation of Fairseat	Brick Top: not proved Base: not proved Lateral projection: Not proved	Not proved
6A	Southern elevation of Fairseat (A-A')	Three brick corbels over concrete Top: 0.45 m Base: 1.35 m Lateral projection at least 500 mm	Not proved
	Southern elevation of Fairseat (B-B')	Three brick corbels over concrete Top: 0.45 m Base: 1.35 m Lateral projection at least 500 mm	Not proved

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Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to the excavation of the subterranean structures and the potential impact on the hydrogeology.

6.0 INTRODUCTION

The proposal is to construct lower ground floor extensions along the eastern and southern elevations of the existing school building, in addition to a 3.10 m deep excavation beneath the existing playground for a new pavilion building, extending to a level of about 110.95 m OD.

To form the eastern extension, Fairseat House will be underpinned locally where no lower ground floor is currently existing. The brick retaining wall to the existing terrace will be demolished and replaced with a steel framed structure. On the northern elevation of the proposed eastern extension, a 250 mm thick concrete retaining wall will be constructed in front of the northern boundary wall on the southern side.

Proposed loadings are understood in the region of about 70 kPa and 210 kPa.

7.0 GROUND MODEL

The desk study has revealed that the site has been occupied by Fairseat House prior to 1870 which was built as a private residence until it was converted into a school in 1926. The site is not considered to have had a contaminative history. On the basis of the fieldwork, the ground conditions at this site can be characterised as follows:

- the investigation encountered a moderate to significant thickness of made ground, overlying the Bagshot Formation, which extends to about 110 m OD, underlain by the Claygate Member; initially comprised of fine sand to 102 m OD, overlying clay, proved to the maximum depth investigated of 17.45 m (97.00 m OD);
- the made ground extends to depths of between 0.32 m and 2.90 m across the site (115.49 m OD and 110.20 m OD) and comprises either brown clayey gravelly sand, brown silty sandy clay or dark greyish brown sandy gravel, with extraneous fragments of brick, concrete and ash;
- the Bagshot Formation extends to depths of between 3.25 m and 5.60 m (111.25 m OD and 108.40 m OD) and predominantly comprises fine to coarse sand with varying quantities of flint gravel;
- the Claygate Member generally comprises light brown silty fine sand, extending to depths of 11.55 m (102.10 m OD) and 12.20 m (101.80 m OD), although an upper horizon of clay was noted locally;
- at depth, the Claygate Member becomes stiff locally firm dark grey silty clay was encountered, extending to the maximum depth investigated of 17.45 m (96.55 m OD);
- groundwater was encountered during drilling at depths of 4.00 m, 5.10 m and 15.50 m;

- subsequent monitoring of the installed standpipes has measured water at depths of 3.89 m and 4.80 m (110.56 m OD and 109.15 m OD); and
- contamination testing has measured elevated concentrations of lead and arsenic in some samples of the made ground, but no asbestos fibres or asbestos containing material (ACM) were noted.

7.1 Conceptual Site Model

Sections through the proposed scheme with the above ground model are included in the appendix.

8.0 ADVICE AND RECOMMENDATIONS

The eastern and southern extensions will be located roughly 3.00 m to 3.50 m above the groundwater table and it should be possible to support these structures on the Bagshot Formation by means of strip or pad foundations.

Recent discussions with the consulting engineers have indicate that pad foundations, ranging in size from 1.5 m to 2.00 m and strip foundations between 1.20 m and 2.80 m wide are proposed.

The pavilion will involve a 3.10 m deep excavation to a level of approximately 110.95 m OD and it is currently proposed to support the building on a raft. Groundwater has been measured close to the base of the proposed excavation and it may not be possible to construct without some form of groundwater control.

It is understood that a well has been covered over in the area of the pavilion and it would be prudent to carry out additional investigation to confirm its exact location prior to construction work and plant being brought onto site. A non-intrusive method such as ground penetrating radar may be the most appropriate.

8.1 Pavilion Excavation

The proposed pavilion excavation will extend to a depth of about 3.10 m below the playground level which is roughly the same level as the existing tennis courts. Formation level is expected to be about 110.95 m OD, close to the boundary of the Bagshot Formation and Claygate Member, which has been interpreted to extend to levels of between 111.25 m OD and 108.40 m OD across the site.

Monitoring has measured groundwater at levels of 110.56 m OD and 109.15 m OD and on this basis the formation level of the pavilion will extend close to or below the groundwater table, depending on seasonal fluctuations. In Borehole No 2, located within the footprint of the proposed pavilion, groundwater has been measured at levels of 109.76 m OD and 109.44 m OD, so there may be about 1.00 m of unsaturated Bagshot Formation beneath the base. Groundwater levels are likely to be at their highest in March or April and not far off their lowest in October so groundwater levels are likely to rise, however as the site is close to a spring line it is unlikely that groundwater levels will be able to rise significantly as they will be pinned by the discharge point. It is also possible that groundwater inflows will be encountered from perched water tables trapped within sand layers between bands of clays in the Bagshot Formation.

