

Geotechnical Assessment

in connection with proposed redevelopment at

55 Fitzroy Park

Camden

N6 6JA

for

The Turner Stokes Family
and the Springer Family

LBH4480 Ver. 2.0

July 2018



LBH WEMBLEY

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Executive Summary

It is proposed to redevelop this property through removal of the existing large residential building and replacement of this by five separate smaller homes. These will each be set back into the natural hillside so that the lowest floor of each property will be regarded as a basement for the purposes of Camden planning policy.

This report provides an assessment of the potential impacts that these proposed subterranean elements of the development may have upon the surrounding area, neighbouring structures and the local environment.

The ground conditions at the site comprise a variable thickness of made ground infilling a shallow valley feature, overlying residual superficial deposits that are underlain by the uppermost beds of the London Clay Formation.

Neighbouring houses have been found to be sufficiently far away from the proposed development works for any ground movement influences induced by excavation for the proposed subterranean elements to be negligible.

The relevant hydrogeological and hydrological impacts of the proposed development have been considered in a separate report.

Potential Hydrogeological Impacts

The BIA screening identified the following potential groundwater issues:

- Groundwater flow to the Highgate ponds could decrease if this was to be obstructed by the proposed development.

The following mitigation measures are proposed:

- In-ground drainage will be introduced to direct flow around the subterranean parts of the structures so that the new development does not form any barrier to groundwater flow.

Hydrological Impacts

The BIA screening has identified the following potential surface water issues:

- The development could alter the way in which surface water is transmitted from the site, resulting in changes to recharge of the Heath Nature Reserve and the Highgate Ponds
- Potential pollution of the surface water run-off may affect ecosystems or reduce amenity
- Surface water flood risk

The following mitigation measures are proposed:

- The proposed drainage system will preserve and enhance the existing surface water drainage routes controlling the discharge of water to the Heath by the weir in exactly the same manner as at present.
- Only assuredly clean surface water will be directed towards the pond drainage system. All road run-off will in future be diverted via interceptors to the combined sewer.
- The surface water flood risk is to be mitigated by landscaping around the pond and additional measures to ensure efficient drainage from the lower-lying courtyards of Plots 4 and 5 during any flood event.

Stability Impacts

The BIA screening has identified the following potential stability Issues:

- Excavations near the site borders could threaten the stability of the adjacent roads, buried services and neighbouring buildings

The following mitigation measures are proposed:

- The stability of all excavations will be ensured through the design of appropriate retaining wall / slope systems in both the temporary and the permanent situations.
- The configuration and depth of the proposed excavations and their distance from neighbouring structures does not put the latter at any stability risk.

No adverse residual or cumulative stability, hydrological or hydrogeological impacts are expected as a result of this development. This BIA concludes that the proposed development will not cause harm to its neighbours or the wider environment.

Contents

Executive Summary	3
Contents	5
Foreword-Guidance Notes	7
1. Introduction	8
1.1 Background	8
1.2 Brief	8
1.3 Planning Policy	8
1.4 Report Structure	9
1.4.1 Stage 1: Screening	9
1.4.2 Stage 2: Scoping	10
1.4.3 Stage 3: Site Investigation and Study	10
1.4.4 Geotechnical Issues	10
1.4.5 Stage 4: Impact Assessment	10
1.4.6 Residual Impacts	10
1.5 Documents Consulted	10
2. The Site	11
2.1 Site Location	11
2.2 Site Topography	11
2.3 Site Description	11
2.4 Proposed Development	13
2.4.1 Proposed Lower Ground Floors	13
3. Stage 1 - Screening Assessment	14
3.1 Screening Assessment	14
3.1.1 Screening Checklist for Subterranean (Groundwater) Flow	14
3.1.2 Screening Checklist for Surface Flow and Flooding	15
3.1.3 Screening Checklist for Stability	15
3.2 Non-Technical Summary of the Screening Process	16
4. Stage 2 - Scoping Assessment	18
4.1.1 Scoping for Subterranean (Groundwater) Flow	18
4.1.2 Scoping for Surface Flow and Flooding	19
4.1.3 Scoping for Stability	20
5. Stage 3 - Site Investigation	22

5.1	Desk Study	22
5.2	Ground Model	22
5.2.1	Made Ground	22
5.2.2	Superficial Deposits	22
5.2.3	London Clay	22
6.	Discussion of Geotechnical Issues and Construction Methodology	24
6.1	Construction Methodology	24
6.1.1	Installation of Protective Barriers, Tree Removal and Demolition	25
6.1.2	Parking Areas and Access Footpath Construction	26
6.1.3	Sheet pile walls and drainage trenches	27
6.1.4	Excavation to Formation Level	28
6.1.5	Foundations	31
6.1.6	Lower Ground Floor Construction	33
6.1.7	Permanent Drainage	33
6.1.8	Landscaping	34
7.	Stage 4 – Basement Impact Assessment	36
7.1	Potential Hydrological and Hydrogeological Impacts	36
7.1.1	Potential Hydrogeological Impacts	36
7.1.2	Potential Hydrological Impacts	36
7.2	Potential Stability Impacts	37
7.3	Residual Impacts	38
8.	Conclusion	39

Foreword-Guidance Notes

GENERAL

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

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

VALIDITY

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

THIRD PARTY INFORMATION

The report may present an opinion based upon information received from third parties. However, no liability can be accepted for any inaccuracies or omissions in that information.

1. Introduction

1.1 Background

It is proposed to redevelop this property through removal of the existing large house and replacement of this by five new smaller homes.

1.2 Brief

LBH WEMBLEY has been appointed as consultants to help assess the potential impacts that the proposed development may have upon its neighbours and the natural environment and to assist with the design of the redevelopment to achieve an exemplar positive impact.

This report has been prepared to support a full planning application to the London Borough of Camden.

This report should be read in conjunction with the Hydrological & Hydrogeological Impact Assessment Report, reference LBH4480 v.2.0, dated 3rd July 2018, which presents a detailed desk study of the site and the results of a recent site investigation.

1.3 Planning Policy

The 2017 Camden Local Plan Policy A5 reads as follows:

“The Council will only permit basement development where it is demonstrated to its satisfaction that the proposal would not cause harm to:

- a) neighbouring properties;*
- b) the structural, ground, or water conditions of the area;*
- c) the character and amenity of the area;*
- d) the architectural character of the building; and*
- e) the significance of heritage assets.*

In determining proposals for basements and other underground development, the Council will require an assessment of the scheme’s impact on drainage, flooding, groundwater conditions and structural stability in the form of a Basement Impact Assessment and where appropriate, a Basement Construction Plan.

The siting, location, scale and design of basements must have minimal impact on, and be subordinate to, the host building and property. Basement development should:

- f) not comprise of more than one storey;*
- g) not be built under an existing basement;*
- h) not exceed 50% of each garden within the property;*
- i) be less than 1.5 times the footprint of the host building in area;*
- j) extend into the garden no further than 50% of the depth of the host building measured from the principal rear elevation;*
- k) not extend into or underneath the garden further than 50% of the depth of the garden;*
- l) be set back from neighbouring property boundaries where it extends beyond the footprint of the host building; and*
- m) avoid the loss of garden space or trees of townscape or amenity value.*

Exceptions to f. to k. above may be made on large comprehensively planned sites.

The Council will require applicants to demonstrate that proposals for basements:

- n. do not harm neighbouring properties, including requiring the provision of a Basement Impact Assessment which shows that the scheme poses a risk of damage to neighbouring properties no higher than Burland Scale 1 'very slight';*
- o. avoid adversely affecting drainage and run-off or causing other damage to the water environment;*
- p. avoid cumulative impacts;*
- q. do not harm the amenity of neighbours;*
- r. provide satisfactory landscaping, including adequate soil depth;*
- s. do not harm the appearance or setting of the property or the established character of the surrounding area;*
- t. protect important archaeological remains; and*
- u. do not prejudice the ability of the garden to support trees where they are part of the character of the area.*

The Council will not permit basement schemes which include habitable rooms and other sensitive uses in areas prone to flooding.

We will generally require a Construction Management Plan for basement developments.

Given the complex nature of basement development, the Council encourages developers to offer security for expenses for basement development to adjoining neighbours."

The following policies in the Local Plan are also relevant to basement development and will be taken into account when assessing basement schemes:

- "Policy A2 Open space";
- "Policy A3 Biodiversity";
- "Policy D1 Design";
- "Policy D2 Heritage"; and
- "Policy CC3 Water and flooding".

In addition to the Local Plan Policy Camden has published updated Camden Planning Guidance on Basements (March 2018) . This CPG document does not carry the same weight as the Local Plan, but is an important supporting document.

1.4 Report Structure

The report commences with a brief description of the proposed development. The report then progresses to a BIA. The methodology for assessing the impact of the proposed construction takes the form of a staged approach as follows.

1.4.1 Stage 1: Screening

Screening uses checklists to identify whether there are potential matters of concern (with regard to hydrogeology, hydrology or ground stability) which are then investigated using (Section 6.2 and Appendix E of the CGHSS). There are three checklists as follows:

- Subterranean (groundwater) flow
- Slope stability

- Surface flow and flooding

1.4.2 Stage 2: Scoping

The scoping stage produces a statement which defines further the matters of concern identified in the screening stage (Section 6.3 of the CGHSS).

1.4.3 Stage 3: Site Investigation and Study

The site investigation and desk study are reported in the accompanying Hydrological & Hydrogeological Impact Assessment Report. The investigation has established the baseline conditions (Section 6.4 of the CGHSS).

1.4.4 Geotechnical Issues

There follows a discussion of geotechnical issues and a description of the envisaged construction methodology and proposed impact mitigation measures.

1.4.5 Stage 4: Impact Assessment

An impact assessment is undertaken to determine the impact of the proposed basement on the baseline conditions, taking into account any mitigation measures proposed (Section 6.5 of the CGHSS).

1.4.6 Residual Impacts

Finally, an assessment of the residual impact is provided.

