STRUCTURAL DESIGN & CONSTRUCTION STATEMENT FOR

26 NETHERHALL GARDENS, NW3

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REVISIONS

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-	23.07.14	Issued for planning.
A	15.01.16	Response to BIA Audit by Campbell Reith
B	17.01.17	Text amendments

CONTENTS

1. INTRODUCTION

The following Structural Design & Construction Statement has been prepared as part of the wider Basement Impact Assessment (BIA) undertaken for the planning application, submitted by Squire and Partners, for the proposed residential redevelopment at 26 Netherhall Gardens, London, NW3 5TL.

The purpose of this report is to describe the existing site and ground conditions, to present the structural scheme to be adopted for the proposed development, and to describe the proposed construction methodology for the execution of the works. The report and information contained within has been prepared for planning purposes only.

This report should be read with Sinclair Johnston & Partners Basement Impact Assessment (BIA) report and all other Consultant's reports produced for the planning application.

The report has been prepared by Mr Thomas Musson BEng CEng MIStructE; Technical Director at Sinclair Johnston & Partners.

2. EXISTING SITE

The site address is 26 Netherhall Gardens, London, NW3 5TL and is located at approximate National Grid reference 550453 178948.

The site is located within the London Borough of Camden within the Frognal & Fitzjohns ward. See Figure 1.

The property is not listed but lies within the Netherhall and Fitzjohns Conservation area.

The site comprises:

- A three storey detached property (26 Netherhall Gardens) arranged over lower ground floor, raised ground floor, first floor and attic storey.
- The property has been converted into flats at some point in the past and a modern garage with extension over built to the right of the property.
- The local area is on a hillside setting sloping down in a generally east-west direction toward Finchley Road. Figure 3.
- The lower ground floor is raised some 1.0m to 1.5m from general street level with the ground floor level being some 3.5m to 4.0m above general street level.
- The property has a raised front garden with steps up to the ground floor entrance and a modern hard standing front drive to the left of the property giving level access to Netherhall Gardens.
- The rear garden gently slopes up from a rear light well to the rear boundary.
- The site is bounded to the left by 28 Netherhall Gardens, to the right by 24A & 24 Netherhall Gardens, to the rear by single storey outbuildings understood to belong to 47 Maresfield Gardens and to the front by Netherhall Gardens.
- Access onto site is directly off Netherhall Gardens.
- There are several mature trees within the rear and front gardens.
- As identified in the Camden Flood Risk Management Strategy the site is not in area at risk of flooding from rivers or the sea. Nor is it in an area that has historically been at risk from surface runoff, groundwater and sewer flooding.

The existing property is believed to have been constructed around 1879 to 1888. A modern garage and extension was added in the late 1950's.

The property is of 'traditional' construction comprising masonry external walls with internal timber and masonry partitions. Floors are of timber construction. This description is provided from a non-intrusive visual inspection without recourse to opening up works or other investigations. No assurances are given that areas that are inaccessible or covered are free from defect.

