Basement Impact Assessment

38 Frognal Lane

Introduction

A Basement Impact Assessment (BIA) is required for all planning applications with basements in Camden.

Basement Impact Assessments must be prepared in general accordance with policies and technical procedures contained within the documents listed below.

- Guidance for Subterranean Development (GSD). Issue 01. November 2010. Ove Arup & Partners.
- Camden Planning Guidance (CPG): Basements (March 2018).
- Camden Local Plan 2017[1] (: Policy A5 Basements and Policy CC3 Water and flooding.

---

[1] https://www.camden.gov.uk/localplan

38 Frognal Lane NW3 6PP

Basement Impact Assessment
Planning reference no 2020/4667/P

For

MRPP

Project Number: T&K 14604

6th November 2020

Revisions & additional material

Document History and Status

Revision	Date	Purpose/Status	File Ref	Author	Check	Review
Initial	7.10.20	Initial Submission	BIA 2020.10.07	NCT		
01	6.11.20	Soils 2020 SI included	BIA 2020.11.06	NCT		

Document Details

Last saved	6th November 2020
Path	Document1
Author	Norman Train, Train and Kemp
Reviewer	Chris Swainston, Soils Ltd
Project Name	38 Frognal Lane
Planning Reference No.	

Additional supporting documents

Please note – the review process will be quicker if these are submitted as Word documents or searchable PDFs.

D	Version	Produced by
Appendix 2: Soil Reports	2020 and 2014 Investigations	Soils Ltd
Flood Risk Assessment	2	Norman Train
Ground Movement and Building Damage Assessment	0	Norman Train
Surface Water Strategy	Drg 1611-100 P2	Simon Dent Associates

Please list all revisions here: 1

D a t e	Version	Produced by
None		

Contents

Appendices

Appendix 5: Structural Engineer's Statement

Appendix 6: Arboricultural Report/Surface Water Drainage Strategy

1. Non-Technical Summary

1. The site location is 38 Frognal Lane, NW3 6PP. See Location Plan on drawing -PL-010.

2. The current site arrangement is a two storey detached house. See schedule of drawings at Appendix 3.

3. The proposed development comprises a two storey detached house with a basement.

4. The following assessments are presented:

   - Desk Study
   - Screening
   - Scoping
   - Additional evidence/assessments (as required)
     - *Site investigation*
     - *Arboricultural report*
     - *Ground movement assessment*
     - *Consultation with adjacent infrastructure/asset owners*
     - *Flood risk assessments*
     - *Surface water drainage strategy/SUDS assessment*
     - *Others*
   - *Impact Assessment*

5. The authors of the assessments are:

   The lead author is Norman Train, BSc, CEng, FICE, FIStructE, consultant to Train and Kemp with over 40 years' experience in foundation design and structures

   The BIA has been reviewed and approved by Chris Swainston, BSc (Hons) Geology PGCE FGS CGeol

6. The ground and groundwater conditions beneath the site are Claygate Members overlying London Clay with a perched water table to the base of the Claygate Members

7. The construction methods proposed are a contiguous piled wall and reinforced concrete box construction to the basement with traditional masonry and concrete floors over. The contiguous piled wall will be propped during the construction with the lid to the box propping it permanently

8. A structural monitoring strategy to control the works and impacts to neighbouring structures will comprise Tell tail crack gauges, as agreed with the adjoining owners party wall surveyor, installed on existing cracks within adjoining properties.

9. The BIA has assessed land stability and the impacts of the proposed development on neighbouring structures will be to no greater that Burland Category 1

10. The BIA has identified that there are no potential slope stability impacts.

11. The BIA has identified that there are no potential hydrological impacts

12. The BIA has identified that the basement perimeter piles will intercept the perched water table in the Claygate Members. To mitigate this, a pea shingle layer will be installed around the outside of the basement to intercept the groundwater on the upper side and replenish the water table on the low side.

13. As in the FRA, there is a very low flood risk with the proposed development.

2. Introduction

The purpose of this assessment is to consider the effects of a proposed basement development at 38 Frognal Lane, NW3 6PP on the local hydrology, geology and hydrogeology and potential impacts to neighbours and the wider environment. The site location is presented in drawing PL-010.

The BIA approach follows current planning procedure for basements and lightwells adopted by LB Camden and comprises the following elements (CPG Basements):

- Desk Study;
- Screening;
- Scoping;
- Site Investigation, monitoring, interpretation and ground movement assessment;
- Impact Assessment

2.1. Authors

2.1.1. The BIA has been authored by Norman Train, BSc, CEng, FICE, FIStructE, consultant to Train and Kemp with over 40 years' experience in foundation design and structures

2.1.2. The BIA has been reviewed and approved by Chris Swainston, BSc (Hons) Geology PGCE FGS CGeol

2.2. Sources of Information

The following baseline data have been referenced to complete the BIA in relation to the proposed development:

- In terms of consultation with neighbours, no specific consultation took place prior to the submission of the previous basement application in 2016 (ref. 2014/7752/P). Furthermore, BIA Guidance states that *"the Council will expect consultation with local residents on all basement developments unless the proposed construction work is minimal and will have a negligible effect on the adjoining or nearby properties as evidenced by the applicant to the satisfaction of the Council."* It is considered appropriate therefore that the same approach is taken with respect of this current application noting that the planning application process enables interested parties to comment on all aspects of the planning application, including the BIA.
- Location Plan (PL-010), Site Plan (PL-011);
- Geological mapping: BGS website base Geological Map or UK;
- Hydrogeological data based on previous and current site investigations
AP Geotechnics;

- Current/historical hydrological data with LB Camden Flood Risk Management Strategy, FRMS, 2013*;*
- Flood risk mapping EA Flood Maps
- LB Camden, Strategic Flood Risk Assessment (produced by URS, 2014);
- LB Camden, Floods in Camden, Report of the Floods Scrutiny Panel (2013);
- LB Camden, Planning Guidance (CPG) – Basements (March 2018);
- LB Camden, Camden Geological, Hydrogeological and Hydrological Study – Guidance for Subterranean Development (produced by Arup, 2010);
- LB Camden, Local Plan Policy A5 Basements (2017);
- LB Camden's Audit Process Terms of Reference;

2.3. Existing and Proposed Development

2.3.1. The Application site is located towards the top of the slope on Frognal Lane where the slope angle is less than 6°.

2.3.2. The site is located on 38 Frognal Lane. The site is located where Chesterford Gardens terminates on Frognal Lane and is sloped. Refer to PL-010 Location Plan, PL-011 Site Plan & PL-204 Street Elevation.

2.3.3. The site currently holds a 2 storey dwelling.

2.3.4. To the east of the site is 40 Frognal Lane; a Grade II listed private house. 40 Frognal Lane has a live consent for a basement until 1 May 2021. To the West is located 12 Langland Gardens, a multi-residential building with a basement. Please refer to PL-011 Site Plan, PL-204 Street Elevation & PL-300 Sections - AA.

2.3.5. Neighbouring buildings include the following Listed properties: 40 Frognal Lane.

2.3.6. Neighbouring gardens and trees are present at 40 Frognal Lane and 12 Langland Gardens and will be protected in accordance with (A5 Basements (Local Plan 2017).

2.3.7.

Existing and Proposed development drawings are presented in the following drawings:

PL-010 Location Plan
PL-011 Site Plan
PL-099 Basement Plan
PL-100 Ground Floor Plan
PL-101 First Floor Plan
PL-102 Second Floor Plan
PL-103 Roof Plan
PL-200 Front Elevation _ North
PL-201 Side Elevation _ East
PL-202 Rear Elevation _ South
PL-203 Side Elevation _ West

PL-204 Street Elevation
PL-300 Sections – AA
Pl-305 Sections - BB

2.3.8. The proposed development will be the full demolition of the existing building, salvaging as many bricks as possible, along with termination of all utilities to allow construction of the new building. The new basement will be formed with contiguous piled external wall and an internal waterproof concrete box. The perimeter walls will be propped during construction with the lid to the concrete box providing the permanent propping. The reduced level of the basement and the pool excavations will be +86.2m OD and 84.4m OD respectively. Given that the upper ground floor to No 12 Langland Gardens is at +88.8 OD, its foundations will be at 88.0m OD which is higher than basement excavation. Streets in the surrounding area are wide enough for both goods and plant machinery.

2.3.9. The outline construction programme for the proposed development is outlined within the Construction Management Plan

3. Desk Study

3.1. Site History

3.1.1. The property is located on the south side of Frognal Lane, opposite the junction with Chesterford Gardens. The property is detached, modest in scale and set back from the road. Much of the ground floor is screened by a low brick wall, fence and planting. The property is comprised of brick, under clay tiles, with timer casement windows. The front façade of the original property is highly symmetrical. The property is pleasant in its appearance but does not have any special architectural features.

There have been a number of additions to the property, notably an attached garage to its left side, a side return to the right side and a large conservatory to the rear. Various internal alterations have also been made, though none manifest externally. There is a modest garden to the rear, which includes a number of trees.

There have been numerous applications on the site for various alterations and extensions to the property, including the addition of a basement underneath the existing building. However, to date, none of these applications have been implemented.

3.2. Geology

3.2.1. The British Geology Survey, Map of the Geology of UK, indicates that the site is underlain by Claygate Members overlying London Clay. This has been confirmed by the historical site investigations

3.3. Hydrogeology

3.3.1. The site is founded on Claygate Members which are classified as a Secondary A Aquifer with the underlying London Clay being an Unproductive Stratum.

3.3.2. LB Camden data indicates the site is not within a groundwater source protection zone and there are no recorded water abstractions in the area.

3.4. Hydrology, Drainage and Flood Risk

3.4.1. CGHH Fig 13, Hampstead Heath Map, shows that the nearest water feature is the Whitestone Pond, 0.75km to the north of the site, at a higher elevation, in a different catchment and on overlying strata and hence too remote to affect the site.

3.4.2. CGHH Fig 11, Watercourses, shows that two tributaries of the River Westbourne start in Langland Gardens and Frognal to the south-west, and the east of the site near University College School; these are at some 100m and 200m from the site respectively and will relate to the outcrop of the London Clay. There are no reported springs in the area.

3.4.3. CGHH Fig 14, Hampstead Heath Surface Water Catchment, shows that the Hampstead Ponds catchment is 0.75km to the north of the site. The site is not within the catchment of the Hampstead Heath Pond Chain.

3.4.4. The total site area is currently some 590 sq.m and is a mixture of roofs, hardstanding driveways and soft areas with approximately 50:50 permeable/impermeable ratio. The current greenfield rates for the sites are very low and are as follows for the 1 year, 30 year & 100 year event respectively; 0.38 lit/sec, 1.02 lit/sec & 1.41 lit/sec. The existing site survey drawing no. 3798-T by MSA refers.

3.4.5. The proposed surface area will comprise a mixture of roofs, hardstandings and soft gardens areas as before however, the external hardstanding areas shall be finished with a drainage cavity board system to both source control flows and provide a treatment train for discharge water. These permeable areas will comprise 280 sq.m with the impermeable roof offering 180 sq.m and the remaining areas to be soft. In addition, all rainwater downpipes shall be provided with water butts to assist in reusing rainwater for irrigation and gardening.

3.4.6. The geology of the site indicates infiltration to the ground is not possible. All storm water discharges from the site will be intercepted by an attenuation geocell below ground structure with the final flow control chamber restricting run off from the site to 2.0 lit/sec.; this being the lowest practicable non mechanical flow control device available and replicating as near to existing greenfield run off rates as possible, with a final connection made to the existing drainage and consequent sewer.

3.4.7. The site is classified as low risk of surface water flooding and is not within a Local Flood Risk Zone.

3.4.8. The site is not within a Critical Drainage Area. The Surface Water Management Plan 2013, Fig 3.1, shows LFRZ 3015, Frognal, is to the east of the site.

4. Screening

4.1.1. A screening process has been undertaken and the findings are described below.

Question	Response	Details
1a. Is the site located directly above an aquifer?	Yes-	CGHH Figs 4 and 8
1b. Will the proposed basement extend beneath the water table surface?	Yes-	See Site Investigation in Appendix 2
2. Is the site within 100mof a watercourse, well (used / disused) or potential spring line?	No-	CGHH Fig 11, Watercourses, show that a tributary to the River Westboure starts over 100m to the south in Langland Gardens
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No-	CGHH Fig 14 , Hampstead Heath Surface Water Catchment Areas shows the site is 0.75km south of these catchments
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No-	The proposed basement has no impact on the final surface area of the site.
5. As part of 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)?	No-	The proposed attenuation and flow control will restrict the run off from the site from a 1 in 100 year storm with 40% climate change increase
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 (not just the pond chains on Hampstead Heath) or spring line?	No-	CGHH Fig 12 Camden Surface Water Features shows the site in not close to any local pond or water feature.

4.2. Slope Stability

Question	Response	Details
1. Does the existing site include slopes, natural or man-made greater than 7 degrees (approximately 1 in 8)?	No-	CGHH Fig 16, Slope Angle Map shows the slopes are less than 7^o
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8)?	No-	The current levels will be maintained and there will not be any re-profiling of the landscaping
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8)?	No-	CGHH Fig 16, Slope Angle Map shows that the site is remote from any railway cuttings or embankements

4. Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately1 in 8)?	No-	CGHH Fig 16 and OS Contour Map
5. Is the London Clay the shallowest strata at the site?	No-	Geological Maps and Site Investigations show the site is founded on Claygate Members
6. Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained?	No	See Arboriculturist's Report in Appendix 6
7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site?`	No-	Claygate Members exhibit less seasonal shrink/swell than London Clay and existing house at No 38 is crack free.
8. Is the site within 100m of a watercourse or a potential spring line?	No-	CGHH Fig 11, Watercourses
9. Is the site within an area of previously worked ground?	No-	No historical records
10. Is the site within an aquifer. If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	No-	Whilst the basement will extend into the aquifer, the contiguous piled water will form its own barrier to the minor flows and dewatering techniques will not be required.
11. Is the site within 50m of the Hampstead Heath Ponds?	No-	CGHH Fig 13, Hampstead Heath Map shows the ponds are 0.75km to the north
12. Is the site within 5m of a highway or pedestrian right of way?	Yes-	The site has a street frontage along Frognal Lane
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes-	12 Langland Gardens is within 3m of the basement
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No-	London Underground Norther Line is 0.5km to east of site

4.3. Surface Water and Flooding

Question	Response	Details
1. Is the site within the catchment of the ponds chains on Hampstead Heath?	No-	CGHH Fig 14 , Hampstead Heath Surface Water Catchment Areas shows the site is 0.75km south of these catchments
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?	Yes	The proposed attenuation and flow control will restrict the run off from the site from a 1 in 100 year storm with 40% climate change increase
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No	The proposed basement has no impact on the final surface area of the site.

4. 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?	No-	Changes in impervious areas are minimal
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No-	No changes in the quality of the surface water discharge.
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 from flooding, for example because the proposed basement is below the static water level of nearby surface water feature.	No-	See FRA in Appendix 6

4.4. Non-Technical Summary of Screening Process

4.4.1. The screening process identifies the following issues to be carried forward to scoping for further assessment:

- The site is on a Secondary A Aquifer
- The basement will extend beneath the water table
- The basement will be deeper than the foundations of the neighbouring properties

4.4.2. 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.

- The site is within 5m of the highway.

5. Scoping

The following issues have been brought forward from the Screening process for further assessment:

5.1. Surface Water and Flooding

5.1.1 Although the site is in EA Flood Zone 1 and a Site Specific Flood Risk Assessment is not required, a SSFRA has been completed and is included Appendix 6.

5.1.2 The conclusions of the SSFRA are:

- The reconstruction of the house with a basement will not impact on the flood risk of the area.
- SUDS will reduce the impact of the surface water discharge into the adopted sewer.
- The forecourt level should include a mound to a level of +91.0 OD to take cognisance of any backflow onto the site from surface water flowing down Frognal Lane.

5.2. Slope Stability

5.2.1. The natural slope on Frognal Lane and Langland Gardens are 1 in 10, which is less than 7°.

5.2.2. This is correlated by GHHS Figure 16, which also shows the site is remote from any railway cuttings or embankments .

5.2.3. No further assessment is considered necessary. There will be no impacts to slope stability.

5.3. Drainage

5.3.1. The application site is not within a critical drainage area.

5.3.2. The existing impermeable area of 200m^2 will increase to 230m^2 with the proposed development; an increase of 30m^2. However, there will be a reduction of run off flows by the addition of attenuation storage with a restricted discharge of only 2.0 lit/sec from the site; the lowest practicable non mechanical flow control available.

5.3.3. A drainage assessment has been indicated by Simon Dent Associates upon their Drawing 1611 100 in Appendix 6.

5.3.4. The assessment and drainage design improves the existing site conditions and reduces the discharge to the adopted drainage infrastructure.

5.4. Ground Movement and Building Damage

5.4.1. The proposed basement will be lower than the foundations to both No 40 Frognal Lane and 12 Langland Gardens.

5.4.2. The proposed development will increase the differential foundation depth with neighbours. Construction and excavation activities will cause ground movements that have the potential to damage existing, neighbouring structures.

5.4.3. It is considered that the development proposals can be suitably designed to maintain stability. In order to demonstrate this, a site specific ground investigation is presented in Section 6, with structural information and a ground movement assessment presented in Section 7. Conclusions of the impact assessment are provided in Section 8.

5.5. Groundwater and Hydrogeology

5.5.1. The Site Investigation have established that the thickness of the Claygate Members beneath the site is 7m with CGHH, Fig 4 showing the London Clay to outcrop 120m down the slope. The thickness of the Claygate Members decreases to the south and west by 1m in 15m.

5.5.2. Water will collect to the base of the Claygate Members perching above the impervious London Clay. Given the moderately low permeability of the Claygate Members, it is expected that it will contain water all year round.

Catchment & Macro Groundwater Flows

5.5.3. The Claygate Member/London Clay contact is shown on CGHH Fig 4 to pass along Lindfield Gardens, across Langland Gardens and Frognal Lane, at an elevation of approximately 82m AOD. This is coincident with the start of the River Westbourne tributary shown on CGHH Fig 11 as being 100m south-west of the site, within a shallow valley. A second tributary commences beneath University College School, 200m east of the site, again on the Claygate Member/London Clay contact, again at an elevation of approximately 82m AOD, again in a shallow valley feature.

5.5.4. The location of these two tributaries, suggests the site is located near a groundwater divide. Hence the area of the catchment contributing to the tributary commencing on Langland Gardens, and in which the site must be located, is relatively small.

5.5.5. Based upon the location of the three tributaries identified on CGHH Fig 11, and the extent of the Hampstead Pond Catchment Area on CGHH Fig 14, defines the catchment area for the Langland Gardens tributary as being approximately 10 hectares (200m wide, 500m long). Assuming a typical average recharge into the Claygate Member of no more than 250mm/yr, would yield an average annual groundwater contribution to the tributary of 25,000m^3/yr, which equates on average to 1 litre per second.

5.5.6. Whilst it is unknown whether these tributaries flow year round or just in winter months, clearly a flow of typically 1 litre per second is fairly minimal, especially if dispersed along a wide seepage horizon.

Groundwater Throughflow beneath the site

5.5.7. An estimate of the groundwater throughflow beneath the site can be calculated using Darcy's Law Q = k i a, where:

k = permeability, which is taken as being 1 x 10^{-6} m/s. [See 7.1.1]

i = hydraulic gradient, which is taken from the 2020 Site Investigation as being 0.1

a = the cross-sectional area comprising a water table depth of 6m and a site and basement widths of 30m and 20m respectively giving cross sectional areas of 180m^2 and 120m^2

This gives a value of 0.018l/s or 1.5m^3/day for the site and 0.012l/s or 1m^3/day for the basement. This is very little water and within the capacity of a sump pump during excavations.

Groundwater Flow Obstructions

5.5.8. No 12 Langland Gardens, down the slope from No 38, is 17m wide and its lower ground floor is at +86m OD. This lower ground floor obstructs but does not cut off the groundwater flow

5.5.9. This means that the proposed basement is in the shadow of No 12 Langland Gardens with the latter defining the status quo with regard to groundwater flow below the site

5.5.10. Groundwater flows will eventually move around the impermeable box consequently there is unlikely to be an effect to the catchment of the river tributaries. Even if the site groundwater flows were to be lost, these site groundwater throughflows (estimated at no more than 0.003 l/s) are less than 0.5% of the estimated catchment groundwater baseflow and hence will be immeasurable and negligible.

5.5.11. However the proposed basement will impact on the water table, raising the free surface on the upstream side and depressing it on the downstream side.

5.5.12. The proposed basement is 14m from the centreline of Frognal Lane. To the rear there are no houses to the south of No 38. No 40 is 19m up the slope to the west of No 38.

5.5.13. The magnitude of the groundwater level changes due to construction of the impermeable basement and pool, without further mitigation are difficult to quantify, given the existing basement disturbance to the Claygate Member at the adjacent houses. However experience in similar strata suggests these will be of the order of 0.2 -0.8m. This will be in No 40 Frognal Lane's garden and will not affect the house which is 20m further up the slope

Mitigation Measures

5.5.14. As mitigation measures:

- 5.5.14.1. a pea shingle blanket will be installed around the basement to intercept the groundwater on the high side, allow it to flow around the basement and replenish the water table on the low side.
  - 5.5.14.1.1.Contiguous piles will be used with 150mm gap between 600mm diameter piles giving a 20% pathways beneath the basement slabs

6. Site Investigation/Additional Assessments

6.1. Site Investigation

Soils Ltd have completed two Site Investigations on 38 Frognal Lane in 2014 and again in 2020. Details of these are given in Appendix 2.

2014
The 2014 site investigation comprised two window samplers to a depth of 6m in the forecourt. This established that the Claygate Members extend to a greater depth than 6m.

Standpipes were installed in both window samplers with the groundwater measured in December 2013 and January 2014. Initially the depth was 2.0m [east] and 2.8m [west] rising after a month to 0.8m [east] and 1.5m [west]. Being on the forecourt, the locations were at the same level,18m apart, so the gradient of the phreatic surface across the site in early 2014 was 1 in 20.

2020
The 2020 site investigation comprised a 20m borehole in the forecourt and two 10m window samplers in the rear garden. The 20m borehole gives strength parameters for the pile design. The 10m window samplers held triangulate the depth of the London Clay, which ranges between 5.5m and 7.8m in depth as well as the ground water phreatic surface.

Standpipes were installed in all three holes and were monitored over a 3 month period. The initial readings during the boring of the holes were discounted. The first set of subsequent readings at the beginning of October established that the phreatic surface across the site had a gradient of 1 in10.

6.2. Additional Assessments

6.2.1 A Ground Movement and Building Damage Assessment is presented in Appendix 4

6.2.2 An Arborcultural Report is presented in Appendix 6

7. Construction Methodology/ Engineering Statements

7.1. Outline Geotechnical Design Parameters

7.1.1. The geotechnical parameters are presented in the Site Investigation Reports in Appendix 2. A falling head permeability test in No 40 Frognal Lane established that the permeability, k, was 4 x10^{-7} m/s. Conservatively the throughflow has been based on k =1 x 10^{-6} m/s

7.2. Outline Temporary and Permanent Works Proposals

7.2.1. The works proposals include:

- Demolition of the existing house
- Installation of contiguous piles to perimeter of basement and piles to basement columns
- Construction of capping beam or installation of high level wailer system with propping to hold excavation stiff
- Excavation of basement. This will require the interception of any seepages with a sump and pump, but formal dewatering techniques will not be required. The throughflow in 5.5.7 at less than 0.01l/s is well within the capacity of a single sump pump.
- Casting of basement raft and perimeter walls in waterproof concrete
- Removal of wailer and completion of lid to basement box.
- Drainage strategy/SUDS proposals as SDA Drawing 1611 100

7.3. Ground Movement and Damage Impact Assessment

7.3.1. A Ground Movement Assessment (GMA) has been carried out in accordance with CIRIA Report C580.

7.3.2. The conceptual model follows the principles in C580, Section 2.5.2 assuming the strains are uniformly distributed over the zone of influence. The strains tabulated in C580 are:

7.3.2.1.at the surface, reducing linearly to zero at the base of the excavation or walling element. This means that on a slope, where the adjoining building is at a different level, it is the net difference in level rather than the excavation depth that defines the zone of influence

7.3.2.2.perpendicular to the excavation. Whilst only applicable to the horizontal strains at excavation corners or changes in the depth of the wall, if the orientation is at an angle, it is the perpendicular component horizontal strain that is appropriate.

7.3.3. All structures / properties within the zone of influence have been assessed including No 40 Frognal Lane, 12 Langland Gardens.

7.3.4. The ground movements resulting from the works are presented as horizontal and vertical differential settlement strains and plotted on Burland Scale Figures for four locations.

7.3.5. No 40 Frognal Lane and No 12 Langland Gardens were assessed, having been identified as potentially within that zone of influence of the proposed basement.

7.3.6. In accordance with the Burland Scale, the damage impacts are assessed as Category 1 Very Slight or less

7.3.7. Propping of the contiguous piles in both the temporary and permanent works will be used to mitigate and reduce ground movements and damage impacts.

7.4. Control of Construction Works

7.4.1. The construction works will be controlled in accordance with the contract preliminaries and the engineering specifications

7.4.2. The predicted vertical movements in the adjacent buildings are less than 5mm with the differential vertical movements being even smaller again. The predicted damage is Burland Category 1, Very Slight, and level monitoring is neither justified nor practical since the movements are within the closing errors of such surveys. At a pragmatic level Tell Tail crack gauges will be installed, if required by the adjoining owners party wall surveyor, to monitor the movement at any historical cracks.

8. Basement Impact Assessment

8.1. Conceptual Site Model

8.1.1. The Conceptual Site Model (CSM) is…

- The proven ground conditions are Claygate Members overlying London Clays
- The natural slope of the road has been terraced to form the current site.
- The existing building has shallow foundations 0.8m below ground level.
- The proposed development will have piled foundations with contiguous piled walls to the basement
- The depths of neighbouring foundations/basements are typically 0.8m below ground level
- The site has a street frontage
- There are no adjacent tunnels or significant utility infrastructure.

8.2. and Stability/Slope Stability

8.2.1. The site investigation has identified that both the Claygate Member and London Clay are suitable founding strata.

8.2.2. The risk of movement and damage to this development due to seasonal movements of the ground are minimal.

8.2.3. A Ground Movement Assessment has concluded that the potential Damage to surrounding structures within the zone of influence has been assessed as Burland Scale Category 1.

8.2.4. The BIA has concluded that there will not be risk(s) or stability impact(s) to the development and/or adjacent sites due to slopes.

8.3. Hydrogeology and Groundwater Flooding

8.3.1. The BIA has concluded there is a very low risks of groundwater flooding. The local changes to the water table with the obstruction of the basement will be mitigated with a perimeter pea shingle blanket and the gaps between the contiguous beams beneath the basement.

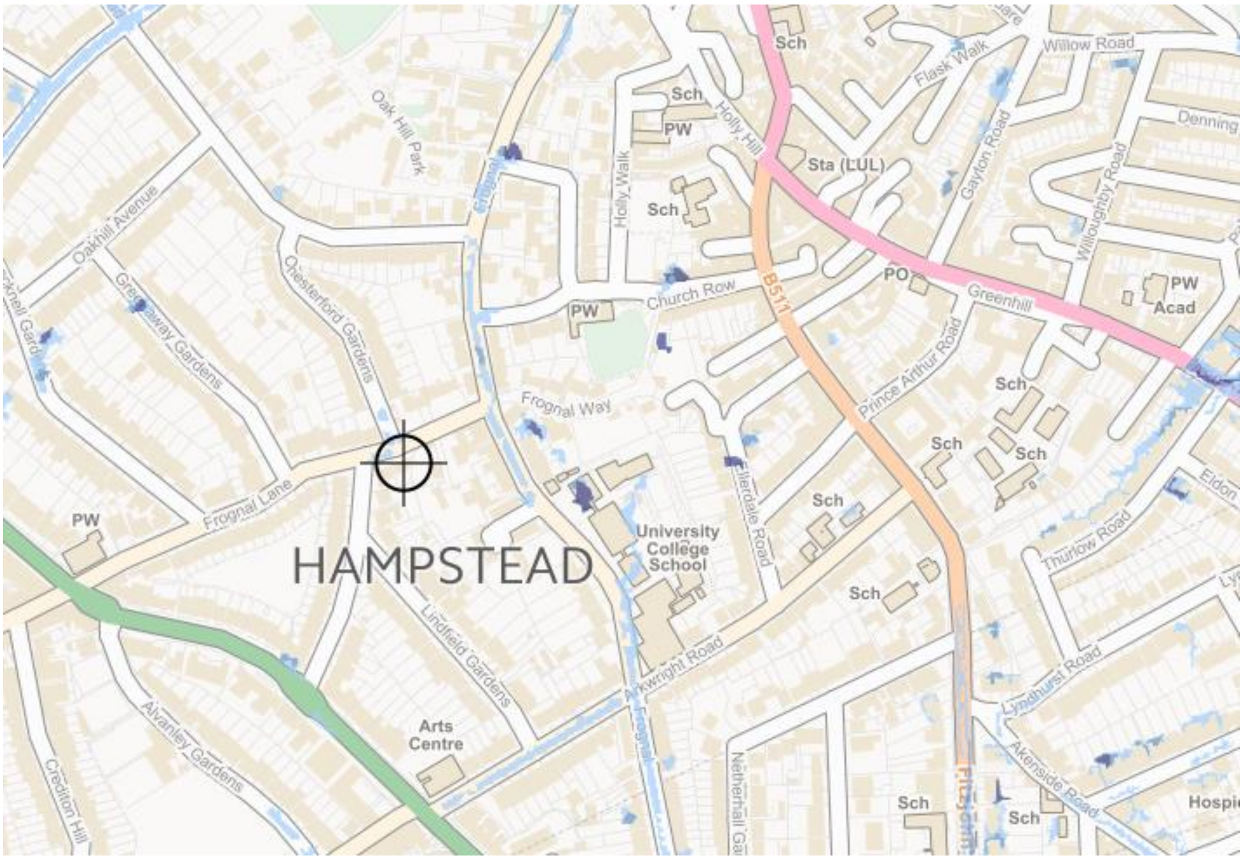
8.3.2. The BIA has concluded there are limited impacts to the wider hydrogeological environment with the construction of the basement are minimal.

8.4. Hydrology, Surface Water Flooding and Sewer Flooding

8.4.1. The site specific FRA has concluded there is a low risk of surface water/sewer flooding. Mitigation measures are proposed to reduce the surface water discharge rate with on site storage, as shown on SDA drawing 100, 101, 200 & 201.

8.4.2. The BIA has concluded there are no impacts to the wider hydrological environment.

Appendix 1: Desk Study References



EA Surface Water Flooding Map of NW3 6PP showing some ponding to the southern end of Chesterford Gardens , but not on Frognal Lane

Appendix 2: Site Investigation Data

soils
L I M I T E D

Main Investigation Report

at
38 Frognal Lane, London NW3 6PP

for
MRPP

Reference: 18577/MIR_R27
October 2020

Control Document

Project
38 Frognal Lane, London NW3 6PP

Document Type
Main Investigation Report

Document Reference
18577/MIR_R27

Document Status
Final

Date
October 2020

Prepared by
T Rudkin BSc. (Hons.), MSc., FGS.

First check by
Eur Ing R B Higginson BSc, PGDip, CEng, MICE, FGS.

Second check by
N J Lambert BSc (Hons), CEnv, FGS, MIEnvSci.

This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Commission

MRPP commissioned Soils Limited to undertake an intrusive ground investigation and prepare a Main Investigation Report on land at 38 Frognal Lane, London NW3 6PP. The scope of the investigation was outlined in the Soils Limited quotation reference Q23072 Rev. 1, dated 24th July 2020.

This document comprises the Main Investigation Report and incorporates the results, discussion and conclusions to this intrusive works.

A Preliminary Investigation Report (Phase I Desk Study) was not commissioned on the site.

Standards

The site works, soil descriptions and geotechnical testing was undertaken in accordance with the following standards:

- BS 5930:2015+A1:2020 and BS EN ISO 22476-2&3:2005+A1:2011
- BS EN ISO 14688-1:2002+A1:2013
- BS EN ISO 14688-2:2004+A1:2013
- NHBC Standards 2020
- BRE Digest 240:1993
- BRE Special Digest 1:2005

The geotechnical laboratory testing was performed by GEO Site & Testing Services Ltd (GSTL) in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

For the preparation of this report, the relevant BS code of practice was adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

The sulphate chemical WAC analyses were undertaken by Derwentside Environmental Testing Services (DETS) in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures. This investigation did not comprise an environmental audit of the site or its environs.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to produce a trial hole.

Contents

List of Figures

List of Tables

List of Appendices

Section 1 Introduction

1.1 Objective of Investigation

MRPP commissioned Soils Limited to undertake an intrusive ground investigation and to prepare a Main Investigation Report to supply the client and their designers with information regarding ground conditions, to assist in preparing a foundation scheme for development that was appropriate to the settings present on the site.