As with any basement development it would be prudent to continue groundwater monitoring for as long as possible to determine the extent of seasonal fluctuations. The groundwater table will rise and fall seasonally. It would be prudent to confirm groundwater inflows by trial excavations to the full depth of the proposed excavation. Alternatively, trial pits could be excavated from the tennis court level, as water is expected to be present roughly 1 m below the ground surface at this level.
Consideration will need to be given to unprotected slopes in uncemented sands, which can suffer from running sands where excavations are unsupported and where water is present, including surface runoff.

There are a number of methods by which the sides of the pavilion excavation could be supported in the temporary and permanent conditions. The choice of wall may be governed to a large extent by whether it is to be incorporated into the permanent works and have a load bearing function.

To support the slope in the temporary condition until the permanent concrete retaining walls are constructed, sheet piles installed on the sides and upslope face could be adopted, which will have the added benefit of preventing groundwater inflows from perched water tables and any infiltrating precipitation. Consideration will however need to be given to noise and the impact of vibrations on Fairseat House and the Stable Block and a bored pile wall may be a more appropriate solution. A secant piled wall is likely to be required to prevent groundwater inflows.

Sandstone nodules were noted during the boreholes, but the sampling rig was able to penetrate this material and likewise sheet piles should be able to deal with this stratum without difficulty.

The construction of the eastern extension will involve excavating 3 m of soil from beneath the terrace and include the underpinning of the eastern elevation of Fairseat House. It should be possible to form the underpins using a traditional ‘hit and miss’ approach. The underpins will be constructed above the water table, but groundwater inflows could conceivably occur from perched water tables, particularly in the vicinity of existing foundations but should be adequately dealt with through sump pumping. It is important to bear in mind that this underpinning technique will require the soils being underpinned to stand unsupported, and in the Bagshot Formation at this site, difficulties may be encountered with unsupported excavations, particularly where groundwater is encountered. The contractor should therefore have a contingency in place to deal with groundwater inflows and / or instability of the granular soils.

Careful workmanship will be required to ensure that movement of the surrounding structures does not arise during underpinning of the existing foundations. The ground movements associated with the excavation of the pavilion and removal of soil beneath the terrace will depend on the method of excavation and support and the overall stiffness of the excavations in the temporary condition. Thus, a suitable amount of propping will be required to provide the necessary rigidity. In this respect the timing of the provision of support to the wall will have an important effect on movements. The stability of the nearby structures will need to be ensured at all times and the existing foundations will need to be underpinned prior to construction of the eastern extension or will need to be supported by new retaining walls.

A ground movement analysis has been completed and the findings are detailed in the appendix.

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8.1.2 Retaining Walls

The following parameters are suggested for the design of permanent retaining walls.

Stratum	Bulk Density (kg/m³)	Effective Cohesion (c′ – kN/m²)	Effective Friction Angle (Φ′ – degrees)
Made Ground	1700	Zero	20
Bagshot Formation (gravelly SAND)	1800	Zero	35
Claygate Member (silty fine SAND)	1800	Zero	32

Groundwater has been measured within the installed standpipes at levels of between 110.56 m OD and 109.15 m OD and is likely to be encountered towards the base of the approximately 3.10 m deep pavilion excavation. Monitoring should be continued to determine the extent of seasonal fluctuations and to determine an appropriate design groundwater level.

Provided that a fully effective drainage system can be ensured in order to prevent the build-up of groundwater behind the retaining walls from surface water inflows and periodic seepages within the made ground and Bagshot Formation, it should be possible to design the pavilion strucutre on the basis that water will not collect behind the walls. If an effective drainage system cannot be ensured, then a water level of two-thirds of the depth of excavation should be assumed. The advice in BS8102:2009[10] should be followed in this respect and with regard to the provision of suitable waterproofing.

8.1.3 Ground Heave

The proposed construction of the 3.00 m deep excavation will result in an approximate unloading of about 60 kN/m², which will result in an elastic heave. However, this is unlikely to be significant due to the predominantly granular nature of the material and as a result of the load applied by the new foundations. A detailed analysis of the heave movements has been completed and the findings are reported in the ground movement assessment report (J17268A, dated December 2017).

8.2 Spread Foundations

Proposed loads are anticipated to be light to moderate for the extensions and it should therefore be possible to adopt spread or pad foundations for the proposed eastern and southern extensions, provided that all new foundations bypass any made ground to found within the predominantly granular soils of the Bagshot Formation.