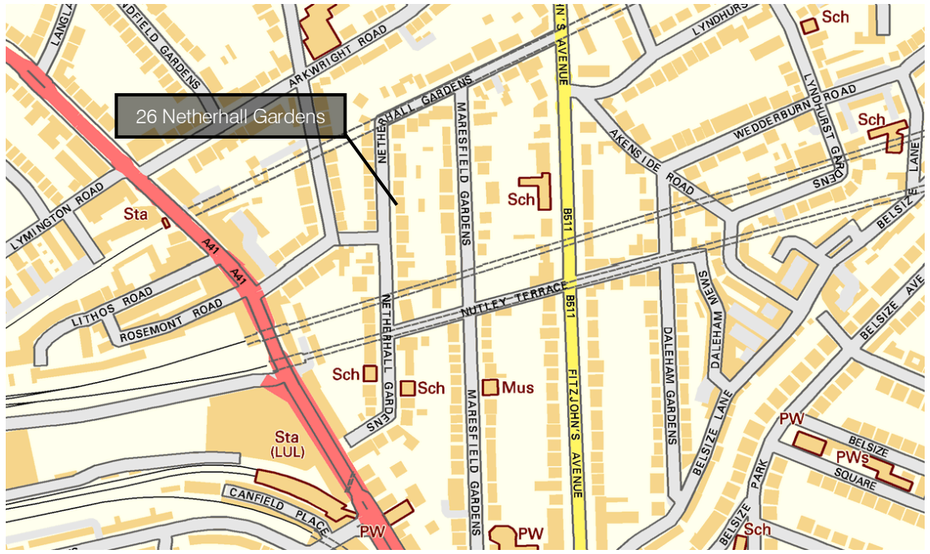

Figure 1. Site Location Map

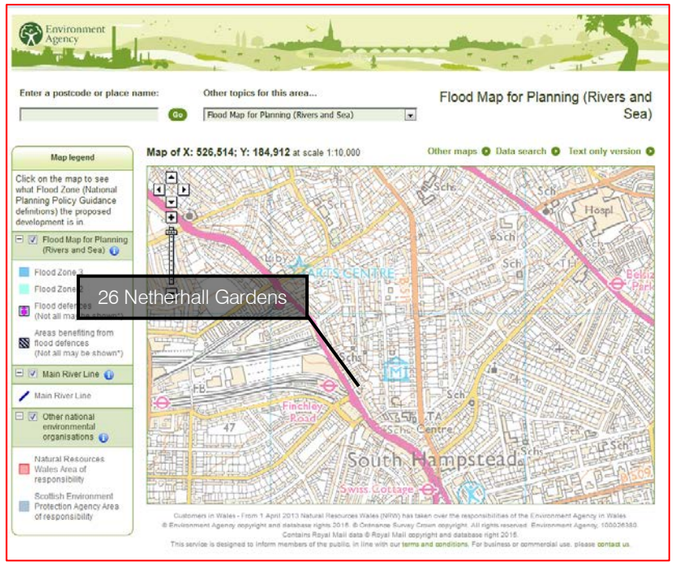

Figure 1A. Site Location Map (Extract from Environment Agency website; site is not in a Flood Risk Area)

Table 1 – Summary of the geological strata in the London Basin [1]

Geological period	Group	Formations	Typical thickness (m)
QUATERNARY		Alluvium River Terrace Deposits Glacial Deposits	Variable
PALAOGENE	THAMES	BAGSHOT FORMATION: sand, fine-grained with thin clay beds	10-25
		CLAYGATE MEMBER: clayey silt, sandy silt, silty sand LONDON CLAY FORMATION: clay	90 - 130
		HARWICH FORMATION: sand, clayey fine grained sand and pebble beds	0-10
	LAMBETH	READING, WOOLWICH & UPNOR formations: clay mottled with fine grained sand, laminated clay, flint pebble beds and shelly clay	10-20
		THANET SAND FORMATION: fine grained sand	0-30
CRETA-CEOUS	CHALK	Upper, Middle and Lower Chalk, each sub-divided into different formations	180-245

Figure 1B. Extract from Camden GHHS; The site ground conditions encountered are consistent with the above (founded in Clay which extends to significant depth)

Table 2 EA aquifer designation of outcropping strata within LB Camden

Strata	Superficial / bedrock	EA aquifer designation
River Terrace Deposits	Superficial	Secondary A
Bagshot Formation	Bedrock	Secondary A
Claygate Member		Secondary A
London Clay Formation		Unproductive Strata

Figure 1C. Extract from Camden GHHS; The site overlies London Clay (unproductive strata)