The investigation was to be undertaken to provide comment on appropriate foundation options for the proposed residential basement development. The investigation was to be made by means of in-situ testing and geotechnical laboratory testing undertaken on soil samples taken from the trial holes.

This report does not include a Basement Impact Assessment (BIA) which is understood to be prepared by others based on the findings of this intrusive site investigation.

A single soil sample was taken for chemical laboratory Waste Acceptance Criteria (WAC) analysis.

No Preliminary Investigation Report (Phase I Desk Study) was commissioned on the site.

1.2 Location

The site was located at 38 Frognal Lane, London NW3 6PP and had an approximate O.S Land Ranger Grid Reference of TQ 260 855.

The site location plan is given in Figure 1.

1.3 Site Description

The application site comprised a two storey house with gravel front driveway and turfed private garden to the rear. The site was situated on a hillside setting with an overall gradient anticipated to be on the order of 10 degrees sloping down to the south-west. The site was levelled into the slope with retaining walls present at the east side of the existing house and gravel driveway.,. The site was lined with mature trees and vegetation and bounded by residential housing in all directions.

An aerial photograph showing the site and its close environs has been included in Figure 2.

1.4 Proposed Development

It was understood the proposed development was to comprise construction of a basement beneath the existing house onsite. The basement formation level of 3.50m bgl and no alterations to the landscaping configuration of the site was presumed.

At the time of report, no proposed development drawings were available. It is recommended this report is revised once these have been issued.

Information provided by the client is presented in Appendix E.

1.5 Anticipated Geology

The 1:50,000 BGS map showed the site to be located upon the bedrock Claygate Member with no recorded overlying superficial deposits. The Claygate Member overlies the London Clay Formation.

1.5.1 Claygate Member

The Claygate Member comprises a finely interbedded and thinly laminated sequence of clay, silt and fine grained sand with numerous interbeds of planar and lenticular bedded fine grained fine laminated sands up to 1m thick.

1.5.2 London Clay Formation

The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay, and precautions against sulphate attack to concrete are sometimes required.

The upper boundary member of the London Clay Formation is known as the Claygate Member and marks the transition between the deep water, predominantly clay environment and succeeding shallow-water, sand environment of the Bagshot Formation.

The lower boundary is generally marked by a thin bed of well-rounded flint gravel and/or a glauconitic horizon. The formation overlies the Harwich Formation or where the Harwich Formation is absent the Lambeth Group.

In the north London area the upper part of the London Clay Formation has been disturbed by periglacial action and may contain pockets of sand and gravel.

1.6 Limitations and Disclaimers

This Main Investigation Report relates to the site located at 38 Frognal Lane, London NW3 6PP and was prepared for the sole benefit of MRPP (The “Client”). The report was prepared solely for the brief described in Section 1.1 of this report.

Soils Limited disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Conditions of Contract of Business and taking into account the resources devoted to us by agreement with the Client.

The report is personal and confidential to the Client and Soils Limited accept no responsibility of whatever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly at its own risk.

The Client may not assign the benefit of the report or any part to any third party without the written consent of Soils Limited.

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot by plot basis prior to the construction of foundations. Supplied site surveys may not include substantial shrubs or bushes and is also unlikely to have data or any trees, bushes or shrubs removed prior to or following the site survey.

Where trees are mentioned in the text this means existing trees, substantial bushes or shrubs, recently removed trees (approximately 20 years to full recovery on cohesive soils) and those planned as part of the site landscaping).

It should be noted that a detailed survey of the possible presence or absence of invasive species, such as Japanese Knotweed, is outside of the scope of investigation.

Ownership of land brings with it onerous legal liabilities in respect of harm to the environment. “Contaminated Land” is defined in Section 57 of the Environment Act 1995 as:

“Land which is in such a condition by reason of substances in, on or under the land that significant harm is being caused or that there is a significant possibility of such harm being caused or that pollution of controlled waters is being, or is likely to be caused”.

The investigation, analysis or recommendations in respect of contamination are made solely in respect of the prevention of harm to vulnerable receptors, using where possible best practice at the date of preparation of the report. The investigation and report do not address, define or make recommendations in respect of environmental liabilities. A separate environmental audit and liaison with statutory authorities is required to address these issues.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets remains with Soils Limited. License is for the sole use of the client and may not be assigned, transferred or given to a third party.

Section 2 Site Works

2.1 Proposed Project Works

The proposed intrusive investigation was designed to provide information on the ground conditions and to aid the design of foundations for the proposed residential basement development. The intended investigation, as outlined within the Soils Limited quotation (Q23072 Rev. 1, dated 24th July 2020), was to comprise the following items:

- 2No. windowless sampler boreholes
- 2No. super heavy dynamic probes
- 2No. 20m deep cable percussion boreholes
- Installation of 3No. up to 10m deep groundwater monitoring well installations
- 2No. falling head soakage tests
- Geotechnical laboratory testing
- Contamination laboratory testing (WAC test plus Haz-waste classification).

2.1.1 Actual Project Works

Given access constraints to the front of the property, the scope was revised to include a single 20m cable percussive borehole and this was agreed by the client. The actual project works were undertaken on between 15th August and 4th September 2020 and comprised:

- 2No. windowless sampler boreholes (WS101 – WS102)
- 1No. super heavy dynamic probe (DP101)
- 1No. 20m deep cable percussive borehole
- Installation of 3No. 10m deep groundwater monitoring wells
- 2No. falling head soakage tests (undertaken post-works down monitoring well)
- Geotechnical laboratory testing
- Contamination laboratory testing (WAC test plus Haz-waste classification)

All three trial holes were installed with monitoring standpipes comprising slotted pipe with non-calcareous gravel pack surround from 10m to 1m below ground level (bgl) with bentonite seal above topped with stopcock cover set in concrete.

All trial hole locations have been presented in Figure 3.

Following completion of site works, soil cores were logged and sub sampled so that samples could be sent to the laboratory for both contamination and geotechnical testing.

2.2 Ground Conditions

Between 25th and 26th August 2020, a single cable percussive borehole (BH1) was drilled to a depth of 20.00m bgl at a location selected by the client. Alternate SPT/U100 testing was undertaken at 1m intervals for the top 5m bgl and at 1.5m intervals thereafter.

On 4th September 2020, two windowless sampler boreholes (WS101 – WS102) were drilled to a depth of 10.00m bgl at locations selected by the client. A single super heavy dynamic probe (DP101) was driven prior and adjacent to WS101 to a depth of 10.00m bgl.

Monitoring standpipes were installed to a depth of 10.00m bgl within each trial hole location to allow for continued monitoring of groundwater levels, where present.

The maximum depths of trial holes have been included in Table 2.1.

All trial holes were scanned with a Cable Avoidance Tool (C.A.T.) and signal generator (Genny) prior to excavation to ensure the health and safety of the operatives.

Table 2.1 Final Depth of Trial Holes

Trial Hole	Depth (m bgl)	Trial Probe	Depth (m bgl)
WS101 W	10.00	DP101	10.00
WS102 W	10.00		
BH1 W	20.00		

Note: w - well installation

The approximate trial hole locations are shown on Figure 3.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the trial hole logs and quoted in this report were measured from ground level.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots, or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix A, but for the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised as:

Made Ground (MG)
Claygate Member (CLGB)
London Clay Formation (LCF)

The ground conditions encountered in the trial holes are summarised in Table 2.2.

Table 2.2 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG	Anthropocene	0.00	0.20 – 1.50	1.00	Dark brown gravelly SAND and CLAY comprising fragments of brick, clinker and flint.
CLGB	Eocene	0.20 – 1.50	4.00 – 5.50	4.00	Grey mottled yellowish brown slightly fine sandy silty CLAY.
LCF	Eocene	4.00 – 5.50	>20.00[1]	Not proven[2]	Dark grey silty CLAY.

Note: [1] Final depth of trial hole. [2] Base of strata not encountered. 0.00 denotes existing ground level.

2.3 Ground Conditions Encountered in Trial Holes

The ground conditions encountered in trial holes have been described below in descending order. The engineering logs are presented in Appendix A.1.

2.3.1 Made Ground

Soils described as Made Ground were encountered in all three trial holes from ground level and persisted to depths ranging between 0.20m and 1.50m bgl.

The Made Ground typically comprised dark brown gravelly SAND and gravelly CLAY. Gravel comprised fragments of brick, clinker, and flint.

The depths of Made Ground have been included in Table 2.3.

Table 2.3 Final Depth of Made Ground

Trial Hole	Depth (m bgl)
WS101	1.50
WS102	1.00
BH1	0.20

2.3.2 Claygate Member

Soils described as Claygate Member were encountered underlying the Made Ground and persisted to depths ranging between 4.00m and 5.50m bgl.

The Claygate Member comprised grey mottled yellowish brown slightly fine sandy silty CLAY with occasional black speckling and sand to gravel sized selenite crystals.

The depth of Claygate Member has been included in Table 2.4.

Table 2.4 Final Depth of Claygate Member

Trial Hole	Depth (m bgl)
WS101	5.20
WS102	4.00
BH1	5.50

2.3.3 London Clay Formation

Soils described as London Clay Formation were encountered underlying the Claygate Member and persisted to the full investigatory depth of 10.00m for windowless sampler boreholes and to 25.00m bgl for the cable percussive borehole.

The London Clay Formation comprised dark grey silty CLAY with rare gravel sized selenite crystals and rare gravel sized calcareous shell fragments.

A discrete mudstone band was encountered in WS101 from 4.90m to 5.20 bgl.

The depth of London Clay Formation has been included in Table 2.5.

Table 2.5 Final Depth of London Clay Formation

Trial Hole	Depth (m bgl)
WS101	>10.00[1]
WS102	>10.00[1]
BH1	>20.00[1]

Note: [1] Final depth of trial hole.

2.4 Roots

Roots/rootlets were encountered in all three trial holes observed to depths ranging between 1.20m and 3.90m bgl. The depths of root penetration have been included in Table 2.6.

Table 2.6 Depth of Root Penetration

Trial Hole	Depth (m bgl)
WS101	3.90
WS102	3.80
BH1	1.20

Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs.

It must be emphasised that the probability of determining the maximum depth of roots from a narrow diameter borehole is low. A direct observation such as from within a trial pit is necessary to gain a better indication of the maximum root depth.

The deeper root penetrated soils were encountered in WS101 and WS102, in proximity to mature trees lining the rear private garden.

2.5 Groundwater

A groundwater strike was only encountered within one trial hole (WS101) recorded at a depth of 6.00m bgl. No definitive water strikes were recorded during the drilling of the remaining trial holes; however, water seepage was noted in BH1 at 2.80m bgl and standing water recorded at 8.50m bgl on completion of drilling.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in August/September (2020) when groundwater levels should at their annual minimum (lowest) elevation. Annual maximum (highest) water levels typically occur around March.

Further groundwater monitoring was conducted within the standpipe installed on site following completion of site works and has been presented in Table 2.7.

A single post-works monitoring visit was undertaken at the time of reporting, with an additional two scheduled at monthly intervals, with the final visit due beginning of December 2020.

Table 2.7 Groundwater Monitoring

Trial Hole	Depth to Water (m bgl)		Base of Well (m bgl)
	04/09/2020	01/10/2020	
WS101	6.00	2.56	10.00
WS102	DRY	1.81	10.00
BH1	8.50	1.67	10.00

Note:

Higher than anticipated water levels were recorded on 1st October 2020 at depths of between 1.67m and 2.56m bgl, likely from the presence of water bearing lenses within the Claygate Member. The results will be updated on completion of the monitoring regime.

Groundwater equilibrium conditions may only be conclusively established if a series of observations are made over a seasonal period via groundwater monitoring wells.

Section 3 Discussion of Geotechnical In-Situ and Laboratory Testing

3.1 Standard Penetration Tests

Standard Penetration Tests (SPTs) were undertaken in BH1. The results were interpreted based on the classifications outlined in Appendix B.1.

The SPT “N60” values presented have been corrected in accordance with BS EN 22476 Part 3, to account for the rig efficiency, borehole depth, overburden factors etc. Further correction of the ‘N’ values should therefore not be necessary. The energy ratio is presented on the individual logs within Appendix A.1.

The Claygate Member recorded SPT “N60” values between 9 and 13 classifying the cohesive soils as medium strength with inferred undrained cohesive strengths of 45kPa to 65kPa.

The London Clay Formation recorded SPT “N60” values between 19 and 39 classifying the cohesive soils as high becoming very high, with undrained cohesions of 95kPa to 195kPa increasing with depth.

A full interpretation of the SPT results are outlined in Appendix B.2, Table B.2.1.

3.2 Dynamic Probe Tests

Dynamic probing (DPSH) was undertaken adjacent to WS101 (DP101) to a depth of 10.00m bgl. The results were converted to equivalent SPT “N60” values based on dynamic energy using commercial computer software (Geostru). The results were then interpreted based on the classifications outlined in Appendix B.1.

The SPT “N60” values presented have been corrected in accordance with BS EN 22476 Part 3, to account for the rig efficiency, borehole depth, overburden factors etc. Further correction of the ‘N’ values should therefore not be necessary. The energy ratio is presented on the individual logs within Appendix B.3.

The Claygate Member recorded equivalent SPT “N60” values between 3 and 6, classifying the cohesive soils as very low to low strength with undrained cohesions of 15kPa to 30kPa, increasing with depth.

The London Clay Formation recorded equivalent SPT “N60” values between 9 and 15 classifying the cohesive soils as medium strength with undrained cohesions of 45kPa to 75kPa, increasing with depth.

A full interpretation of the DPSH tests are outlined in Appendix B.2, Table B.2.2.

3.3 Falling Head Soakage Tests

Two falling head soakage tests were undertaken, within WS101 and WS102. At the time of completing the falling head soakage tests, water was recorded in the standpipes at depths of 2.56m and 1.81m bgl in WS101 and WS102, respectively. Water was added on top of the standing water levels to complete the tests. **Estimated** soakage rates were calculated and outlined in Table 3.1. It must be emphasised that the rates given must not be used for design calculations and full in-situ testing must be undertaken to BRE 365 Soakaway Design standards.

Table 3.1 Soakage Rates

Trial Hole	Test No.	Soakage Rate (Ltr/min)
WS101	1	0.104
WS102	1	0.071

3.4 Quick Unconsolidated Undrained Triaxial Compression Tests

Quick Unconsolidated Undrained Triaxial Compression Tests (QUU) were performed on six samples, one obtained from the Claygate Member and five from the London Clay Formation. The strength interpretation was based on the classification outlined in Appendix B.1.

The QUU testing indicated soils of the Claygate Member were of a high strength with an undrained cohesion of 83kPa.

Soils of the London Clay Formation were of a high strength with undrained cohesions of between 94kPa and 144kPa.

A full interpretation of the QUU tests are outlined Table B.2.3, Appendix B.2 and the laboratory report in Appendix B.3.

3.5 Atterberg Limit Tests

Atterberg Limit tests were performed on six samples, two obtained from the Claygate Member and four from the London Clay Formation. The results were classified in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

The Claygate Member was classified as low to medium volume change potential in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

The London Clay Formation was classified as medium to high volume change potential in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

A full interpretation of the Atterberg Limit tests are outlined in Table B.2.4, Appendix B.2 and the laboratory report in Appendix B.3.

3.6 Sulphate and pH Tests

Two samples were taken from the Claygate Member and one from the London Clay Formation for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, ‘Concrete in Aggressive Ground’.

The tests recorded water soluble sulphate between 216mg/l and 2500mg/l with pH values of 7.4 to 7.7.

The significance of the sulphate and pH test results are discussed in Section 4.6 and the laboratory report in Appendix B.3.

Section 4 Foundation Design

4.1 General

An engineering appraisal of the soil types encountered during the site investigation and likely to be encountered during the redevelopment of this site is presented. Soil descriptions are based on analysis of disturbed samples taken from the trial holes.

4.1.1 Made Ground and Topsoil

The terms *Fill* and *Made Ground (non-engineered fill)* are used to describe material, which has been placed by man either for a particular purpose e.g. to form an embankment, or to dispose of unwanted material. For the former use, the Fill and/or Made Ground may well have been selected for the purpose and placed and compacted in a controlled manner. With the latter, great variations in material type, thickness and degree of compaction invariably occur and there can be deleterious or harmful matter, as well as potentially methanogenic organic material.

The BSI Code of Practice for Foundations, BS 8004:2015, Clause 4.1.2.2 states, *'Spread foundations should not be placed on non-engineered fill unless such use can be justified on the basis of a thorough ground investigation and detailed design.'*

Soils described as Made Ground were encountered in all three trial holes from ground level and persisted to depths ranging between 0.20m and 1.50m bgl. The Made Ground typically comprised dark brown gravelly SAND and gravelly CLAY. Gravel comprised fragments of brick, clinker, and flint.

A result of the inherent variability, particularly of uncontrolled Topsoil, Fill and/or Made Ground is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should, therefore, be taken through any Topsoil and/or Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

4.1.2 Claygate Member

Soils described as Claygate Member were encountered underlying the Made Ground and persisted to depths ranging between 4.00m and 5.50m bgl. The Claygate Member comprised grey mottled yellowish brown slightly fine sandy silty CLAY with occasional black speckling and sand to gravel sized selenite crystals.

The results from SPT testing inferred that the cohesive soils of the Claygate Member were of medium strength with undrained cohesions of between 45kPa and 65kPa.

The results from DPSH testing inferred that the cohesive soils of the Claygate Member were of a very low to low strength with undrained cohesions of between 15kPa and 30kPa.

The results from QUU tests indicated the soils of the Claygate Member were of a high strength with an undrained cohesion of 83kPa.

The results from Atterberg Limits tests confirmed that the soils of the Claygate Member had **low to medium volume change potential** in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

Soils of the Claygate Member are overconsolidated, predominantly cohesive soils and are expected to display moderate bearing and settlement characteristics. The soils of the Claygate Member were considered a suitable bearing stratum, depending on the final depth of the proposed basement.

4.1.3 London Clay Formation

Soils described as London Clay Formation were encountered underlying the Claygate Member and persisted to the full investigatory depth of 10.00m for windowless sampler boreholes and to 25.00m bgl for the cable percussive borehole. The London Clay Formation comprised dark grey silty CLAY with rare gravel sized selenite crystals and rare gravel sized calcareous shell fragments.

A discrete mudstone band was encountered in WS101 from 4.90m to 5.20 bgl.

The results from SPT testing inferred that the London Clay Formation was of high becoming very high strength, with undrained cohesive strengths of 95kPa to 195kPa, increasing with depth.

The results from DPSH testing inferred that the London Clay Formation was of medium strength with undrained cohesions of 45kPa to 75kPa.

The results form QUU testing indicated the soils of the London Clay Formation were of a high strength with undrained cohesions of between 94kPa and 144kPa.

The results from Atterberg Limit tests classified the cohesive London Clay Formation as medium to high volume change potential in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

Soils of the London Clay Formation are heavily overconsolidated cohesive soils and expected to display moderate bearing and settlement characteristics. The London Clay Formation was considered a suitable bearing stratum for the proposed development.

4.2 Foundation Scheme General

It was understood the proposed development was to comprise construction of a basement beneath the existing house onsite. A Basement formation level of 3.50m bgl and no alterations to the landscaping configuration of the site was presumed.

At the time of report, no proposed development drawings were available. It is recommended this report is revised once these have been issued.

Development plans provided by the client are presented in Appendix E.

4.2.1 Guidance on Shrinkable Soils

The Building Research Establishment (BRE) Digests 240, 241 and 242 provide guidance on ‘best practice’ for the design and construction of foundations on shrinkable soils.

The results from Atterberg Limit tests showed that the Claygate Member had low to medium volume change potential and the London Clay Formation had medium to high volume change potential. in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

Medium and high volume change potential must therefore be adopted where foundations pass through the Claygate Member and London Clay Formation, respectively.

The BRE Digest 241 states: *“An increasingly common, potentially damaging situation is where trees or hedges have been cut down prior to building. The subsequent long-term swelling of the zone of clay desiccated by the roots, as moisture slowly returns to the ground, can be substantial. The rate at which the ground recovers is very difficult to predict and if there is any doubt that recovery is complete then bored pile foundations with suspended beams and floors should be used”.*

The stated intention of the NHBC is to ensure that shrinkage and swelling of plastic soils does not adversely affect the structural integrity of foundations to such a degree that remedial works would be required to restore the serviceability of the building. It must be borne in mind that adherence to the NHBC tables and design recommendations may not, in all cases, totally prevent foundation movement and cracking of brickwork might occur.

The BRE Digest 240 suggests: *“Two courses of action are open:*

Estimate the potential for swelling or shrinkage and try to avoid large changes in the water content, for example by not planting trees near the foundations.

Accept that swelling or shrinkage will occur and take account of it. The foundations can be designed to resist resulting ground movements or the superstructure can be designed to accommodate movement without damage.”

The design of foundations suitable to withstand movements is presented in BRE Digest 241 “Low-rise buildings on shrinkable clay soils: Part 2”

4.3 Foundation Scheme

Foundations **must not** be constructed within any Made Ground/Topsoil due to the likely variability and potential for large load induced settlements both total and differential.

Roots/rootlets were encountered in all three trial holes observed to depths ranging between 1.20m and 3.90m bgl. If roots are encountered during the construction phase foundations **must not be placed within any live root penetrated** or desiccated **cohesive soils or those with a volume change potential**. Should the foundation excavations reveal such materials, the excavations **must** be extended to greater depth in order to bypass these unsuitable soils. Excavations must be checked by a suitable person prior to concrete being poured.

Considering the type of development, a traditional strip foundation within the basement may be feasible however, given root/rootlet observations at the trial holes locations, traditional foundations within the basement cannot be recommended at depths shallower than 4.00m bgl. Notwithstanding, constructional challengers of adopting strip foundations at this depth and possible presence of groundwater within discrete granular seams within the Claygate Member may prove piled foundations more economical. Both options have been considered below.

4.3.1 Shallow Foundations within Basement

Foundations constructed within the basement excavation could be considered and the bearing capacity of such foundations is given below. If the foundation is to include lateral load from retained soil, then the distribution of loads on the foundation will be trapezoidal and the maximum pressure will be at the toe of the foundation. In such cases additional analyses must be requested by the client such that the appropriate analyse is undertaken.

If the wall is to have backfill placed on both sides, the backfill must be placed in shallow rises on both sides to maintain similar lateral forces on both sides of the wall.

A proposed basement excavation 3.50m deep would remove an overburden pressure of circa 60kPa, based on a unit weight of $18kN/m^3$ for the overlying soil.

An “net” allowable bearing capacity of 80kPa was calculated, founding at a minimum depth of 4.00m bgl within the Claygate Member, based on a 5m by 0.75m strip foundation.

Taking account of the removed overburden pressure the “gross” bearing value could be taken as 140kPa.

For the allowable bearing value given above, settlements should not exceed 20mm, provided that excavation bases are carefully bottomed out and blinded, or concreted as soon after excavation as is possible and kept dry. Settlements may be taken as proportional to the applied foundation pressure for the given size of the foundations.

The use of reinforced trench fill foundations must be used to reduce the potential of differential settlement across foundations.

Settlements may be taken as proportional to the bearing capacity given for the same configuration of foundation i.e. halving the applied loads the settlements would have.

Special care must be taken during foundation excavation in order to establish that any soft/loose spots found within the soils are removed from the base of excavations.

Foundations must not be cast over foundations of former structures and other hard spots.

4.3.2 Basement and Stability Requirements

This report does not comprise a basement impact assessment (BIA), which was understood to be undertaken by others based on the findings of this intrusive site investigation.

4.3.3 Basement Construction Stability Issues

The excavation of the basement **must not** affect the integrity of any adjacent structures beyond the site boundaries. Where there is a sufficient distance between the site boundary and the basement excavation, support may be permitted using a strip foundation to form an earth retaining structure. In other cases, the most suitable form of construction should be within a coffer dam structure using a sheet piles, secant or contiguous concrete piled wall around the periphery of the structure.

Generally cantilevered piled walls have an open face to embedded ratio of about one to two ie. a supported face 3.50m in height would require a penetration into the ground, below the base of the excavation, of about 7.00m. Should the piled wall be purely an unsupported cantilever then it is likely that quite deep section sheet piles or large diameter bored piles would be required. Installing a braced waling to the wall could reduce the sheet section, or diameter of the piles.

4.3.4 Piled Foundations

If adopted, the piled foundations must be taken through any Made Ground and Claygate Member into suitable strength soils of the London Clay Formation.

The construction of a piled foundation is a specialist job with the actual pile working load depending on the particular type pile and installation method. Prior to finalising the foundation design the advice from a reputable contractor who is familiar with the ground and groundwater conditions present at the site should be sought.

The vertical load capacities are provided for varying diameters and lengths of bored piles taken into the London Clay Formation, based on SPT “N60” values and QUU test results and must only be used for preliminary design purposes. These values have been calculated modelling the Claygate Member and London Clay Formation as granular over the full borehole length. A factor of safety of three was applied to both the shaft and base and depicted by the design line outlined in Appendix C.1. An alpha value of 0.45 and Nc value of 9 was adopted for the clay soils.

The bearing values given in Appendix C.1., are applicable to single piles. Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of about 0.8 and a calculation made to check the factor of safety against block failure.

From ground level the upper 6m of the pile shaft has been ignored in the preliminary pile design given.

To prevent necking of the green concrete, temporary casing may be required where the pile passes through the Made Ground and below the groundwater table (if encountered). To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

No allowance has been made for negative skin friction that could be generated where piles pass through Made Ground deposits underlying the site. The negative skin friction must be applied to the pile working load and must not be factored.

4.4 Retaining Wall

If the foundation is to include lateral load from retained soil, then the distribution of loads on the foundation will be trapezoidal and the maximum pressure will be at the toe of the foundation. The foundation has to resist both overturning and sliding forces. The overturning forces are derived from the loads imposed both by the soils retained, by any line loads from structures to the rear of the wall and by groundwater.

To calculate the lateral loads from the soils their coefficient of active earth pressure must be calculated from effective stress testing.

For the allowable bearing value given above, settlements should not exceed the presented values, provided that excavation bases are carefully bottomed out and blinded, or concreted as soon after excavation as possible and kept dry. Foundations must not be constructed over former structures and other hard spots. The foundations design must be suitable for the conditions present at the site.

The anticipated settlement includes both elastic settlement and long-term drained settlement (in the case of cohesive soils).

4.5 Slope Stability

It must be noted the proposed basement construction will be undertaken on sloped terrain, with the wider hillside setting anticipated to slope down to the south-west at an approximate average angle of 10 degrees.

This report does not include a dedicated slope stability analysis. The following comments are of a general and non-specific nature.

Natural slopes, in cohesive soils in England, typically stand with a factor of safety against sliding of about one during periods when the groundwater is at or close to ground level. Factors such as drainage installed into the slope and foliage can enhance the overall or local stability of the slope but generally only marginally.

Interference by man in the profile of a natural slope, the groundwater regime in or around the slope, or in the loading on a slope, can initiate both local and/or overall instability. Natural erosional processes, such as a river or the sea eroding the toe of a slope can, and does, initiate instability.

Manmade slopes, such as railway cuttings, can be stable over long periods of time and then fail decades after their construction (due to equalisation of pore water pressures within the slope). Embankments, if not properly engineered can have failures in the short-term due to excess porewater pressures being setup during construction.

Analyses of slopes generally takes the form of a back analyses of the existing ground profile to permit an assessment of the strength parameters within the soil mass being estimated. Laboratory testing, of various forms depending on the slope type or failure, of soils samples taken through the ground section is then undertaken and the strength parameters found compared to those estimated from the back analyses. The comparison may then be used to provide background data to establish the failure mechanism, to design remedial works or to check the factor of safety against failure of a standing slope. Slope stability analysis must consider the stability of the site and land both upslope and downslope of it.

Initial design parameters can be taken from published values for the residual strength of London Clay Formation and worst-case assumptions of winter groundwater levels, though these would need to be verified by laboratory analysis and groundwater monitoring.

4.6 Subsurface Concrete

Sulphate concentration measured in 2:1 water/soil extracts fell into Class **DS-3** of the BRE Special Digest 1 2005, *'Concrete in Aggressive Ground'.* Table C2 of the Digest indicated ACEC (Aggressive Chemical Environment for Concrete) site classifications of **AC-3**. The pH of the soils tested ranged between 7.4 and 7.7. The classification given was determined using the mobile groundwater case, in the view of groundwater being encountered. The laboratory results are presented in Appendix B.3.

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1 2005, *'Concrete in Aggressive Ground'* taking into account any possible exposure of potentially pyrite bearing natural ground and the pH of the soils.

4.7 Excavations

Shallow excavations in the Made Ground are likely to be marginally stable in the short term at best.

Deeper excavations taken into the Claygate Member are likely to be stable in the short term. Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported or battered back to a safe angle of repose before excavations are entered by personnel.

Excavations beneath the groundwater table are likely to be unstable and dewatering of foundation trenches may be necessary.

Section 5 Soil Chemical Analysis

5.1 General

The production of a Preliminary Investigation Report (Phase I Desk Study) and preparation of a Conceptual Site Model (CSM) was outside the scope of this investigation. This investigation did not comprise an environmental audit of the site or its environs.

5.2 Soil Chemical Analysis

Soil sampling for contamination purposes was undertaken following instruction from the client and one sample was analysed for a wide range of common brownfield contaminants.

The results of the soil chemical analysis including Waste Acceptance Criteria certificate are presented in Appendix D.1.

5.3 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust is generated as a result of construction activities. The site should be securely fenced at all times to prevent unauthorised access.

Washing facilities should be provided and eating restricted to mess huts.

5.4 Excavated Material

Excavated material as waste must be defined or classified prior to any disposal, transport, recycling or re-use at or by an appropriately licensed or exempt carrier and/or off-site disposal facility. The requirements inherent in both Duty of Care and Health and Safety must also be complied with. In order to determine what is to happen, what is suitable, appropriate and most effective in the disposal of wastes, especially those subject to CDM waste management plan requirements, several factors must be considered and competent advice should always be sought.

The amount, type and nature of the material to be removed will in part determine the amount and type of analysis that may be required to comply with current waste guidance, and thereby allow a competent person to suitably classify the material. Often this data is uncertain or unavailable, especially in the early stages of a project, and therefore further investigation, testing and analysis may be required as additional information regarding the development becomes available.

Wastes must be classified and defined by their solid characteristics to comply with current waste guidance. Existing information and analysis derived for environmental purposes may therefore be suitable for use in this context. Waste Acceptance Criteria (WAC) report the leachability of materials and therefore cannot be used to classify, characterise or define wastes. The only purpose of a WAC analysis is to determine the suitability of a given material for acceptance at one of the three different types of available licenced landfills (inert, stable non-reactive hazardous or hazardous).

WAC analysis was undertaken on the sample and the certificate is included within the analysis report in Appendix D.1.

Other options are available that may lead to significant savings against disposal to landfill and expert advice should always be sought from a competent person to advise on their relative costs or benefits and advise on any additional analysis, sampling or investigation that may be required to reduce remaining uncertainties and comply with current guidance.

Further consideration of results using HazWasteOnlineTM was undertaken to give an indication of potentially hazardous properties and the report is presented in Appendix D.1.

5.5 Re-use of Excavated Material On-site

The re-use of on-site soils may be undertaken either under the Environmental Permitting Regulations 2007 (EPR), in which case soils other than uncontaminated soils are classed as waste, or under the CL:AIRE Voluntary Code of Practice (CoP) which was published in September 2008 and is accepted as an alternative regime to the EPR.

Under the EPR, material that is contaminated but otherwise suitable for re-use is also classified as waste and its re-use should be in accordance with the Environmental Permitting Regulations 2007 (EPR). Environmental Permit Exemptions (EPE) are for the re-use of non-hazardous or inert waste only; hazardous waste cannot be re-used under a permit exemption. EPE apply only to imported inert waste materials; inert material arising on site and recovered on site is not classified as waste and does not require an exemption. It is possible that materials arising on-site will be classified as inert and would not need an exemption.

Environmental Permit Exemptions are only allowed for certain activities, placing controls on the quantities that can be stored and re-used. The re-use of waste shall be within areas and levels defined in planning applications and permissions for the development. An EPE requires a site-specific risk assessment for the receptor site to demonstrate that the materials are suitable for use, i.e. that they will not give rise to harm to human health or pollution of the environment.

Under the CL:AIRE voluntary code of practice (CoP) materials excavated on-site are not deemed contaminated if suitable for re-use at specified locations or generally within the site.

Material that may have been classified as hazardous waste under the EPR may be re-used. The CoP regime requires that a 'Qualified Person' as defined under the CoP reviews the development of the Materials Management Plan, including review of Risk Assessments and Remediation Strategy/Design Statement together with documentation relating to Planning and Regulatory issues, and signs a Declaration which is forwarded to the Environment Agency and which confirms compliance with the CoP.

Should it be necessary to import materials from another site where materials are excavated and which is not material from a quarry or produced under a WRAP protocol, then an EPE would be necessary for the imported material whether the work was managed under the CoP or the EPR.