Made ground within the footprint of the southern extension was found to extend to a level of 112.54 m OD and a structural slab level (SSL) of 113.60 m OD is proposed. The eastern extension will have an SSL of roughly 114.35 m OD and the made ground has been found to extend to a depth of 114.00 m OD in this area.

Moderate width strip or pad foundations bearing on medium dense clayey gravelly sand of the Bagshot Formation should be placed at a minimum depth of 0.75 m. The foundations may be designed to apply a net allowable bearing pressure of 100 kN/m². Where foundations are deepened to depths greater than 2.50 m, founding on dense sand of the Bagshot Formation, an increased bearing capacity of 200 kN/m² may be adopted.

10 BS8102 (2009) *Code of practice for protection of below ground structures against water from the ground*

These values incorporate an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits. The recommended bearing pressure takes account of the variable nature of the soils and any foundations should be nominally reinforced where they span clay and granular material to protect against differential settlement.

The Bagshot Formation is unlikely to be susceptible to shrink/swell, given the predominantly granular nature of the soils encountered on site. Clay soils were generally absent in the upper 3 m, except in Borehole No 1 where a silty sandy clay was encountered from a depth of 0.60 m to 0.85 m.

It would be prudent to have all foundation excavations inspected by a suitably experienced engineer. Due allowance should be made for future growth of the trees. Medium volume change clay soils should be assumed. The requirement for compressible material alongside foundations should be determined by reference to the NHBC guidelines.

A check should be made on the potential effects of foundation loadings on slopes that are below the foundation level. As an initial check it should be ensured that when a line is drawn at an angle of 45º from the underside of the new foundation, it does not “exit” a slope face, but further analysis should ideally be carried out once proposed development details are finalised.

If for any reason spread foundations are not considered appropriate, piled foundations would provide a suitable alternative.

8.3 Raft Foundation

It is proposed that the pavilion will be supported on a raft with a formation level at about 110.95 m OD, with foundations extending into clayey gravelly sand of the Bagshot Formation.

The suitability of a raft foundation will be governed by the net loading intensity, taking into consideration the weight of soil removed by the excavation. An analysis of the likely movements should be carried out once the proposed uniform distributed load is known.

8.4 Piled Foundations

For the ground conditions at this site some form of bored pile is likely to be the most appropriate type. A conventional rotary augered pile may be appropriate but consideration will need to be given to the possible instability and water ingress in the Bagshot Formation and Claygate Member. The use of bored piles installed using continuous flight auger (cfa) techniques may therefore be the most appropriate as this would overcome the need for casing.

The following tables of ultimate coefficients may be used for the preliminary design of bored piles, based on the measured SPT and cohesion / depth graph in the appendix. The groundwater table has been assumed to be present at a level of 110.56 m OD.

Stratum	Level (m OD)	kN / m^2
Skin Friction		
Bagshot Formation (gravelly SAND) (ϕ =35)	113 to 110	20
Claygate Member (saturated) (silty fine SAND) (ϕ =32)	113 to 102	35
Claygate Member (silty sandy CLAY) α=0.45	102 to 97	Increasing from 31.5 to 45
End Bearing		
Claygate Member	100 to 97	Increasing linearly from 720 to 900

In the asbsence of pile tests, a factor of safety of 3.0 should be adopted for piles in the Bagshot Formation and Claygate Member. On the basis of the above coefficients and a factor of safety of 3.0, it has been estimated that a 450 mm diameter pile, 13 m long, extending to a level of 100 m OD would provide a safe working load in the region of 235 kN.

The above example is not intended to constitute any form of recommendation with regard to pile size or type, but merely serve to illustrate the use of the above coefficients. Specialist piling contractors should be consulted with regard to the design of an appropriate piling scheme and their attention should be drawn to potential groundwater inflows within the Bagshot Formation and Claygate Member.

Heave movements are expected to be minimal but will confirmed in the ground movement assessment.

8.5 Basement and Ground Floor Slabs

Following the removal of the made ground and a proof rolling exercise it should be possible to adopt a ground bearing floor slab bearing on the natural granular soils of the Bagshot Formation.

8.6 Shallow Excavations

On the basis of the borehole findings and trial pits, it is considered that shallow excavations for foundations and services that extend through the made ground or Bagshot Formation should remain generally stable in the short term, although some instability may occur.

However, should deeper excavations be considered such as the pavilion or if excavations are to remain open for prolonged periods it is recommended that provision be made for battered side slopes or lateral support. Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

Groundwater inflows may be encountered within made ground, particularly within the vicinity of existing foundations. Any such inflows of groundwater into excavations should be suitably controlled by sump pumping.

Towards the base of the excavation for the pavilion, groundwater may be encountered. It would be prudent to confirm groundwater inflows by trial excavations to the full depth of the proposed excavation.