Figure 2. Aerial View of Site looking North

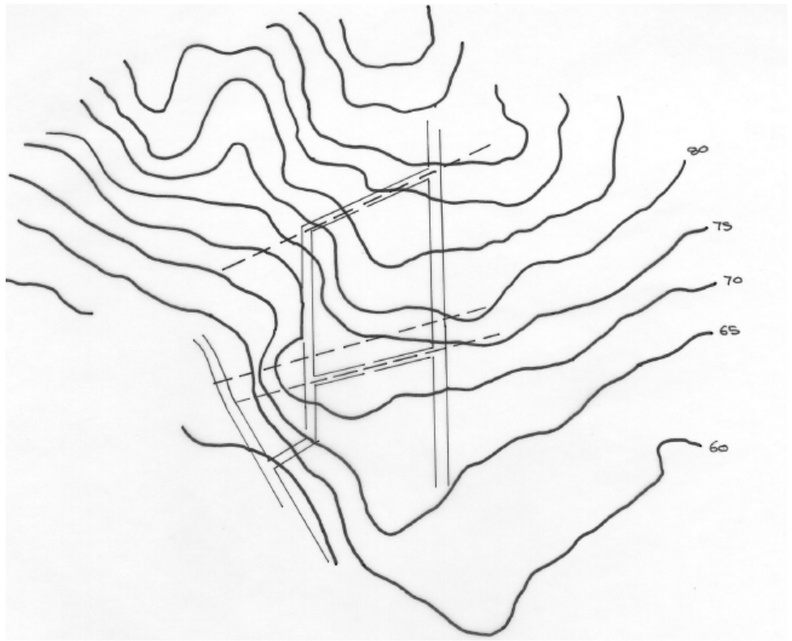

Figure 3 – Approximate Ground Contours

Photo 1: Front Elevation

Photo 2: No. 24A & 24 Netherhall Gardens

Photo 3: No 28 Netherhall Gardens

Photo 4: View down Netherhall Gardens

Photo 5: Rear Garden

Photo 6: Rear Garden Right Hand Side

3. SITE GROUND CONDITIONS

The following is a brief description of the site ground conditions. Reference should be made to Site Analytical Services 'Phase 1 Preliminary Risk Assessment' (Ref. 14/22068-1) and 'Report on a Ground Investigation' (Ref. 14/22068) for detailed information.

In summary the site ground profile comprises:

Ground	Depth below ground level (m)	Thickness (m)	Notes
Made Ground	0	0.3 - 06	
London Clay	0.3 – 0.6	To depth	Clay was encountered to full depth of investigation (20m bgl)

Figure 4 – Summary of Ground Conditions

Ground water was monitored at approximately 1.14m and 1.88m below existing ground level and is likely to be due to minor seepages within permeable Silty lens within the Clay.

The site is classified by the Environment Agency as 'non-productive' strata.

The local area is a hill side setting with the hill running south west down toward Finchley Road.

There are several Network Rail train tunnels, the Belsize Old and New tunnels some 100m to the north and 100m to the south of the site. These tunnels run approximately North-east to South-west. These tunnels are not significant in respect to the proposed development. Please see map opposite showing the locations of these tunnels:

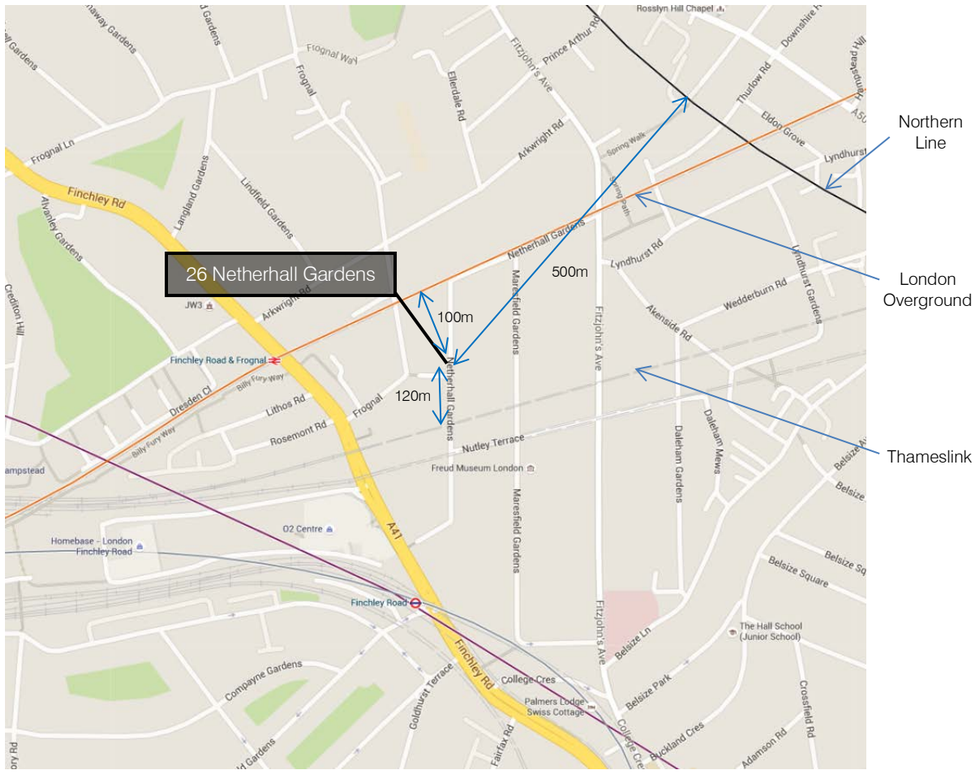

Figure 4C – Map of Nearby Below Ground Tunnels

4. PROPOSED DEVELOPMENT

The description of the proposed development given below is provided to give context to the following sections of the report. For a detailed description of the various disciplines proposals reference should be made to the various reports submitted with the planning application.