5.6 Imported Material

Any soil, which is to be imported onto the site, must undergo chemical analysis to permit classification prior to its importation and placement in order to ascertain its status with specific regard to contamination, i.e. to prove that it is suitable for the purpose for which it is intended.

5.7 Discovery Strategy

There may be areas of contamination not identified during the course of the investigation. Such occurrences may also be discovered during the demolition and construction phases for the redevelopment of the site.

Care should be taken during excavation works especially to investigate any soils, which appear by eye (e.g. such as fibrous materials, large amounts of ash and unusual discolouration), odour (e.g. fuel, oil and chemical type odours or unusual odours such as sweet odours or fishy odours) or wellbeing (e.g. light headedness and/or nausea, burning of nasal passages and blistering or reddening of skin due to contact with soil) to be contaminated or of unusual and/or different character to standard soils or those analysed.

In the event of any discovery of potentially contaminated soils or materials, this discovery should be quarantined and reported to the most senior member of site staff or the designated responsible person at the site for action. The location, type and quantity must be recorded and the Local Authority, and a competent and appropriate third party Engineer/Environmental consultant notified immediately. An approval from the Local authority must be sought prior to implementing any proposed mitigation action.

The discovery strategy must remain on site at all times and must demonstrate a clear allocation of responsibility for reporting and dealing with contamination. A copy of the strategy must be placed on the health and safety notice board and /or displayed in a prominent area where all site staff are able to take note of and consult the document at any time. Any member of the workforce entering the site to undertake any excavation must be made aware of the potential to discover contamination and the discovery strategy.

List of Figures

List of Appendices

Figure 1 – Site Location Map

Job Number 18577	**Project** 38 Frognal Lane, London NW3 6PP
Client MRPP	**Date** October 2020

Figure 2 – Aerial Photograph

Project
38 Frognal Lane, London NW3 6PP

Client
MRPP

Date
October 2020

Job Number
18577

Figure 3 – Trial Hole Plan

Project
38 Frognal Lane, London NW3 6PP

Client
MRPP

Date
October 2020

Job Number
18577

Appendix A Field Work

Appendix A.1 Engineers Logs

soils LIMITED

Contract Name: 38 Frognal Lane			Client: MRPP			Hole ID: **BH01**
Contract Number: 18577	Start and End Date: 25-08-20 - 26-08-20	Logged By: DW	Checked By:	Status:		Hole Type: **CP**
Easting: 526008.8	Northing: 185472.3	Ground Level: 90.96mAOD	Plant Used: Dando 2000	Print Date: 09-11-2020		Scale: 1:50
Weather:	Termination:		SPT Hammer: AR3201 Energy Ratio: 71%			Sheet 1 of 2

Samples & In Situ Testing

Depth	Type	Results
0.20	D	
0.50	D	
1.00	D	
1.20	D	
1.20 - 1.50	B	
1.50	SPT	N=8 (1,2/2,2,2,2)
1.50 - 1.95	D	
2.30	D	
2.50 - 2.95	U	Ublow = 20
3.00	D	
3.50	SPT	N=11 (1,2/2,3,3,3)
3.50 - 3.95	D	
4.30	D	
4.50 - 4.95	U	Ublow = 25
5.00	D	
5.50	D	
6.00	SPT	N=16 (2,2/3,4,4,5)
6.00 - 6.45	D	
7.00	D	
7.50 - 7.95	U	Ublow = 30
8.00	D	
8.50	D	
9.00	SPT	N=22 (2,3/4,6,6,6)
9.00 - 9.45	D	
10.00	D	

Strata Details

Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description
90.91	0.05		From driller's logs: GRAVEL. MADE GROUND.
90.86	0.10		From driller's logs: Plastic matting and foam. MADE GROUND.
90.76	0.20		From driller's logs: Compacted type 1 stone. MADE GROUND.
	(1.00)		Firm, black speckled, grey and orangish brown mottled, brown, slightly sandy CLAY. Sand is fine to medium. Occasional rootlets and woody roots.
89.76	1.20		
	(2.80)		Firm to stiff, black speckled, grey and orangish brown mottled, brown, sandy silty CLAY. Sand is fine.
86.96	4.00		
	(1.50)		Stiff, slightly orangish brown mottled, slightly sandy CLAY. Sand is fine. Occasional coarse sand sized selenite crystals. CLAYGATE MEMBER.
85.46	5.50		
	(9.00)		Stiff to very stiff, greyish brown to brownish grey with depth, slightly sandy, slightly silty CLAY. Sand is fine. Rare coarse sand to fine gravel sized selenite crystals. LONDON CLAY FORMATION.

Groundwater: Water Strike | Backfill/ Installation

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter		Casing Diameter	
Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
20.00	150	3.00	150

Remarks:
Rootlets observed to 1.2m bgl.

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	10.00	SLOTTED	50

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	No groundwater "strikes" recorded during drilling. Water seepage at 2.8m bgl.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name: 38 Frognal Lane			Client: MRPP		Hole ID: **BH01**
Contract Number: 18577	Start and End Date: 25-08-20 - 26-08-20	Logged By: DW	Checked By:	Status:	Hole Type: **CP**
Easting: 526008.8	Northing: 185472.3	Ground Level: 90.96mAOD	Plant Used: Dando 2000	Print Date: 09-11-2020	Scale: 1:50
Weather:	Termination:		SPT Hammer: AR3201 Energy Ratio: 71%		Sheet 2 of 2

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
						Stiff to very stiff, greyish brown to brownish grey with depth, slightly sandy, slightly silty CLAY. Sand is fine. Rare coarse sand to fine gravel sized selenite crystals. LONDON CLAY FORMATION.		
10.50 - 10.95	U	Ublow = 50						
11.00	D							
11.50	D							
12.00 12.00 - 12.45	SPT D	N=26 (3,4/6,6,7,7)						
13.00	D							
13.50 - 13.95	U	Ublow = 45						
14.00	D							
14.50	D		76.46	14.50		Stiff to very stiff dark blackish green mottled, brownish grey slightly sandy, silty CLAY. Sand is fine, and features in occasional laminations and lenses. LONDON CLAY FORMATION.		
15.00 15.00 - 15.45	SPT D	N=30 (3,4/6,7,8,9)						
16.00	D							
16.50 - 16.95	U	Ublow = 50						
17.00	D							
				(5.50)				
17.50	D							
18.00 18.00 - 18.45	SPT D	N=33 (3,4/6,7,10,10)						
19.00	D							
19.50 - 19.95	U	Ublow = 60						
20.00	D		70.96	20.00		End of Borehole at 20.00m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
					20.00	150	3.00	150

Remarks:

Rootlets observed to 1.2m bgl.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)
				0.00	1.00	PLAIN	50
				1.00	10.00	SLOTTED	50

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	No groundwater "strikes" recorded during drilling. Water seepage at 2.8m bgl.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name: 38 Frognal Lane		Client: MRPP			Hole ID: **WS101**
Contract Number: 18577	Start and End Date: 04-09-20	Logged By: DW	Checked By:	Status:	Hole Type: **WS**
Easting: 526008.9	Northing: 185446.9	Ground Level: 90.47mAOD	Plant Used: TERRIER	Print Date: 09-11-2020	Scale: 1:50
Weather:	Termination:				Sheet 1 of 1

Samples & In Situ Testing

Depth	Type	Results
0.20	ES	
0.50 - 1.20	WAC	
1.40	D	
1.60	D	
2.10	D	
2.60	D	
3.10	D	
3.60	D	
4.10	D	
4.60	D	
5.10	D	
5.50	D	
6.50	D	
6.90	D	
7.90	D	
8.50	D	
8.90	D	
9.60	D	
9.90	D	

Strata Details

Level (mAOD)	Depth (m) (Thickness)	Strata Description
90.17	(0.30) 0.30	From driller's logs: Dark brown, slightly clayey SAND. Occasional fine to coarse flint and fine brick gravel. Frequent rootlets. MADE GROUND.
89.57	(0.60) 0.90	From driller's logs: Recovered as loose brown gravelly SAND. Gravel is angular to sub-angular, fine to coarse brick and occasional fine flint gravel. MADE GROUND.
88.97	(0.60) 1.50	Firm, slightly black speckled brown CLAY. Occasional angular fine to coarse brick, clinker and rare flint gravel, with a band from 0.1 - 0.2m bgl. Occasional rootlets. MADE GROUND.
85.57	(3.40) 4.90	Firm black speckled, grey and yellowish brown mottled, brown, slightly sandy silty CLAY. Sand is fine and features in frequent partings and occasional laminations. Occasional rootlets and woody roots 2mm diameter. Rare coarse to fine gravel sized sand sized selenite crystals from 4.5m bgl. CLAYGATE MEMBER. *Fine sandy lenses at 3.6 and 3.9m bgl.*
85.27	(0.30) 5.20	Brown calcareous MUDSTONE.
82.67	(2.60) 7.80	Firm, slightly black speckled, grey mottled, brown, slightly sandy, silty CLAY. Sand is fine, and features in occasional laminations. Occasional to rare coarse to fine gravel sized sand sized selenite crystals. *Disturbed sample from 6.0 - 6.5, 7.0 - 7.5m bgl.*
80.47	(2.20) 10.00	Firm to stiff, brownish, silty CLAY. Rare fine gravel sized selenite crystals, with an angular medium gravel sized selenite crystal at 8.98m bgl. Very rare fine gravel sized calcareous shells at 8.7, and 9.7m bgl. LONDON CLAY FORMATION. *Disturbed sample from 8.0 - 8.5, 9.0 - 9.5m bgl.*
		End of Borehole at 10.00m

Groundwater

Water Strike	Backfill/ Installation
▼ 6.00	

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter		Casing Diameter	
Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
10.00	150		

Remarks:

Live rootlets observed to 3.9m bgl.

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	33
1.00	10.00	SLOTTED	33

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
6.00			20	6.00	

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils
L I M I T E D

Contract Name: 38 Frognal Lane		Client: MRPP			Hole ID: **WS102**
Contract Number: 18577	Start and End Date: 04-09-20	Logged By: DW	Checked By:	Status:	Hole Type: **WS**
Easting: 525999.2	Northing: 185451.2	Ground Level: 90.48mAOD	Plant Used: TERRIER	Print Date: 09-11-2020	Scale: 1:50
Weather:	Termination:				Sheet 1 of 1

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.20	ES			(0.30)		From driller's logs: Dark brown, slightly clayey SAND. Occasional fine flint and brick gravel. Occasional rootlets. MADE GROUND.		
			90.18	0.30				
0.50	ES			(0.60)		From driller's logs: Recovered as loose brown gravelly SAND. Gravel is angular to sub-angular, fine to coarse brick and occasional fine flint gravel. MADE GROUND.		
			89.58	0.90		From driller's logs: Stiff brown CLAY. Frequent brick gravel. MADE GROUND.		
			89.48	1.00		Stiff to firm, black speckled, grey and yellowish brown mottled, brown, slightly sandy silty CLAY. Sand is fine and features in occasional laminations and partings. Occasional rootlets and woody roots 3mm diameter. Rare coarse to fine gravel sized sand sized selenite crystals from 4.5m bgl. CLAYGATE MEMBER. *Firm from 1.5m bgl. Rare sub-rounded, fine to medium marl gravel from 3.5m bgl. Becoming stiff at 3.7m bgl.*		
1.20	D							
1.70	D							
2.20	D							
				(3.00)				
2.70	D							
3.20	D							
3.70	D							
			86.48	4.00		Stiff, grey mottled, brown, slightly sandy, silty CLAY. Sand is fine, and features in occasional laminations. Frequent desiccated rootlets. Occasional to rare coarse to fine gravel sized sand sized selenite crystals. *Sandy lens with medium to coarse sand sized selenite crystals at 3.65m bgl. Grey mottling to 5.9m bgl. Rare yellowish brown fine gravel sized silt inclusions and laminations from 5.0m bgl.*		
4.10	D							
4.60	D							
5.20	D							
				(3.30)				
5.70	D							
6.20	D							
6.70	D							
			83.18	7.30		Stiff to very stiff, slightly black speckled brownish grey, silty CLAY. Rare fine gravel sized selenite crystals. Very rare fine gravel sized calcareous shells. LONDON CLAY FORMATION. *Coarse gravel to cobble sized broken marl nodule at 7.5m bgl. Occasional fine sand in top of stratum. Fine gravel sized pyritised plant fossil at 7.6m bgl.*		
7.40	D							
7.90	D							
8.40	D							
				(2.70)				
8.90	D							
9.40	D							
9.90	D							
			80.48	10.00		End of Borehole at 10.00m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
					10.00	150		

Remarks:
Live rootlets observed to 3.8m bgl.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)
				0.00	1.00	PLAIN	33
				1.00	10.00	SLOTTED	33

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	No groundwater encountered.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

Appendix B Geotechnical In-Situ and Laboratory Testing

Appendix B.1 Classification

Classification based on SPT "N" values:

The inferred undrained strength of the cohesive soils was based on the SPT "N" blow counts, derived from the relationship suggested by Stroud (1974) and classified using Table B.1.1. (Ref: Stroud, M. A. 1974, "The Standard Penetration Test – its application and interpretation", Proc. ICE Conf. on Penetration Testing in the UK, Birmingham. Thomas Telford, London.).

Table B.1.1 SPT "N" Blow Count Cohesive Classification

Classification	Undrained Cohesive Strength C_u (kPa)
Extremely low	<10
Very low	10 – 20
Low	20 – 40
Medium	40 – 75
High	75 – 150
Very high	150 – 300
Extremely high	> 300

Note: (Ref: BS EN ISO 14688-2:2004+A1:2013 Clause 5.3.)

Appendix B.2 Interpretation

Table B.2.1 Interpretation of SPT Tests

BH	Strata	SPT N60 Blow Counts	Inferred Cohesive Strength
BH1	CLGB 0.20 – 5.50 Silty CLAY	9 – 13	Medium (Cu = 45 - 65kPa)
	LCF 5.50 – 20.00 Silty CLAY	19 – 39	High to very high (Cu = 95 – 195kPa)

Note:

Table B.2.2 Interpretation of DPSH Blow Counts

DP	Strata	Equivalent SPT N60 Blow Counts	Inferred Cohesive Strength
DP101	CLGB 1.50 – 5.20 Silty CLAY	3 – 6	Very low to low (C_u = 15 – 30kPa)
	LCF 5.20 – 10.00 Silty CLAY	9 – 15	Medium (C_u = 45 – 75kPa)

Note: [1] Ground conditions inferred past the base of windowless sampler boreholes.

Table B.2.3 Interpretation of QUU Tests

Location	Stratum	Sample Depth (m bgl)	Moisture Content (%)	Soil Strength	Shear Strength (kPa)
BH1	CLGB	4.50	26	High	83
BH1	LCF	7.50	25	High	130
BH1	LCF	10.50	23	High	144
BH1	LCF	13.50	23	High	94
BH1	LCF	16.50	23	High	117
BH1	LCF	19.50	22	High	135

Note:

Table B.2.4 Interpretation of Atterberg Limit Tests

Stratum	Moisture Content (%)	Plasticity Index (%)	Passing 425µm Sieve (%)	Modified Plasticity Index (%)	Soil Classification	Volume Change Potential	
						BRE	NHBC
CLGB	23 - 26	18 - 22	100	18 - 22	CI	Low to medium	Low to medium
LCF	26 - 27	34 - 53	100	34 - 53	CH – CV	Medium to high	Medium to high

Note: BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
NHBC Volume Change Potential refers to NHBC Standards Chapter 4.2
Soils Classification based on British Soil Classification System

The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240. The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates. The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2 µm are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2 µm and some particles, 'rock flour' for example, can be finer than 2 µm but are not clay minerals.

(The Atterberg Limit Tests were undertaken in accordance with BS 1377:Part 2:1990 Clauses 3.2, 4.3 and 5)

Appendix B.3 Geotechnical In-Situ and Laboratory Results

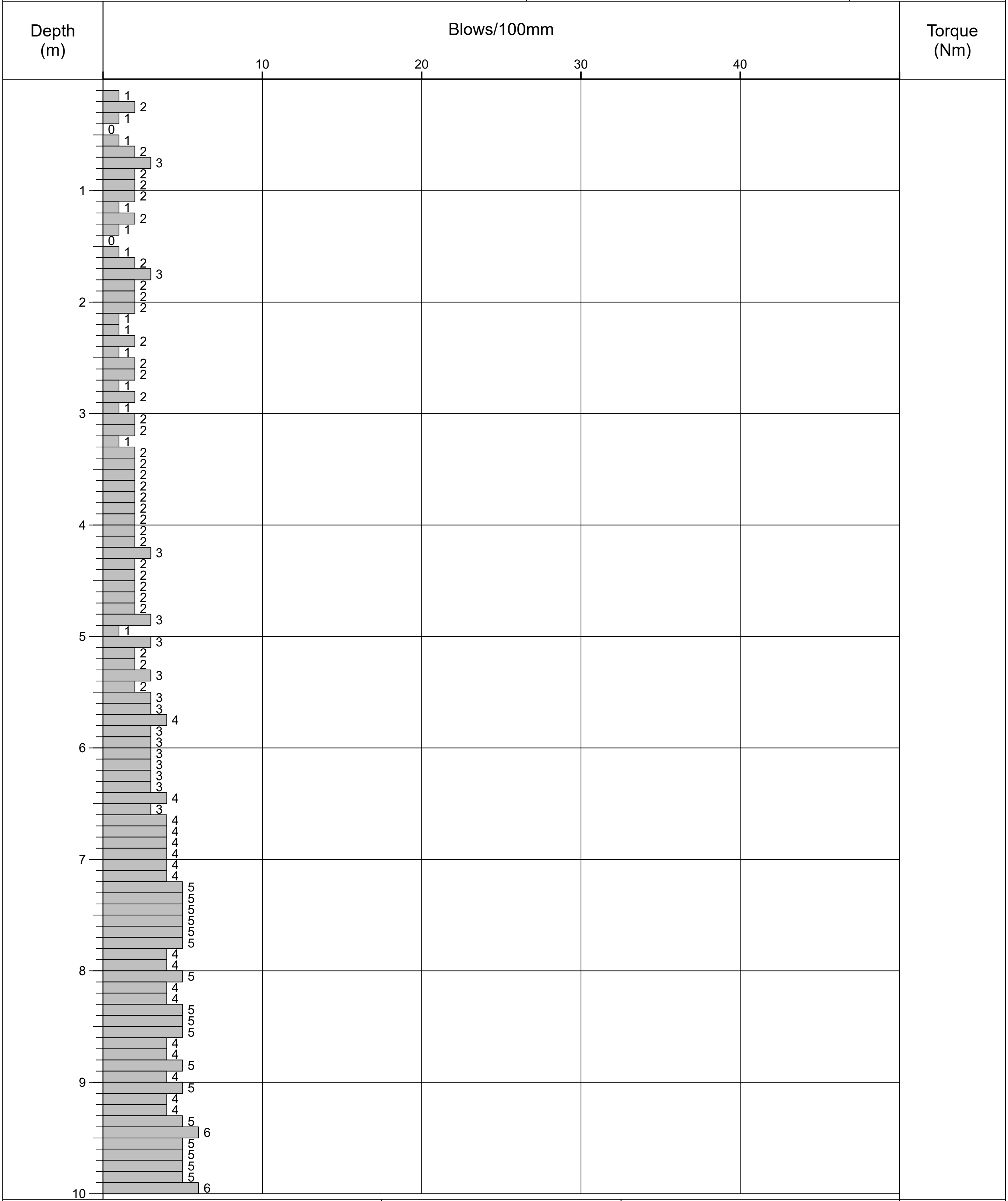
Soils Limited

Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Probe Log

Probe No.
DP101
Sheet 1 of 2

Project Name:	38 Frognal Lane	Project No. 18577	Co-ords:	526008.91E - 185446.87N	Hole Type DP
Location:	London NW3 6PP		Level:	90.4714m AOD	Scale 1:50
Client:	MRPP		Dates:	04-09-2020	Logged By



Remarks	Fall Height	760mm	Cone Base Diameter	50.5mm	
	Hammer Weight	63.5kg	Final Depth	10m	
	Probe Type	DPSH	Energy Ratio (Er)	65.8%	

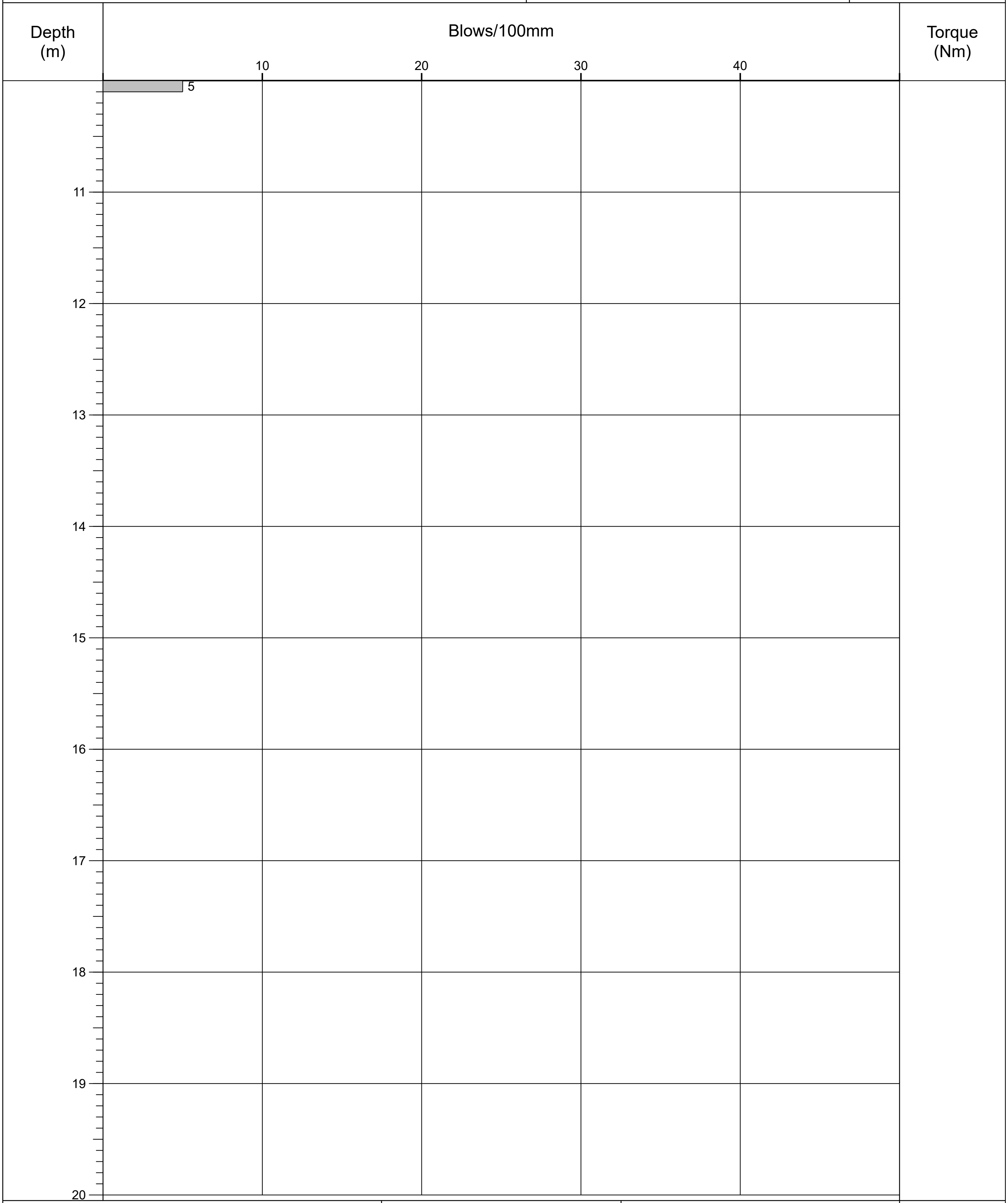
Soils Limited

Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Probe Log

Probe No.
DP101
Sheet 2 of 2

Project Name:	38 Frognal Lane	Project No. 18577	Co-ords: 526008.91E - 185446.87N	Hole Type DP
Location:	London NW3 6PP		Level: 90.4714m AOD	Scale 1:50
Client:	MRPP		Dates: 04-09-2020	Logged By



Remarks	Fall Height	760mm	Cone Base Diameter	50.5mm
	Hammer Weight	63.5kg	Final Depth	10m
	Probe Type	DPSH	Energy Ratio (Er)	65.8%

UKAS TESTING
2788

Laboratory Report

GSTL
GEO Site & Testing Services Ltd

Contract Number: 50122

Client Ref:	**18577**	Report Date:	**06-10-2020**
Client PO:	**18577**		

Client **Soils Limited**
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

Contract Title: **Frognal Lane**
For the attention of: **Tim Rudkin**

Date Received: **08-09-2020**
Date Completed: **06-10-2020**

Test Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	6
1 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.4 & 5.3 - * UKAS	6
Quick Undrained Triaxial Compression Test - Multi-stage Loading of a single specimen (100mm diameter) BS 1377:1990 - Part 7 : 9 - * UKAS	7
Disposal of samples for job	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

Approved Signatories:
Emma Sharp (Office Manager/Director) - Paul Evans (Quality/Technical Manager) - Richard John (Advanced Testing Manager)
Sean Penn (Administrative/Accounts Assistant) - Shaun Jones (Laboratory manager) - Wayne Honey (Administrative/Quality Assistant)

GSTL

NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
(BS 1377 : Part 2 : 1990 Method 5)

Contract Number	**50122**
Site Name	**Frognal Lane**
Date Tested	**23/09/2020**

DESCRIPTIONS

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Descriptions
BH01		D	1.00	-		Brown silty CLAY.
BH01		D	3.00	-		Greyish brown silty CLAY.
BH01		D	7.00	-		Greyish brown silty CLAY.
BH01		D	10.00	-		Brown silty CLAY.
BH01		D	14.00	-		Brown silty CLAY.
BH01		D	19.00	-		Greyish brown silty CLAY.
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		

Operators	Checked	06/10/2020	Wayne Honey (Administrative/Quality Assistant)
Clayton Jenkins	Approved	06/10/2020	Paul Evans (Quality/Technical Manager)

UKAS TESTING
2788

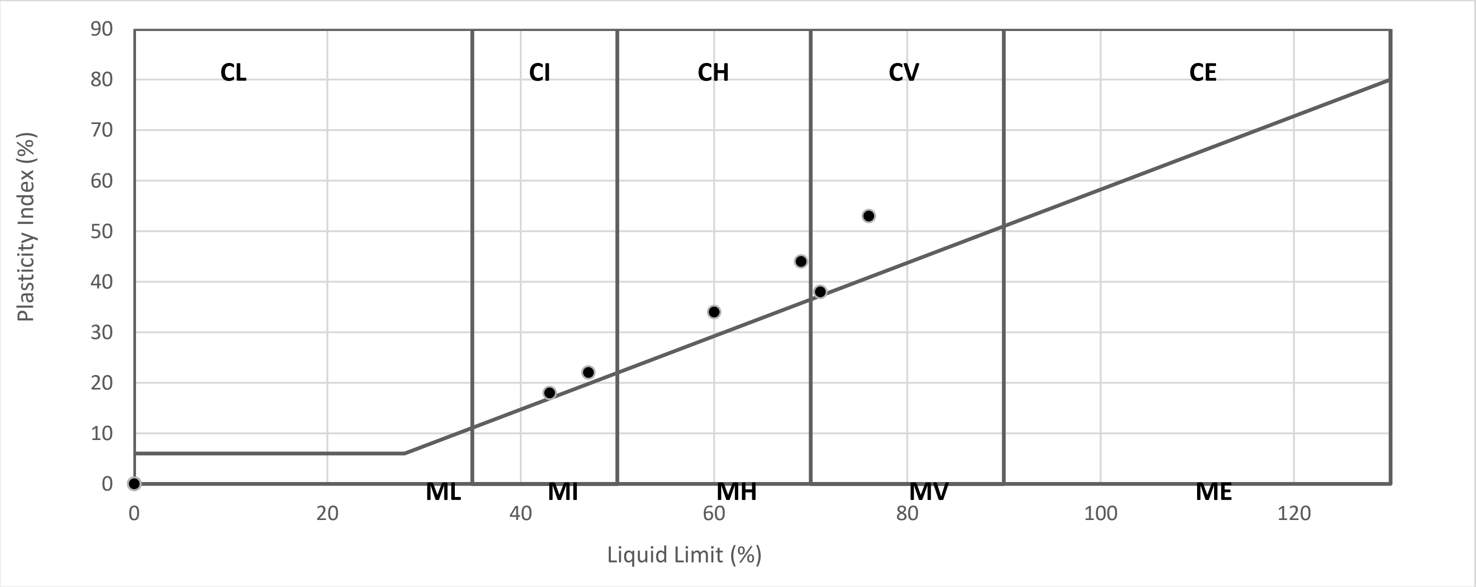
NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
(BS 1377 : Part 2 : 1990 Method 5)

Contract Number	**50122**	
Project Location	**Frognal Lane**	
Date Tested	**23/09/2020**	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing 0.425mm %	Remarks
BH01		D	1.00	-		23	47	25	22	100	CI Intermediate Plasticity
BH01		D	3.00	-		26	43	25	18	100	CI Intermediate Plasticity
BH01		D	7.00	-		27	60	26	34	100	CH High Plasticity
BH01		D	10.00	-		27	71	33	38	100	CV Very High Plasticity
BH01		D	14.00	-		27	76	23	53	100	CV Very High Plasticity
BH01		D	19.00	-		26	69	25	44	100	CH High Plasticity
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							

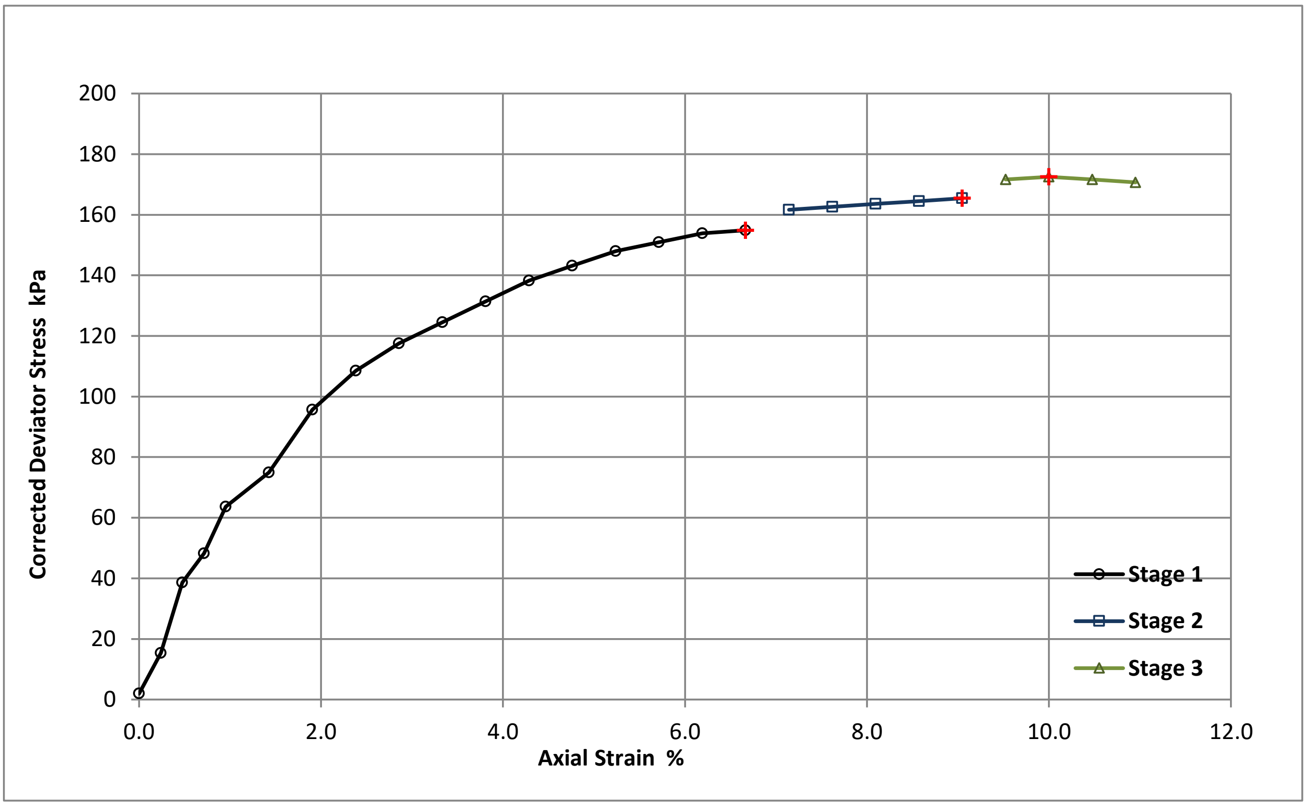
Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:1999+A2:2010