8.7 Effect of Sulphates

Chemical analyses carried out on 17 samples including 12 sample of made ground and five samples of natural soils.
The results for the made ground have revealed concentrations of soluble sulphate and pH in accordance with Class DS-1 to DS-2. The measured pH value of the samples show that an ACEC class of AC-1 and AC-2.

Class DS-1 with an ACEC class of AC-1 would be appropriate for the Bagshot Formation and sand of the Claygate Member. Where concrete is required to extend into the grey silty clay of the Claygate Member Class DS-2 should be adopted within an ACEC class of DS-2. Mobile water has been assumed at this site. The guidelines contained in the above digest should be followed in the design of foundation concrete.

8.8 Surface Water Disposal

The results of the falling head permeability tests undertaken within two boreholes are presented in the table below.

Borehole No	Test No	Soakage Rate (m/s)
BH12	1	2.55×10^{-5}
	2	1.31×10^{-5}
	3	6.89×10^{-6}
BH6	1	3.14×10^{-6}

The permeability of the underlying granular soils of the Bagshot Formation has been estimated from Hazen's equation, which is based on the permeability of sand on the D10 particle size.

Borehole No.	Depth m (Level m OD)	Stratum	Estimated permeability (m/sec)
1	2.40 (112.10)	Bagshot Formation (clayey gravelly SAND)	7.34×10^{-5}
2	2.00 (111.65)	Bagshot Formation (clayey gravelly SAND)	4.36×10^{-6}
3	4.00 (110.00))	Bagshot Formation (clayey sandy GRAVEL)	3.16×10^{-5}
4	2.00 (112.21)	Bagshot Formation (clayey gravelly SAND)	3.06×10^{-5}
4	3.00 (111.21)	Bagshot Formation (clayey gravelly SAND)	5.33×10^{-5}
5	3.00 (113.90)	Bagshot Formation (clayey gravelly SAND)	1.8×10^{-5}
7	1.70 (115.29)	Bagshot Formation (clayey gravelly SAND)	2.92×10^{-5}
8	2.00 (114.93)	Bagshot Formation (clayey sandy GRAVEL)	2.2×10^{-5}
12	2.50 (110.80)	Bagshot Formation (clayey gravelly SAND)	3.3×10^{-5}

8.9 Site Specific Risk Assessment

The desk study research has indicated that the site was already developed by the existing building of Fairseat House, prior to 1870, which at that time was used as a private house. It is understood that the site has been used as a school since 1926 and is not considered to have a contaminative history.

The contamination testing has revealed elevated concentrations of lead and arsenic. This assessment has been conducted against a residential end use with plant uptake; which is considered to be conservative for this site occupied by a school.

Lead was elevated with respect to guideline values for a residential end use with plant uptake above 200 mg/kg in seven samples. Lead concentrations were below the 310 mg/kg threshold for residential with no plant uptake in four of these samples. The highest concentration of lead measured was 1200 mg/kg from Trial Pit No 1 at a depth of 0.40 m. The three significantly elevated concentrations of lead push the US95 value of lead to 466.7 mg/kg, which is elevated above acceptable levels for residential end uses. In commercial uses, lead concentrations of 2330 mg/kg are acceptable.

Arsenic was elevated in a single sample tested from Trial Pit No 1 at a depth of 0.40 m, at a concentration of 48 mg/kg, above the screening value of 37 mg/kg for residential with plant uptake and 40 mg/kg for residential with no plant uptake. The US95 value of arsenic is 23.47 mg/kg and is therefore not elevated.

The source of the metal contamination could be from fragments of metal, paint, ash and coal or airborne contaminants. It is also possible that the metal contamination is from historic use of pesticides. The arsenic and lead compounds are considered to be non-volatile or of a low volatility and of a low solubility and they do not thus present a significant vapour risk or a significant risk of leaching and migration within groundwater. These contaminants could, however, pose an unacceptable risk to human health through direct contact, accidental ingestion or inhalation of soil or soil derived dust.

Lead exceeded 310 mg/kg in Borehole No 12, Trial Pit No 1 and Trial Pit No 6 at concentrations of 360 mg/kg, 1200 mg/kg and 480 mg/kg, respectively. Arsenic was also elevated in Trial Pit No 6.

The proposed extensions will cover the positions where the elevated concentrations were recorded in Borehole No 12 and Trial Pit No 1 and 6. Direct contact with the soil will therefore be prevented to end users of the site. It is therefore considered that the critical pathways for exposure to these contaminants will not be realised following the completion of the development and thus remedial action in this area would not be required in this respect.

If consideration is to be given to growing homegrown produce on the site, it would be prudent to conduct further chemical testing in these proposed areas.