The proposed development comprises:

- Demolition of the existing property.
- Construction of a new three storey above ground apartment block arranged over ground, first and second floors and attic storey.
- Construction of a single storey habitable basement with sub-basement plant room below.
- Re-profiling of the front and rear gardens including the removal of several trees.

5. STRUCTURAL PROPOSALS

5.1 DESCRIPTION OF PROPOSED STRUCTURE

Drawings describing the structural proposals are provided in Appendix A.

The structural works can be divided into substructure (structure below ground) and superstructure (structure above ground).

The substructure comprises:

- Secant (hard / firm) bored piled retaining walls to the perimeter of the basement providing temporary and permanent earth support.
- Contiguous bored piled retaining walls internally to form the sub-basement providing temporary and permanent earth support.
- A reinforced concrete box structure inboard of, but acting integral with, the bored piled walls to providing the permanent earth support.
- Reinforced concrete retaining walls are to be adopted along the site boundaries to deal with varying levels between adjacent properties.

The superstructure scheme is to be developed further during detailed design but is to comprise either a reinforced concrete framed structure or load bearing masonry building with precast concrete floors. The roof is to be steel framed with timber infill.

5.2 STRUCTURAL STABILITY

Secant piled retaining walls are proposed to the basement perimeter walls. The final design for the embedded retaining structure is to be undertaken by a Specialist Piling Contractor sub-contracted to the Main Contractor. At the pre-planning stage the Main Contractor and their appointed sub-contractors are not appointed. Therefore, preliminary piling designs have been investigated at the planning stage using previous experience and generally the approach set out in CIRIA C580. The form of retaining wall proposed has been successfully used on many similar basement projects and the performance characteristics of such walls in London Clay are well documented and understood.

All retaining structures are to be designed to support the lateral pressures resulting from earth, surcharge and transient hydrostatic loads. Pressures are to be calculated using the geotechnical parameters set out in Site Analytical Services' site investigation report. A design ground water level of -1.0m below the retained earth level is to be adopted for the design of all retaining structures. A minimum surcharge pressure of 10kN/m^2 is to be adopted over and above any adjacent foundation surcharge loads.

The embedded retaining walls are to be propped in the temporary and permanent cases. Temporary propping is to take the form of hydraulic struts such as Groundforce Shorco 250T Hydraulic Struts. Permanent propping is provided by the reinforced concrete ground bearing basement slabs and reinforced concrete suspended floor slabs.

Due to the topography of the site the proposed basement has varying retaining wall heights, summarised as follows:

Location	Retained Ground Level (m)	Lowest Basement Level (m)	Retained Height (m)	Permanent Prop Levels (m)
Front (single storey basement)	+72.62	+69.42	3.20	+72.62 (Ground floor slab) +69.42 (Basement slab)
Front (double basement)	+72.62	+66.22	6.40	+72.62 (Ground floor slab) +66.22 (Basement slab)
Rear (single storey basement)	+78.15	+69.42	8.73	+76.62 (Garden slab) +74.15 (Intermediate slab) +69.42 (basement slab)
Rear (double basement)	+76.62	+66.22	10.40	+76.62 (Capping beam) +72.62 (Ground floor slab) +69.42 (basement slab) +66.22 (sub-basement slab)

Figure 5 – Summary of Retaining Heights

The retaining walls to the sides of the proposed basement are to step along their lengths to accommodate the site slope.

The global 'out of balance' forces resulting from the varying retaining heights are to be resisted by the passive earth pressures acting on the opposite basement faces.

The ground investigation found ground water at 1.14m and 1.88m below the existing ground level. These readings are likely due to minor seepages of ground water within permeable Silty lens present within the Clay. A secant piled wall provides a high degree of resistance to any potential inflows of ground water during construction. This will allow the Contractor to construct the basement in a relatively 'dry' environment without the need for significant de-watering.