Operators	Checked	06/10/2020	Wayne Honey (Administrative/Quality Assistant)
Clayton Jenkins	Approved	06/10/2020	Paul Evans (Quality/Technical Manager)

GSTL	Multi Stage Unconsolidated-Undrained Triaxial Test BS 1377 : 1990 Part 7 : 9	Contract Number	50122
		Borehole/Pit No.	BH01
Site Name	Frognal Lane	Sample No.	
Soil Description	Brown silty CLAY	Depth Top	4.50
		Depth Base	4.95
Date Tested	06/10/2020	Sample Type	U



Moisture Content (%)	26		
Bulk Density (Mg/m^3)	1.91		
Dry Density (Mg/m^3)	1.52		
Specimen Length (mm)	210		
Specimen Diamteter (mm)	104		
Cell Pressures (kPa)	45	90	180
Deviator Stress (kPa)	155	165	173
Undrained Shear Strength (kPa)	77	83	86
Failure Strain (%)	6.7	9.0	10.0
Mode Of Failure	Brittle		
Membrane Used/Thickness	Rubber/0.3mm		
Rate of Strain (%/min)	3.00		

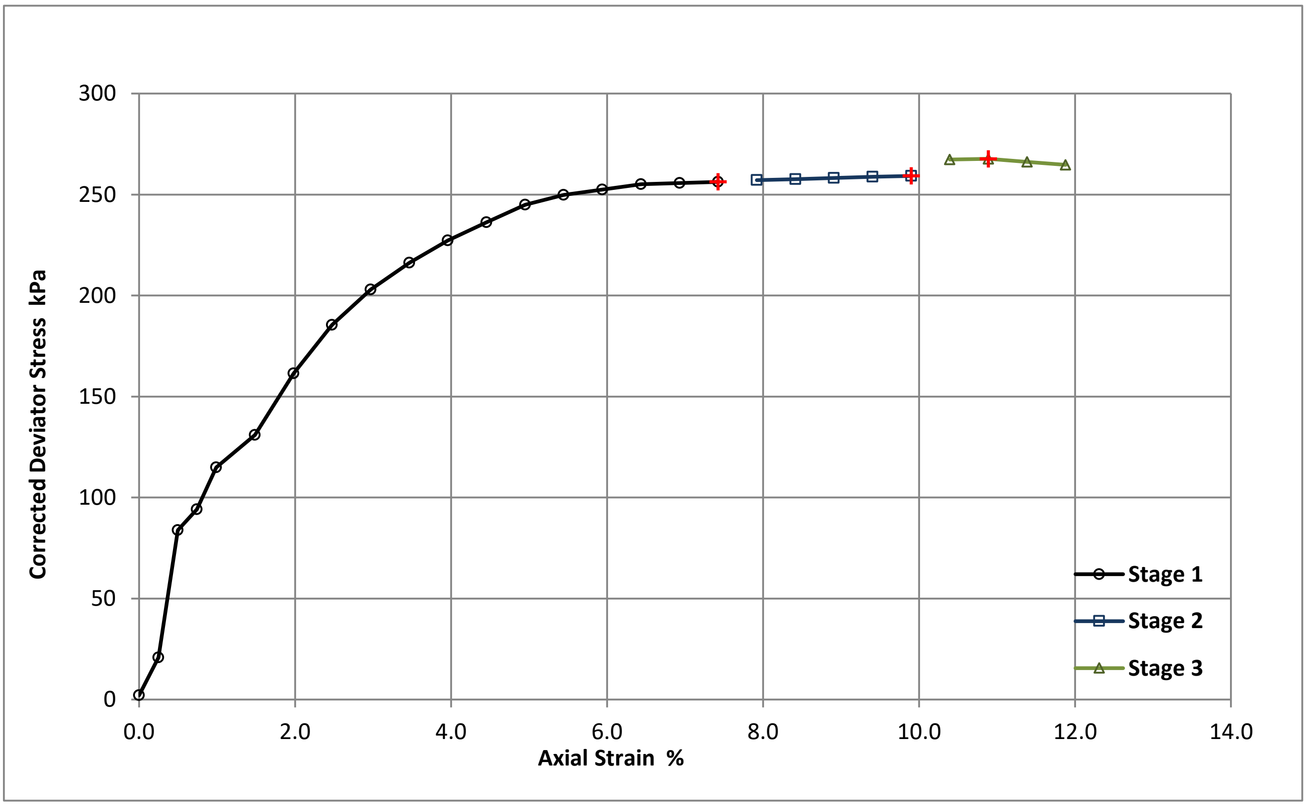
Specimen Post Test

Sample Split

Checked	05/10/2020	Emma Sharp	
Approved	06/10/2020	Paul Evans	D P Evans

UKAS TESTING
2788

GSTL	Multi Stage Unconsolidated-Undrained Triaxial Test BS 1377 : 1990 Part 7 : 9	Contract Number	50122
		Borehole/Pit No.	BH01
Site Name	Frognal Lane	Sample No.	
Soil Description	Brown silty CLAY	Depth Top	7.50
		Depth Base	7.95
Date Tested	06/10/2020	Sample Type	U



Moisture Content (%)	25		
Bulk Density (Mg/m^3)	2.02		
Dry Density (Mg/m^3)	1.61		
Specimen Length (mm)	202		
Specimen Diamteter (mm)	100		
Cell Pressures (kPa)	75	150	300
Deviator Stress (kPa)	256	259	268
Undrained Shear Strength (kPa)	128	130	134
Failure Strain (%)	7.4	9.9	10.9
Mode Of Failure	Brittle		
Membrane Used/Thickness	Rubber/0.3mm		
Rate of Strain (%/min)	3.00		

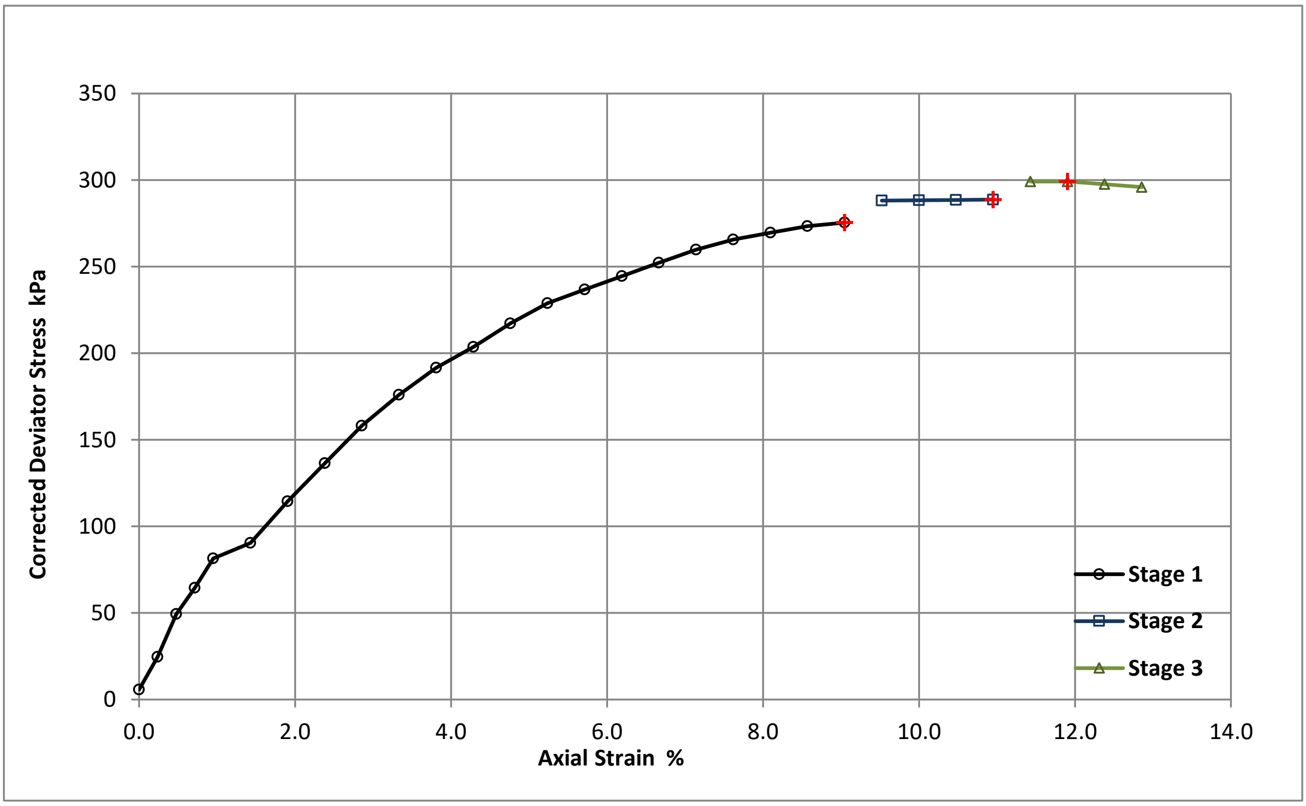
Specimen Post Test

Sample Split

Checked	05/10/2020	Emma Sharp	
Approved	06/10/2020	Paul Evans	DP Evans

UKAS TESTING
2788

GSTL	**Multi Stage Unconsolidated-Undrained Triaxial Test** **BS 1377 : 1990 Part 7 : 9**	Contract Number	50122
		Borehole/Pit No.	BH01
Site Name	Frognal Lane	Sample No.	
Soil Description	Brown silty CLAY	Depth Top	10.50
		Depth Base	10.95
Date Tested	06/10/2020	Sample Type	U



Moisture Content (%)	23		
Bulk Density (Mg/m^3)	1.88		
Dry Density (Mg/m^3)	1.53		
Specimen Length (mm)	210		
Specimen Diamteter (mm)	105		
Cell Pressures (kPa)	105	210	420
Deviator Stress (kPa)	275	289	299
Undrained Shear Strength (kPa)	138	144	150
Failure Strain (%)	9.0	11	11.9
Mode Of Failure	Brittle		
Membrane Used/Thickness	Rubber/0.3mm		
Rate of Strain (%/min)	3.00		

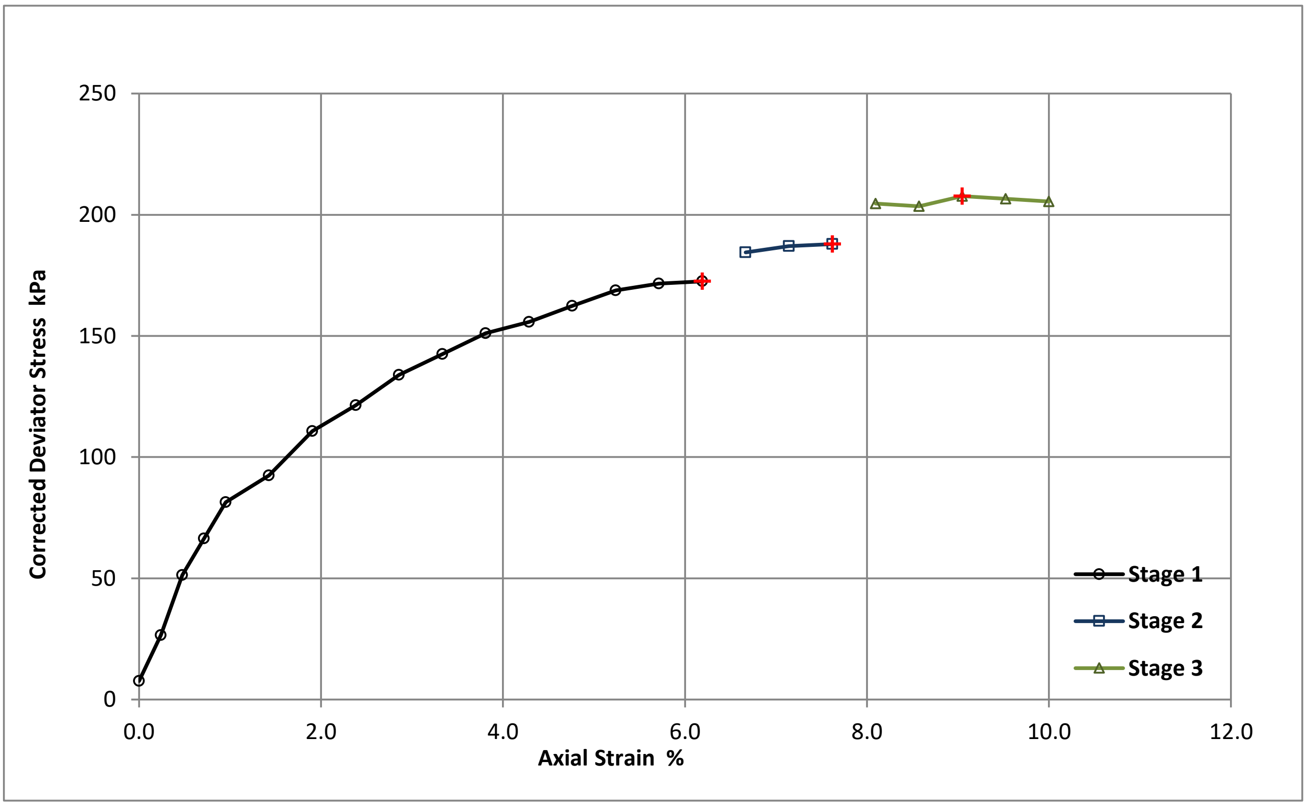
Specimen Post Test

Sample Split

Checked	05/10/2020	Emma Sharp	
Approved	06/10/2020	Paul Evans	D P Evans

UKAS TESTING
2788

GSTL	**Multi Stage Unconsolidated-Undrained Triaxial Test BS 1377 : 1990 Part 7 : 9**	Contract Number	50122
		Borehole/Pit No.	BH01
Site Name	Frognal Lane	Sample No.	
Soil Description	Brown silty CLAY	Depth Top	13.50
		Depth Base	13.95
Date Tested	06/10/2020	Sample Type	U



Moisture Content (%)	23		
Bulk Density (Mg/m^3)	1.92		
Dry Density (Mg/m^3)	1.57		
Specimen Length (mm)	210		
Specimen Diamteter (mm)	105		
Cell Pressures (kPa)	135	270	540
Deviator Stress (kPa)	173	188	208
Undrained Shear Strength (kPa)	86	94	104
Failure Strain (%)	6.2	7.6	9.0
Mode Of Failure	Brittle		
Membrane Used/Thickness	Rubber/0.3mm		
Rate of Strain (%/min)	3.00		

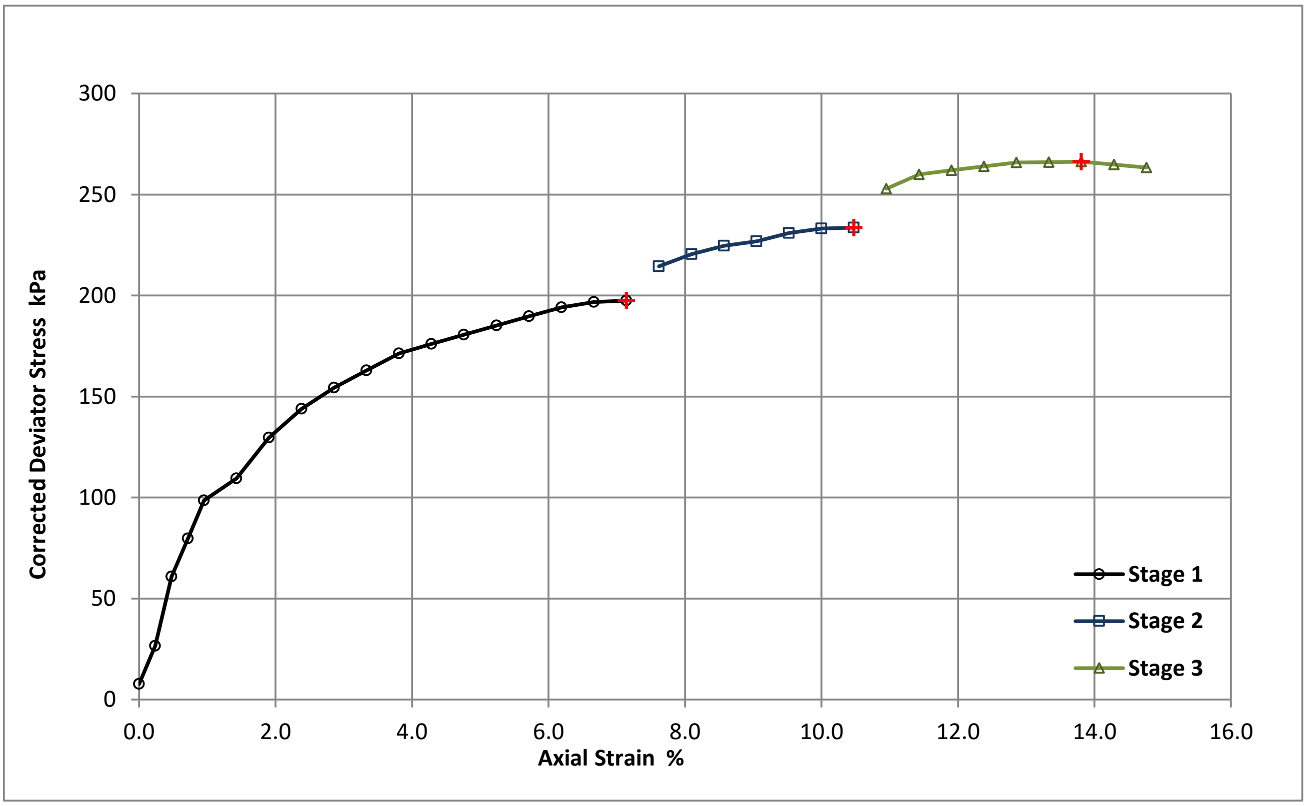
Specimen Post Test

Sample Split

Checked	05/10/2020	Emma Sharp	
Approved	06/10/2020	Paul Evans	D P Evans

UKAS TESTING
2788

GSTL	**Multi Stage Unconsolidated-Undrained Triaxial Test** **BS 1377 : 1990 Part 7 : 9**	Contract Number	50122
		Borehole/Pit No.	BH01
Site Name	Frognal Lane	Sample No.	
Soil Description	Brown silty CLAY	Depth Top	16.50
		Depth Base	16.95
Date Tested	06/10/2020	Sample Type	U



Moisture Content (%)	23		
Bulk Density (Mg/m^3)	1.94		
Dry Density (Mg/m^3)	1.57		
Specimen Length (mm)	210		
Specimen Diamteter (mm)	105		
Cell Pressures (kPa)	135	330	660
Deviator Stress (kPa)	197	234	266
Undrained Shear Strength (kPa)	99	117	133
Failure Strain (%)	7.1	10	13.8
Mode Of Failure	Brittle		
Membrane Used/Thickness	Rubber/0.3mm		
Rate of Strain (%/min)	3.00		

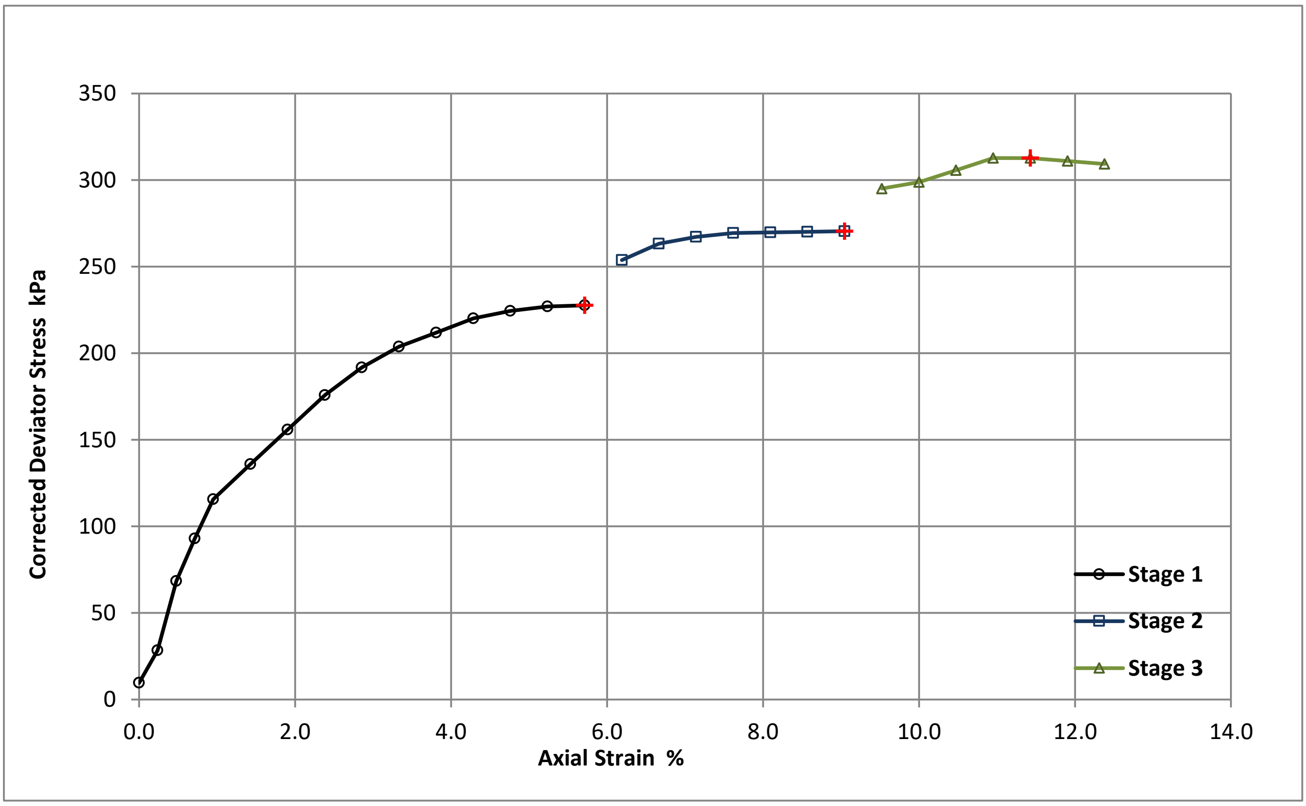
Specimen Post Test

Sample Split

Checked	05/10/2020	Emma Sharp	
Approved	06/10/2020	Paul Evans	D P Evans

UKAS
TESTING
2788

GSTL	**Multi Stage Unconsolidated-Undrained Triaxial Test** **BS 1377 : 1990 Part 7 : 9**	Contract Number	50122
		Borehole/Pit No.	BH01
Site Name	Frognal Lane	Sample No.	
Soil Description	Brown silty CLAY	Depth Top	19.50
		Depth Base	19.95
Date Tested	06/10/2020	Sample Type	U



Moisture Content (%)	22		
Bulk Density (Mg/m^3)	1.92		
Dry Density (Mg/m^3)	1.57		
Specimen Length (mm)	210		
Specimen Diamteter (mm)	105		
Cell Pressures (kPa)	200	400	800
Deviator Stress (kPa)	228	271	313
Undrained Shear Strength (kPa)	114	135	156
Failure Strain (%)	5.7	9.0	11.4
Mode Of Failure	Brittle		
Membrane Used/Thickness	Rubber/0.3mm		
Rate of Strain (%/min)	3.00		

Specimen Post Test

Sample Split

Checked	05/10/2020	Emma Sharp	
Approved	06/10/2020	Paul Evans	D P Evans

UKAS
TESTING
2788

UKAS TESTING
4480

Tim Rudkin
Soils Ltd
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 20-10253

Site Reference:	38 Frognal Lane
Project / Job Ref:	18577
Order No:	18577/TR
Sample Receipt Date:	07/09/2020
Sample Scheduled Date:	07/09/2020
Report Issue Number:	1
Reporting Date:	17/09/2020

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Soil Analysis Certificate						
DETS Report No: 20-10253	**Date Sampled**	None Supplied	None Supplied	None Supplied		
Soils Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: 38 Frognal Lane	**TP / BH No**	BH01	BH01	BH01		
Project / Job Ref: 18577	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: 18577/TR	**Depth (m)**	2.30	5.00	8.00		
Reporting Date: 17/09/2020	**DETS Sample No**	496863	496864	496865		

Determinand	**Unit**	**RL**	**Accreditation**					
pH	pH Units	N/a	**MCERTS**	7.7	7.4	7.7		
Total Sulphate as SO_4	mg/kg	< 200	NONE	482	5864	2505		
Total Sulphate as SO_4	%	< 0.02	NONE	0.05	0.59	0.25		
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	**MCERTS**	216	2500	1010		
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	**MCERTS**	0.22	2.50	1.01		
Total Sulphur	%	< 0.02	NONE	< 0.02	0.39	0.78		
Ammonium as NH_4	mg/kg	< 0.5	NONE	2.8	5.1	14		
Ammonium as NH_4	mg/l	< 0.05	NONE	0.28	0.51	1.40		
W/S Chloride (2:1)	mg/kg	< 1	**MCERTS**	50	204	81		
W/S Chloride (2:1)	mg/l	< 0.5	**MCERTS**	25	102	40.5		
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	**MCERTS**	7	24	< 3		
Water Soluble Nitrate (2:1) as NO_3	mg/l	< 1.5	**MCERTS**	3.5	11.8	< 1.5		
W/S Magnesium	mg/l	< 0.1	NONE	10	94	62		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion

Subcontracted analysis (S)

Soil Analysis Certificate - Sample Descriptions

DETS Report No: 20-10253
Soils Ltd
Site Reference: 38 Frognal Lane
Project / Job Ref: 18577
Order No: 18577/TR
Reporting Date: 17/09/2020

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
^ 496863	BH01	None Supplied	2.30	16.2	Light brown sandy clay
^ 496864	BH01	None Supplied	5.00	16.8	Light brown sandy clay
^ 496865	BH01	None Supplied	8.00	14.8	Brown clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample $^{I/S}$

Unsuitable Sample $^{U/S}$

^ no sampling date provided; unable to confirm if samples are within acceptable holding times

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 20-10253
Soils Ltd
Site Reference: 38 Frognal Lane
Project / Job Ref: 18577
Order No: 18577/TR
Reporting Date: 17/09/2020

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

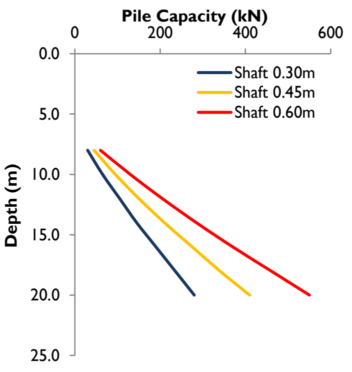
Appendix C Foundation Design

Appendix C.1 Preliminary Pile Design

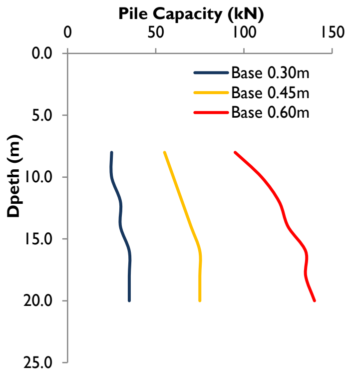
Preliminary Pile Working Loads
Single Vertically Loaded Pile (kN)

Name:	**TR**	**N_C value**	**9**	**Pile Start Depth:**	**6**	**FOS**	
Job No:	**18577**	**α value:**	**0.45**	**Pile Final Depth:**	**20**	**Shaft**	**Base**
Date:	**1.10.20**			**Pile Increment:**	**2**	**3**	**3**

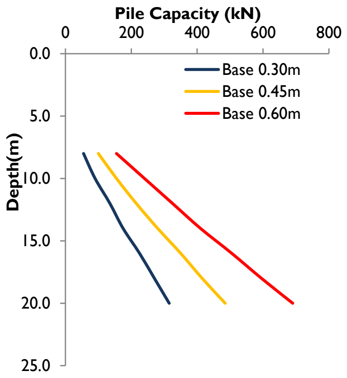
Shaft



Base

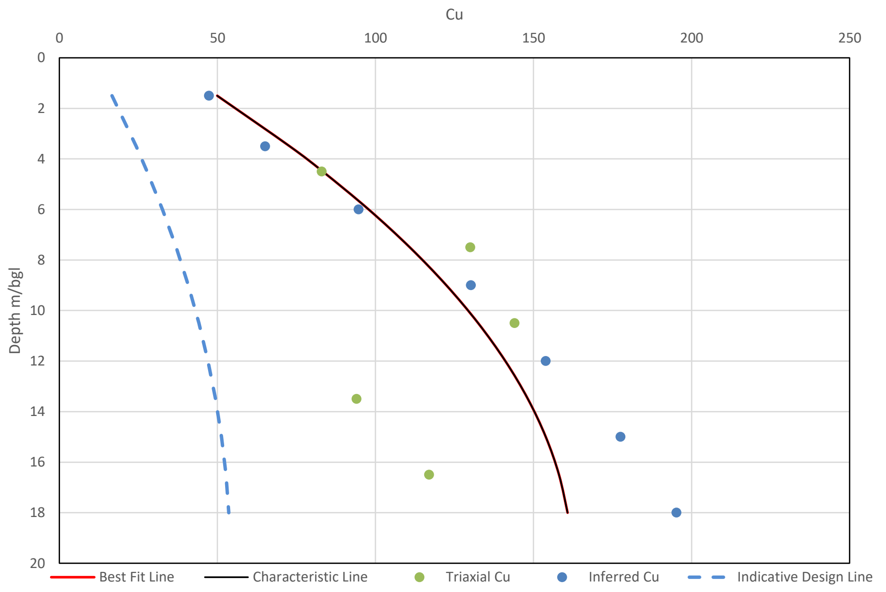


Total



Pile Diameter (m):

Pile Depths		**0.30**			**0.45**			**0.60**	
(m bgl)	**Shaft**	**Base**	**Total**	**Shaft**	**Base**	**Total**	**Shaft**	**Base**	**Total**
6.0									
8.0	30	25	55	45	55	100	60	95	155
10.0	65	25	90	95	60	155	130	110	240
12.0	105	30	135	150	65	215	205	120	325
14.0	145	30	175	210	70	280	285	125	410
16.0	190	35	225	275	75	350	370	135	505
18.0	235	35	270	340	75	415	460	135	595
20.0	280	35	315	410	75	485	550	140	690



Appendix D Chemical Laboratory Testing

Appendix D.1 Chemical Laboratory Results

Tim Rudkin
Soils Ltd
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 20-10416

Site Reference:	38 Frognal Lane
Project / Job Ref:	18577
Order No:	18577
Sample Receipt Date:	10/09/2020
Sample Scheduled Date:	10/09/2020
Report Issue Number:	1
Reporting Date:	23/09/2020

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Soil Analysis Certificate

DETS Report No: 20-10416	**Date Sampled**	09/09/20				
Soils Ltd	**Time Sampled**	None Supplied				
Site Reference: 38 Frognal Lane	**TP / BH No**	WS101				
Project / Job Ref: 18577	**Additional Refs**	None Supplied				
Order No: 18577	**Depth (m)**	0.50 - 1.20				
Reporting Date: 23/09/2020	**DETS Sample No**	497811				

Determinand	**Unit**	**RL**	**Accreditation**					
Asbestos Screen $^{(S)}$	N/a	N/a	**ISO17025**	Not Detected				
pH	pH Units	N/a	**MCERTS**	8.1				
Organic Matter	%	< 0.1	**MCERTS**	1.6				
Arsenic (As)	mg/kg	< 2	**MCERTS**	22				
W/S Boron	mg/kg	< 1	NONE	< 1				
Cadmium (Cd)	mg/kg	< 0.2	**MCERTS**	< 0.2				
Chromium (Cr)	mg/kg	< 2	**MCERTS**	33				
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2				
Copper (Cu)	mg/kg	< 4	**MCERTS**	20				
Lead (Pb)	mg/kg	< 3	**MCERTS**	134				
Mercury (Hg)	mg/kg	< 1	**MCERTS**	< 1				
Nickel (Ni)	mg/kg	< 3	**MCERTS**	14				
Selenium (Se)	mg/kg	< 2	**MCERTS**	< 3				
Vanadium (V)	mg/kg	< 1	**MCERTS**	45				
Zinc (Zn)	mg/kg	< 3	**MCERTS**	73				
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)

Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 20-10416	**Date Sampled**	09/09/20				
Soils Ltd	**Time Sampled**	None Supplied				
Site Reference: 38 Frognal Lane	**TP / BH No**	WS101				
Project / Job Ref: 18577	**Additional Refs**	None Supplied				
Order No: 18577	**Depth (m)**	0.50 - 1.20				
Reporting Date: 23/09/2020	**DETS Sample No**	497811				