1.5 Documents Consulted

The following documents have been consulted during the preparation of this report:

1. Camden Local Plan, Adoption Version, 2017
2. Camden Planning Guidance 4, Basements and Lightwells, 2018
3. Camden Development Policies DP27 – Basements and Lightwells, 2010
4. London Borough of Camden Geological, Hydrogeological and Hydrological Study (CGHSS), by Ove Arup & Partners Limited, dated 18th November, 2010, Issue 1
5. Desk Study and the Hydrological & Hydrogeological Impact Assessment of proposed redevelopment of 55 Fitzroy Park, LBH WEMBLEY, 26th October 2017, LBH4480 Ver. 1.1
6. Site Investigation Factual Report, Concept Site Investigations, dated 15th of September, 2017, Issue 00, Ref.:17/3003
7. Proposed Sections: Plots 1-3 by Piercy & Company, Drwg. No. 13529_AP_Z1_LXX_05_140
8. Proposed Section: Plots 5 by Piercy & Company, Drwg. No. 13529_AP_Z3_LXX_05_150
9. Proposed Section: Fitzroy Park – Plot 4 by Fathom Architects, dated 11th May 2018, Drwg. No. A2200, Rev. 2
10. Proposed Site Plan by Land Use Consultants Ltd, dated 25th June 2018, Drwg. No. 7122_010, Iss. X

2. The Site

2.1 Site Location

The site is located on the south western side of the residential area of Fitzroy Park and may be located approximately by National Grid Reference 527780, 186940. To the southwest lie Hampstead Heath and the Kenwood Ladies' and Bird Sanctuary ponds.



2.2 Site Topography

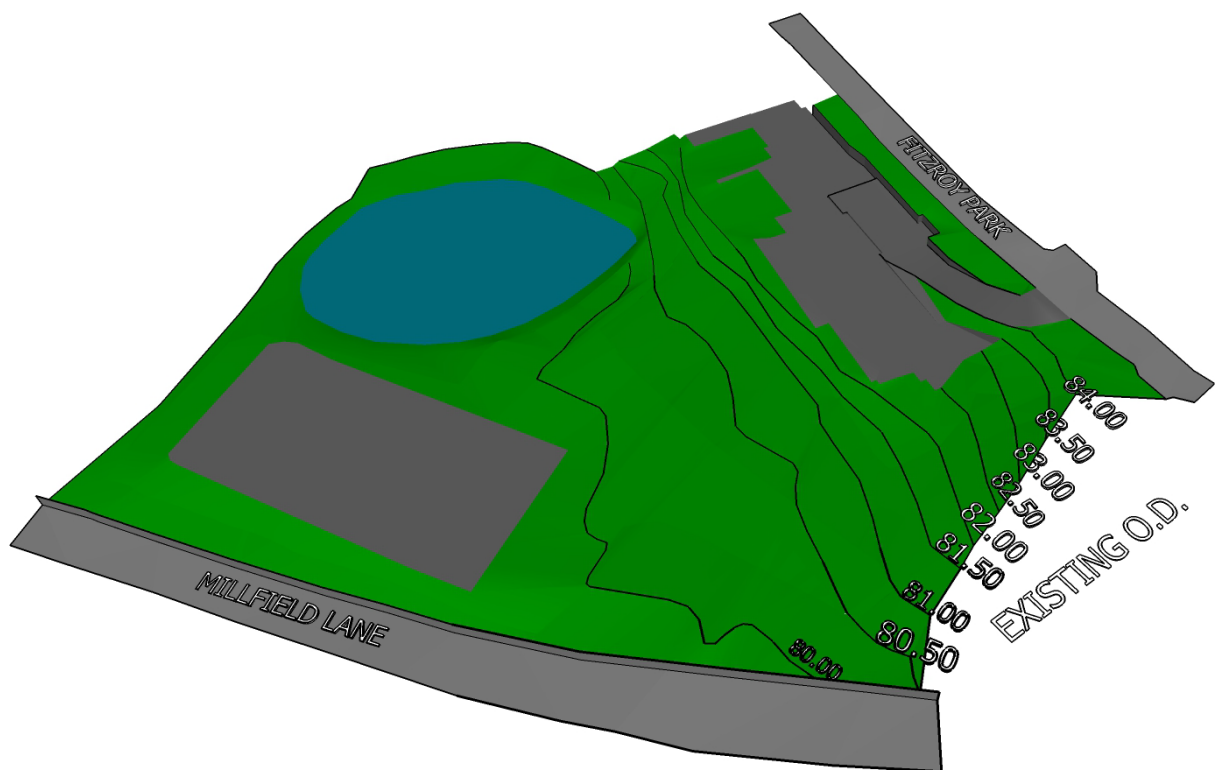
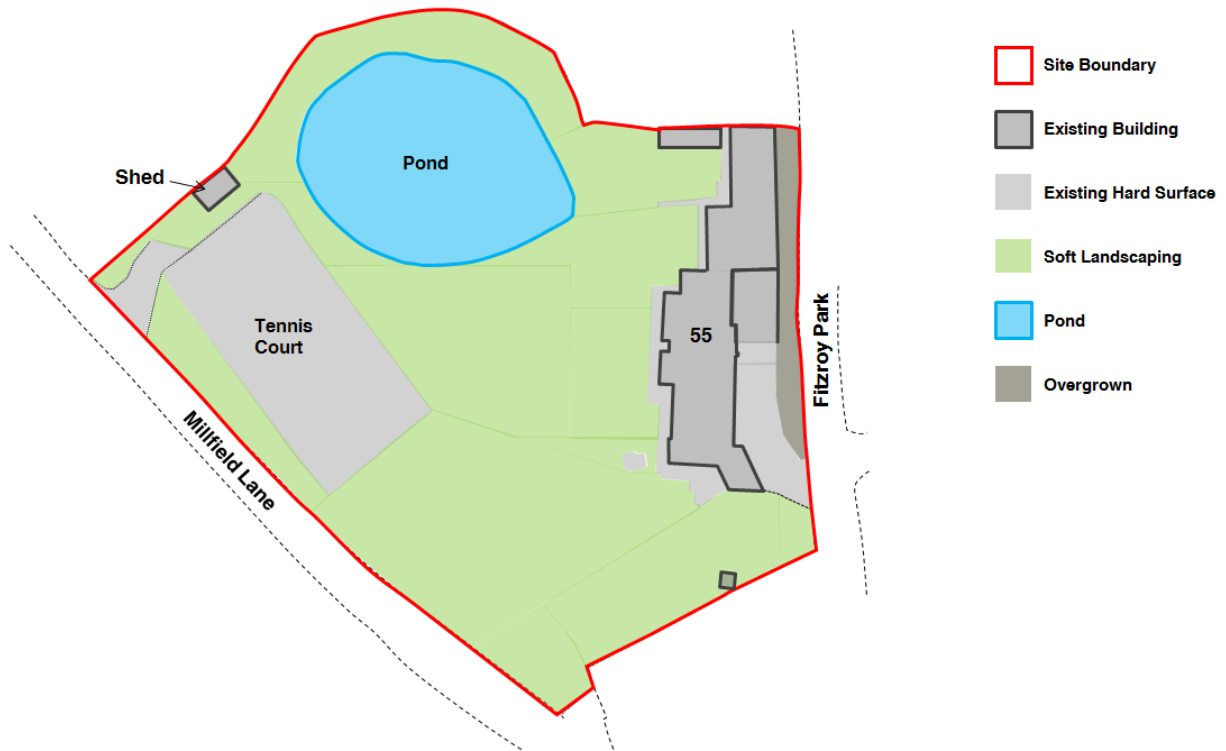
The site lies on the lower south western slopes of Highgate Hill with the ground surface falling from a maximum of about +84 m OD adjacent to Fitzroy Park in the east, down to about +80 m OD in the main site area, and down to about +77.5 m OD adjacent to the Millfield Lane.

2.3 Site Description

The site comprises a roughly trapezoidal area lying between Millfield Lane and Fitzroy Park. A linked series of single and two-storey flat-roofed red brick 1950s buildings are located along the eastern edge of the site, set about a storey below the line of the adjacent road and approached by a ramped driveway.

To the west of the terrace on which the existing building site lies is a large garden that includes the remnants of a small orchard. The lawn slopes down towards a large circular pond that is situated in the north of the site.

The south western parts of the garden appear to have been levelled with the creation of a further terrace, upon which a tennis court stands and beyond which there is a sharp bank down to Millfield Lane.



2.4 Proposed Development

It is proposed to construct five new detached houses at the property, together with associated landscaping. The proposed arrangement of the development is shown on the site plan below.



2.4.1 Proposed Lower Ground Floors

The houses proposed for development on Plots 1, 2 and 3 are envisaged to be two storey detached houses with accompanying lower ground floors built into the slope of the site.

The lower ground floors of Plots 1, 2 and 3 are proposed to be set at approximately +81.2m OD, with the ground floor level at +84.2m OD.

The ground between the houses will be landscaped so that it slopes down from the front of the houses (facing Fitzroy Park) to the rear of the houses, where there will be lower ground floor level access to the rear garden.

The existing slope is expected to be excavated down to lower ground floor level prior to construction of the houses, with the slope landscaping up to the proposed levels to take place following.

Plot No's 4 and 5 are proposed as two storey detached dwellings each with a lower ground floor level set behind retaining walls bordering the pond.

3. Stage 1 - Screening Assessment

The following BIA Screening & Scoping Assessments have been undertaken with reference to Appendices E and F of the CGHHS.

3.1 Screening Assessment

The Screening Assessment consists of a series of checklists that identifies any matters of concern relating to the following:

- Subterranean (groundwater) flow
- Surface flow and flooding
- Slope stability

3.1.1 Screening Checklist for Subterranean (Groundwater) Flow

Question	Response	Justification
Is the site located directly above an aquifer?	No	The site is underlain by the London Clay which is classified by the Environmental Agency (EA) as Unproductive Strata.
Will the proposed basement extend beneath the water table surface?	No	No groundwater is expected within the London Clay Formation due to its impermeability and the overlying superficial deposits consist of a clay matrix which behaves hydraulically as clay.
Is the site within 100m of a watercourse, well (used/disused) or potential spring line?	Yes	There is a manmade private pond on the site and the Highgate Chain of ponds which are thought to be manmade is located approximately 80m to the southwest of the site.
Is the site within the catchment of the pond chains on Hampstead Heath?	Yes	The site is within the Highgate Ponds Chain catchment area as shown on Figure 14 of the Arup report.
Will the proposed development result in a change in the area of hard-surfaced/paved areas?	Yes	It is envisaged the overall amount of hard-surfaced areas within the site will decrease due to the development. This is due to the removal of the hard-surfaced tennis court and introduction of hydrologically permeable surfacing on proposed access lane and driveways.
Will more surface water (e.g. rainfall and run-off) than at present will be discharged to the ground (e.g. via soakaways and/or SUDS)?	No	Despite a 'no' response, this issue will be carried forward to scoping in view of the sensitivity involved.
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?	Yes	The proposed ground floor level of the house at Plot 5 is situated below the mean water level of the private pond present on site.