The excavation required to form the basement results in the removal of the original over-burden pressure. This results in the bottom of the excavation rising a phenomenon commonly known as 'heave'. Initially this heave is unrestrained as the

site is an open excavation. During construction of the new building the weight of the new structure resists any on-going heave.

5.3 PREDICTED STRUCTURAL DAMAGE TO NEIGHBOURING PROPERTY

An initial prediction of structural damage to neighbouring properties has been undertaken in general accordance with CIRIA publication C580. Calculations are provided in Appendix B.

CIRIA C580 provides guidance on possible ground movements due to excavation and construction of embedded retaining walls within clay ground. The use of the procedures and guidance set out in CIRIA C580 is therefore considered to be highly applicable in this instance.

A more detailed ground movement analysis using industry standard software, such as OASYS X-Disp and P-Disp, will be undertaken during the detailed design stage.

5.3.1 DESCRIPTION OF NEIGHBOURING PROPERTIES

24 & 28 Netherhall Gardens are similar in size, scale and form as 26 Netherhall Gardens. The properties appear to have been constructed around the same time and are of load bearing masonry construction most likely with timber floors. No. 24A Netherhall Gardens appears to be a modern addition to No. 24 but again also appears to be of load bearing masonry construction. For the purposes of the category of damage prediction No. 24 & 24A are considered to be a single structure.

A visual inspection of No's 24, 24A and 28, undertaken from street level, did not identify any apparent defects or evidence of historic movement. Post-planning, as part of the party wall process, a more detailed structural inspection of the adjacent properties including internal inspections will be undertaken prior to completing the detailed ground movement analysis.

5.3.2 CATEGORY OF DAMAGE (BURLAND et al.)

The category of damage to 24A, 24 & 28 Netherhall Gardens, as classified under Burland et al, anticipated from the proposed construction of the new basement is expected to be no worse than category 2 slight.

The Contractor will be required to monitor ground movements during the works to check the validity of the ground movement analysis and the performance of the temporary works and working methods. A 'traffic light' system of green, amber, red trigger values will be set with specific Contractor actions set against each trigger values.

Traffic Light	Trigger Value (mm)	Contractor Action
Green	<10	No action required.
Amber	10-15	Notify the CA and Party Wall Surveyor(s). Increase frequency of monitoring. Implement contingency measures if movement continues.
Red	>15	Notify the CA and the Party Wall Surveyor(s). Implement measures to cease movement and stop work.

Figure 6. Indicative Ground Movement Trigger Values

The monitoring method is to be developed further during detailed design but may take the form of precise levelling, geospatial surveying, inclinometers, tiltmeters or electrolevel beams, or extensometer's or a combination of these methods. The monitoring will be undertaken prior to installation of the piled walls and continue through to completion of the basement structure.

It is envisaged that the movement monitoring will take the form of pairs of targets placed on the external walls of nearby buildings (at 1m above ground level and close 1m below roof eaves level), spaced 3m apart along the length of the wall. These will be monitored on a weekly basis, against the trigger values noted above.

5.4 SUSTAINABLE DRAINAGE SYSTEMS

The proposals comprise the re-profiling of the existing front and rear gardens resulting in the following changes to total area of soft landscaping present on site:

Existing soft landscaping: 390m^2 (approximately)

Proposed soft landscaping: 160m^2 (approximately)

The proposals therefore result in an increase in the total amount of hard-standing on site with an associated increased volume of surface water runoff. To offset this increase sustainable drainage systems (SuD's) should be adopted in the final detailed proposals.

The overall drainage system is to be designed and detailed by the appointed drainage designer. At the pre-planning stage this Designer is not appointed. Therefore, for the purposes of this planning stage report a high level review of the various different SUD's technologies has been undertaken and the potential for adoption discussed.

SuD Technology	Potential for Adoption
Living Roofs (Green Roofs)	Given the pitched roof and surrounding architectural environment living roofs would appear not to be feasible.
Recycling / rain water harvesting	Tanks and associated plant for rain water harvesting and reuse could be located within the sub-basement plant room. Rain water harvesting would appear feasible.
Permeable paving and hard standing systems and soakaway systems	Given the clay ground permeable surfacing using 'soak-a-aways' would appear not to be feasible.
On / off line storage	Storage of runoff may be feasible but requires further investigation to ascertain storage volume requirements.
Swales and infiltration basins	Given the site constraints swales and infiltration basins would not appear feasible.
Bioretention and biofiltration	Given the site constraints swales and infiltration basins would not appear feasible.
Permeable conveyance systems	Given the site constraints swales and infiltration basins would not appear feasible.