Site workers will be protected from the contamination through adherence to normal high standards of site safety.

8.9.1 Site Workers

Site workers should be made aware of the metal contamination and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE[11] and CIRIA[12] and the requirements of the Local Authority Environmental Health Officer.

11 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO

12 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association

8.10 Waste Disposal

Under the European Waste Directive, waste is classified as being either Hazardous or Non-Hazardous and landfills receiving waste are classified as accepting hazardous or non-hazardous wastes or the non-hazardous sub-category of inert waste in accordance with the Waste Directive. Waste classification is a staged process and this investigation represents the preliminary sampling exercise of that process. Once the extent and location of the waste that is to be removed has been defined, further sampling and testing may be necessary. The results from this ground investigation should be used to help define the sampling plan for such further testing, which could include WAC leaching tests where the totals analysis indicates the soil to be a hazardous waste or inert waste from a contaminated site. It should however be noted that the Environment Agency guidance WM3[13] states that landfill WAC analysis, specifically leaching test results, must not be used for waste classification purposes.

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE[14] guidance, will need to be disposed of to a licensed tip. Waste going to landfill is subject to landfill tax at either the standard rate of £86.10 per tonne (about £150 per m^3) or at the lower rate of £2.70 per tonne (roughly £5 per m^3). However, the classifications for tax purposes and disposal purposes differ and currently all made ground and topsoil is taxable at the 'standard' rate and only naturally occurring soil and stones, which are accurately described as such in terms of the 2011 Order, would qualify for the 'lower rate' of landfill tax.

Based upon on the technical guidance provided by the Environment Agency it is considered likely that the soils encountered during this ground investigation, as represented by the 12 chemical analyses carried out, would be generally classified as follows;

Soil Type	Waste Classification (Waste Code)	WAC Testing Required Prior to Landfill Disposal?	Comments
Made ground	Non-hazardous (17 05 04)	No	-
Bagshot Formation	Inert (17 05 04)	Should not be required but confirm with receiving landfill	-
Claygate Member	Inert (17 05 04)	Should not be required but confirm with receiving landfill	-

Under the requirements of the European Waste Directive all waste needs to be pre-treated prior to disposal. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper[15] which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated material may not have to be treated prior to landfilling if the soils can be segregated onsite prior to excavation by sufficiently characterising the soils insitu prior to excavation.

13 Environment Agency 2015. *Guidance on the classification and assessment of waste.* Technical Guidance WM3 First Edition
14 CL:AIRE March 2011. *The Definition of Waste: Development Industry Code of Practice* Version 2
15 Environment Agency 23 Oct 2007 *Regulatory Position Statement Treating non-hazardous waste for landfill - Enforcing the new requirement*

The above opinion with regard to the classification of the excavated soils is provided for guidance only and should be confirmed by the receiving landfill once the soils to be discarded have been identified.

The local waste regulation department of the Environment Agency (EA) should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material but may require further testing.

9.0 BASEMENT IMPACT ASSESSMENT

The screening identified a number of potential impacts. The desk study and ground investigation information has been used below to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The table below summarises the previously identified potential impacts and the additional information that is now available from the site investigation in consideration of each impact.

The current development proposal includes the construction of single storey extensions at the lower ground floor against the eastern and southern elevations of the existing school building. A pavilion is also proposed which will include an excavation beneath the existing playground to a depth of approximately 3.10 m (110.95 m OD).

The site investigation indicates that the site is underlain by a moderate to significant thickness of made ground, directly overlying the Bagshot Formation, extending to depths of between 3.25 m and 5.60 m (111.25 m OD and 104.40 m OD), in turn overlying the Claygate Member, proved to the maximum depth investigated of 17.45 m (96.55 m OD). Groundwater has been measured at levels of between 110.56 m OD and 109.15 m OD and the pavilion may extend close to or below the groundwater table.

The pavilion structure may impede groundwater inflows and the presence of groundwater inflows during excavation of the pavilion may be problematic if construction is not carefully designed.

Potential Impact	Site Investigation Conclusions
The site is underlain by a Secondary 'A' Aquifer.	Both the Bagshot Formation and Claygate Member are classified as Secondary 'A' Aquifers.
The pavilion excavation may extend below the water table	The proposed 3.10 m deep excavation for the pavilion will have a formation level within the Bagshot Formation, close to or below the groundwater table. There is the potential for the pavilion to locally affect the groundwater regime and groundwater flows will be diverted around the structure.
Increase in proportion of hard-standing and paved areas.	The proposed development for the site will marginally increase the amount of hard-standing. Consideration may need to be given to permeable paving to mitigate a potential loss of groundwater recharge.
Trees may be felled as part of the proposals.	The site is underlain predominantly by granular soils of the Bagshot Formation and removal of trees is unlikely to cause heave of such soils.
Seasonal shrink-swell.	The Bagshot Formation is unlikely to be of volume change potential given the sandy nature of the soil, confirmed by particle size distribution tests.