Determinand	**Unit**	**RL**	**Accreditation**					
Naphthalene	mg/kg	< 0.1	**MCERTS**	< 0.1				
Acenaphthylene	mg/kg	< 0.1	**MCERTS**	< 0.1				
Acenaphthene	mg/kg	< 0.1	**MCERTS**	< 0.1				
Fluorene	mg/kg	< 0.1	**MCERTS**	< 0.1				
Phenanthrene	mg/kg	< 0.1	**MCERTS**	0.13				
Anthracene	mg/kg	< 0.1	**MCERTS**	< 0.1				
Fluoranthene	mg/kg	< 0.1	**MCERTS**	0.40				
Pyrene	mg/kg	< 0.1	**MCERTS**	0.37				
Benzo(a)anthracene	mg/kg	< 0.1	**MCERTS**	0.21				
Chrysene	mg/kg	< 0.1	**MCERTS**	0.17				
Benzo(b)fluoranthene	mg/kg	< 0.1	**MCERTS**	0.31				
Benzo(k)fluoranthene	mg/kg	< 0.1	**MCERTS**	0.13				
Benzo(a)pyrene	mg/kg	< 0.1	**MCERTS**	0.26				
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	**MCERTS**	0.18				
Dibenz(a,h)anthracene	mg/kg	< 0.1	**MCERTS**	< 0.1				
Benzo(ghi)perylene	mg/kg	< 0.1	**MCERTS**	0.17				
Total EPA-16 PAHs	mg/kg	< 1.6	**MCERTS**	2.3				

Soil Analysis Certificate - EPH Texas Banded

DETS Report No: 20-10416	**Date Sampled**	09/09/20				
Soils Ltd	**Time Sampled**	None Supplied				
Site Reference: 38 Frognal Lane	**TP / BH No**	WS101				
Project / Job Ref: 18577	**Additional Refs**	None Supplied				
Order No: 18577	**Depth (m)**	0.50 - 1.20				
Reporting Date: 23/09/2020	**DETS Sample No**	497811				

Determinand	**Unit**	**RL**	**Accreditation**					
EPH Texas (C6 - C8)	mg/kg	< 0.05	NONE	< 0.05				
EPH Texas (>C8 - C10)	mg/kg	< 1	**MCERTS**	< 1				
EPH Texas (>C10 - C12)	mg/kg	< 1	**MCERTS**	< 1				
EPH Texas (>C12 - C16)	mg/kg	< 1	**MCERTS**	< 1				
EPH Texas (>C16 - C21)	mg/kg	< 1	**MCERTS**	< 1				
EPH Texas (>C21 - C40)	mg/kg	< 6	**MCERTS**	13				
EPH Texas (C6 - C40)	mg/kg	< 6	NONE	13				

Waste Acceptance Criteria Analytical Certificate - BS EN 12457/2

DETS Report No: 20-10416	**Date Sampled**	09/09/20
Soils Ltd	**Time Sampled**	None Supplied
Site Reference: 38 Frognal Lane	**TP / BH No**	WS101
Project / Job Ref: 18577	**Additional Refs**	None Supplied
Order No: 18577	**Depth (m)**	0.50 - 1.20
Reporting Date: 23/09/2020	**DETS Sample No**	497811

				Landfill Waste Acceptance Criteria Limits		
Determinand	**Unit**	**MDL**		**Inert Waste Landfill**	**Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
TOC^{MU}	%	< 0.1	0.9	3%	5%	6%
Loss on Ignition	%	< 0.01	1.50	--	--	10%
BTEX^{MU}	mg/kg	< 0.05	< 0.05	6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1	1	--	--
Mineral Oil^{MU}	mg/kg	< 10	< 10	500	--	--
Total PAH^{MU}	mg/kg	< 1.7	2.3	100	--	--
pH^{MU}	pH Units	N/a	8.1	--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	< 1	--	To be evaluated	To be evaluated

					Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Eluate Analysis	**10:1 mg/l**			**Cumulative 10:1 mg/kg**			
Arsenic^{U}	0.01			0.1	0.5	2	25
Barium^{U}	< 0.02			< 0.2	20	100	300
Cadmium^{U}	< 0.0005			< 0.005	0.04	1	5
Chromium^{U}	< 0.005			< 0.05	0.5	10	70
Copper^{U}	< 0.01			< 0.1	2	50	100
Mercury^{U}	< 0.0005			< 0.005	0.01	0.2	2
Molybdenum^{U}	0.009			0.09	0.5	10	30
Nickel^{U}	< 0.007			< 0.07	0.4	10	40
Lead^{U}	< 0.005			< 0.05	0.5	10	50
Antimony^{U}	< 0.005			< 0.05	0.06	0.7	5
Selenium^{U}	< 0.005			< 0.05	0.1	0.5	7
Zinc^{U}	< 0.005			< 0.05	4	50	200
Chloride^{U}	2.9			29	800	15000	25000
Fluoride^{U}	1.3			13	**10**	150	500
Sulphate^{U}	5.2			52	1000	20000	50000
TDS	79			790	4000	60000	100000
Phenol Index	< 0.01			< 0.1	1	-	-
DOC	15			150	500	800	1000

Leach Test Information				
Sample Mass (kg)	0.10			
Dry Matter (%)	89.6			
Moisture (%)	11.8			
Stage 1				
Volume Eluate L10 (litres)	0.89			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Stated limits are for guidance only and DETS Ltd cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

Soil Analysis Certificate - Sample Descriptions
DETS Report No: 20-10416
Soils Ltd
Site Reference: 38 Frognal Lane
Project / Job Ref: 18577
Order No: 18577
Reporting Date: 23/09/2020

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
497811	WS101	None Supplied	0.50 - 1.20	10.5	Red gravelly clay with brick

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample $^{I/S}$

Unsuitable Sample $^{U/S}$

Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 20-10416
Soils Ltd
Site Reference: 38 Frognal Lane
Project / Job Ref: 18577
Order No: 18577
Reporting Date: 23/09/2020

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D	**Dried**
AR	**As Received**

Parameter	Matrix Type	Suite Reference	Expanded Uncertainity Measurement	Unit
TOC	Soil	BS EN 12457	13.49	%
Loss on Ignition	Soil	BS EN 12457	17	%
BTEX	Soil	BS EN 12457	14	%
Sum of PCBs	Soil	BS EN 12457	23	%
Mineral Oil	Soil	BS EN 12457	9	%
Total PAH	Soil	BS EN 12457	20	%
pH	Soil	BS EN 12457	0.399	Units
Acid Neutralisation Capacity	Soil	BS EN 12457	18	%
Arsenic	Leachate	BS EN 12457	16.63	%
Barium	Leachate	BS EN 12457	14.29	%
Cadmium	Leachate	BS EN 12457	14.44	%
Chromium	Leachate	BS EN 12457	18.06	%
Copper	Leachate	BS EN 12457	21.27	%
Mercury	Leachate	BS EN 12457	24.13	%
Molybdenum	Leachate	BS EN 12457	12.55	%
Nickel	Leachate	BS EN 12457	20.08	%
Lead	Leachate	BS EN 12457	13.43	%
Antimony	Leachate	BS EN 12457	18.85	%
Selenium	Leachate	BS EN 12457	18.91	%
Zinc	Leachate	BS EN 12457	13.71	%
Chloride	Leachate	BS EN 12457	16	%
Fluoride	Leachate	BS EN 12457	19.4	%
Sulphate	Leachate	BS EN 12457	19.63	%
TDS	Leachate	BS EN 12457	12	%
Phenol Index	Leachate	BS EN 12457	14	%
DOC	Leachate	BS EN 12457	10	%
Clay Content	Soil	BS 3882: 2015	15	%
Silt Content	Soil	BS 3882: 2015	14	%
Sand Content	Soil	BS 3882: 2015	13	%
Loss on Ignition	Soil	BS 3882: 2015	17	%
pH	Soil	BS 3882: 2015	0.399	Units
Carbonate	Soil	BS 3882: 2015	16	%
Total Nitrogen	Soil	BS 3882: 2015	12	%
Phosphorus (Extractable)	Soil	BS 3882: 2015	24	%
Potassium (Extractable)	Soil	BS 3882: 2015	20	%
Magnesium (Extractable)	Soil	BS 3882: 2015	26	%
Zinc	Soil	BS 3882: 2015	14.9	%
Copper	Soil	BS 3882: 2015	16	%
Nickel	Soil	BS 3882: 2015	17.7	%
Available Sodium	Soil	BS 3882: 2015	23	%
Available Calcium	Soil	BS 3882: 2015	23	%
Electrical Conductivity	Soil	BS 3882: 2015	10	%

HazWasteOnline™

Waste Classification Report

LEYRC-Q6LPN-2GQNY

Job name

18577 38 Frognal Lane

Description/Comments

Project

18577

Site

38 Frognal Lane

Related Documents

#	Name	Description
None		

Waste Stream Template

DETS suite 1

Classified by

Name:
Chris Swainston
Date:
07 Oct 2020 12:30 GMT
Telephone:
02476 629013

Company:
Soils Ltd
Newton House
Cross Road
Tadworth
KT20 5SR

HazWasteOnline™ Training Record:

Course	**Date**
Hazardous Waste Classification	07 Dec 2016
Advanced Hazardous Waste Classification	08 Dec 2016

Report

Created by: Chris Swainston
Created date: 07 Oct 2020 12:30 GMT

Job summary

#	Sample Name	Depth [m]	Classification Result	Hazard properties	Page
1	WS101	0.50 - 1.20	Non Hazardous		2

Classification of sample: WS101

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:		LoW Code:	
WS101		Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:			
0.50 - 1.20 m		Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:			
10.5% (dry weight correction)			

Hazard properties

None identified

Determinands

Moisture content: 10.5% Dry Weight Moisture Correction applied (MC)

#		Determinand			CLP Note	**User entered data**	Conv. Factor	Compound conc.	**Classification value**	MC Applied	Conc. Not Used
		CLP index number	EC Number	CAS Number							
1		asbestos				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		**<LOD**
		650-013-00-6	- - - - - - -	12001-28-4 132207-32-0 12172-73-5 77536-66-4 77536-68-6 77536-67-5 12001-29-5							
2	●	monohydric phenols				<2 mg/kg		<2 mg/kg	<0.0002 %		**<LOD**
				P1186							
3	●	pH				8.1 pH		8.1 pH	8.1 pH		
				PH							
4		arsenic { arsenic trioxide }				22 mg/kg	1.32	26.287 mg/kg	0.00263 %	✓	
		033-003-00-0	215-481-4	1327-53-3							
5		boron { diboron trioxide; boric oxide }				<1 mg/kg	3.22	<3.22 mg/kg	<0.000322 %		**<LOD**
		005-008-00-8	215-125-8	1303-86-2							
6		cadmium { cadmium oxide }				<0.2 mg/kg	1.142	<0.228 mg/kg	<0.0000228 %		**<LOD**
		048-002-00-0	215-146-2	1306-19-0							
7		chromium in chromium(VI) compounds { chromium(VI) oxide }				<2 mg/kg	1.923	<3.846 mg/kg	<0.000385 %		**<LOD**
		024-001-00-0	215-607-8	1333-82-0							
8		chromium in chromium(III) compounds { ● chromium(III) oxide (worst case) }				33 mg/kg	1.462	43.648 mg/kg	0.00436 %	✓	
			215-160-9	1308-38-9							
9		copper { copper(II) oxide }				20 mg/kg	1.252	22.657 mg/kg	0.00227 %	✓	
		029-016-00-6	215-269-1	1317-38-0							
10		lead { ● lead compounds with the exception of those specified elsewhere in this Annex }			1	134 mg/kg		121.267 mg/kg	0.0121 %	✓	
		082-001-00-6									
11		mercury { inorganic compounds of mercury with the exception of mercuric sulphide and those specified elsewhere in this Annex }			1	<1 mg/kg		<1 mg/kg	<0.0001 %		**<LOD**
		080-002-00-6									

#		Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
		CLP index number	EC Number	CAS Number							
12	⚛	nickel { nickel(II) oxide (nickel monoxide) }				14 mg/kg	1.273	16.123 mg/kg	0.00161 %	✓	
		028-003-00-2	215-215-7 [1] 234-323-5 [2] - [3]	1313-99-1 [1] 11099-02-8 [2] 34492-97-2 [3]							
13	⚛	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }				<3 mg/kg	2.554	<7.661 mg/kg	<0.000766 %		**<LOD**
		034-002-00-8									
14	⚛	vanadium { divanadium pentaoxide; vanadium pentoxide }				45 mg/kg	1.785	72.7 mg/kg	0.00727 %	✓	
		023-001-00-8	215-239-8	1314-62-1							
15	⚛	zinc { zinc oxide }				73 mg/kg	1.245	82.23 mg/kg	0.00822 %	✓	
		030-013-00-7	215-222-5	1314-13-2							
16		naphthalene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		**<LOD**
		601-052-00-2	202-049-5	91-20-3							
17	●	acenaphthylene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		**<LOD**
			205-917-1	208-96-8							
18	●	acenaphthene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		**<LOD**
			201-469-6	83-32-9							
19	●	fluorene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		**<LOD**
			201-695-5	86-73-7							
20	●	phenanthrene				0.13 mg/kg		0.118 mg/kg	0.0000118 %	✓	
			201-581-5	85-01-8							
21	●	anthracene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		**<LOD**
			204-371-1	120-12-7							
22	●	fluoranthene				0.4 mg/kg		0.362 mg/kg	0.0000362 %	✓	
			205-912-4	206-44-0							
23	●	pyrene				0.37 mg/kg		0.335 mg/kg	0.0000335 %	✓	
			204-927-3	129-00-0							
24		benzo[a]anthracene				0.21 mg/kg		0.19 mg/kg	0.000019 %	✓	
		601-033-00-9	200-280-6	56-55-3							
25		chrysene				0.17 mg/kg		0.154 mg/kg	0.0000154 %	✓	
		601-048-00-0	205-923-4	218-01-9							
26		benz[e]acephenanthrylene				0.31 mg/kg		0.281 mg/kg	0.0000281 %	✓	
		601-034-00-4	205-911-9	205-99-2							
27		benzo[k]fluoranthene				0.13 mg/kg		0.118 mg/kg	0.0000118 %	✓	
		601-036-00-5	205-916-6	207-08-9							
28		benzo[a]pyrene; benzo[def]chrysene				0.26 mg/kg		0.235 mg/kg	0.0000235 %	✓	
		601-032-00-3	200-028-5	50-32-8							
29	●	indeno[123-cd]pyrene				0.18 mg/kg		0.163 mg/kg	0.0000163 %	✓	
			205-893-2	193-39-5							
30		dibenz[a,h]anthracene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		**<LOD**
		601-041-00-2	200-181-8	53-70-3							
31	●	benzo[ghi]perylene				0.17 mg/kg		0.154 mg/kg	0.0000154 %	✓	
			205-883-8	191-24-2							
32	●	TPH (C6 to C40) petroleum group				<20 mg/kg		<20 mg/kg	<0.002 %		**<LOD**
				TPH							
								Total:	0.0426 %		

Key

🟨	User supplied data
▨	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
⚛	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

Appendix A: Classifier defined and non CLP determinands

- **monohydric phenols** (CAS Number: P1186)

Description/Comments: Combined hazards statements from harmonised entries in CLP for phenol, cresols and xylenols (604-001-00-2, 604-004-00-9, 604-006-00-X)
Data source: CLP combined data
Data source date: 26 Mar 2019
Hazard Statements: Acute Tox. 3 H301 , Acute Tox. 3 H311 , Acute Tox. 3 H331 , Skin Corr. 1B H314 , Skin Corr. 1B H314 >= 3 %, Skin Irrit. 2 H315 1 £ conc. < 3 %, Eye Irrit. 2 H319 1 £ conc. < 3 %, Muta. 2 H341 , STOT RE 2 H373 , Aquatic Chronic 2 H411

- **pH** (CAS Number: PH)

Description/Comments: Appendix C4
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Hazard Statements: None.

- **chromium(III) oxide (worst case)** (EC Number: 215-160-9, CAS Number: 1308-38-9)

Conversion factor: 1.462
Description/Comments: Data from C&L Inventory Database
Data source: https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/33806
Data source date: 17 Jul 2015
Hazard Statements: Acute Tox. 4 H332 , Acute Tox. 4 H302 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315 , Resp. Sens. 1 H334 , Skin Sens. 1 H317 , Repr. 1B H360FD , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

- **lead compounds with the exception of those specified elsewhere in this Annex**

CLP index number: 082-001-00-6
Description/Comments: Least-worst case: IARC considers lead compounds Group 2A; Probably carcinogenic to humans; Lead REACH Consortium, following CLP protocols, considers many simple lead compounds to be Carcinogenic category 2
Data source: Regulation 1272/2008/EC - Classification, labelling and packaging of substances and mixtures. (CLP)
Additional Hazard Statement(s): Carc. 2 H351
Reason for additional Hazards Statement(s):
03 Jun 2015 - Carc. 2 H351 hazard statement sourced from: IARC Group 2A (Sup 7, 87) 2006; Lead REACH Consortium www.reach-lead.eu/substanceinformation.html. Review date 29/09/2015

- **acenaphthylene** (EC Number: 205-917-1, CAS Number: 208-96-8)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Hazard Statements: Acute Tox. 4 H302 , Acute Tox. 1 H330 , Acute Tox. 1 H310 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315

- **acenaphthene** (EC Number: 201-469-6, CAS Number: 83-32-9)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Hazard Statements: Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410 , Aquatic Chronic 2 H411

- **fluorene** (EC Number: 201-695-5, CAS Number: 86-73-7)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Hazard Statements: Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

- **phenanthrene** (EC Number: 201-581-5, CAS Number: 85-01-8)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Hazard Statements: Acute Tox. 4 H302 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Carc. 2 H351 , Skin Sens. 1 H317 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410 , Skin Irrit. 2 H315

- **anthracene** (EC Number: 204-371-1, CAS Number: 120-12-7)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Hazard Statements: Eye Irrit. 2 H319 , STOT SE 3 H335 , Skin Irrit. 2 H315 , Skin Sens. 1 H317 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

- **fluoranthene** (EC Number: 205-912-4, CAS Number: 206-44-0)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 21 Aug 2015
Hazard Statements: Acute Tox. 4 H302 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

- **pyrene** (EC Number: 204-927-3, CAS Number: 129-00-0)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 2014
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 21 Aug 2015
Hazard Statements: Skin Irrit. 2 H315 , Eye Irrit. 2 H319 , STOT SE 3 H335 , Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

- **indeno[123-cd]pyrene** (EC Number: 205-893-2, CAS Number: 193-39-5)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Hazard Statements: Carc. 2 H351

- **benzo[ghi]perylene** (EC Number: 205-883-8, CAS Number: 191-24-2)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 28/02/2015
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 23 Jul 2015
Hazard Statements: Aquatic Acute 1 H400 , Aquatic Chronic 1 H410

- **TPH (C6 to C40) petroleum group** (CAS Number: TPH)

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Hazard Statements: Flam. Liq. 3 H226 , Asp. Tox. 1 H304 , STOT RE 2 H373 , Muta. 1B H340 , Carc. 1B H350 , Repr. 2 H361d , Aquatic Chronic 2 H411

Appendix B: Rationale for selection of metal species

arsenic {arsenic trioxide}

Most likely form in Soils and Made Ground

boron {diboron trioxide; boric oxide}

Most likely form in Soils and Made Ground

cadmium {cadmium oxide}

Most likely in Soils and Made Ground

chromium in chromium(VI) compounds {chromium(VI) oxide}

(enter justification for selecting this species)

chromium in chromium(III) compounds {chromium(III) oxide (worst case)}

(enter justification for selecting this species)

copper {copper(II) oxide}

Most likely in soil/Made Ground environment

lead {lead compounds with the exception of those specified elsewhere in this Annex}

Most likely form of Lead in soils and Made Ground including demolition materials

mercury {inorganic compounds of mercury with the exception of mercuric sulphide and those specified elsewhere in this Annex}

Mercury in soil and Made Ground most likely to combine with organic materials

nickel {nickel(II) oxide (nickel monoxide)}

Most likely form in Soils and Made Ground

selenium {selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex}

Most likely form in Soils and Made Ground

vanadium {divanadium pentaoxide; vanadium pentoxide}

Most likely form in Soils and Made Ground

zinc {zinc oxide}

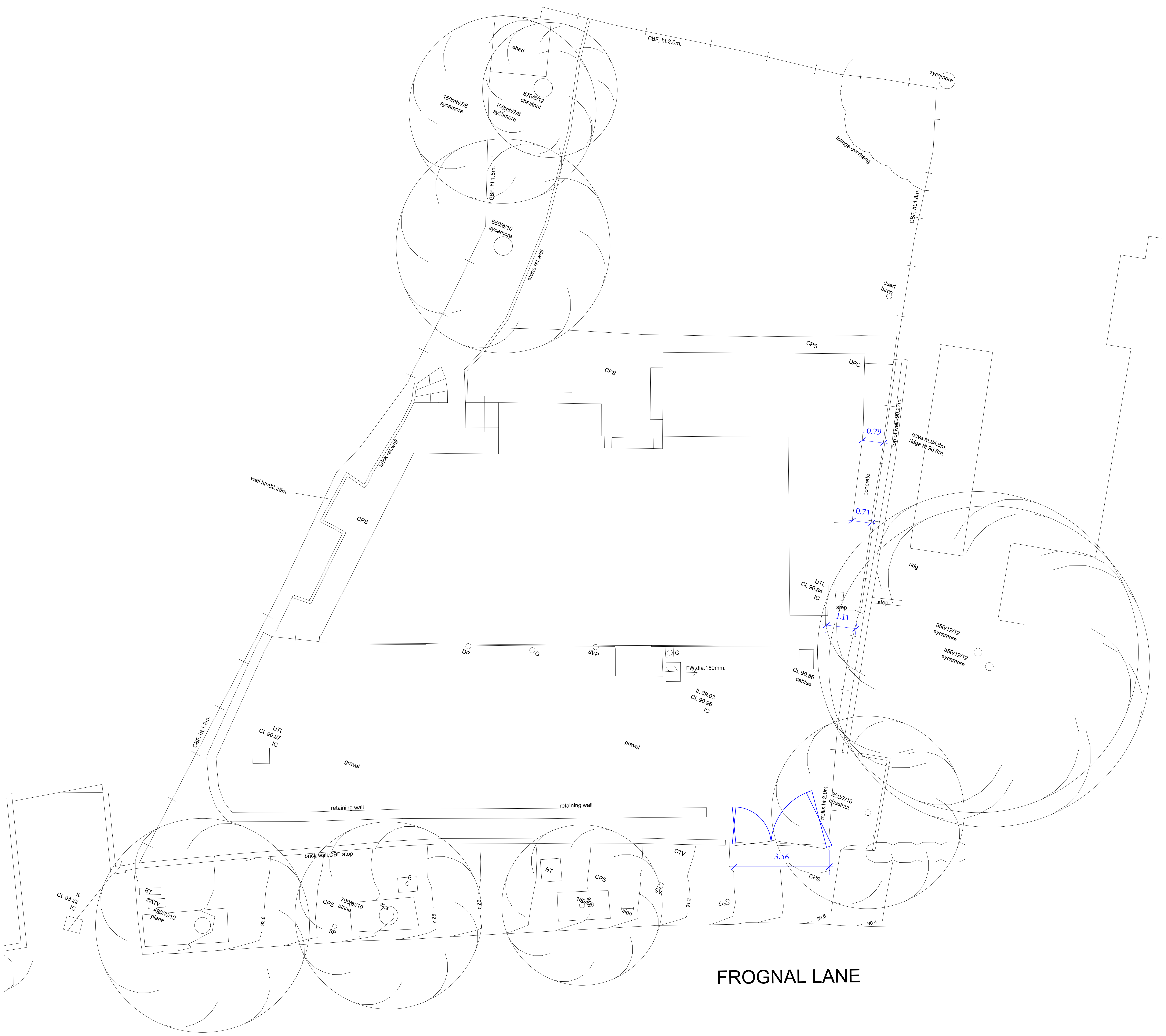
Most likely form of Zinc in Made Ground and soil

Appendix C: Version

HazWasteOnline Classification Engine: WM3 1st Edition v1.1, May 2018
HazWasteOnline Classification Engine Version: 2020.276.4488.8743 (02 Oct 2020)
HazWasteOnline Database: 2020.276.4488.8743 (02 Oct 2020)

This classification utilises the following guidance and legislation:
WM3 v1.1 - Waste Classification - 1st Edition v1.1 - May 2018
CLP Regulation - Regulation 1272/2008/EC of 16 December 2008
1st ATP - Regulation 790/2009/EC of 10 August 2009
2nd ATP - Regulation 286/2011/EC of 10 March 2011
3rd ATP - Regulation 618/2012/EU of 10 July 2012
4th ATP - Regulation 487/2013/EU of 8 May 2013
Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013
5th ATP - Regulation 944/2013/EU of 2 October 2013
6th ATP - Regulation 605/2014/EU of 5 June 2014
WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014
Revised List of Wastes 2014 - Decision 2014/955/EU of 18 December 2014
7th ATP - Regulation 2015/1221/EU of 24 July 2015
8th ATP - Regulation (EU) 2016/918 of 19 May 2016
9th ATP - Regulation (EU) 2016/1179 of 19 July 2016
10th ATP - Regulation (EU) 2017/776 of 4 May 2017
HP14 amendment - Regulation (EU) 2017/997 of 8 June 2017
13th ATP - Regulation (EU) 2018/1480 of 4 October 2018
14th ATP - Regulation (EU) 2020/217 of 4 October 2019
15th ATP - Regulation (EU) 2020/1182 of 19 May 2020
POPs Regulation 2004 - Regulation 850/2004/EC of 29 April 2004
1st ATP to POPs Regulation - Regulation 756/2010/EU of 24 August 2010
2nd ATP to POPs Regulation - Regulation 757/2010/EU of 24 August 2010

Appendix E Information Provided by the Client



1 Site Plan
Scale: 1:100

N

Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL

Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

Drawing Title
Access Inspection - Site Dimensions

Date	Drawn	Checked
03/08/2020	MCW	

Scale
1:100

Issue Status

Project Number	Drawing Number	Revision
20022	SK-00-102	

Soils Limited
Geotechnical & Environmental Consultants

Newton House
Cross Road, Tadworth
Surrey KT20 5SR

T 01737 814221
W soilslimited.co.uk

soils
LIMITED

Geotechnical &
Environmental Consultants

Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

T: 44(0)1737 814221

www.soilslimited.co.uk

Fitzpatrick Construction Ltd

Via Email Only: shelly@fitzp.com

FAO: Brian Fitzpatrick

10 January 2014

Our ref: 14005/FDL/RG

Dear Sir

Re: 38 Frognal Lane, Hampstead, London, NW3 6PP

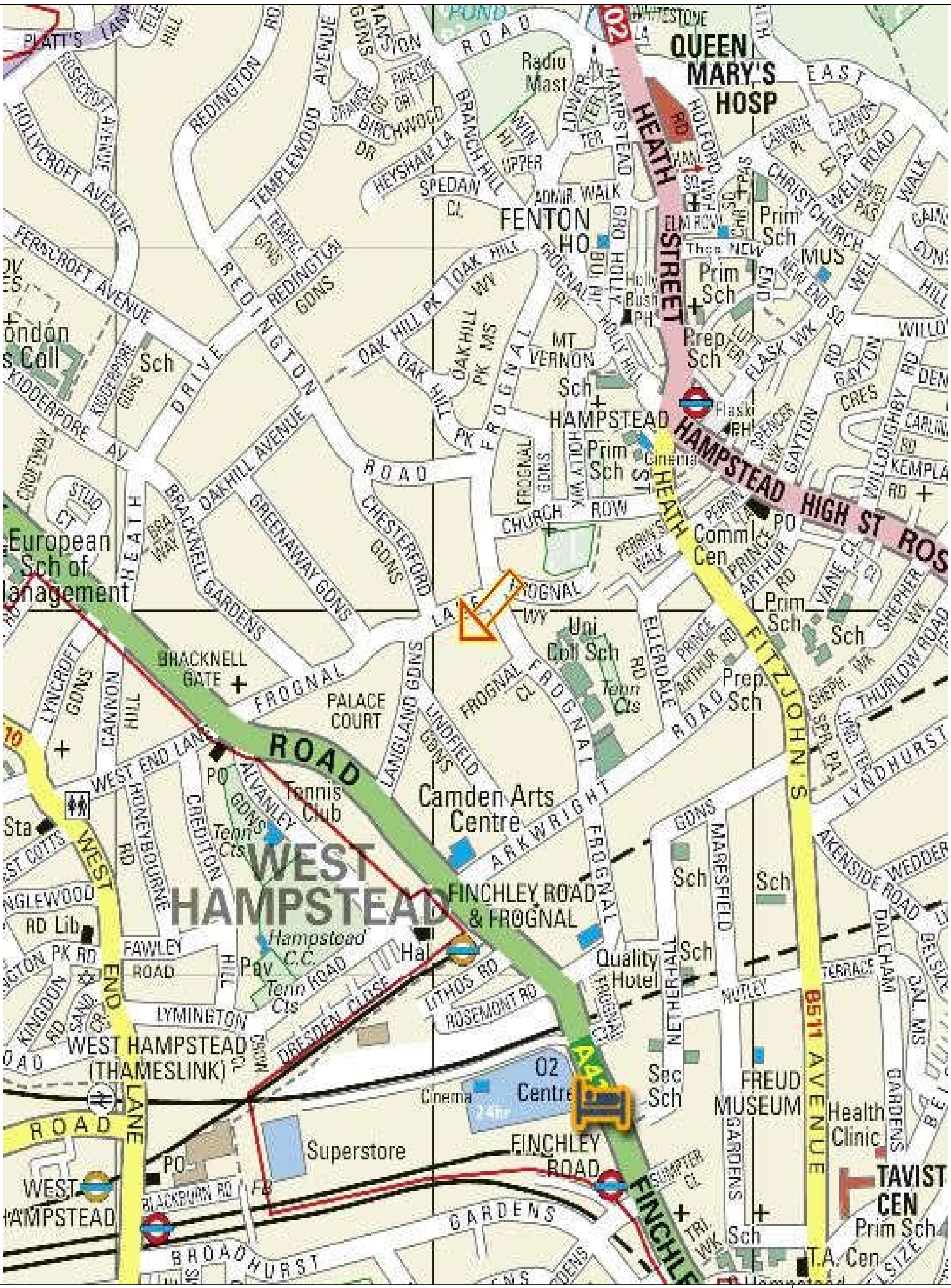
Please find enclosed the field data on the Ground Investigation undertaken on the aforementioned site.

We trust this is the requested data, though should you have any queries please do not hesitate to contact us.