3.1.2 Screening Checklist for Surface Flow and Flooding

Question	Response	Justification
Is the site within the catchment area of the pond chains on Hampstead Heath?	Yes	The site is within catchment of the Hampstead Heath Ponds specified by Figure 14 of the CGHHS.
As part of the site drainage, will surface water flows (e.g. rainfall and run-off) be materially changed from the existing route?	No	Despite a 'no' response, this issue will be carried forward to scoping in view of the sensitivity involved.
Will the proposed basement development result in a change in the proportion of hard-surfaced/paved areas?	Yes	It is envisaged the overall amount of hard-surfaced areas within the site will decrease due to the development. This is due to the removal of the hard-surfaced tennis court and introduction of hydrologically permeable surfacing on proposed access lane and driveways.
Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface-water being received by adjacent properties or downstream watercourses?	Yes	The drainage system design proposes for the run-off from all garden and landscape areas to be redirected into the pond.
Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	Despite a 'no' response, this issue will be carried forward to scoping in view of the sensitivity involved.
Is the site in an area known to be at risk from surface water flooding, or is it at risk from flooding for example because the proposed basement is below the static water level of nearby surface water feature?	Yes	The EA identifies the north west extent of the site as low to medium risk of surface flooding, however, the pond area is highlighted as a high risk zone for surface flooding.

3.1.3 Screening Checklist for Stability

Question	Response	Justification
Does the existing site include slopes, natural or manmade, greater than 7 degrees?	Yes	The slope from the Millfield Lane to the site exceeds 7 degrees due to an approximate drop of 2m.
Does the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees?	No	
Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees?	No	

Is the site within a wider hillside setting in which the general slope is greater than 7 degrees?	No	No. Figure 16 of the CGHHS shows that there is the presence of slopes 7-10 degrees in the local site area, although the regional slope in the site area is generally less than 7 degrees.
Is London Clay the shallowest strata at the site?	Yes	Carried forward to scoping.
Will trees be felled as part of the proposed development and/or are works proposed within tree protection zones where trees are to be retained?	Yes	Carried forward to scoping.
Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	No	No evidence of cracks or building movements was evident upon visiting the site.
Is the site within 100m of a watercourse of a potential spring line?	Yes	A manmade private pond is located on the site and the Highgate Chain of ponds is approximately 80m southwest of the site.
Is the site within an area of previously worked ground?	No	Figure 16 of the CGHHS indicates that no worked ground is present at the site.
Is the site within an aquifer?	No	The Environment Agency (EA) maps indicate that the site is not directly underlain by an aquifer.
Will the proposed basement extend beneath the water table such that dewatering may be required during construction?	No	Despite a 'no' response, this issue will be carried forward to scoping in view of the sensitivity involved.
Is the site within 50m of the Hampstead Heath ponds?	No	The site is approximately 80m away from the Hampstead Heath ponds.
Is the site within 5m of a highway or pedestrian right of way?	Yes	The rear of the site is located within 5m of Millfield Lane; however the proposed houses on the west side of the site are approximately 8m away from the road.
Will the proposed basement significantly increase the differential depth of foundations relative to the neighbouring properties?	No	The nearest neighbour is Fitzroy Lodge, whose garage is set above the proposed floor level of Plot 3. However, as a result of the distance between Plot 3 and the foundations of the garage, the excavations will not extend into the zone of influence of these foundations and there will hence be no potential loss of support to the garage foundations.
Is the site over (or within the exclusion zone of) tunnels, e.g. railway lines?	No	

3.2 Non-Technical Summary of the Screening Process

The screening process identified the following issues to be carried forward to scoping and further assessment:

Groundwater (subterranean) Flow:

- The site is within 100m of a watercourse
- The site is within the catchment area of the area of the Hampstead Heath Ponds

- The proposed development will result in a change in the amount of hard-surfaced areas
- Potentially more surface water than at present will be discharged to the ground
- The lowest point of the proposed excavation is lower than the mean water level in the pond on site

Surface Flow and Flooding:

- The site is within the catchment area of the Hampstead Heath Ponds
- Surface water flows may be materially changed from the existing route
- The proposed development will result in a decrease in the proportion of hard-surfaced areas
- The proposed basement will result in changes to the profile of the inflows of surface water being received by downstream watercourses
- Proposed basement construction may result in changes to quality of water received downstream
- The area in the vicinity of the pond is highlighted as up to a high risk of surface water flooding

Stability:

- The site includes a slope greater than 7 degrees
- London Clay is the shallowest geological strata on site
- Trees will be felled as part of the proposed development
- The site is within 100m of the Highgate Ponds chain
- The proposed basement may extend beneath the water table such that dewatering may be required
- The site is within 5m of a highway and pedestrian right of way

The other potential concerns considered within the screening process have been demonstrated to be not applicable or not significant when applied to the proposed development.

4. Stage 2 - Scoping Assessment

Where the checklist is answered with a “yes” or “unknown” to any of the questions posed in the flowcharts, these matters are carried forward to the scoping stage of the BIA process.

The scoping produces a statement which defines further the matters of concern identified in the screening stage. This defining should be in terms of ground processes, in order that a site specific BIA can be designed and executed (Section 6.3 of the CGHHS).

4.1.1 Scoping for Subterranean (Groundwater) Flow

- **Is the site within 100m of a watercourse, well (used/disused) or potential spring line?**

The guidance advises that the flow from a spring, well or watercourse may increase or decrease if the groundwater flow regime which supports that water feature is affected by a proposed basement. If the flow is diverted, it may result in the groundwater flow finding another location to issue from with new springs forming or old springs being reactivated.

A secondary impact is on the quality of the water issuing or abstracted from the spring or water well respectively.

- **Is the site within the catchment of the pond chains on Hampstead Heath?**

The guidance advises that with regard to the pond chains on Hampstead Heath, any reduction in the spring inflow to the ponds would reduce the overall flow through the ponds, which in turn could allow an increased build-up of contaminants. This may potentially lead to the bathing ponds not attaining the required Bathing Water Directive water quality standards.

- **The proposed development may result in a change in the area of hard-surfaced/paved areas?**

The guidance advises that the sealing off of the ground surface by pavements and buildings to rainfall will result in decreased recharge to the underlying ground. In areas underlain by an aquifer, this may impact upon the groundwater flow or levels. In areas of non-aquifer (i.e. on the London Clay), this may mean changes in the degree of wetness which in turn may affect stability.

- **More surface water (e.g. rainfall and run-off) than at present may be discharged to the ground (e.g. via soakaways and/or SUDS)?**

The guidance advises that in areas underlain by an aquifer, this may impact upon the groundwater flow or levels – this would then have similar impacts to those listed in 1b) and 2). In areas of non-aquifer (i.e. on the London Clay), this may mean changes in the degree of wetness which in turn may affect stability.

- **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 any local pond?**

The guidance advises that groundwater may drain from the pond or spring and flow into the basement/excavation space.

4.1.2 Scoping for Surface Flow and Flooding

- **The site is within the catchment area of the pond chains on Hampstead Heath.**

The guidance advises that with regard to the pond chains on Hampstead Heath, in particular the bathing ponds, changes in quality would be of concern; in particular the risk of contamination. This may potentially lead to the bathing ponds not attaining the required Bathing Water Directive water quality standards.

The guidance advises that any reduction in the surface water inflow to the ponds would reduce the overall flow through the ponds, which in turn could allow an increased build-up of contaminants. Any increase in surface water inflow to the ponds could result in an increase in contaminants (e.g. animal faeces and organic matter) being washed into the ponds. Any increase in surface water inflow to the ponds could also result in an increase in the “normal” volume of water in the ponds. With more water in the ponds on a day-to-day basis, the available spare capacity in the ponds for receiving storm rainfall would be reduced, thus increasing the risk of the ponds over-topping when, in the event of a storm, that spare capacity is needed. If overtopping were to occur, this could cause inundation of land and properties downstream.

- **As part of the site drainage, surface water flows (e.g. rainfall and run-off) may be materially changed from the existing route.**

The guidance advises that basement development may increase the load on the sewer and drainage systems if it leads to increased occupancy of dwellings. In turn this may increase the risk of flooding should the sewer and drainage systems become overwhelmed. Constructing a basement, either beneath or adjacent to an existing building will typically remove the permeable shallow ground that previously occupied the site footprint. This reduces the capacity of the ground to allow rainfall to be stored in the ground (which in essence acts as a natural SUDS, or sustainable urban drainage system). This runoff must then be managed by other means (eg through construction of SUDS), to ensure that it doesn't impact on adjoining properties or downstream watercourses. For sites in the catchments of the pond chains the potential impacts listed above under (1) apply if the resulting changes in drainage affect the flow to the ponds.

- **The proposed basement development may result in a change in the proportion of hard-surfaced/paved areas.**

The guidance advises that a change in the in proportion of hard surfaced or paved areas of a property will affect the way in which rainfall and surface water are transmitted away from a property. This includes changes to the surface water received by the underlying aquifers, adjacent properties and nearby watercourses. Changes could result in decreased flow, which may affect ecosystems or reduce amenity, or increased flow which may additionally increase the risk of flooding.

- **The proposed basement may result in changes to the profile of the inflows (instantaneous and long-term) of surface-water being received by adjacent properties or downstream watercourses.**

The guidance advises that changes could result in decreased volume, which may affect ecosystems or reduce amenity, or increased flow which may additionally increase the risk of flooding.

- **The proposed basement may result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.**

The guidance advises that changes could result in decreased quality, which may affect ecosystems or reduce amenity.

- **The site is in an area known to be at risk from surface water flooding, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature.**

The guidance advises that the developer should undertake a Flood Risk Assessment (FRA).

4.1.3 Scoping for Stability

- **The existing site includes slopes, natural or manmade, greater than 7 degrees.**

The guidance advises that there may be local slope instability within the site.

- **London Clay is the shallowest strata at the site.**

The guidance advises that of the at-surface soil strata present in LB Camden, the London Clay is the most prone to seasonal shrink-swell (subsidence and heave).