Potential Impact	Site Investigation Conclusions
Site is within 5 m of a highway or pedestrian right of way.	The investigation has not indicated any specific problems, such as weak or unstable ground, voids or a high water table that would make working within 5 m of public infrastructure particularly problematic at this site. The pavilion excavation is located in excess of 5 m from Highgate High Street, but the eastern extension is located within 5 m. Careful workmanship will be undertaken to ensure no movements. This will be modelled in the GMA.
Founding depths relative to neighbours.	The site is currently occupied by a detached building. Where required the foundations of Fairseat House will be underpinned to ensure its stability. The ground movement analysis and building damage assessment have indicated that the predicted damage to the adjoining and nearby structures would generally be Category 0 (Negligible), with a limited number of segments of 'Very Slight' damage. The result falls within acceptable limits.
The existing site and surrounding areas includes areas where the slopes are greater than 7°.	According to the slope angle map produced by Arup as part of the Camden geological, hydrogeological and hydrological study, the site is not located within a wider hillside setting in which the general slope is greater than 7°. The proposed basement excavation will cut into a steep bank to the north of the tennis courts. On the basis of a visual assessment of the site, no evidence of the slopes having suffered from movement was found. Further, the site sections indicate that the depth of the new pavilion structure to be constructed in the steepest slope will be such that greater stability will be provided by the permanent concrete retaining walls through the redevelopment than at present. In the temporary condition the slope will be supported with sheet piles. The proposed excavation for the pavilion is not therefore considered to be a cause for concern regarding slope stability issues.

The results of the site investigation have been used below to review the remaining potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The site is underlain by a Secondary 'A' Aquifer and the pavilion may extend below water table

The investigation has indicated that the site is directly underlain by the Bagshot Formation, with the Claygate Member present at depth. Both strata are classified as Secondary 'A' Aquifers.

Monitored groundwater levels in October and November are about 1 m beneath the proposed pavilion excavation, however early spring groundwater levels are likely to be higher. The measured groundwater table is close to the proposed excavation depth for the pavilion. There will be adequate space for water to flow around the structure, given its size relative the size of the site and the absence of neighbouring basement structures, such that there will not be an impact on any groundwater flow.

On the basis of all of the above, it is still concluded that the proposed development will not have an impact on the hydrogeological setting.

There will be an increase in the proportion of hardstanding

The proposals will increase the amount of hardstanding marginally and some mitigation measures may be required, such as permeable paving.

The site and surrounding area includes slopes of greater than 7º

The site is underlain by the Bagshot Formation, which generally comprises fine to coarse sand with gravel and rare pockets of clay, in turn overlying the Claygate Member comprised of silty fine sand and at depth clay.

The proposed eastern and southern extensions will sit on an essentially level plot. The pavilion will be located within a steep slope and the proposal will cut into the existing slope. At the time of the investigation there were no visual signs of movement of the slope.

The excavation will be within gravelly sand of the Bagshot Formation and it is proposed to install sheet piles or bored piles to support the faces of the excavation to prevent instability. The construction will therefore ensure stability of the slope in the short term and be suitably designed to retain and support the soils in the long term with permanent concrete retaining walls.

Felling of trees – heave of clay soils

The site is underlain by granular soils at shallow depth and heave of clay soils is not anticipated as they are absent.

Shrink / swell potential

Shrinkable clay of the Bagshot Formation is not present within a depth that can be affected by tree roots. There is no evidence of structural movement within the existing building.

Site within 5 m of highway

The site is located within 5 m of Highgate High Street. A retention system will need to be adopted that maintains the stability of the excavation at all times to protect the highways. This is however standard construction practice.

Differential founding depths

Fairseat House will be set back from the excavation and its stability will be ensured. The results of the ground movement assessment indicate that the damage to the adjoining and nearby structures would generally be Category 0 (Negligible). Some limited sections of Category 1 (Very Slight) damage have been identified along three walls of the existing school building, notably DL06, DL29 and DL30. However, this is only marginally above the limit for Category 0 damage of 0.05.

9.1 Non-Technical Summary

This section provides a short summary of the evidence acquired and used to form the conclusions made within the BIA.

9.1.1 Screening

The following table provides the evidence used to answer the surface water flow and flooding screening questions.