Yours sincerely

Roland Galinski
rg@soilslimited.co.uk
for and on behalf of Soils Limited
enc

Offices: Southampton, Cornwall, Greece
Registered office as above
Registration number 1612073
(England & Wales)
VAT No: 318273558



Project:

38 Frognal Lane, Hampstead, London, NW3 6PP

Client

Fitzpatrick Construction Ltd

Date:

January 2014

Site Location Map

Ref:

14005

Fig No. 1

soils LIMITED

Geotechnical & Environmental Consultants

Project:

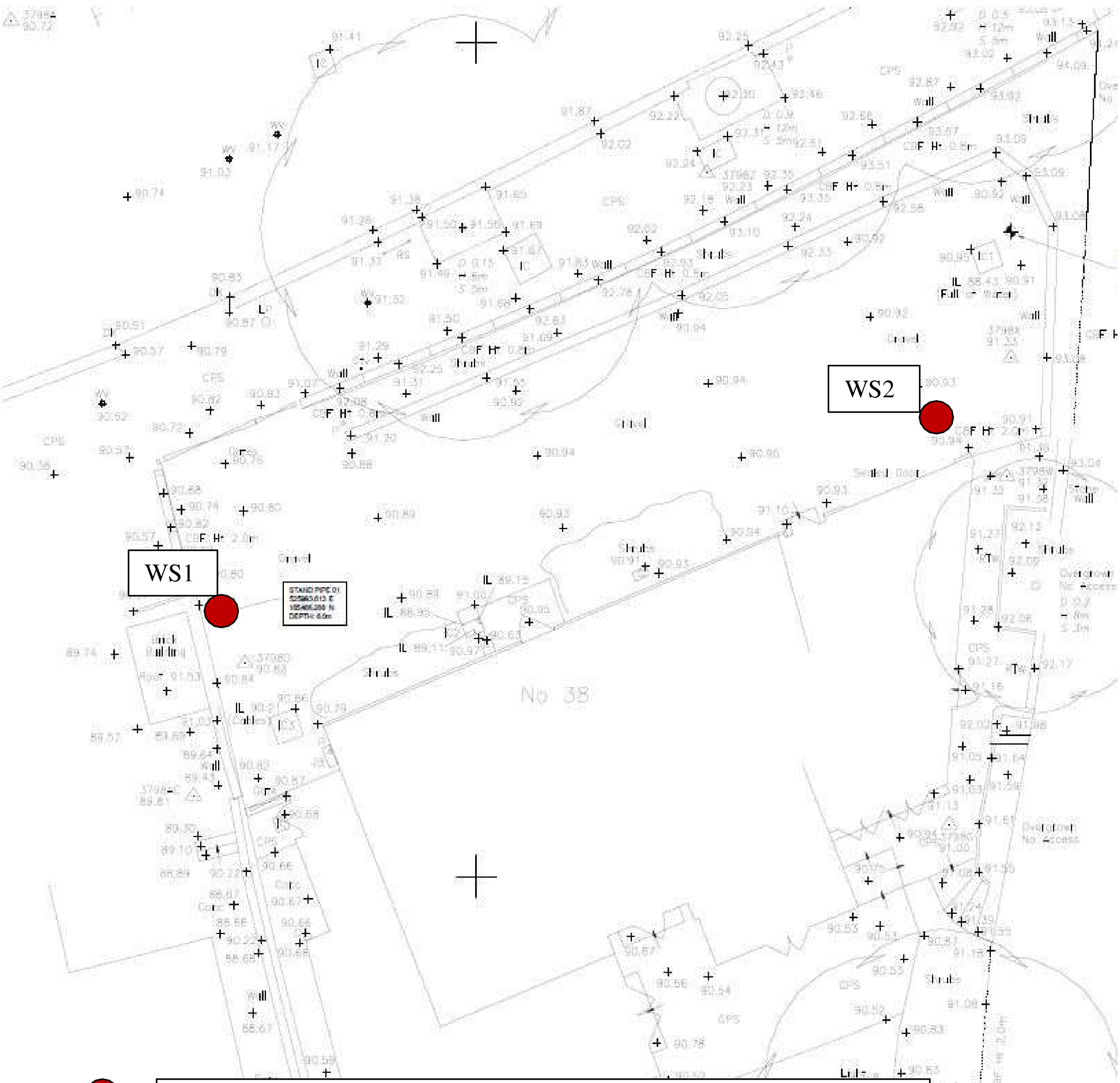
38 Frognal Lane, Hampstead, London, NW3 6PP

Client **Fitzpatrick Construction Ltd**	Date: **January 2014**
Site Location Plan	Ref: **14005**

Fig No. 2

soils LIMITED

Geotechnical & Environmental Consultants



● Windowless sampler borehole with groundwater monitoring well

WS2 location was moved due to a car parked over proposed location

Project: **38 Frognal Lane, Hampstead, London, NW3 6PP**		**Fig No. 3** soils LIMITED Geotechnical & Environmental Consultants
Client **Fitzpatrick Construction Ltd**	Date: **January 2014**	
Trial Hole Location Plan	Ref: **14005**	

Soils Limited
Newton House
Cross Road
Tadworth
Surrey KT20 5SR
Tel: 01737 814221
Fax: 01737 812557

Record of Borehole WS 1

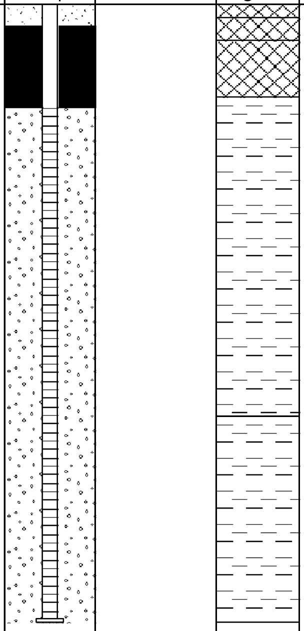
Sheet 1 of 1

Start Date:	18/12/2014	**Ground Level:**	-
End Date:	18/12/2014	**Easting:**	-
Logged By:	GB	**Northing:**	-

Site:	38 Frognal Lane, Hampstead, London, NW3 6PP	**Boring Method:**	WS
Client:	Fitzpatrick Construction Ltd	**Weather:**	
Project No:	14005	**Driller:**	SN

Samples, In-situ Tests & Installations

Depth	Type	Result
0.40	D & J	
0.60	D & J	
0.80	D & J	
1.00	D	
1.50	D	
2.00	D	
2.50	D	
3.00	D	
3.50	D	
4.00	D	
4.50	D	
5.00	D	
5.50	D	
6.00	D	



Strata

Depth	(Thk)	Description
0.13	0.13	10mm shingle over block paving, reinforcement grid. MADE GROUND
0.35	0.22	Pink crushed limestone. MADE GROUND
0.90	0.55	Soft to firm dark orangish red sandy CLAY with brick and ash fragments and occasional rootlets. MADE GROUND
4.00	3.10	Soft to very soft light orangish brown becoming dark greyish mottled brown CLAY at 2.80m with occasional rootlets. CLAYGATE MEMBER
6.00	2.00	Soft to firm brown closely fissured CLAY. CLAYGATE MEMBER

End of Borehole at 6.00 m

Daily Progress					**Water Strikes**							**Chiselling**			**Hole Diameter**		**Casing Diameter**	
Date	Time	Hole	Depth	Water Depth	Strike Depth	Casing Depth	Date	Time	Post Depth	Elapsed Minutes	Depth Sealed	Start Depth	End Depth	Hours	Depth	Diam. (mm)	Depth	Diam. (mm)
					2.80	-	18/12/2014	0000	5.25	10	-							

General Remarks:

Roots observed to 2.80m bgl

Soils Limited
Newton House
Cross Road
Tadworth
Surrey KT20 5SR
Tel: 01737 814221
Fax: 01737 812557

Record of Borehole WS 2

Sheet 1 of 1

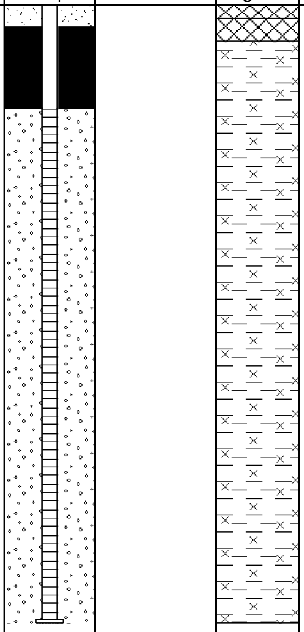
Start Date:	18/12/2014	**Ground Level:**	-
End Date:	18/12/2014	**Easting:**	-
Logged By:	GB	**Northing:**	-

Site: 38 Frognal Lane, Hampstead, London, NW3 6PP
Client: Fitzpatrick Construction Ltd
Project No: 14005

Boring Method: WS
Weather:
Driller: SN

Samples, In-situ Tests & Installations

Depth	Type	Result
0.45	D & J	
0.60	D & J	
0.80	D & J	
1.00	D	
1.50	D	
2.00	D	
2.50	D	
3.00	D	
3.50	D	
4.00	D	
4.50	D	
5.00	D	
5.50	D	
6.00	D	



Strata

Depth	(Thk)	Description
0.13	0.13	10mm shingle black plastic reinforcement grid. MADE GROUND
0.35	0.22	White crushed limestone. MADE GROUND
6.00	5.65	Soft becoming firm light orangish brown slightly silty CLAY with occasional rootlets and occasional sandy partings. Claystone band at 2.30m bgl. CLAYGATE MEMBER

End of Borehole at 6.00 m

Daily Progress

Date	Time	Hole Depth	Water Depth

Water Strikes

Strike Depth	Casing Depth	Date	Time	Post Depth	Elapsed Minutes	Depth Sealed
2.00	-	18/12/2014	0000	1.56	15	-

Chiselling

Start Depth	End Depth	Hours

Hole Diameter

Depth	Diam. (mm)

Casing Diameter

Depth	Diam. (mm)

General Remarks:
Roots observed to 2.00m bgl

IN SITU PERMEABILITY TEST

HVORSLEV'S TIME LAG

Project: 40 FROGNAL LANE, CAMDEN
Client: Arlington Management Services Limited

Project No: 3611
Sheet No: 1/1

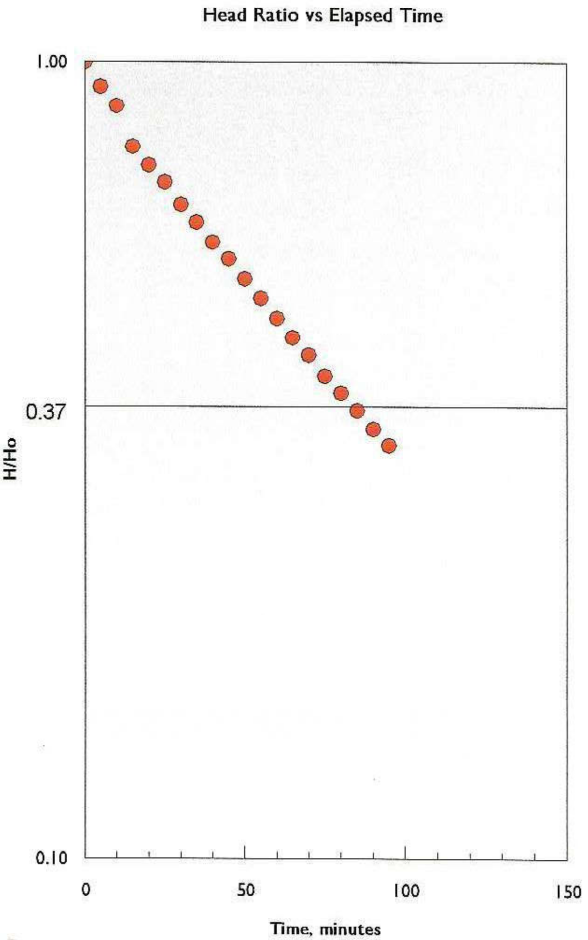
Location: BH 1

Test deptl from 7.00 m
to 1.00 m

Height of casing above g.l., m	0.00
Depth of casing below g.l., m	1.00
Diameter of casing, m	0.15
Depth to water at start of test, m b.g.l.	2.86

Description of stratum under test
Claygate Member to 5.6m then London Clay

Elapsed Time min	Depth to Water, m from Casing	Depth to Water, m from GL	H	H / Ho
0	6.00	6.00	-3.14	1.000
5	5.79	5.79	-2.93	0.933
10	5.63	5.63	-2.77	0.882
15	5.32	5.32	-2.46	0.783
20	5.19	5.19	-2.33	0.742
25	5.08	5.08	-2.22	0.707
30	4.94	4.94	-2.08	0.662
35	4.84	4.84	-1.98	0.631
40	4.73	4.73	-1.87	0.596
45	4.64	4.64	-1.78	0.567
50	4.54	4.54	-1.68	0.535
55	4.45	4.45	-1.59	0.506
60	4.36	4.36	-1.50	0.478
65	4.28	4.28	-1.42	0.452
70	4.21	4.21	-1.35	0.430
75	4.13	4.13	-1.27	0.404
80	4.07	4.07	-1.21	0.385
85	4.01	4.01	-1.15	0.366
90	3.95	3.95	-1.09	0.347
95	3.90	3.90	-1.04	0.331



k = A/FT
A = 0.018 m²
F = 8.603 m
T = 82 min
k = 4.18E-007 m/s

Standpipe Readings

	18.12.13		23.01.14	
Location	Depth BGL	OD	Depth BGL	OD
WS1 [West]	2.8m	+88.0m	1.5m	+89.3m
WS2 [East]	2.0m	+88.9m	0.8m	+90.1m
Difference across site		0.9m		0.8m

Road level at WS2 = +92.8m OD with road gradient at 1 in 10.

WS1 and WS2 spaced 18m apart so water table difference of 0.9m gives gradient of 1 in 20.

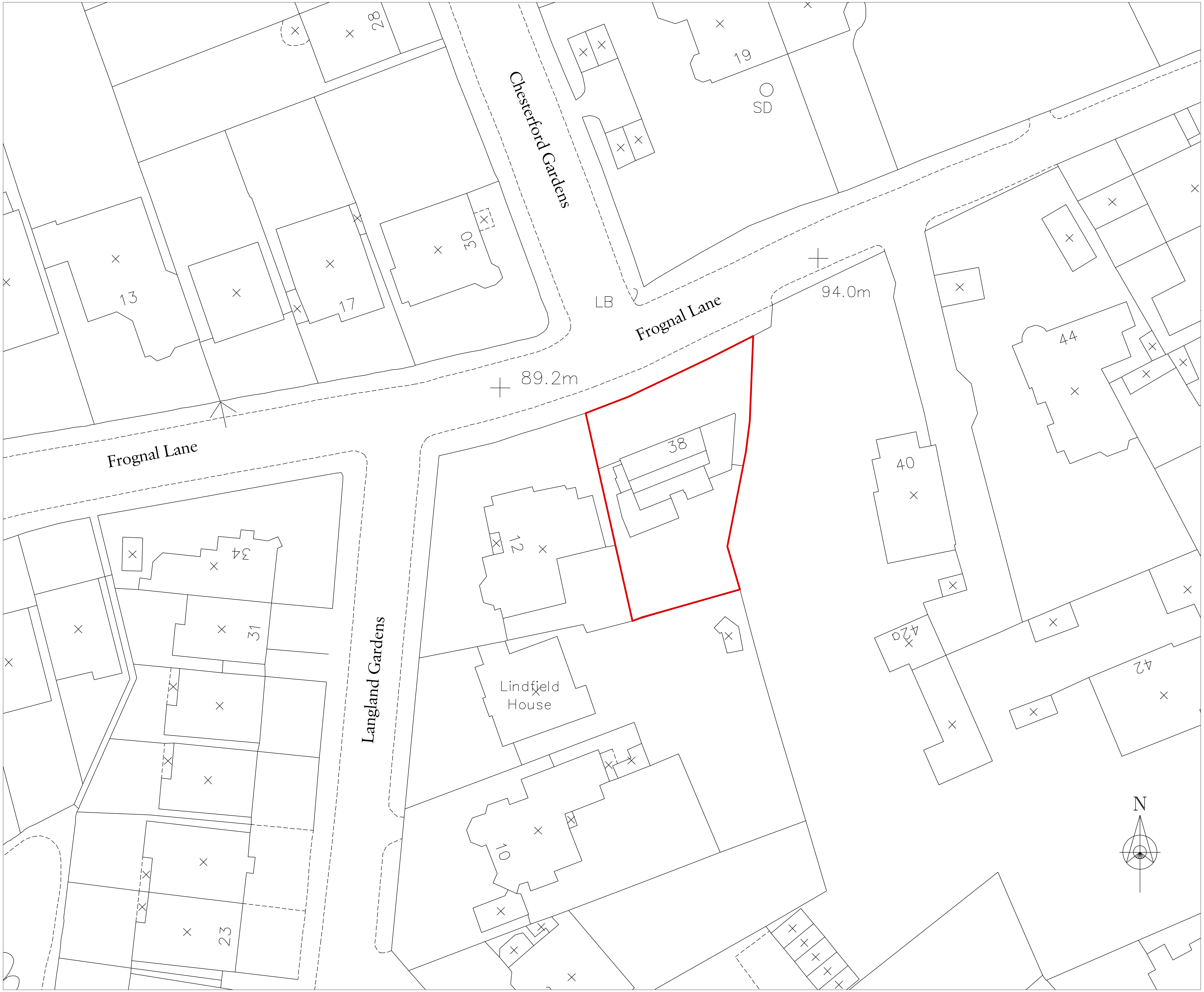
Extrapolating gradients:

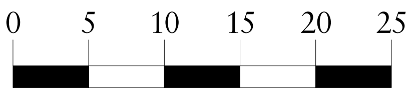
- with water table in WS2 as +90.1m, water table at surface 55m to the west.
- with water table in WS2 as +88.9m, water table at surface 80m to the west.

Appendix 3: Existing and Proposed Development Drawings

The following Architects drawings form part of the planning application

PL-010 Location Plan
PL-011 Site Plan
PL-099 Basement Plan
PL-100 Ground Floor Plan
PL-101 First Floor Plan
PL-102 Second Floor Plan
PL-103 Roof Plan
PL-200 Front Elevation _ North
PL-201 Side Elevation _ East
PL-202 Rear Elevation _ South
PL-203 Side Elevation _ West
PL-204 Street Elevation
PL-300 Sections - AA
PL-305 Sections - BB





Rev Date Details By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL

Telephone	+44(0)20 7794 1234
Email	office@charltonbrown.com
Website	www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

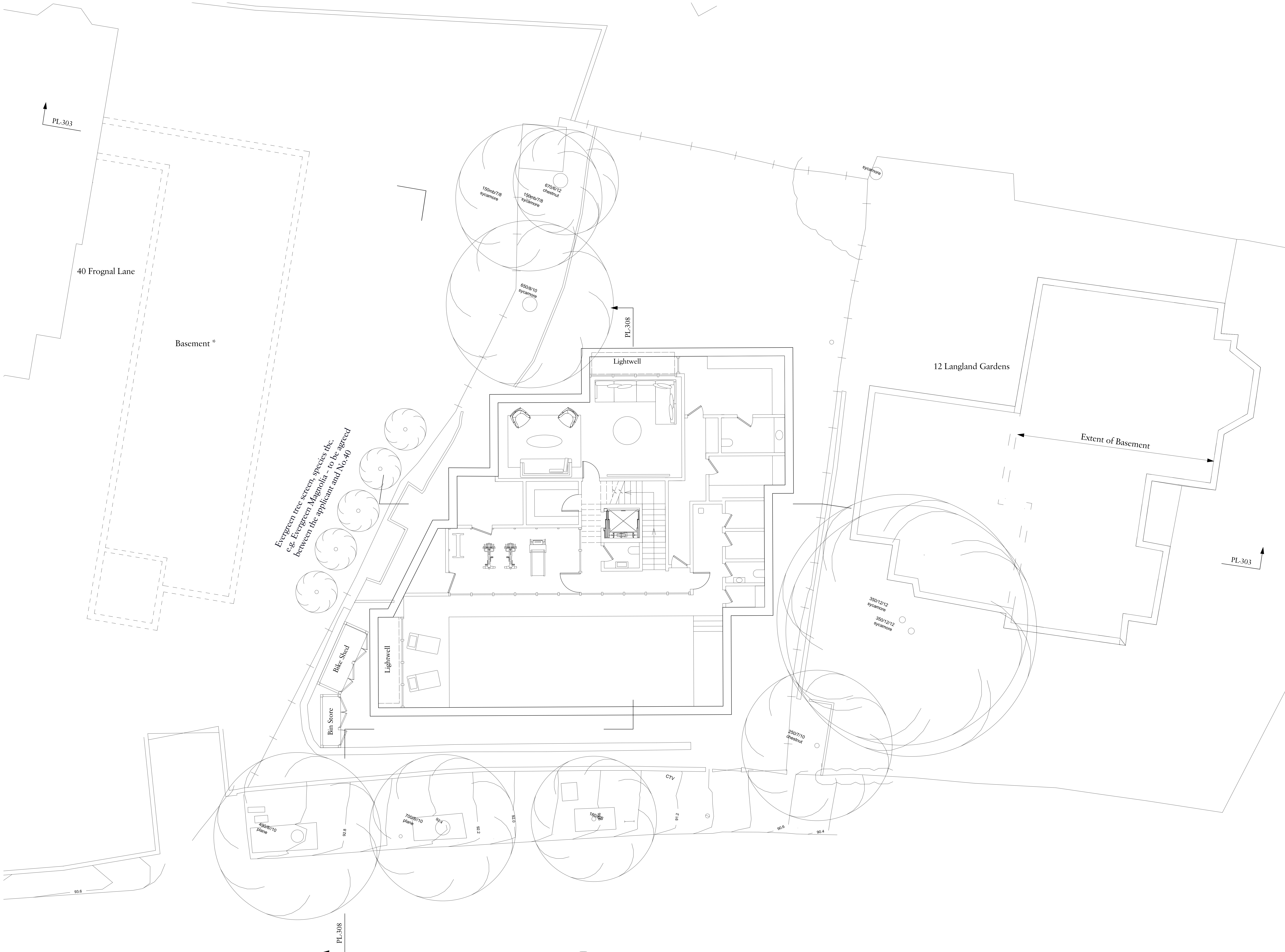
Drawing Title
Location Plan

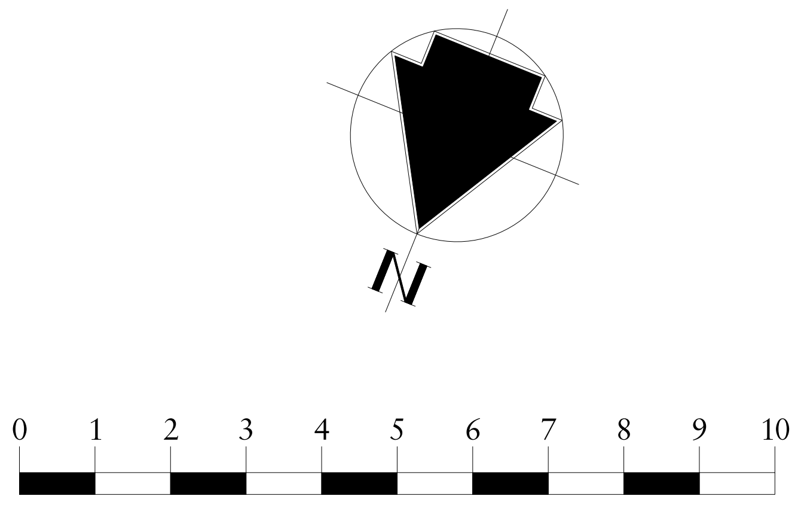
Date	Drawn	Checked
29/09/2020	MCW	JM

Scale
1:500 @ A1 / 1:1000 @ A3

Issue Status
Planning Application

Project Number	Drawing Number	Revision
20022	PL-010	





1 Site Plan
Scale: 1:100

40 Frognal Lane position from O/S.

* Basement Plan derived from Planning
application ref: 2014/5915/P
Live consent until 1 May 2021

12 Langland Gardens position from O/S.

Rev	Date	Details	By
A	17/11/20	Updated Tree Screen	MCW

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

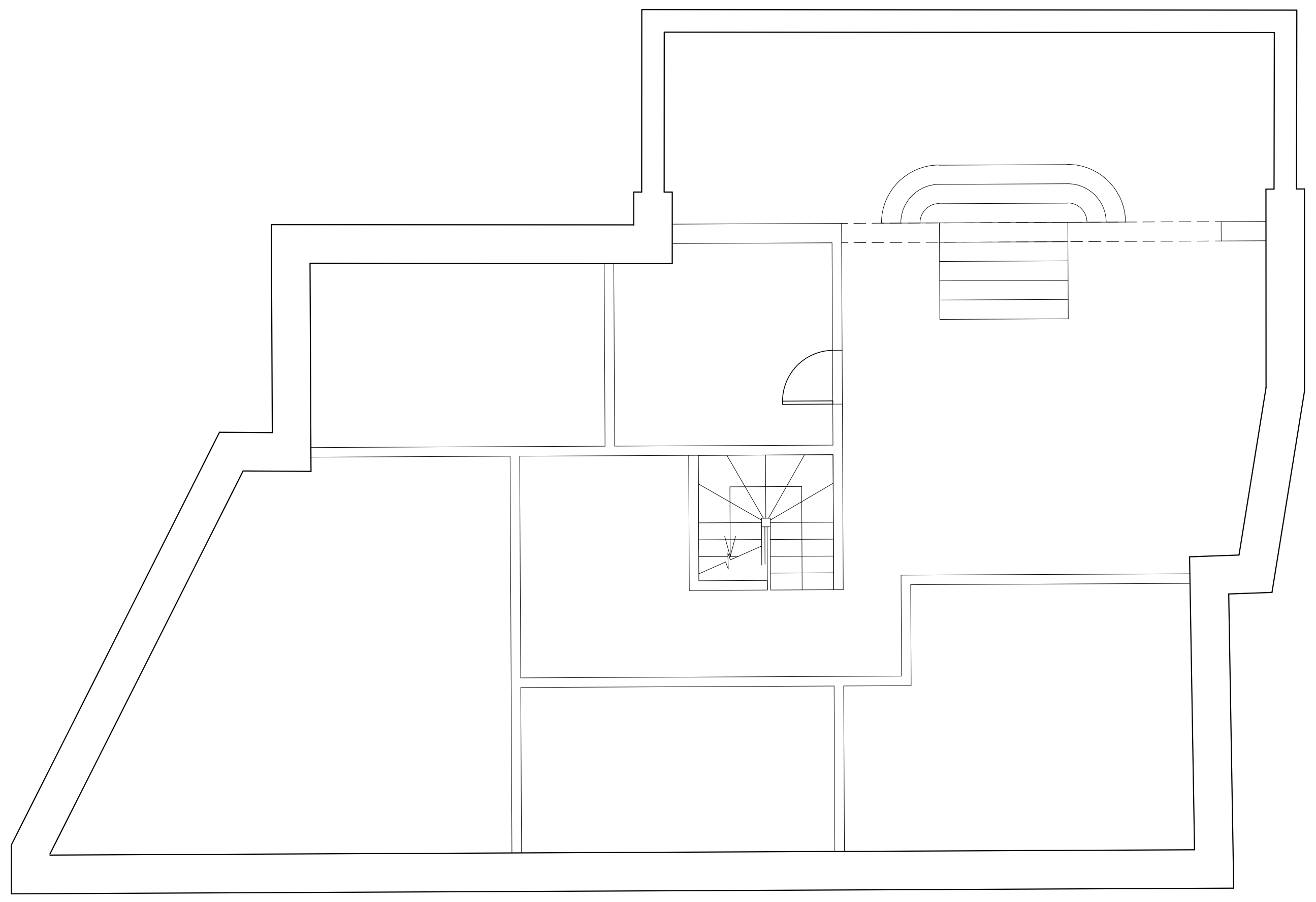
Drawing Title
Site Plan

Date	Drawn	Checked
29/09/2020	MCW	JM

Scale
1:100 @ A1 / 1:200 @ A3

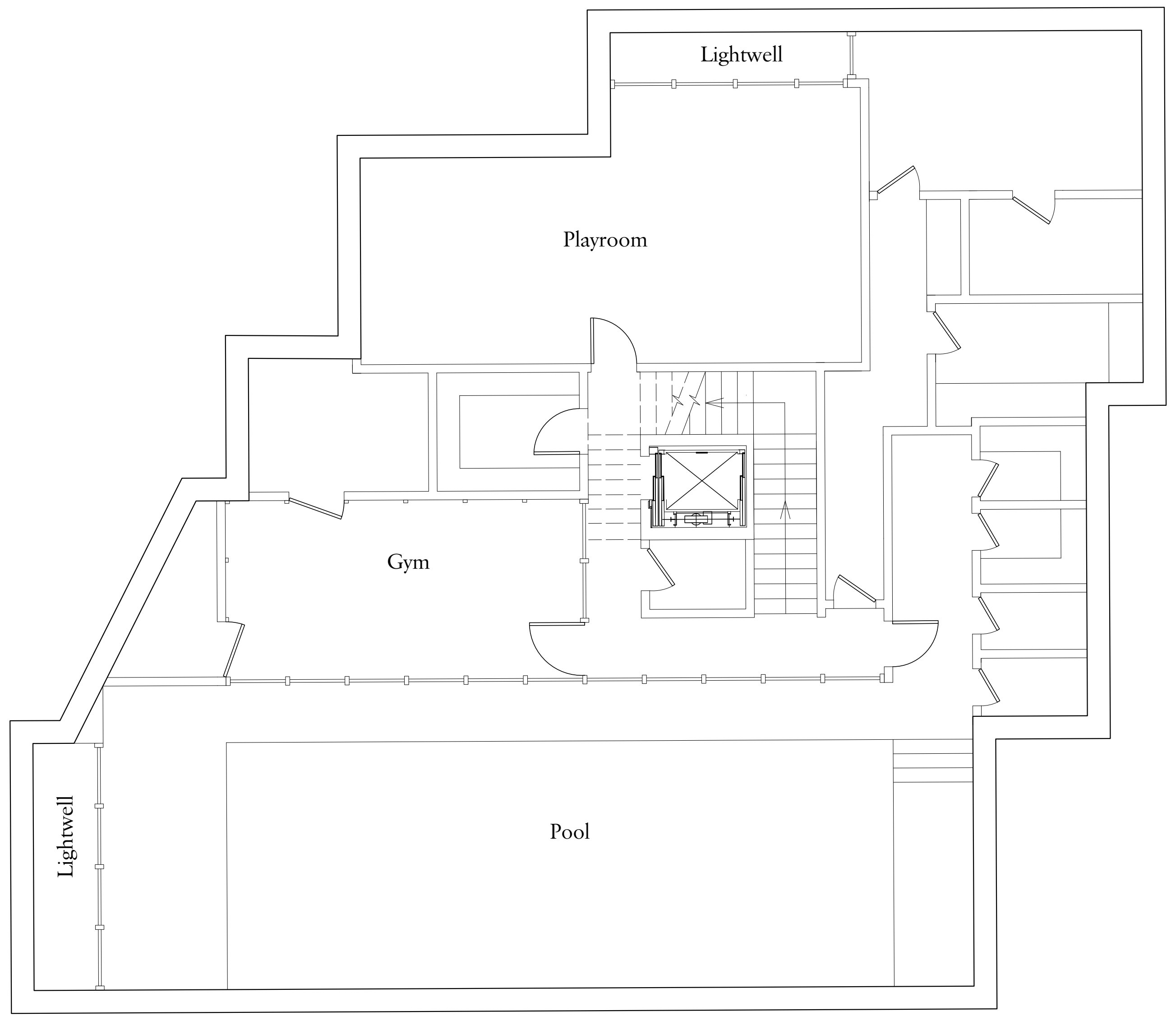
Issue Status
Planning Application

Project Number	Drawing Number	Revision
20022	PL-011	A

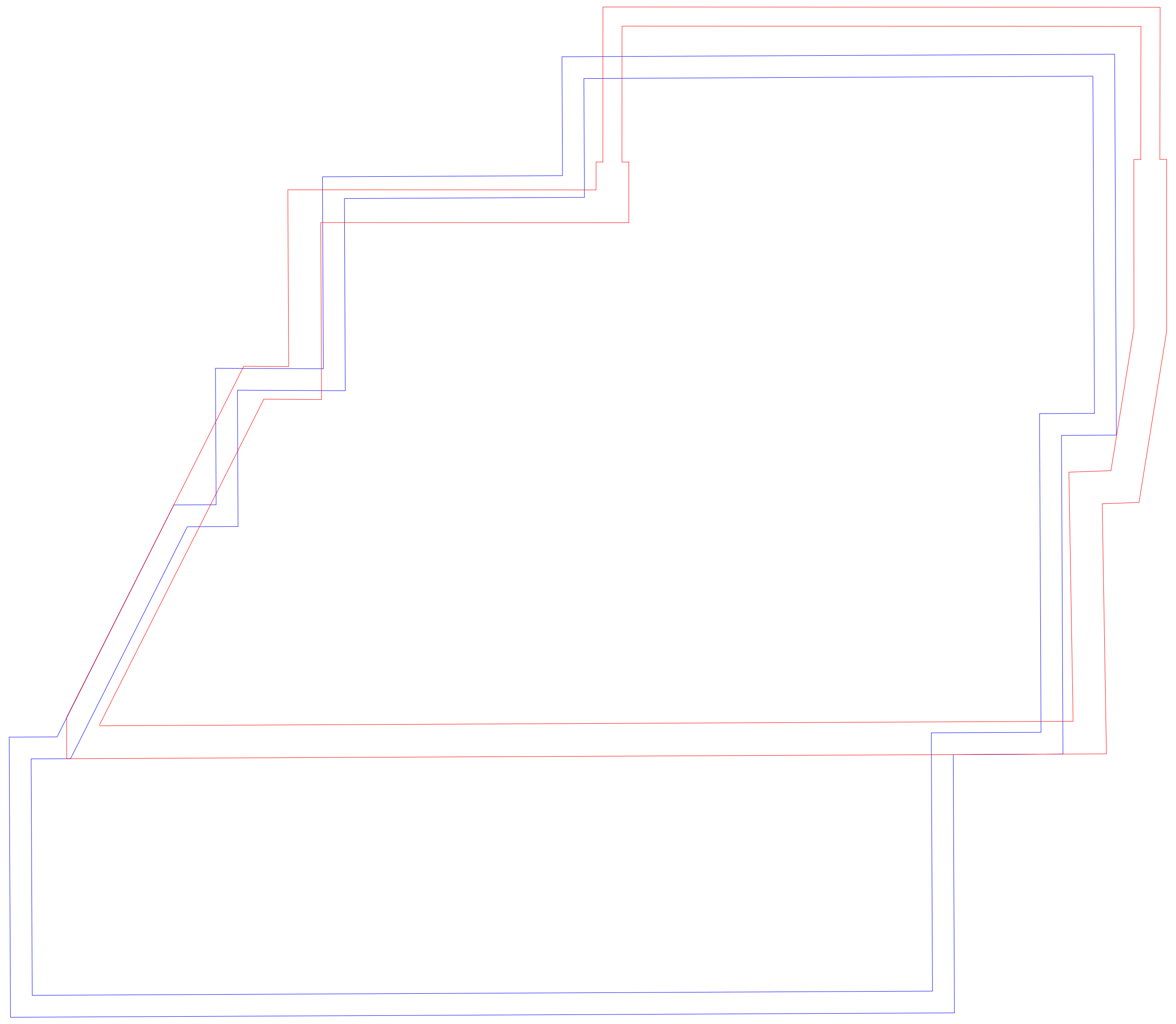


1 Consented Basement
Scale: 1:100

Consent Ref: 2014/5915/P
(consent for basement level swimming pool excavation)
Expired on 11th May 2019