- **Trees will be felled as part of the proposed development and/or works are proposed within tree protection zones where trees are to be retained.**

The guidance advises that the soil moisture deficit associated with felled tree will gradually recover. In high plasticity clay soils (such as London Clay) this will lead to gradual swelling of the ground until it reaches a new value. This may reduce the soil strength which could affect the slope stability. Additionally the binding effect of tree roots can have a beneficial effect on stability and the loss of a tree may cause loss of stability.

- **The site is within 100m of a watercourse, well (used/disused) or potential spring line.**

The guidance advises that flow from a spring, well or watercourse may increase or decrease if the groundwater flow regime which supports that water feature is affected by a proposed basement.

If the flow is diverted, it may result in the groundwater flow finding another location to issue from with new springs forming or old springs being reactivated.

A secondary impact is on the quality of the water issuing or abstracted from the spring or water well respectively.

- **The proposed basement may extend beneath the water table such that dewatering may be required during construction.**

The guidance advises that the groundwater flow regime may be altered by the proposed basement. Changes in flow regime could potentially cause the groundwater level within the zone encompassed by the new flow route to increase or decrease locally.

For existing nearby structures then the degree of dampness or seepage may potentially increase as a result of changes in groundwater level.

The guidance advises that dewatering can cause ground settlement. The zone of settlement will extend for the dewatering zone, and thus could extend beyond a site boundary and affect neighbouring structures. Conversely, an increase in water levels can have a detrimental effect on stability.

- **The site is within 5m of a highway or pedestrian right of way.**

The guidance advises that excavation for a basement may result in damage to the road, pathway or any underground services buried in trenches beneath the road or pathway.

5. Stage 3 - Site Investigation

5.1 Desk Study

A detailed desk study performed for the site can be found in the Desk study and Hydrological & Hydrogeological Impact Assessment Report.

5.2 Ground Model

The site investigation reported in the Hydrological & Hydrogeological Impact Assessment Report has confirmed a variable thickness of made ground overlying superficial deposits and subsequently the London Clay Formation. Summary descriptions are presented as follows:

5.2.1 Made Ground

The made ground varies in thickness and ranges in composition from essentially re-deposited gravelly clay fill to dirty grey and brown gravelly clay containing fragments of extraneous materials including fragments of brick, china, flint and concrete. The made ground may be assigned a nominal bulk density of 1800 kg/m^3 .

5.2.2 Superficial Deposits

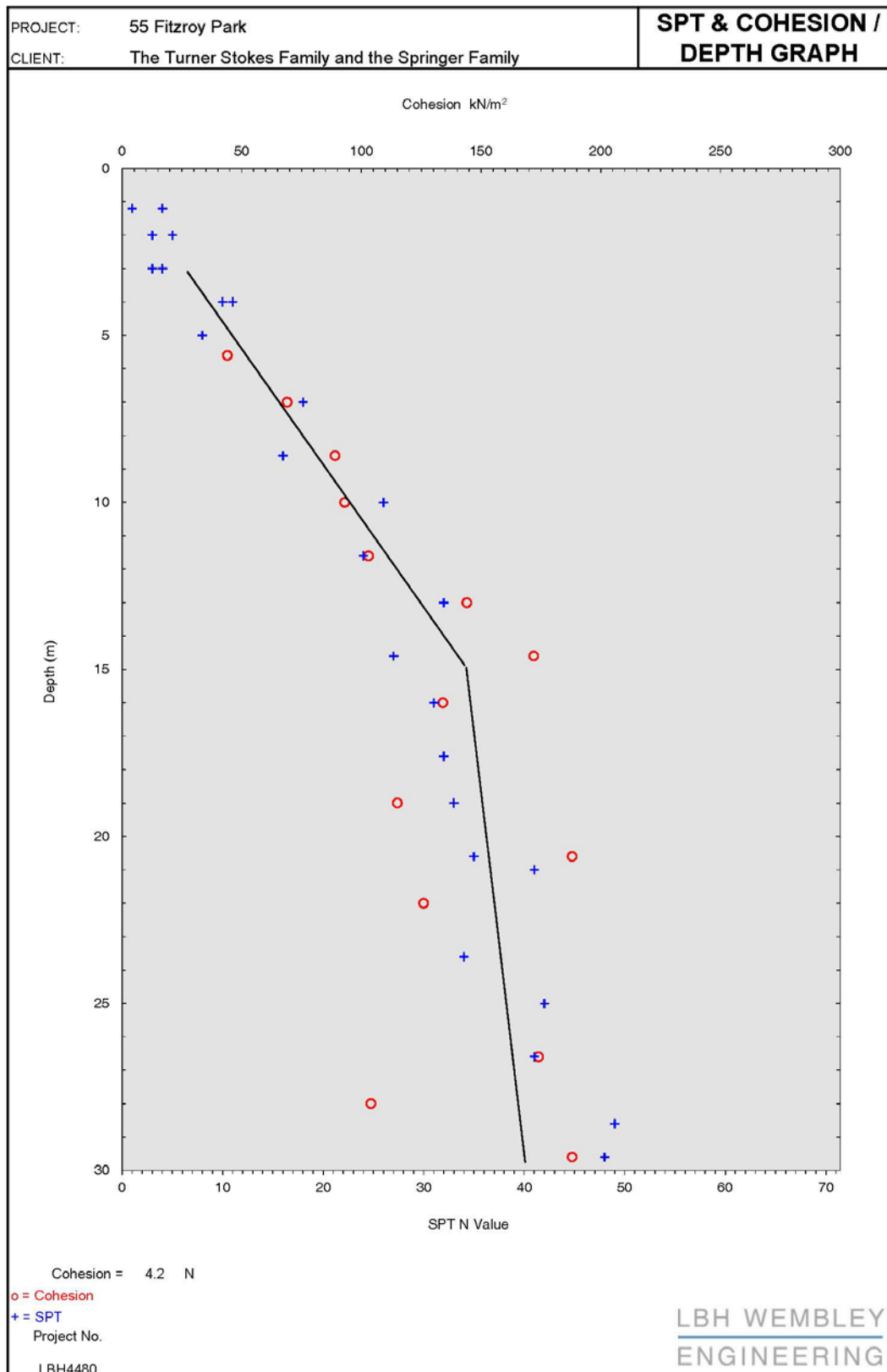
A layer of superficial deposits of variable thickness is confirmed to be present mainly below the western part of the site, where a buried valley feature is present. The superficial deposits appear to comprise soft to firm silty and sandy grey clay with scattered gravel and to vary in thickness from less than 1m to over 2.5m. These deposits can be described by a bulk density of 1900 kg/m^3 together with an undrained cohesion of approximately 30 kN/m^2 . Under drained conditions the effective cohesion can be taken as zero, with an effective friction angle of 15 degrees.

5.2.3 London Clay

The surface of the London Clay Formation follows that of the valley feature previously discussed, varying from approximately +75m OD at the base of the valley to over +81m OD. The orientation of the valley is northeast to southwest across the site as shown on the following plan.



The London Clay may be assigned a bulk density of 1900 kg/m³. The average undrained cohesion is to be taken as 50 kN/m² at the surface of the clay increasing linearly at 5kN/m² per metre depth. In a drained situation an effective cohesion of zero should be used in conjunction with an effective angle of internal friction of 20 degrees.



6. Discussion of Geotechnical Issues and Construction Methodology

6.1 Construction Methodology

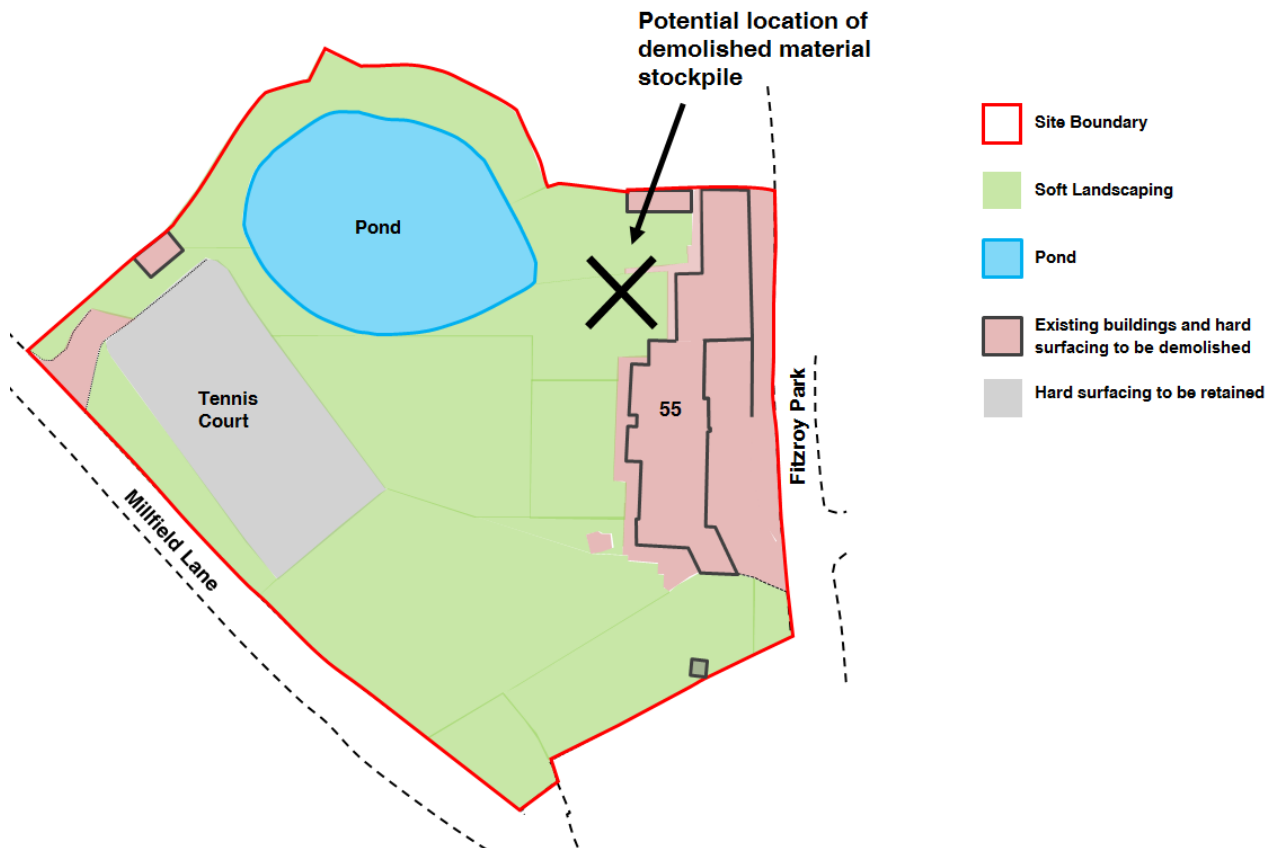
The envisaged construction sequence is summarised as follows.