Question	Evidence
1. Is the site within the catchment of the pond chains on Hampstead Heath?	Figures 12 and 14 of the Arup report.
2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	A site walkover and existing plans of the site have confirmed the proportions of hardstanding and soft landscaping, which have been compared to the proposed drawings to determine the changes in the proportions.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	
4. Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?	As above.
5. Will the proposed basement result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses?	
6. Is the site in an area known to be at risk from surface water flooding such as South Hampstead, West Hampstead, Gospel Oak and Kings Cross, or is it at risk of flooding because the proposed basement is below the static water level of a nearby surface water feature?	Flood risk maps acquired from the Environment Agency as part of the desk study, Figure 15 of the Arup report, the Camden Flood Risk Management Strategy dated 2013 and the North London Strategic Flood Risk Assessment dated 2008.

The following table provides the evidence used to answer the subterranean (groundwater flow) screening questions.

Question	Evidence
1a. Is the site located directly above an aquifer?	Aquifer designation maps acquired from the Environment Agency as part of the desk study and Figures 3, 5 and 8 of the Arup report.
1b. Will the proposed basement extend beneath the water table surface?	Previous nearby GEA investigations.
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	Historical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	Figures 12 and 14 of the Arup report.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	A site walkover and existing plans of the site have confirmed the proportions of hardstanding and soft landscaping, which have been compared to the proposed drawings to determine the changes in the proportions.
5. As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	The details of the proposed development do indicate the use of soakaway drainage.
6. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than, the mean water level in any local pond or spring line?	Topographical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report.

The following table provides the evidence used to answer the stability screening questions.

Question	Evidence
1. Does the existing site include slopes, natural or manmade, greater than 7°?	Site survey drawing and Figures 16 and 17 of the Arup report and confirmed during a site walkover.
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	The details of the proposed development provided do not include the re-profiling of the site to create new slopes at the property boundary.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	Topographical maps and Figures 16 and 17 of the Arup report and confirmed during a site walkover
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	
5. Is the London Clay the shallowest strata at the site?	Geological maps and Figures 3, 5 and 8 of the Arup report
6. Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained?	A site walkover confirmed that there are trees on site. An arboriculturist should be consulted if any trees are to be removed from the site.
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	Knowledge on the ground conditions of the area was used to make an assessment of this.
8. Is the site within 100 m of a watercourse or potential spring line?	Topographical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report
9. Is the site within an area of previously worked ground?	Geological maps and Figures 3, 5 and 8 of the Arup report
10. Is the site within an aquifer?	Aquifer designation maps acquired from the Environment Agency as part of the desk study and Figures 3, 5 and 8 of the Arup report.
11. Is the site within 50 m of Hampstead Heath ponds?	Topographical maps acquired as part of the desk study and Figures 12 and 14 of the Arup report.
12. Is the site within 5 m of a highway or pedestrian right of way?	Site plans and the site walkover.
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Site walkover confirmed the position of the proposed basement relative to nearby structures.
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	Maps and plans of infrastructure tunnels were reviewed.

9.1.2 Scoping and Site Investigation

The questions in the screening stage that required further assessment, were taken forward to a scoping stage and the potential impacts discussed in Section 4.0 of this report, with reference to the possible impacts outlined in the Arup report.

A ground investigation was carried out, which has allowed an assessment of the potential impacts of the basement development on the various receptors identified from the screening and scoping stages. Principally the investigation aimed to establish the ground conditions, including the groundwater level, the engineering properties of the underlying soils to enable suitable design of the basement development and the configuration of existing party wall foundations. The findings of the investigation are discussed in Section 5.0 of this report and summarised in both Section 7.0 and the Executive Summary.

9.1.3 Impact Assessment

Section 9.0 of this report summarises whether or not, on the basis of the findings of the investigation, the potential impacts still need to be given consideration and identifies ongoing risks that will require suitable engineering mitigation. Section 8.0 of this report also provides recommendations for the design of the proposed development.

A Ground Movement Analysis and building damage assessment has been completed and reported. Please refer to report J17268A, dated December 2017 for the full findings, which is included in the appendix.

10.0 OUTSTANDING RISKS AND ISSUES

This section of the report aims to highlight areas where further work is required as a result of limitations on the scope of this investigation, or where issues have been identified by this investigation that warrant further consideration. The scope of risks and issues discussed in this section is by no means exhaustive, but covers the main areas where additional work is considered to be required.

The ground is a heterogeneous natural material and variations will inevitably arise between the locations at which it is investigated. This report provides an assessment of the ground conditions based on the discrete points at which the ground was sampled, but the ground conditions should be subject to review as the work proceeds to ensure that any variations from the Ground Model are properly assessed by a suitably qualified person.

Careful consideration will need to be given to the construction of the pavilion with regards to groundwater inflows and slope stability.

Further groundwater monitoring should be carried out to confirm longer term groundwater levels and seasonal fluctuations. It would be prudent to carry out trial excavations to determine groundwater inflows at formation level of the pavilion.