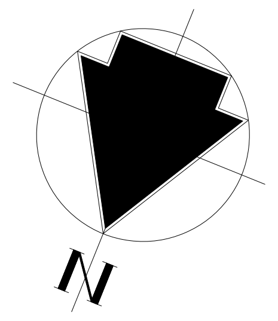


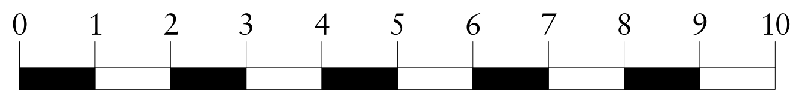
2 Proposed Basement
Scale: 1:100



3 Comparison Basement
Scale: 1:100

Consented Design
Proposed Design





Rev Date Details By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

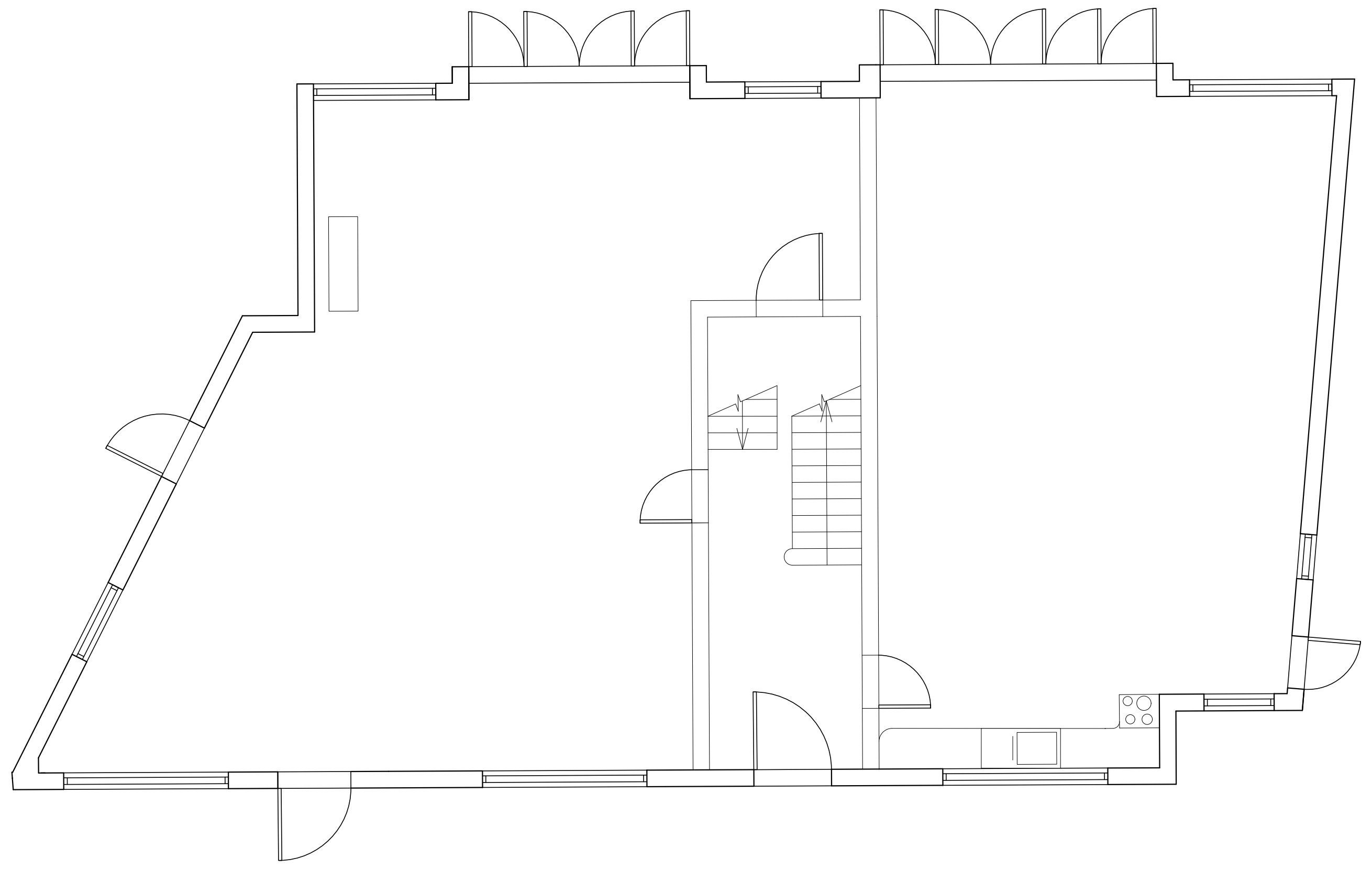
Drawing Title
Basement Plan

Date 29/09/2020
Drawn MCW
Checked JM

Scale
1:100 @ A1 / 1:200 @ A3

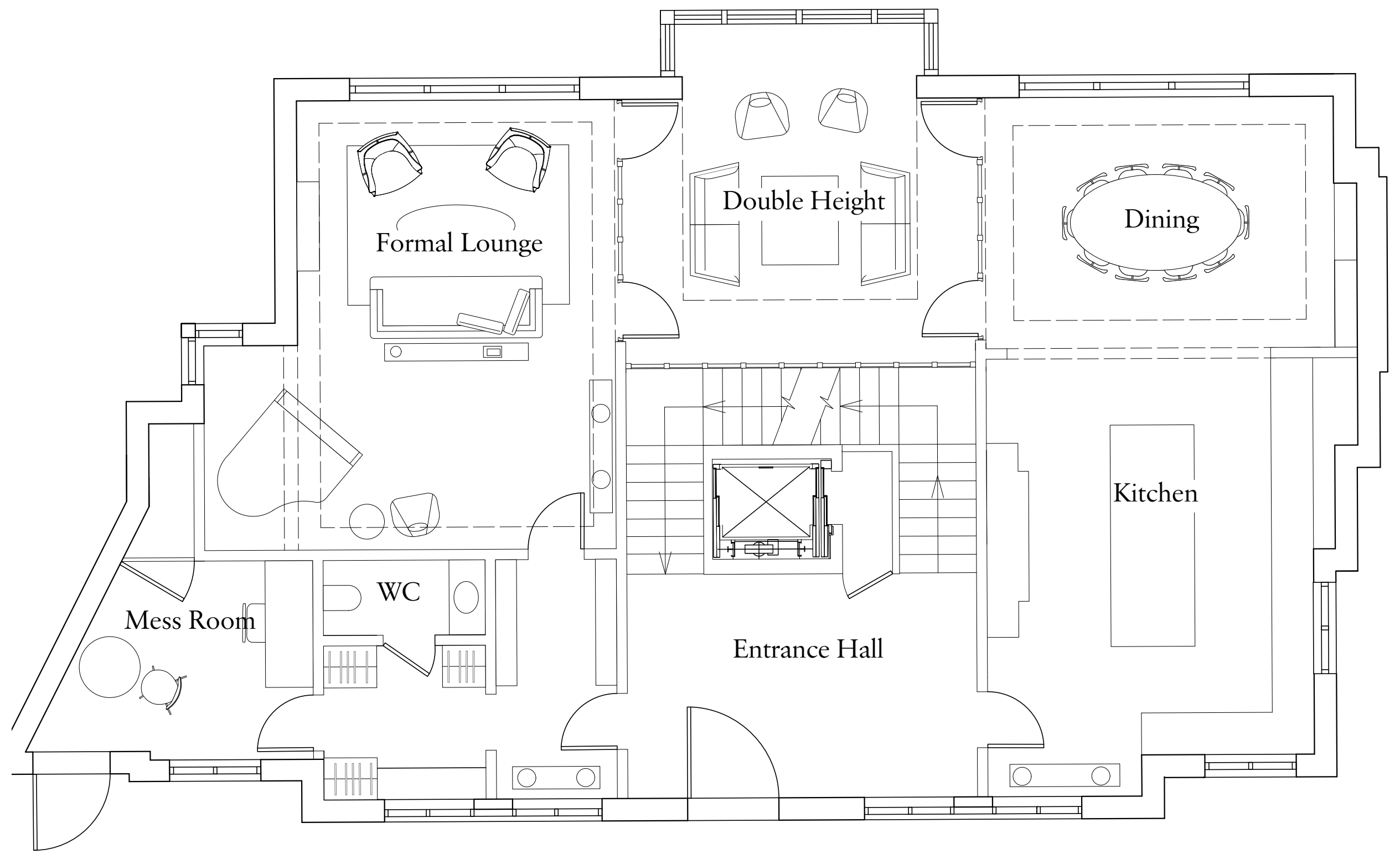
Issue Status
Planning Application

Project Number 20022
Drawing Number PL-099
Revision

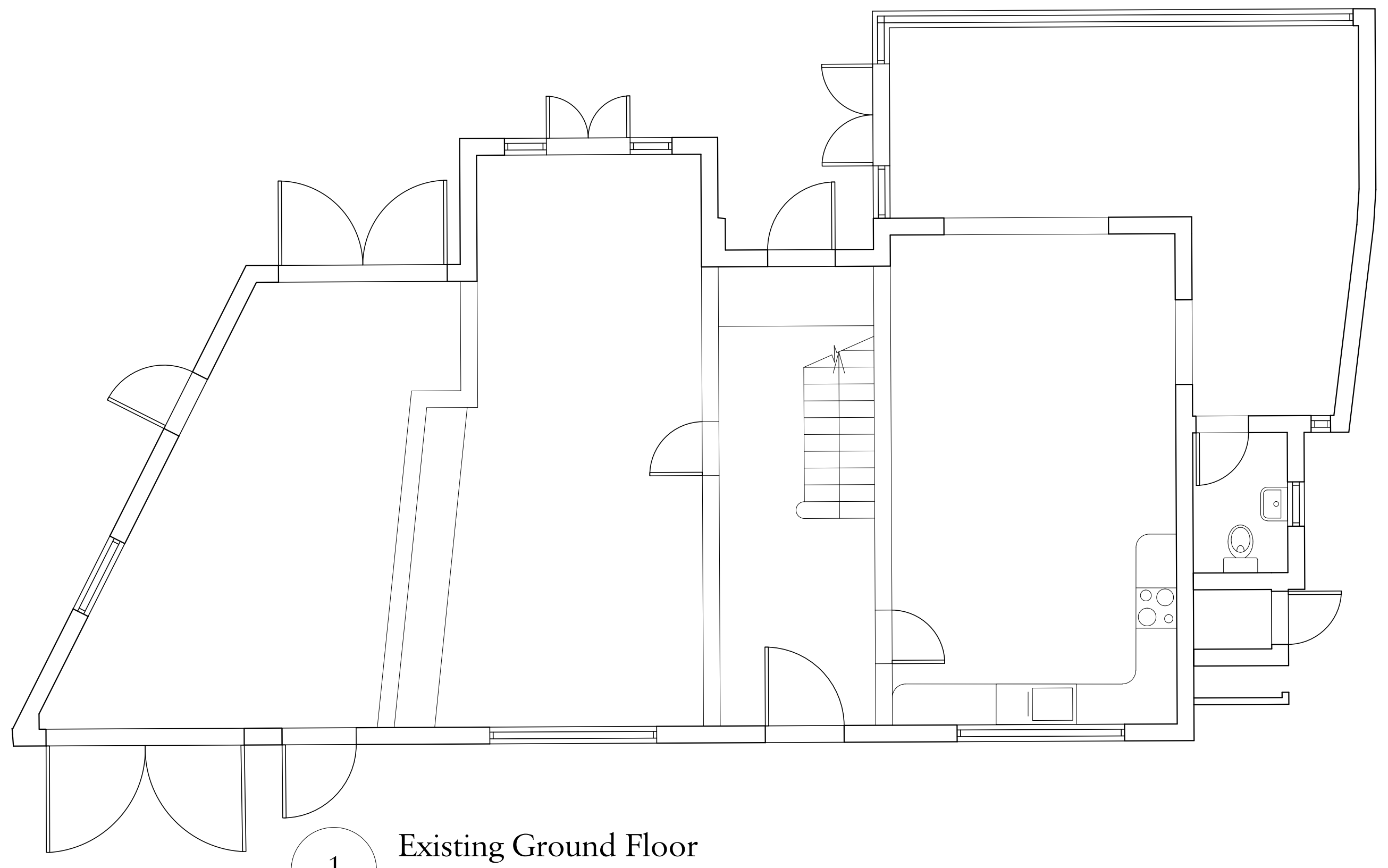


2 Approved Ground Floor
Scale: 1:100

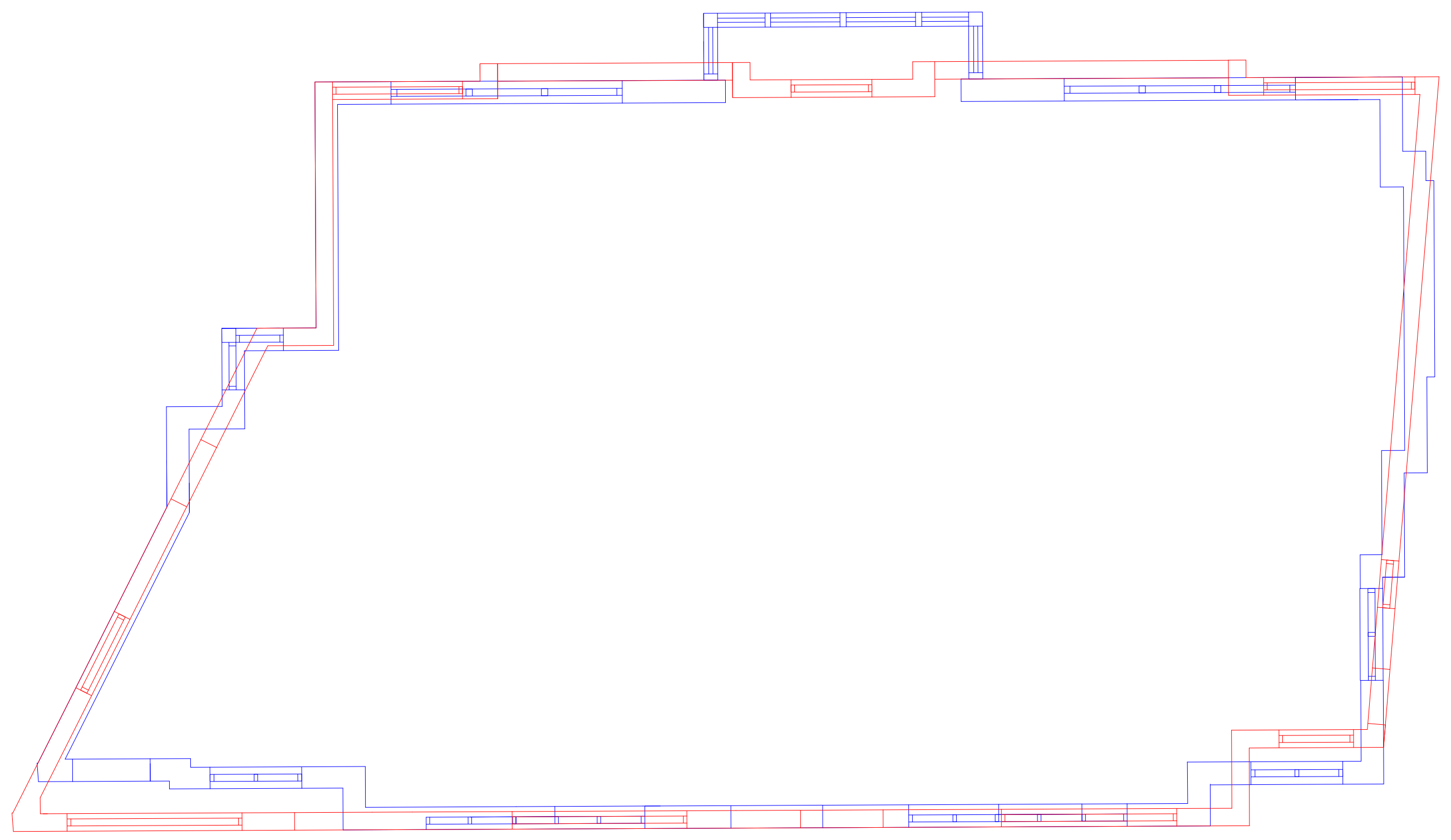
Approved Ref: 2019/4220/P
(approval for full demolition and replacement)



3 Proposed Ground Floor
Scale: 1:100

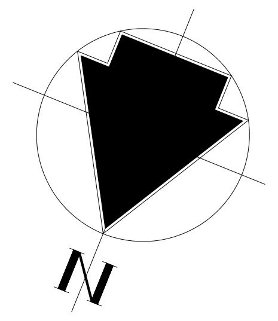


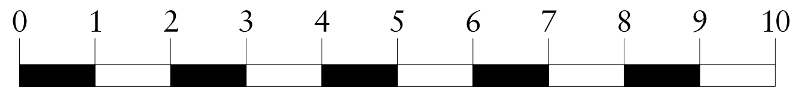
1 Existing Ground Floor
Scale: 1:100



4 Comparison Ground Floor
Scale: 1:100

Approved Design
Proposed Design





Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

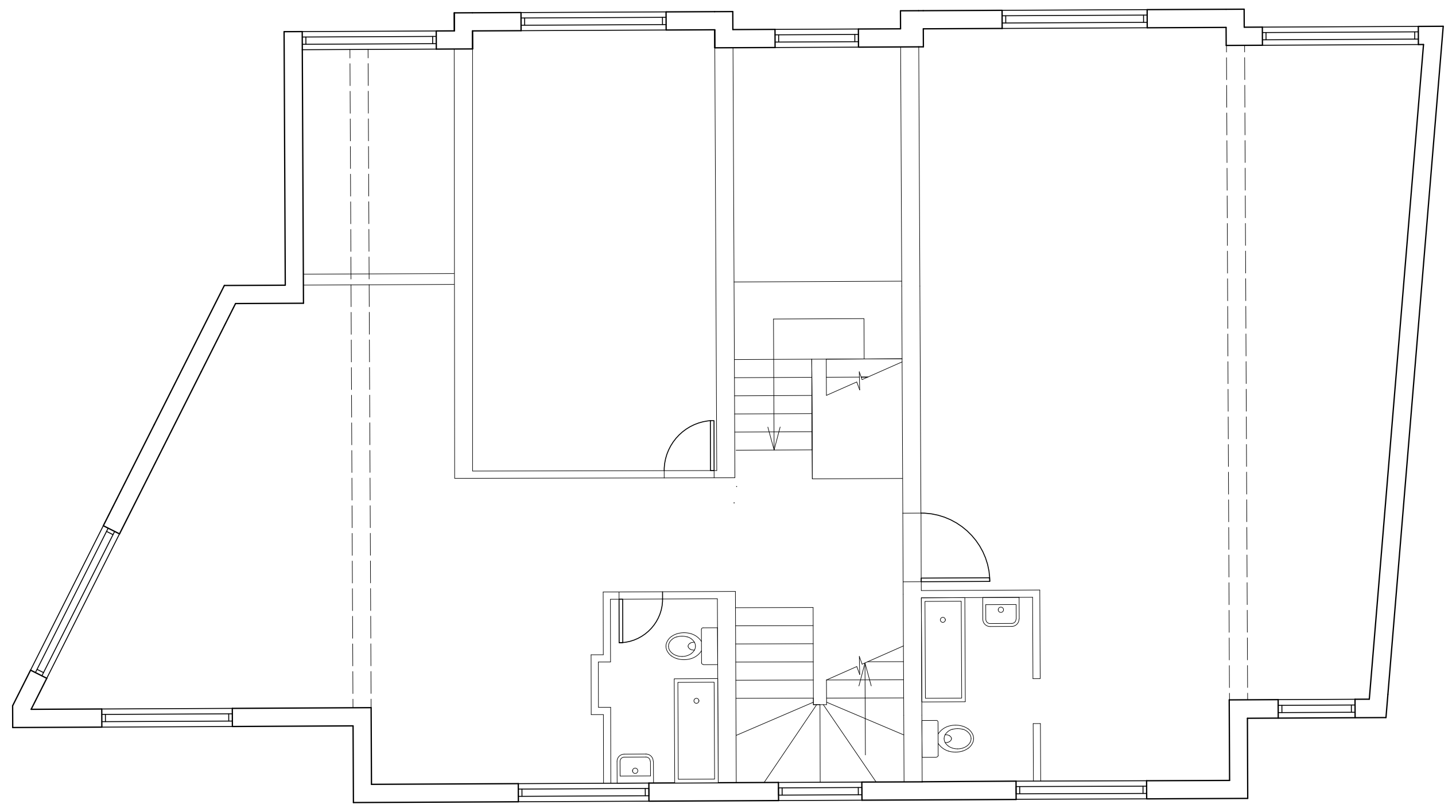
Drawing Title
Ground Floor Plan

Date	Drawn	Checked
29/09/2020	MCW	JM

Scale
1:100 @ A1 / 1:200 @ A3

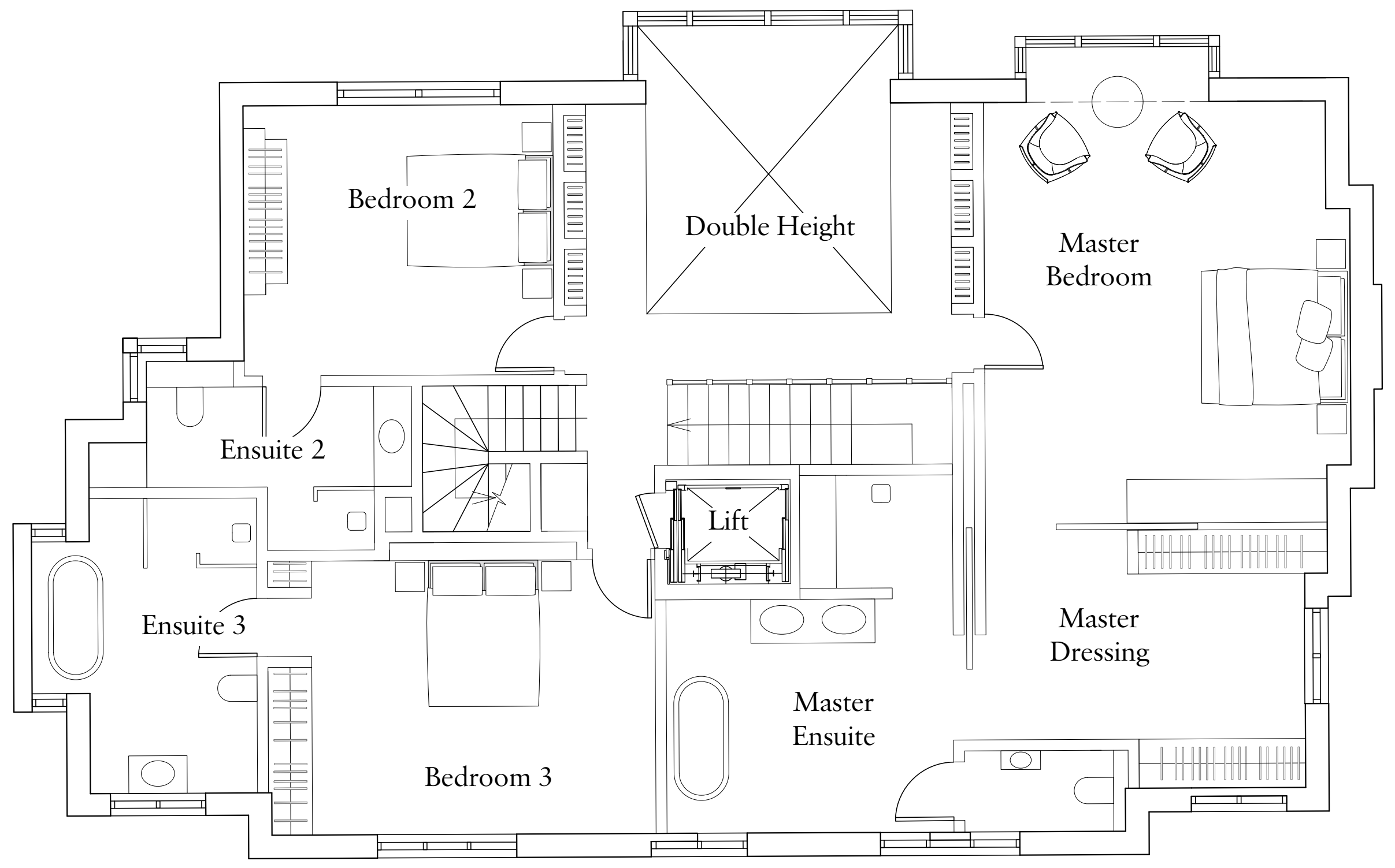
Issue Status
Planning Application

Project Number	Drawing Number	Revision
20022	PL-100	

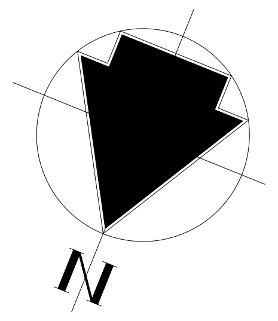


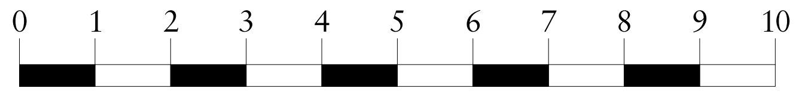
2 Approved First Floor
Scale: 1:100

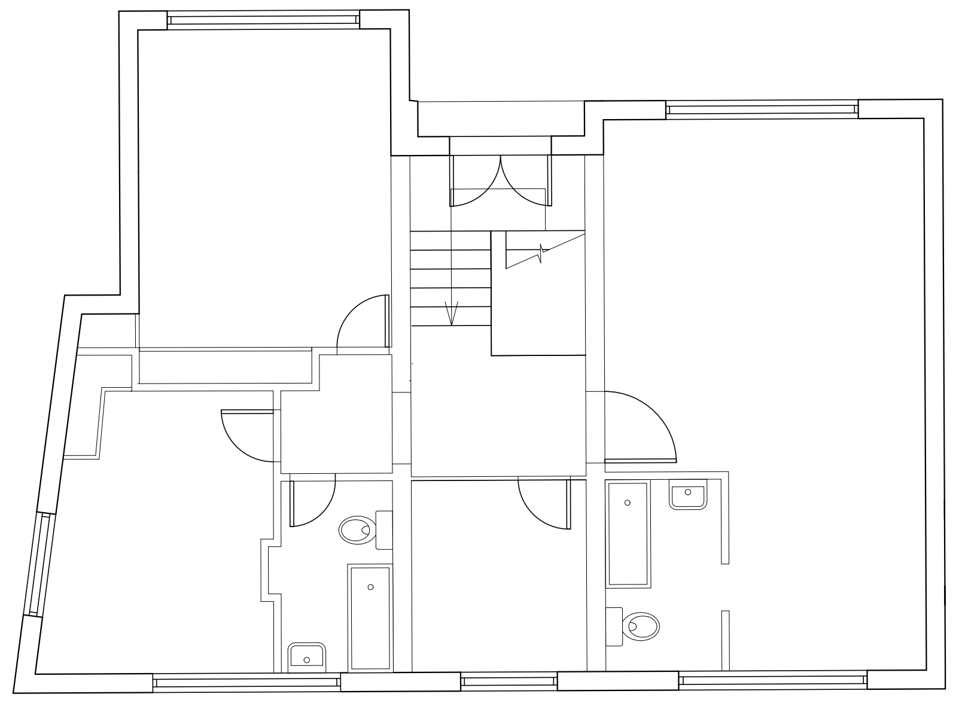
Approved Ref: 2019/4220/P
(approval for full demolition and replacement)



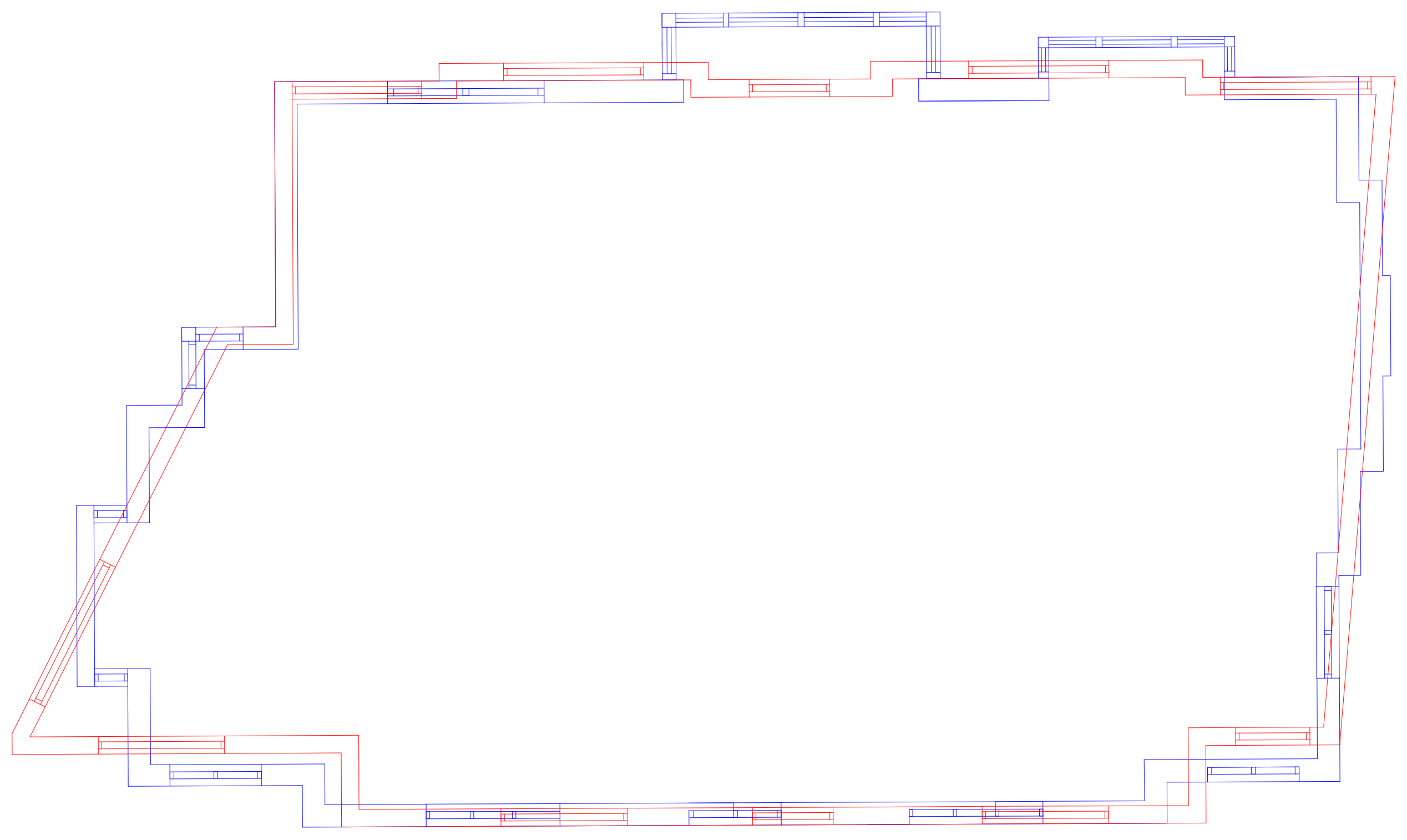
3 Proposed First Floor
Scale: 1:100







1 Existing First Floor
Scale: 1:100



4 Comparison First Floor
Scale: 1:100

Approved Design
Proposed Design

A	16/11/2020	Updated Window Design	MCW
Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