1. Installation of protective barriers to pond and trees.
2. Removal of trees.
3. Demolition of the existing building and hard surfacing.
4. Construction of the access pathway.
5. Installation of sheet piling.
6. Construction of temporary drainage trenches.
7. Excavation of soil to formation levels at Plot locations. Placing of piling mats at all 5 locations, and installation of all piles.
8. Construction of the buildings.
9. Installation of permanent systems.
10. Landscaping.

The individual stages of this sequence are explored in detail in the following sections of the report.

6.1.1 Installation of Protective Barriers, Tree Removal and Demolition

Prior to demolition works barriers and screens are to be installed to protect the pond and the trees that are to be retained. This is to be followed by removal of selected trees and demolition of existing buildings. If necessary, a temporary stockpile of resultant demolition material is to be created in the northern part of the site.

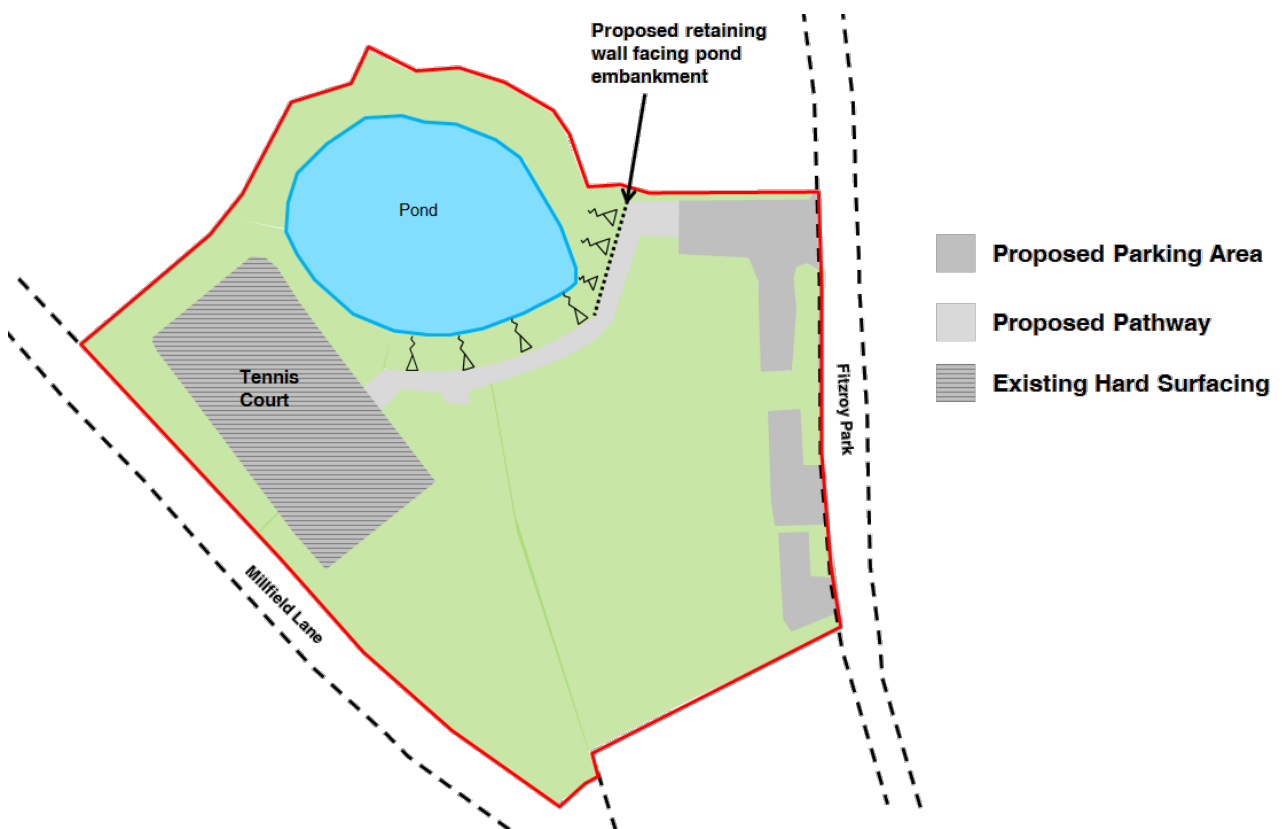


6.1.2 Parking Areas and Access Footpath Construction

The sloping access pathway will be retained by a combination of a banked slope and retaining walls facing the pond.

Construction access to the site will be provided through the main entrance and parking area to Plot 1 (marked on the plan), with a possibility to use the pathway site temporarily as further access as required for construction to take place at plots 4 & 5.

Should this be the case, a temporary drainage routing or collection system should to be introduced for the pathway, ensuring no silted or otherwise polluted run-off is discharged directly to the pond.