Figure 7 – Potential SuD's

From the above, it is envisaged that the most appropriate form of SUDs techniques to be adopted will be a combination of rainwater harvesting tanks and storage of rainwater run-off in attenuation tanks on site.

6. PARTY WALL MATTERS

The works comprise the excavation for a new basement adjacent to the site boundaries and within close proximity to 24A and 28 Netherhall Gardens and the single storey outbuildings to the rear of the site. Full procedures under The Party Wall etc Act 1996 are therefore required.

The structural scheme adopted has been designed with due regard to maintaining the structural stability and integrity of neighbouring buildings & structures and surrounding land. The structural form of the basement and the method of construction have been developed to ensure that lateral deflections, and associated ground movements, are kept within acceptable limits. An initial assessment of the predicted ground surface movements using the approach set out in CIRIA C850 has indicated that the predicted category of damage to adjacent properties would be no worse than category 1 – very slight.

7. CONSTRUCTION METHODOLOGY

7.1 CONSTRUCTION SEQUENCE.

The proposed sequence of works given below has been assumed for the purposes of undertaking the planning stage structural design of the building and is provided to demonstrate that the works can be executed with due regard to the local amenity.

Proposed Sequence of Works

a) Soft strip to be undertaken including removal of landscaping.

b) Scaffolding and protective hoarding to be erected around the property.

c) Demolish existing property using hand techniques and small items of plant. Existing ground bearing slab to be retained across the site. Construction vehicles to park on-site in front drive.

d) Install movement monitoring equipment to adjacent structures and base line readings to be taken. Regular monitoring to be undertaken throughout the works.

e) Site to be cleared and piling platform installed.

f) Secant piled walls to be installed using bored piling methods. Firm piles (weak concrete say 10N/mm^2) installed first. Hard piles (reinforced concrete say 35N/mm^2) installed second.

g) Once piling is installed insitu reinforced concrete boundary retaining walls to be constructed. Temporary trench sheets installed to retain the earth locally in the temporary case and allow the walls to be formed.

h) Capping beams to piled walls to be constructed. Monitoring equipment to capping beams to be installed and base line readings taken. Regular monitoring to be undertaken throughout the works.

j) Reduce rear garden level to approximately +76.10m and install lateral propping at +76.35m.

k) Continue excavation down to +72.10m and install lateral propping at +72.35m.

l) Continue excavation down to +68.92m and construct -01 basement slabs and reinforced concrete walls.

m) Excavate below -01 slab to form the -02 basement in a top down manner.

n) Install raking props to -01 basement level to prop top of basement walls. Once installed removed lateral propping at +72.35m.

p) Construct ground floor reinforced concrete slab. Once slab has achieved its specified 28 day strength raking props are to be removed.

q) Cast remaining reinforced concrete walls. The basement is then complete.

7.2 CONSTRUCTION GENERALLY

The works are required to be undertaken in accordance with all statutory legislation relating to construction works.

The Contractor will be required to demonstrate a positive attitude and commitment toward minimising environmental disturbance to local residents and will be required to be registered with the Considerate Contractors Scheme.

Noise, dust and vibration will be controlled by employing Best Practicable Means (BPM) as prescribed in the following legislative documents and the approved code of practice BS 5228:

The Control of Pollution Act 1972
The Health & Safety at Work Act 1974
The Environmental Protection Act 1990
Construction (Design and Management) Regulations 1994
The Clean Air Act 1993

General measures to be adopted by the Contractor to reduce noise, dust and vibration include:

- Erection of site hoarding to act as minor acoustic screen.
- Use of super silenced plant where feasible.
- Use of well-maintained modern plant.
- Site operatives to be well trained to ensure that noise minimisation and BPM's are implemented.
- Effective noise and vibration monitoring to be implemented.
- Reducing the need to adopt percussive and vibrating machinery.
- Bored piling techniques to be adopted to reduce piling induced vibration.
- Piles to be broken down using non-percussive techniques.
- Vehicles not to be left idling.
- Vehicles to be washed and cleaned effectively before leaving site.
- All loads entering and leaving the site to be covered.
- Measures to be adopted to prevent site runoff of water or mud.
- Water to be used as a dust suppressant.
- Cutting equipment to use water as suppressant or suitable local exhaust ventilation system.
- Skips to be covered.
- Drop heights to be minimised during deconstruction.
- Use of agreed wet cleaning methods or mechanical road sweepers on all roads around site.
- Set up and monitor effective site monitoring of dust emissions.