If during ground works any visual or olfactory evidence of contamination is identified further investigation should be carried out and the risk assessment reviewed.

These items should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.

APPENDIX

GEA

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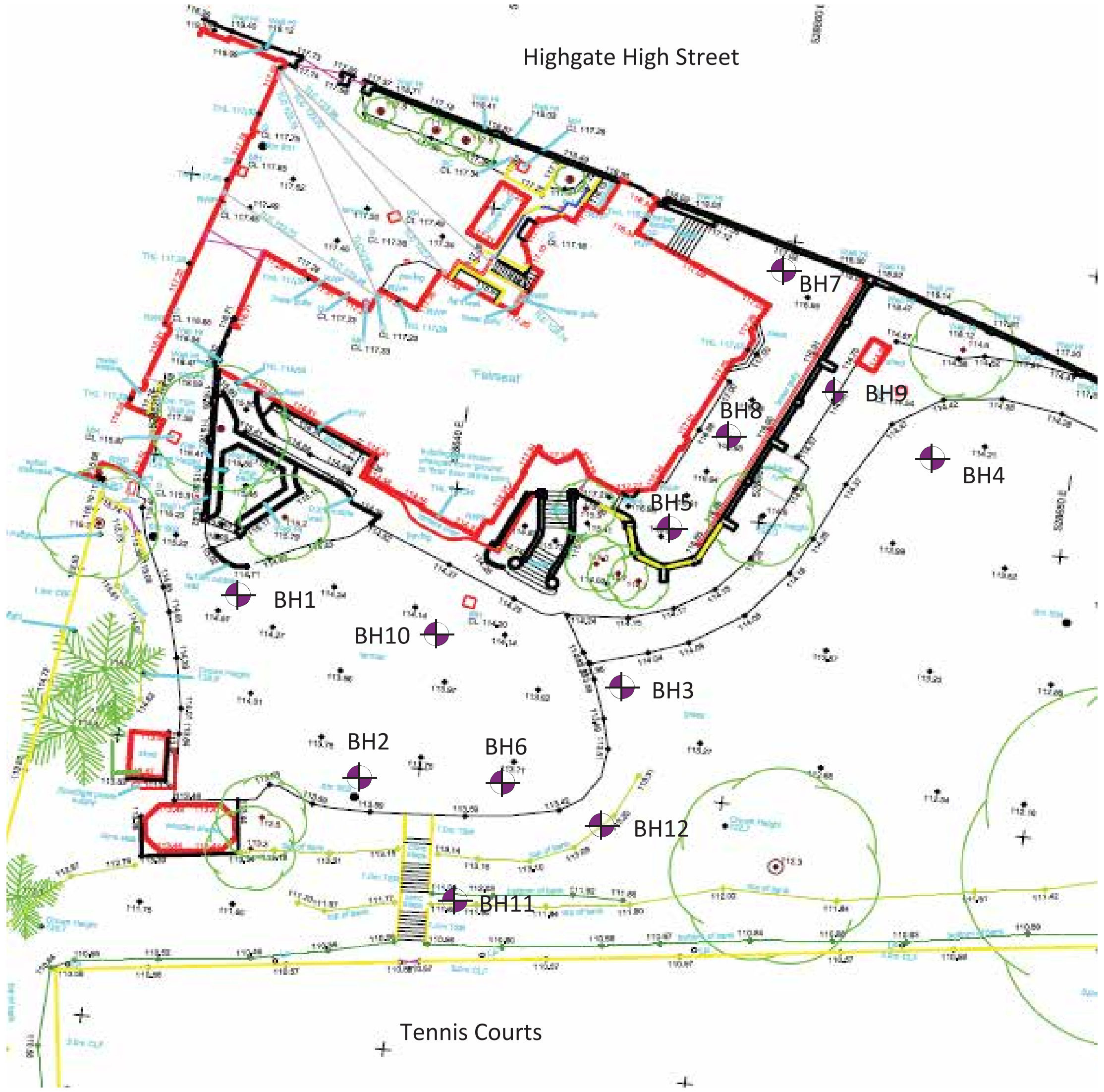
Herts | 01727 824666 Notts | 01509 674888

Site Plan

Site	Channing Junior School, Highgate High Street, N6 5JR	**Job Number**	J17268
Client	Channing Junior School	**Sheet**	3/3
Engineer	Heyne Tillett Steel		

BOREHOLE LOCATIONS



GEA

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Herts | 01727 824666 Notts | 01509 674888

Site Plan

Site	Channing Junior School, Highgate High Street, N6 5JR	**Job Number**	J17268
Client	Channing Junior School	**Sheet**	1/3
Engineer	Heyne Tillett Steel		

Highgate High Street

EXISTING LOWER GROUND FLOOR
TRIAL PIT LOCATIONS