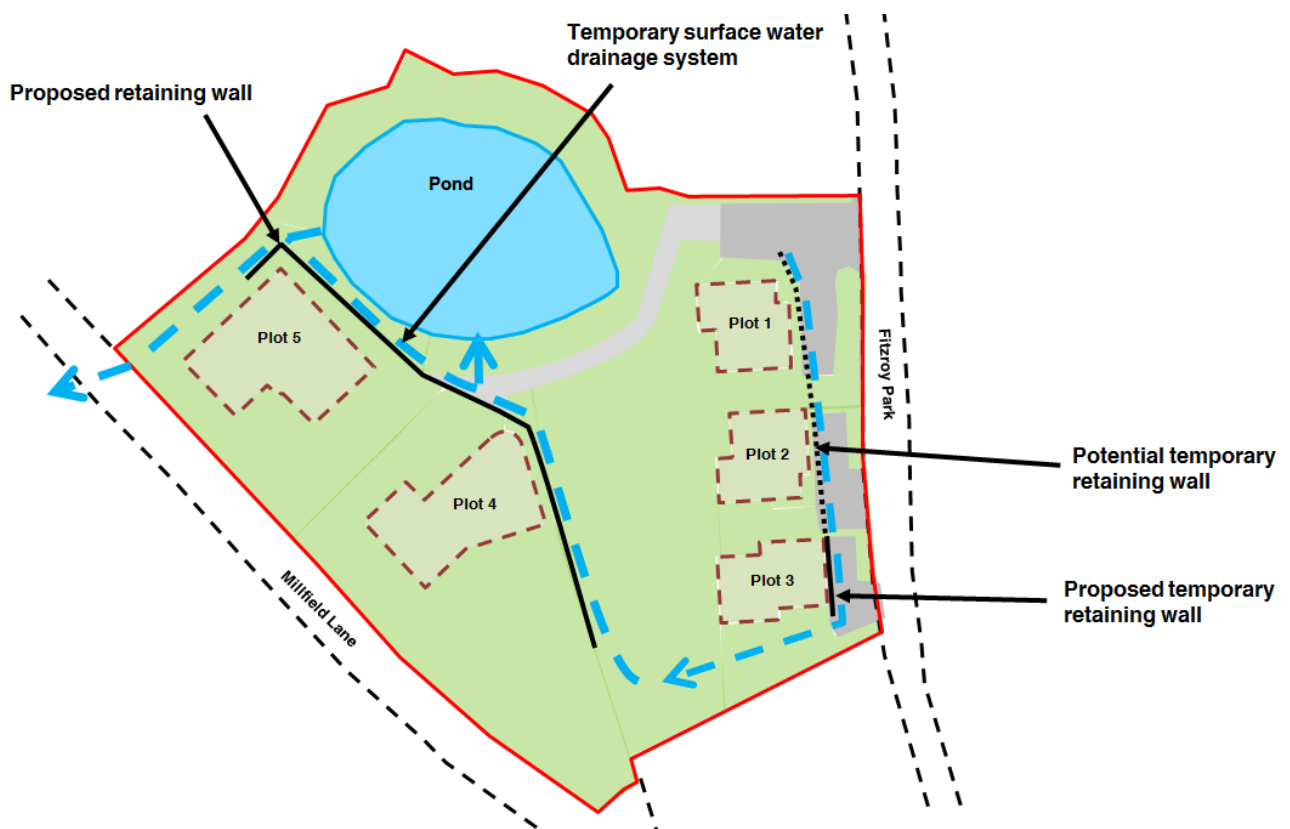


6.1.3 Sheet pile walls and drainage trenches

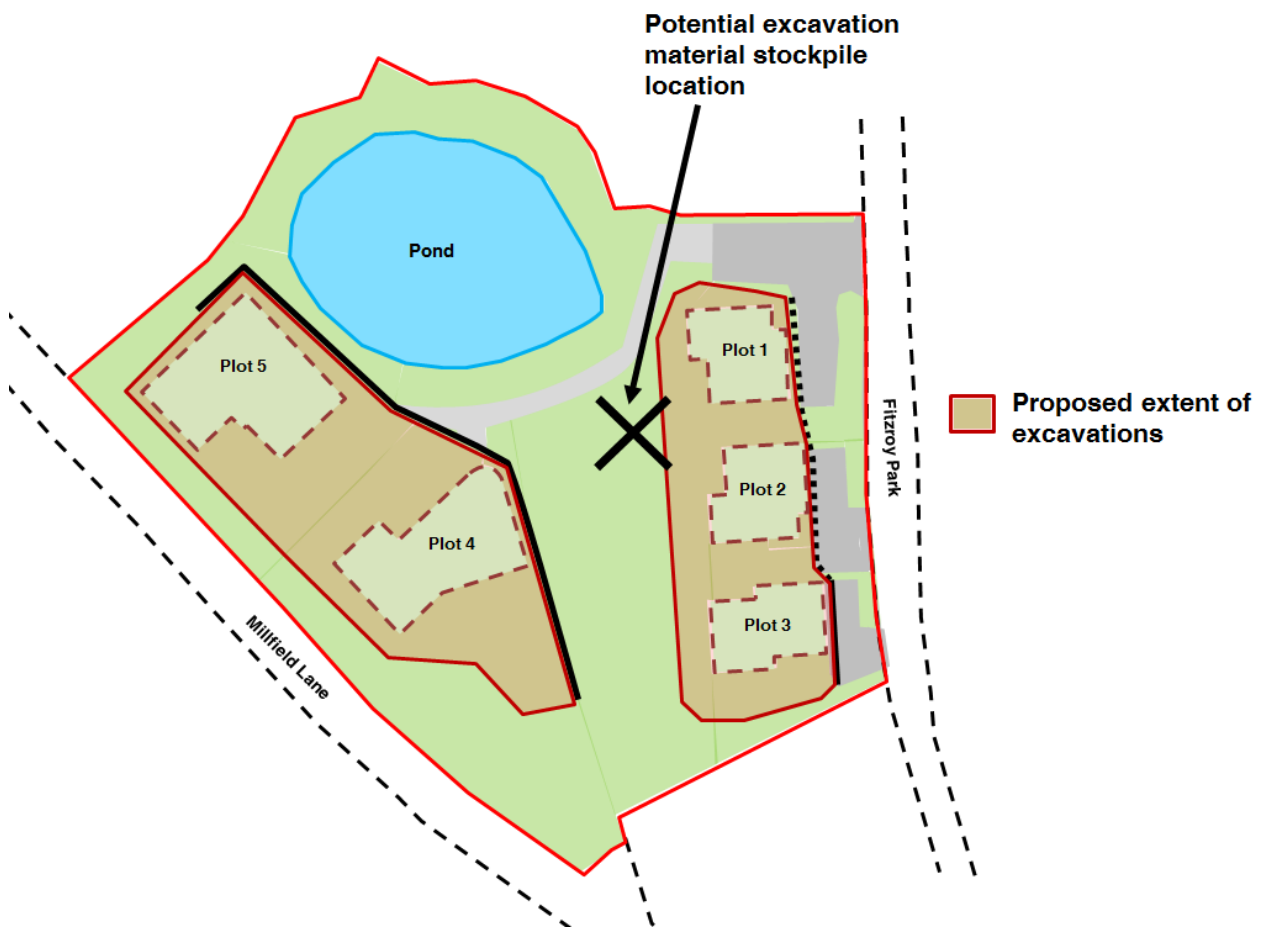
In order to allow for excavation with a step ground level change, it is envisaged that sheet piling may be required to facilitate the construction of Plots 3, 4 and 5.

It is possible that the formation for plots 1 and 2 can be attained by means of a simple battered excavation.

It is envisaged that temporary sheet pile retaining walls and drainage trenches will need to be constructed as indicated below in order to ensure the excavation areas do not receive inflows from surface water. The trench system would direct water to the pond.



6.1.4 Excavation to Formation Level



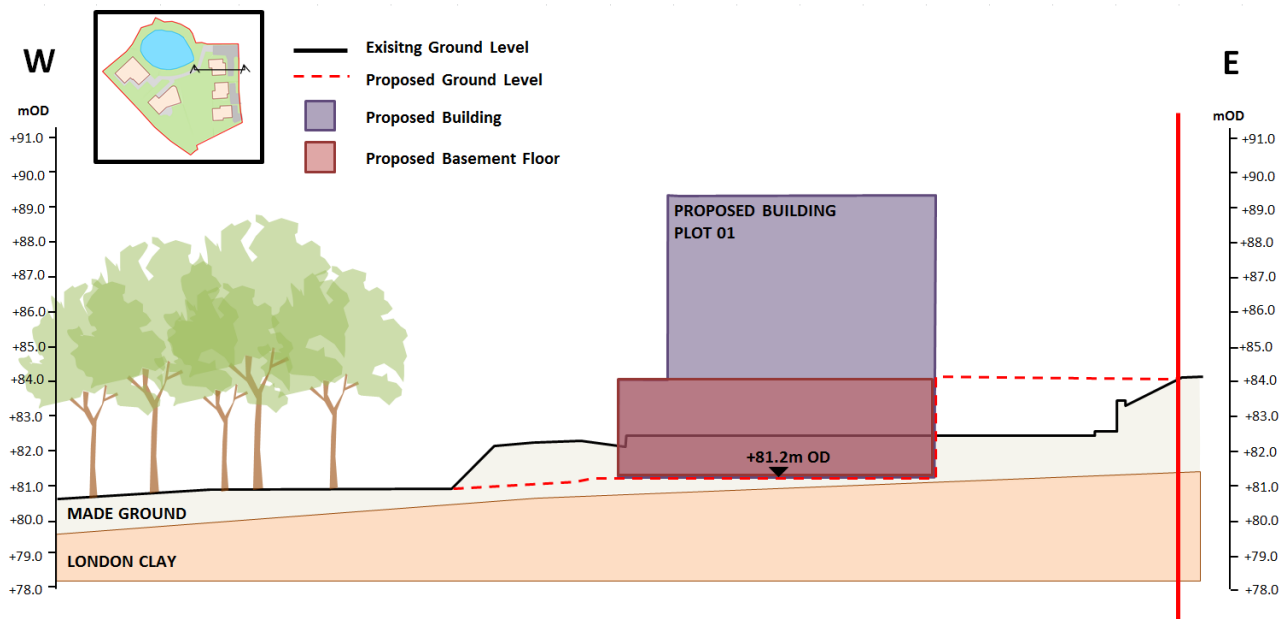
The ground at the proposed houses on Plots 1, 2 and 3 is to be lowered to allow construction of the finished lower ground floor levels at +81.2m OD.

The ground surrounding the proposed houses at Plots 4 and 5 is to be excavated as well, with the proposed ground floor levels set at +78.36m OD and +78.2m OD, respectively.

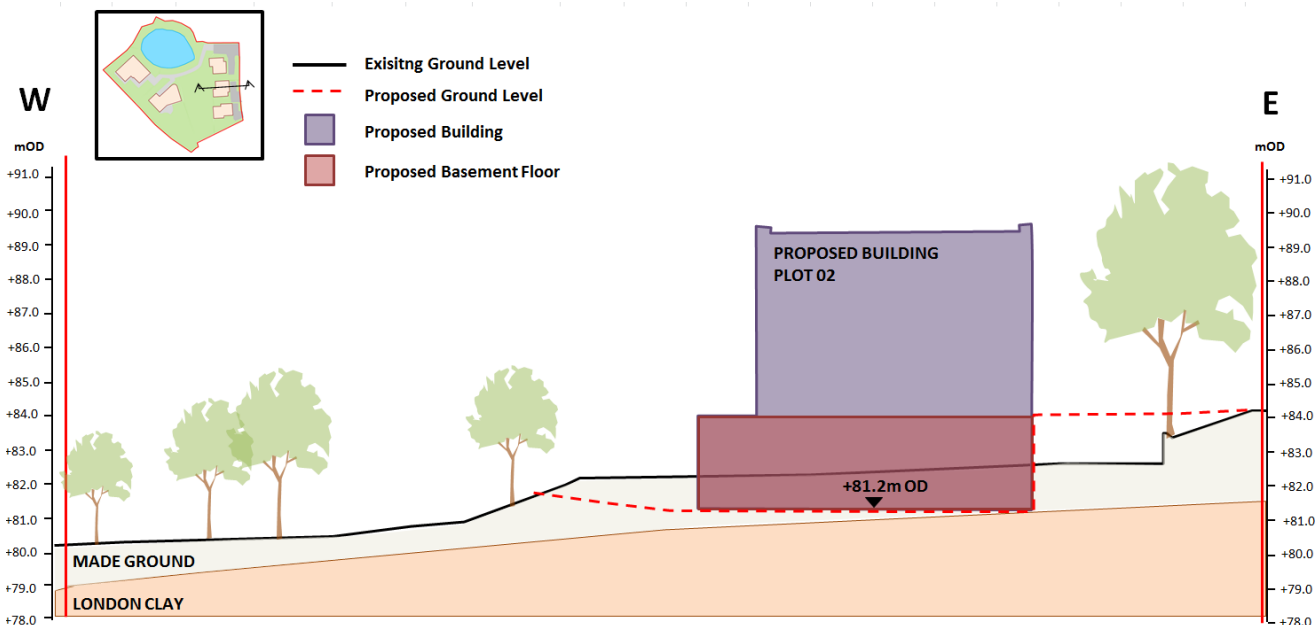
The excavated ground can be stockpiled and retained on site in order to be reused during landscaping.

The lower ground floors at Plots 1, 2 and 3 are expected to be placed close to the surface of the London Clay, within the made ground stratum. It is envisaged that following the excavations the maximum depth to this surface would be only about 0.5m.

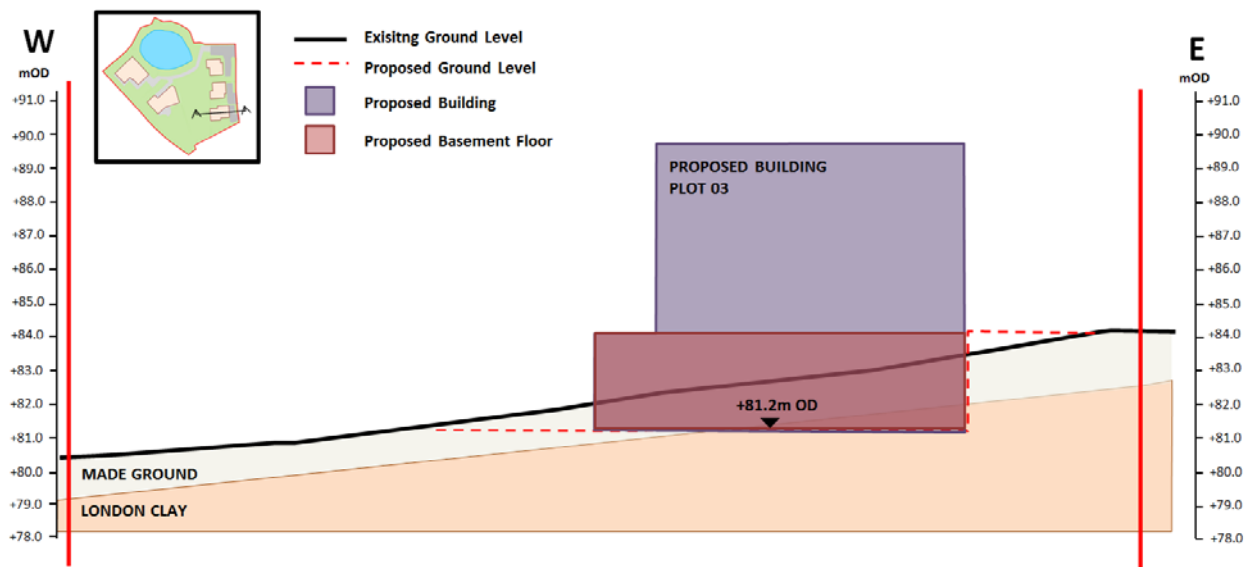
Section drawings showing the proposed lower ground floors for each house are presented on the following pages.