- Working hours to be restricted as required by the Local Auhtority.

7.3 DEMOLITION

The proposals comprise the demolition of the existing building. The demolition works will be required to undertaken in accordance with the legislative documents stated in section 7.2 and, as stated in Camden

Planning Guidance CPG4 Section 2.83, Contractors are to adopt the practices outlined within the ICE Demolition Protocol in order to mitigate the impact of the works.

Where practical demolition material should be taken to recycling plants.

7.4 CONSTRUCTION

The Contractor will be required to be registered with the Considerate Contractor scheme.

The Piling Contractor is to be a registered member of the Federation of Piling Specialists.

Impacts on the local amenity will be strictly controlled and managed by the Contractor.

Working hours will be restricted as required by the Local Authority.

The Contractor will be required to provide a Construction Management Plan prior to undertaking the works. The contents of this plan must be agreed with the Local Authority and complied with unless otherwise agreed with the Council.

The Contractor will be required to provide a Site Waste Management Plan describing how site waste is to be minimised and dealt with.

Ground water is well below the proposed basement formation level. Therefore, ground water will not be significant during execution.

7.5 TEMPORARY WORKS

The Contractor will be required to appoint a Temporary Works Co-ordinator to advise, design, co-ordinate and oversee all temporary works aspects. All temporary works are to be in accordance with BS 5975 'Code of practice for temporary works procedures and the permissible stress design of falsework'.

The planning stage structural design has highlighted the following specific temporary works that will need to be further developed during detailed design and construction:

- Temporary lateral propping to the secant piled walls. This propping is required to prevent significant lateral movement of the secant walls. The propping is to be kept in place until the permanent propping (reinforced concrete slabs) are constructed. Due to the estimated prop forces and the relatively long prop spans hydraulic struts such as Groundforce Shorco 250T.

7.6 CONSTRUCTION TRAFFIC MANAGEMENT

The Contractor will be required to develop a Construction Traffic Management Plan for submission and agreement with the Local Authority. This Traffic Management Plan is to be in accordance with Camden Planning Guidance 6 Section 8.

Refer to planning stage Construction Traffic Management Plan submitted with the planning application for further details.

8. CONCLUSIONS

The structural proposals and construction methodology for the redevelopment at 26 Netherhall Gardens have been developed with due regard to the existing site constraints, the site specific and local ground conditions, the local amenity and the local highways.

The ground conditions are well understood and have been investigated by Site Analytical Service Limited and are described within their 'Phase 1 Preliminary Risk Assessment' (Ref. 14/22068-1) and 'Report on a Ground Investigation' (Ref. 14/22068).

Ground water was monitored at 1.14m and 1.88m below ground level. A secant piled wall to provide a relatively water tight construction in the temporary case is proposed. Significant dewatering of the site is therefore not likely to be required.

The structure has been designed to maintain the stability and integrity of the surrounding land and neighbouring buildings, structures and below ground services.

The basement is to be formed using secant (hard / firm) piled wall with a reinforced concrete 'box' inboard but integral with the piled walls. The piled walls are to be propped in the temporary and permanent cases by hydraulic struts and the permanent reinforced concrete slabs respectively. This form of construction has been successfully used on many similar basement projects and the performance characteristics of such walls in London Clay are well documented and understood.

Anticipated ground movements associated with the works can be limited to acceptable values by a combination of the proposed structure and suitably designed temporary works. The predicted category of damage to the adjacent buildings has been estimated to be no worse than category 2 – slight as defined by Burland et al.

This report demonstrates that by adopting good construction practices the works can be executed in a safe manner while minimising the impact on the local amenity.

The use of onsite vehicle parking is to be maximised to ensure that vehicles do not block Netherhall Gardens.

APPENDIX A – STRUCTURAL DRAWINGS

APPENDIX B – STRUCTURAL CALCULATIONS FOR PLANNING