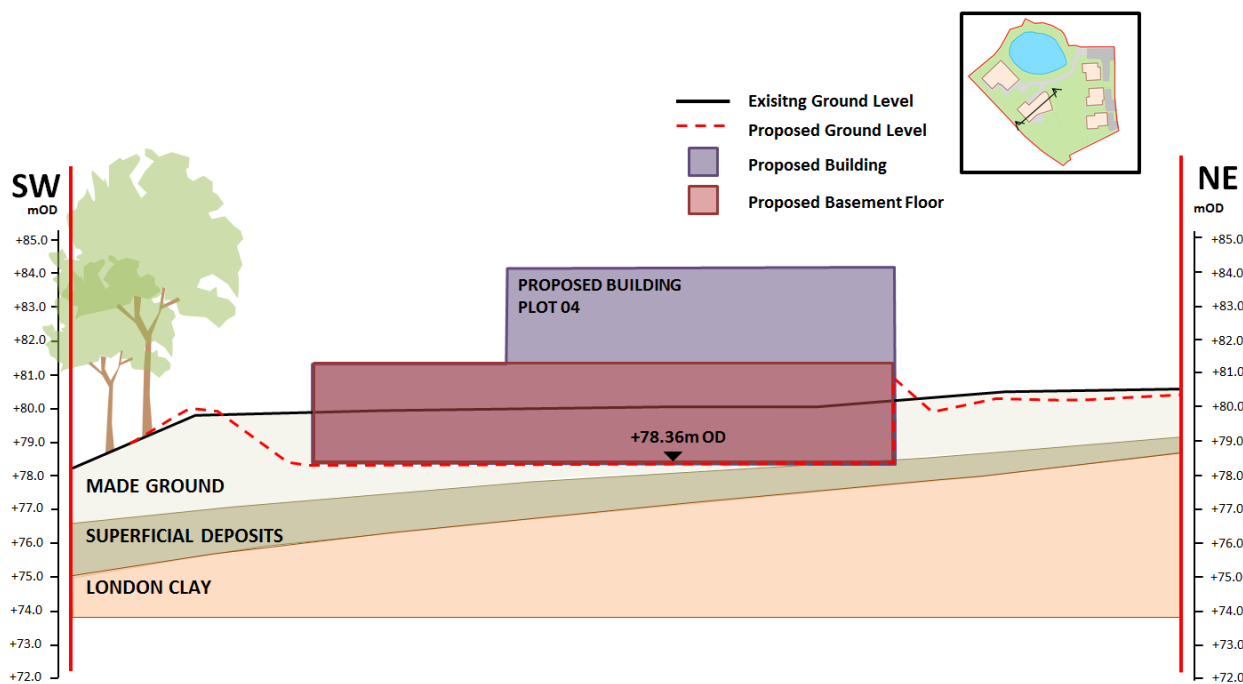
West – East section drawing showing the geology underlying Plot 1



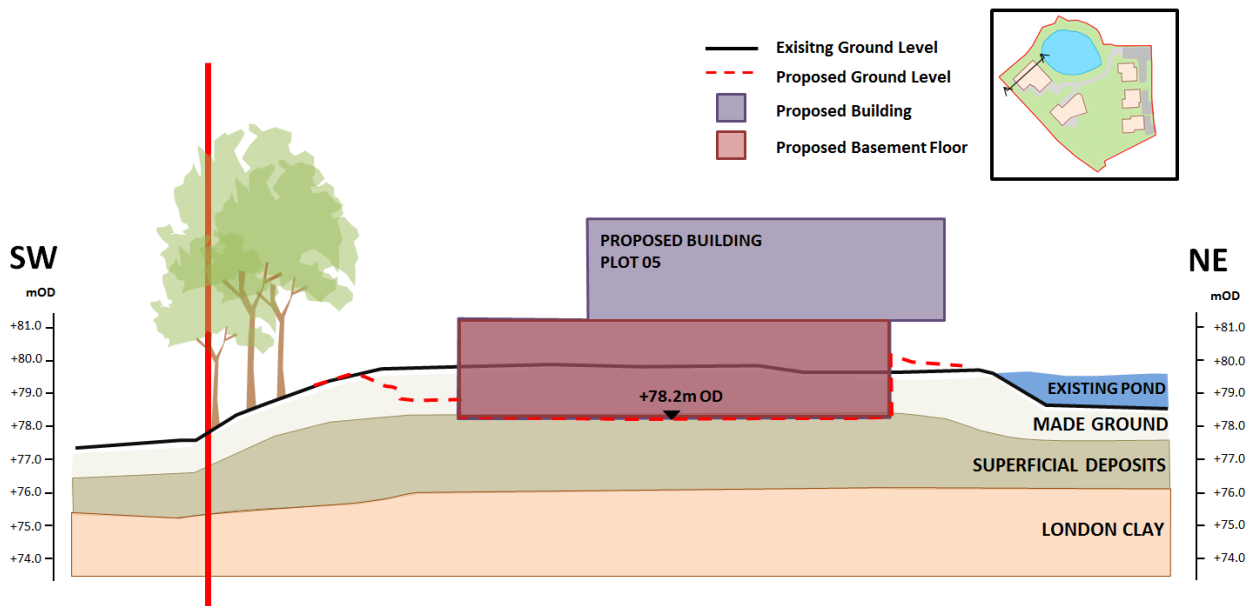
West – East section drawing showing the geology underlying Plot 2



West – East section drawing showing the geology underlying Plot 3



Southwest – northeast section drawing showing the geology underlying Plot 4



Southwest – northeast section drawing showing the geology underlying Plot 5

6.1.5 Foundations

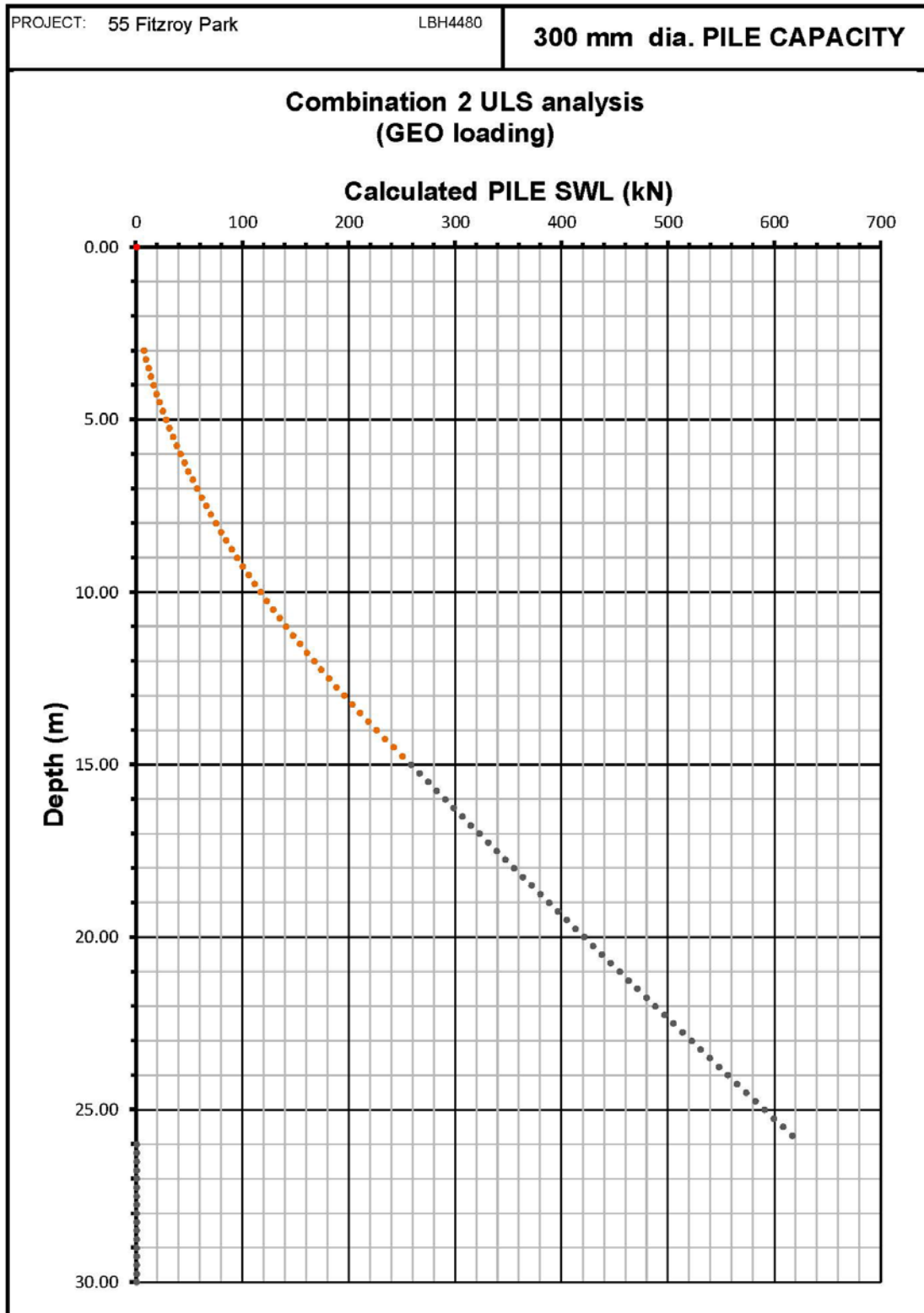
In view of the somewhat variable ground conditions at this site a piled foundation solution has been selected.

6.1.5.1 Pile Foundation Design

A bored or cfa variety of pile is likely to be the most suitable for this site.

It is envisaged piles of up to 25m depth may be used.

A preliminary assessment of the envisaged achievable capacity of piles is presented on the chart overleaf, based on a pile diameter of 300mm. It should be noted that this chart does not include any provision for special precautions in the vicinity of existing or former trees.



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6.1.5.2 Foundation Concrete

The results of chemical analyses carried out on selected samples of the soils encountered indicate soluble sulphate concentrations falling within up to Class DS-3 as defined by BRE Special Digest 1 (2005). The recommendations of that guidance for Class DS-3 sulphate conditions should therefore be followed, assuming an Aggressive Chemical Environment for Concrete (ACEC) site classification of AC-3 for mobile groundwater.

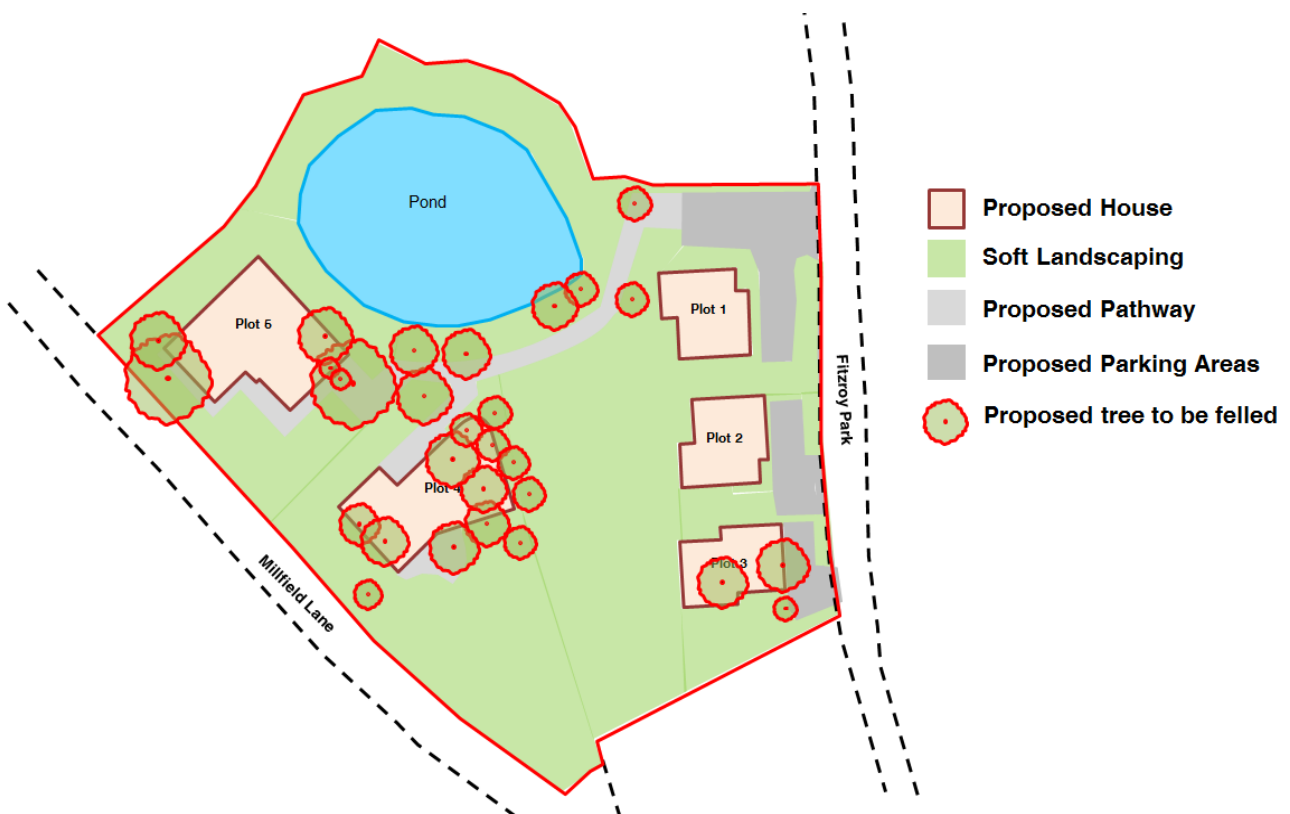
6.1.6 Lower Ground Floor Construction

It is envisaged that the below ground sections of the perimeter walls to the lower ground floors of Plots 1, 2 and 3 and to the ground floors of Plots 4 and 5 will be constructed in reinforced cast-in situ concrete.

The basements will be fully waterproofed in accordance with Guidance provided in BS8102:2009, Code of Practice for the Protection of Below-Ground Structures against Water from the Ground.

6.1.6.1 Flooring

Suspended, cast in-situ reinforced concrete floor slabs will be adopted for all the proposed buildings at these plots to avoid possible ground movement.



6.1.7 Permanent Drainage

The temporary sheet piling is to be withdrawn either partially or fully following construction so that it does not present any obstruction to groundwater flow.

The post construction drainage system is described in the Hydrological & Hydrogeological Assessment Report and comprises, in essence, a system of perforated drainage pipes set in stone bedding, a vegetated drainage channel in front of the Plot 4 retaining wall and a similar planted linear swale along the boundary with Millfield Lane.



6.1.8 Landscaping

The stated aim is to balance the cut and fill of soils at the site is to eliminate the need for transporting any excess material off-site. This excavated soil will be used to raise the front driveways and the wildlife corridor side slopes of Plots 1-3 and for the infill of the access pathway embankment and embankments to Plot 4 and Plot 5.



Proposed landscape plan detailing the main areas of excavation and filling as part of the development

7. Stage 4 – Basement Impact Assessment

The screening and scoping stages have identified potential adverse effects of the development on the attributes or features of the geological, hydrogeological and hydrological environment. This stage is concerned with evaluating the direct and indirect implications of each of these potential impacts.

7.1 Potential Hydrological and Hydrogeological Impacts

The issues raised in scoping relating to the development impacts on the subterranean and surface water flow beneath the site are addressed in detail in the 'Potential Development Impacts' section of the Hydrological & Hydrogeological Impact Assessment Report. A summary of how these issues are envisaged to be addressed is presented below.

7.1.1 Potential Hydrogeological Impacts

- **The site is within 100m of a watercourse, well (used/disused) or potential spring line.**

The recharge of the pond will remain unaffected by virtue of the proposed drainage system, which will route the flow of groundwater and springline towards the pond.

- **The site is within the catchment of the pond chains on Hampstead Heath.**

The springline groundwater flow will not be altered or affected by the development and the overall flow through the site to the Highgate Ponds, will be preserved as present.

- **The proposed development will result in a change in the area of hard-surfaced/paved areas.**

No decrease in groundwater recharge is envisaged as a result of this development.

- **More surface water (e.g. rainfall and run-off) than at present will be discharged to the ground (e.g. via soakaways and/or SUDS).**

Various SUDS elements are planned as described in the Hydrological & Hydrogeological Impact Assessment Report. The London Clay will not be affected.

- **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 any local pond.**

The landscaping around the two Plots 4 and 5 will include specific flood resistant design measures to prevent any build-up of flood water and the buildings will be protected as waterproof structures.

7.1.2 Potential Hydrological Impacts

- **The site is within the catchment area of the pond chains on Hampstead Heath.**

In order to prevent construction site pollution from threatening the Ponds, an impermeable water retention system will be formed around each working area with sumps for the duration of the works. Any surface water collected within the sumps will then be analysed to ensure it is suitable for disposal to combined sewer via settlement tanks.

- **As part of the site drainage, surface water flows (e.g. rainfall and run-off) will be materially changed from the existing route.**

Suds attenuation will be incorporated into the combined sewer discharge in accordance with Camden policy to reduce the risk of sewer flooding downstream.

With continued discharge of the surface water flow to the heath as at present, the development will not affect the Highgate Ponds.

- **The proposed basement development will result in a change in the proportion of hard-surfaced/paved areas.**

The proposed development will not result a change in the way water is transmitted away from the property. The rate of flow discharged to the heath is not expected to significantly change.

- **The proposed basement may result in changes to the profile of the inflows (instantaneous and long-term) of surface-water being received by adjacent properties or downstream watercourses.**

The volume and profile of flow will be retained as existing.

- **The proposed basement may result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.**

The proposed development will not result a change in the way water is transmitted away from the property. The rate of flow discharged to the heath is not expected to significantly change.

- **The site is in an area known to be at risk from surface water flooding, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature.**

The site is known to include areas at risk of surface water flooding, particularly in the vicinity of the pond.

The risk to Plots 4 and 5 is to be mitigated by landscaping and by routing of excess drainage over the weir area as at present.

7.2 Potential Stability Impacts

- **The existing site includes slopes, natural or manmade, greater than 7 degrees.**

The southwest border of the site sloping towards the Millfield Lane, which is identified as the only area on site to have an inclination in excess of 7°, will be landscaped to ensure adequate slope stability.

- **London Clay is the shallowest strata at the site**

The proposed structures will be protected from any risk of seasonal shrink-swell due to the proposed construction methods involving piled foundations and fully suspended cast in-situ ground floor slabs.

- **Trees will be felled as part of the proposed development and/or works are proposed within tree protection zones where trees are to be retained.**

The proposed structures will be protected from any risk of shrink-swell due to the proposed construction methods involving piled foundations and fully suspended cast in-situ ground floor slabs.

- **The site is within 100m of a watercourse, well (used/disused) or potential spring line.**

The proposed drainage strategy as set out in the Hydrological & Hydrogeological Report will direct surface water and groundwater flows in order to ensure recharge of the pond without any adverse effects.

The potential groundwater springline in front of the proposed buildings at Plots 1 – 3 will be routed around the structures using the proposed collector drain system.

- **The proposed basement may extend beneath the water table such that dewatering may be required during construction.**

Any groundwater seepage is to be excluded from the construction areas and no dewatering requirement is envisaged as the excavations will not extend below the groundwater table.

- **The site is within 5m of a highway or pedestrian right of way.**

The proposed lower ground floor at Plot 3 is the closest to a highway or pedestrian right of way, placed approximately 6m away from Fitzroy Park. As a result the theoretical 45° zone of support to the pedestrian right of way will not to be compromised by the development.

During construction, the existing retaining wall against Fitzroy Park is to be kept and further strengthened in order not to adversely affect the stability of Fitzroy Park.

7.3 Residual Impacts

Taking into account the proposed surface and groundwater drainage routing system to be placed following construction and relatively shallow excavations to be performed in order to accommodate the subterranean sections of the development, it is envisaged any residual impacts will be negligible.

8. Conclusion

No adverse residual or cumulative stability, hydrological or hydrogeological impacts are expected as a result of this development. It is concluded that the proposed development will not cause harm to its neighbours or the wider environment and has been demonstrated to comply with the requirements of Camden Local Plan Policy A5 in terms of protection of the local structural, hydrological and hydrogeological environment.