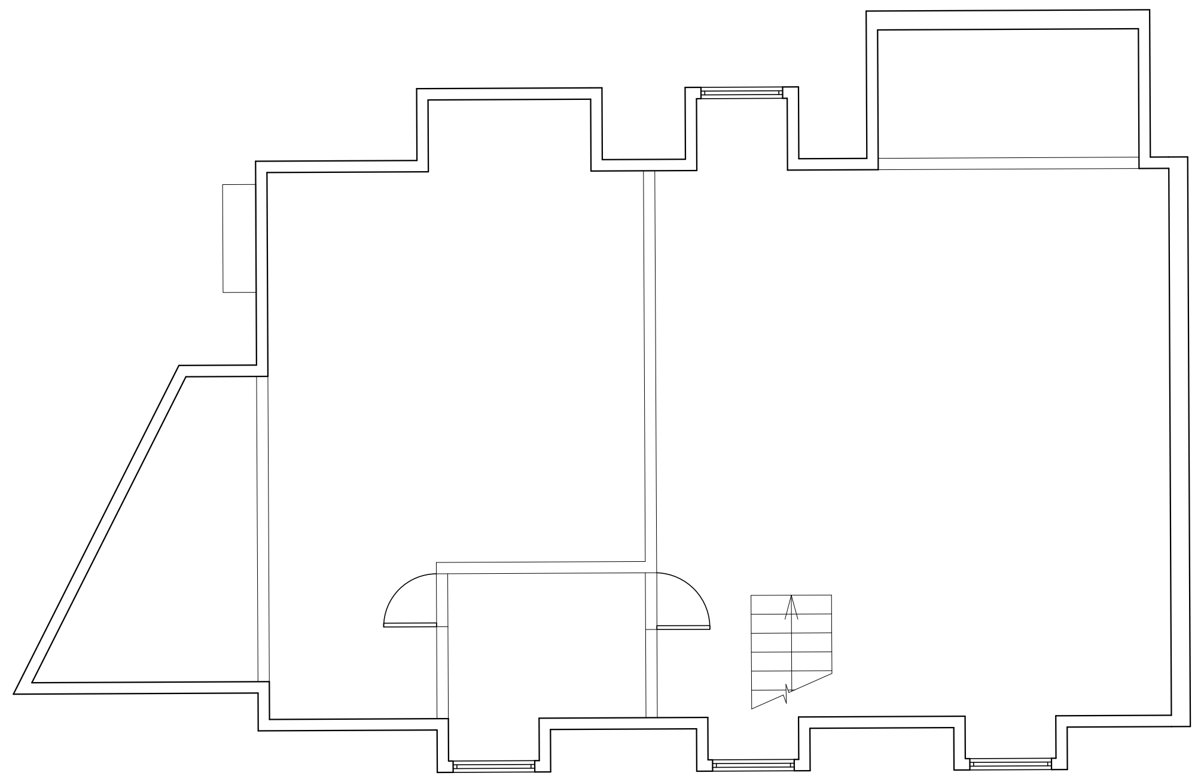
Drawing Title
First Floor Plan

Date	Drawn	Checked
29/09/2020	MCW	JM

Scale
1:100 @ A1 / 1:200 @ A3

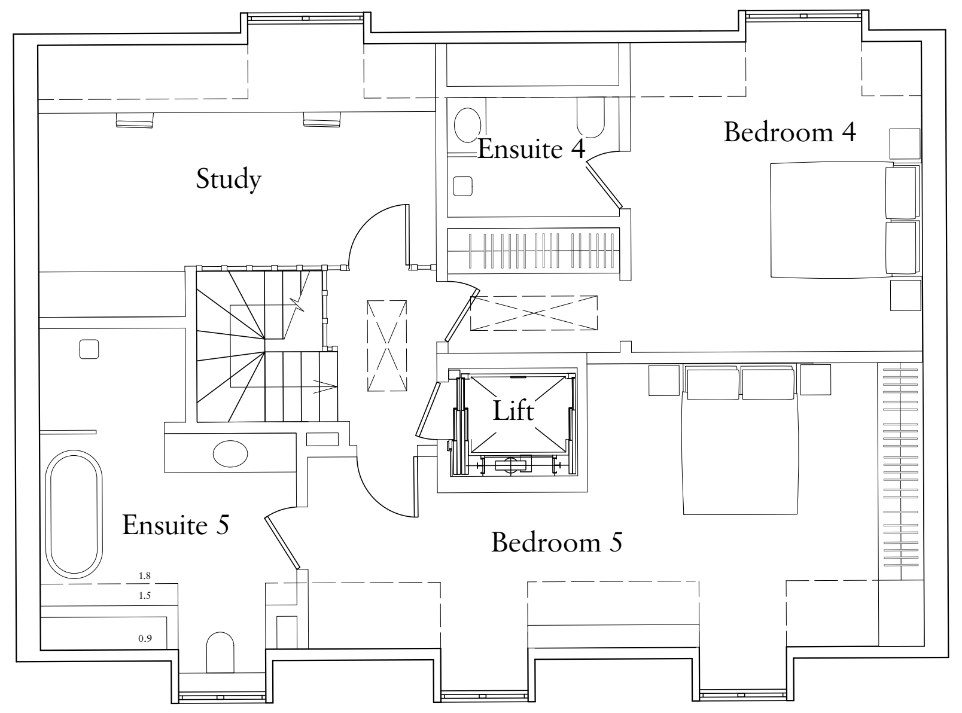
Issue Status
Planning Application

Project Number	Drawing Number	Revision
20022	PL-101	A

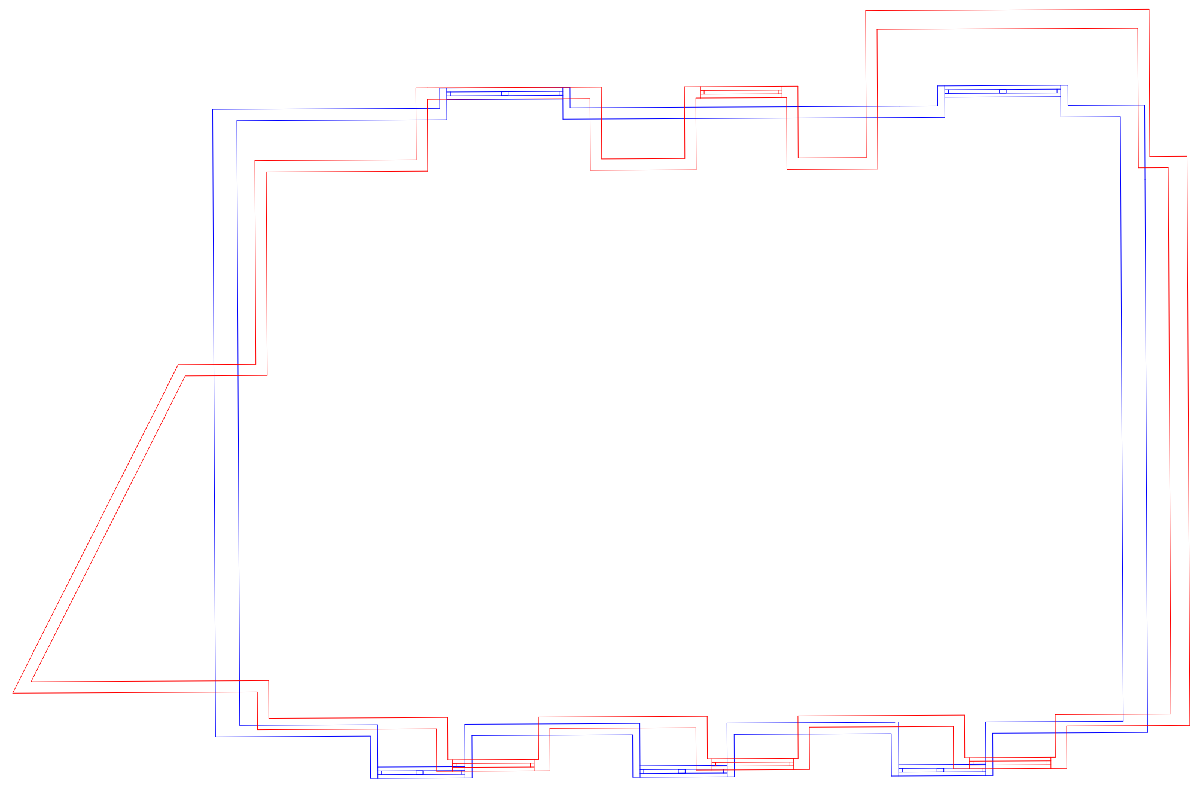


1 Approved Second Floor
Scale: 1:100

Approved Ref: 2019/4220/P
(approval for full demolition and replacement)

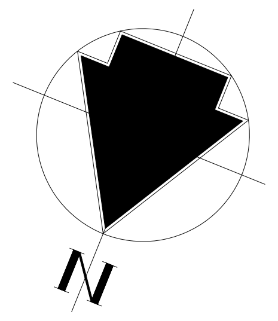


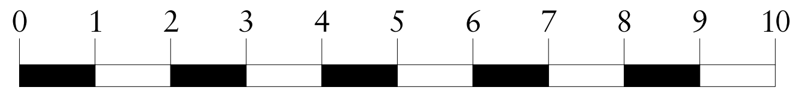
2 Proposed Second Floor
Scale: 1:100



3 Comparison Second Floor
Scale: 1:100

Approved Design
Proposed Design





Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

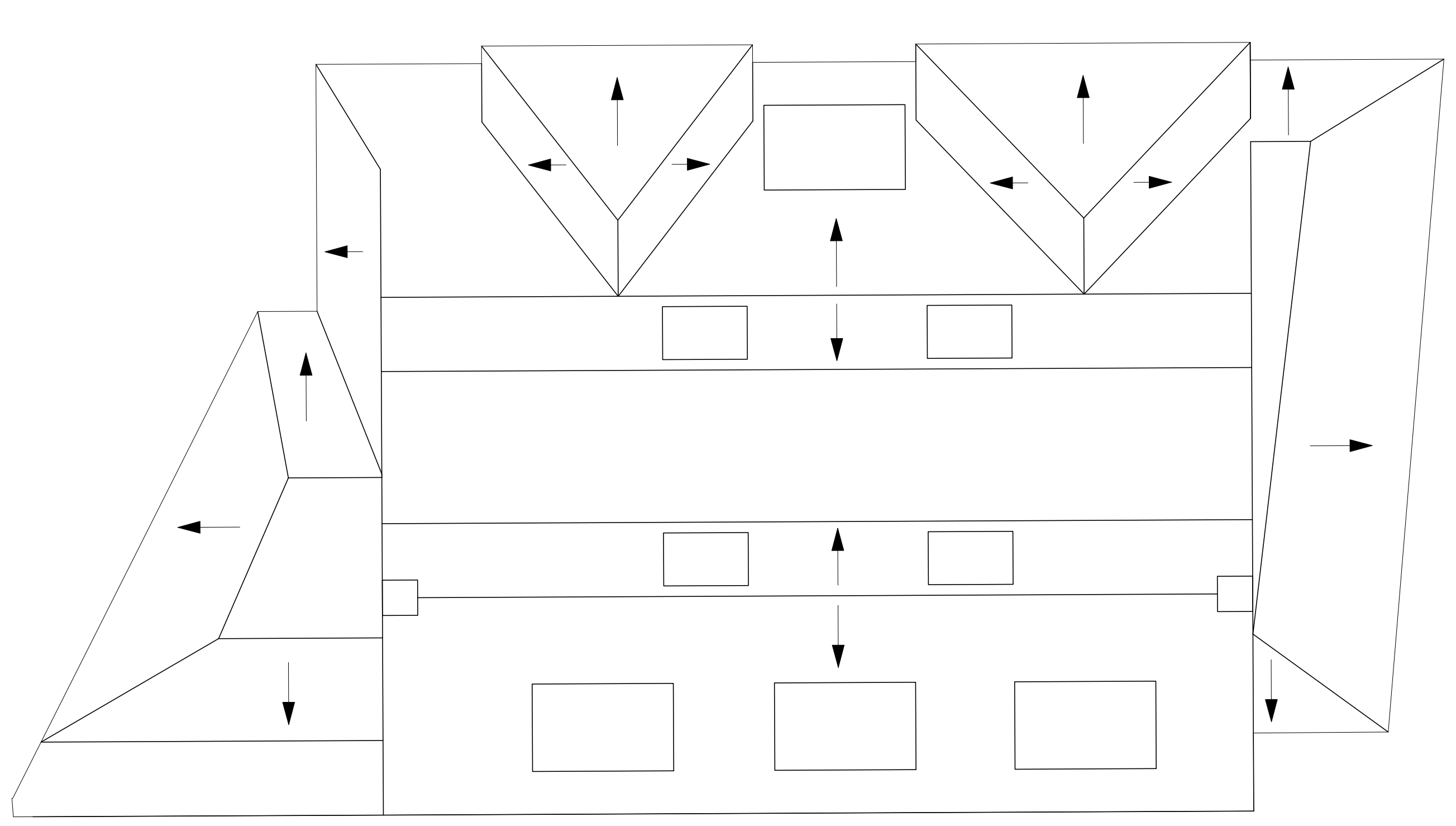
Drawing Title
Second Floor Plan

Date	Drawn	Checked
29/09/2020	MCW	JM

Scale
1:100 @ A1 / 1:200 @ A3

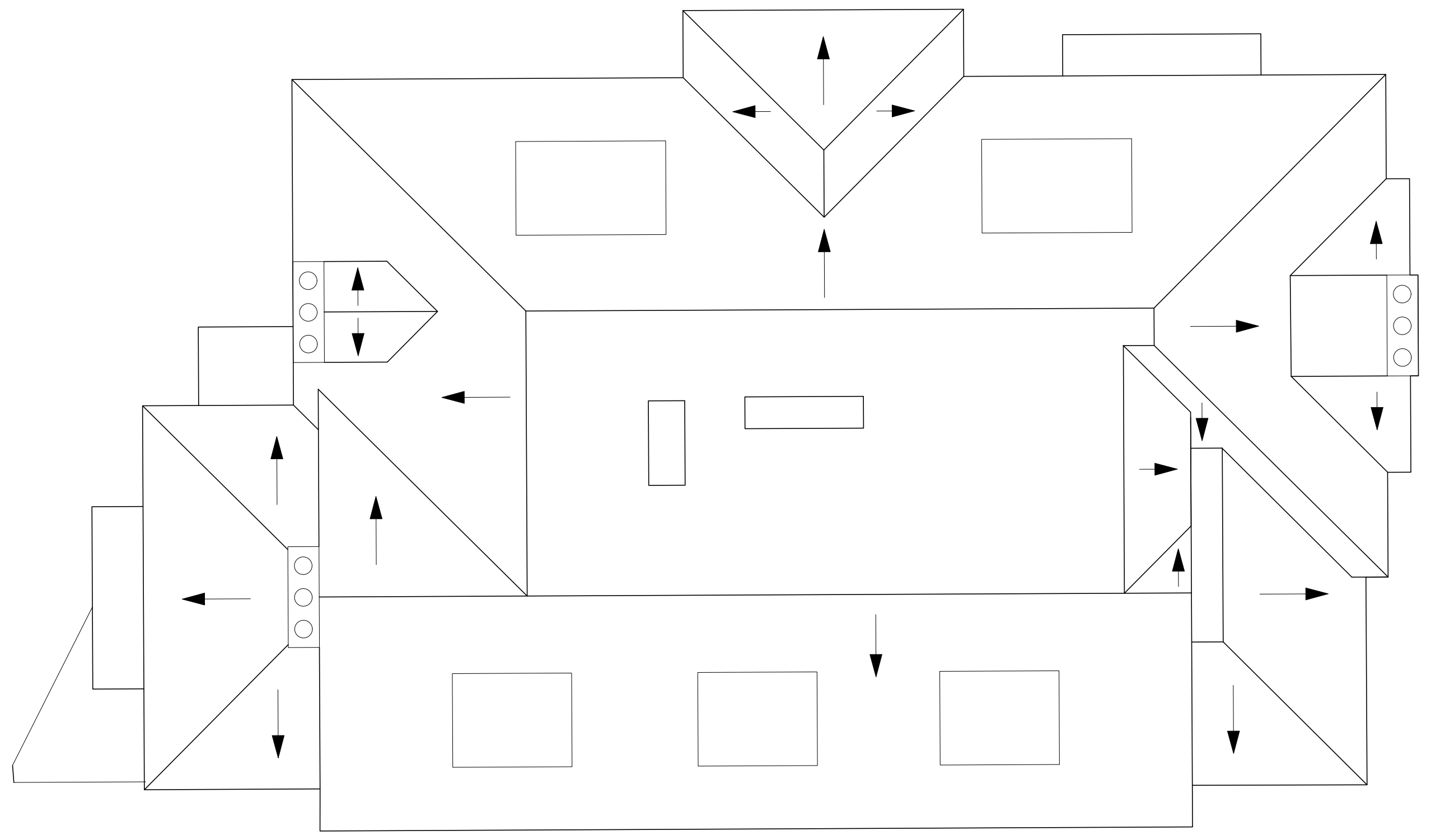
Issue Status
Planning Application

Project Number	Drawing Number	Revision
20022	PL-102	

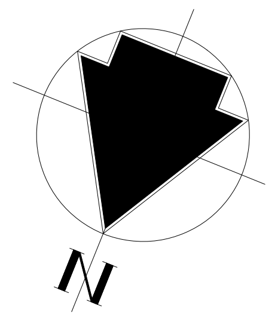


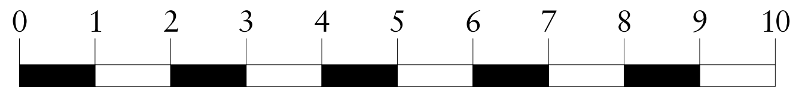
2 Approved Roof Plan
Scale: 1:100

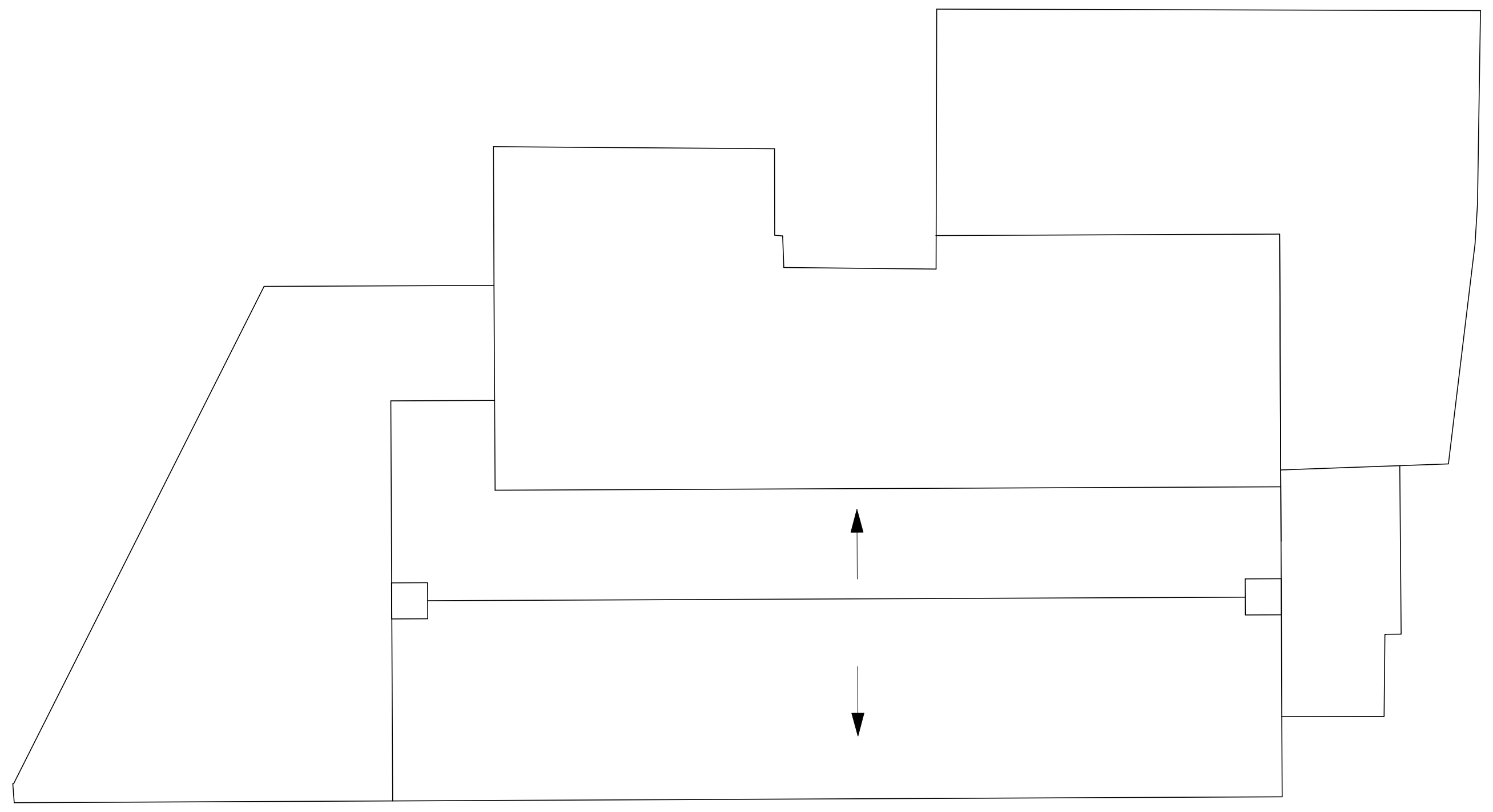
Approved Ref: 2019/4220/P
(approval for full demolition and replacement)



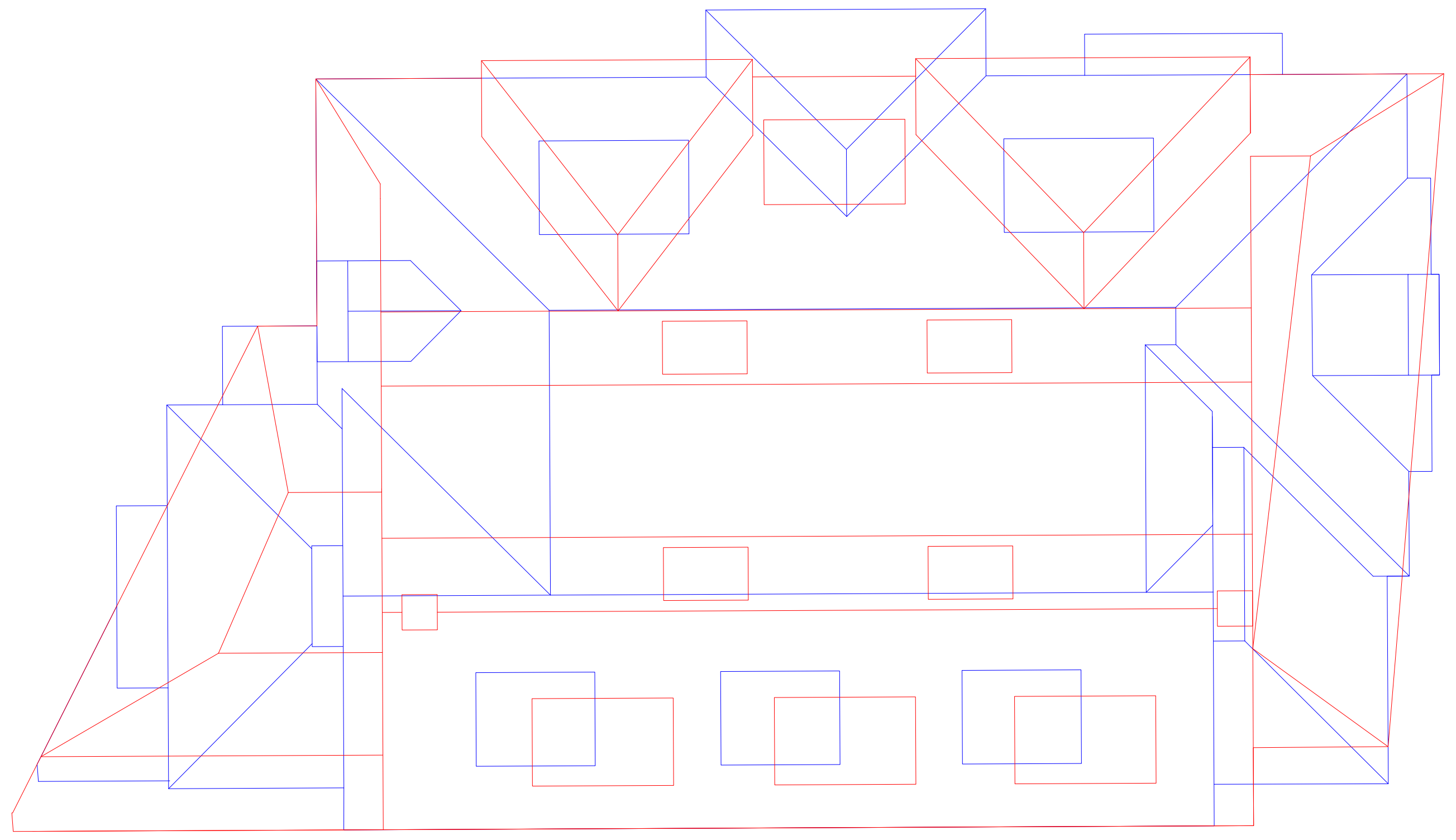
3 Proposed Roof Plan
Scale: 1:100







1 Existing Roof Plan
Scale: 1:100



4 Comparison Roof Plan
Scale: 1:100

Approved Design
Proposed Design

A	17/11/20	Updated Window Design	MCW
Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

Drawing Title
Roof Plan

Date	Drawn	Checked
29/09/2020	MCW	JM

Scale
1:100 @ A1 / 1:200 @ A3

Issue Status
Planning Application

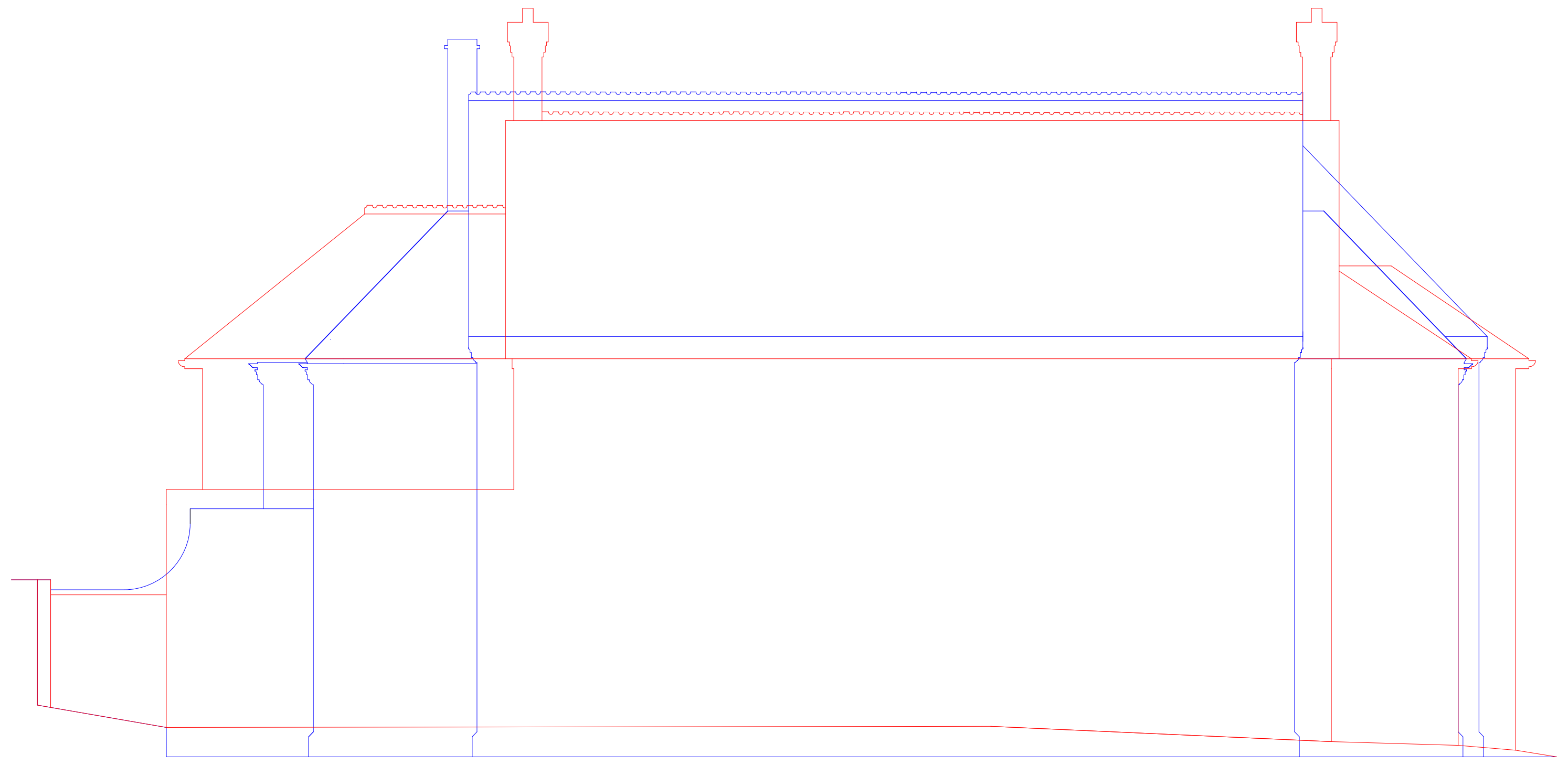
Project Number	Drawing Number	Revision
20022	PL-103	A

2 Approved Front Elevation
Scale: 1:100

Approved Ref: 2019/4220/P
(approval for full demolition and replacement)

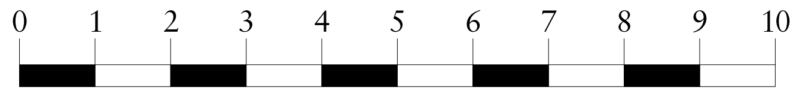
3 Proposed Front Elevation
Scale: 1:100

1 Existing Front Elevation
Scale: 1:100



4 Approved Front Elevation
Scale: 1:100

Approved Design
Proposed Design



A	16/11/2020	Updated Window Design	MCW
Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

Drawing Title
Front Elevation _ North

Date	Drawn	Checked
02/10/2020	MCW	JM

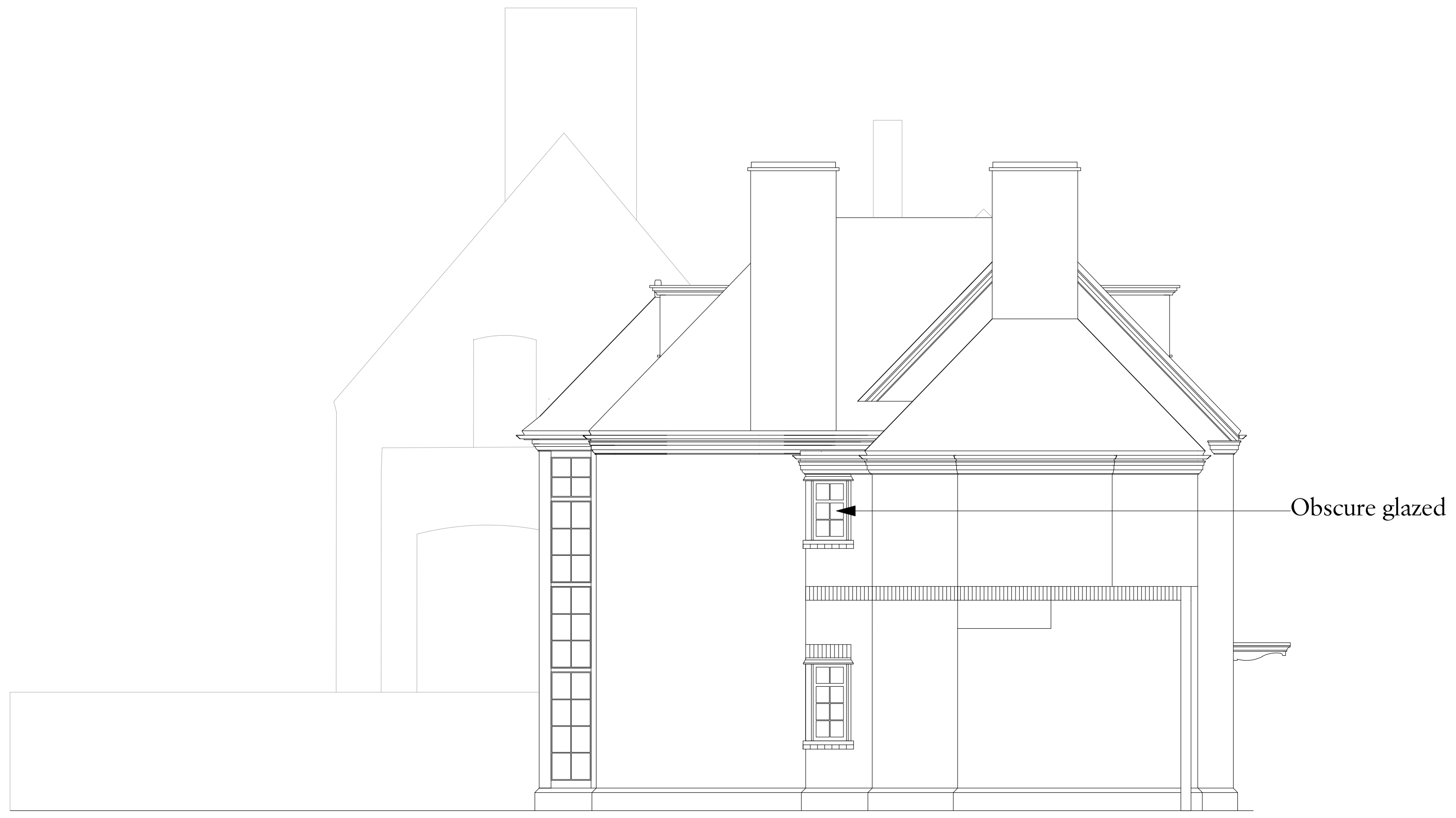
Scale
1:100 @ A1 / 1:200 @ A3

Issue Status
Planning Application

Project Number	Drawing Number	Revision
20022	PL-200	A

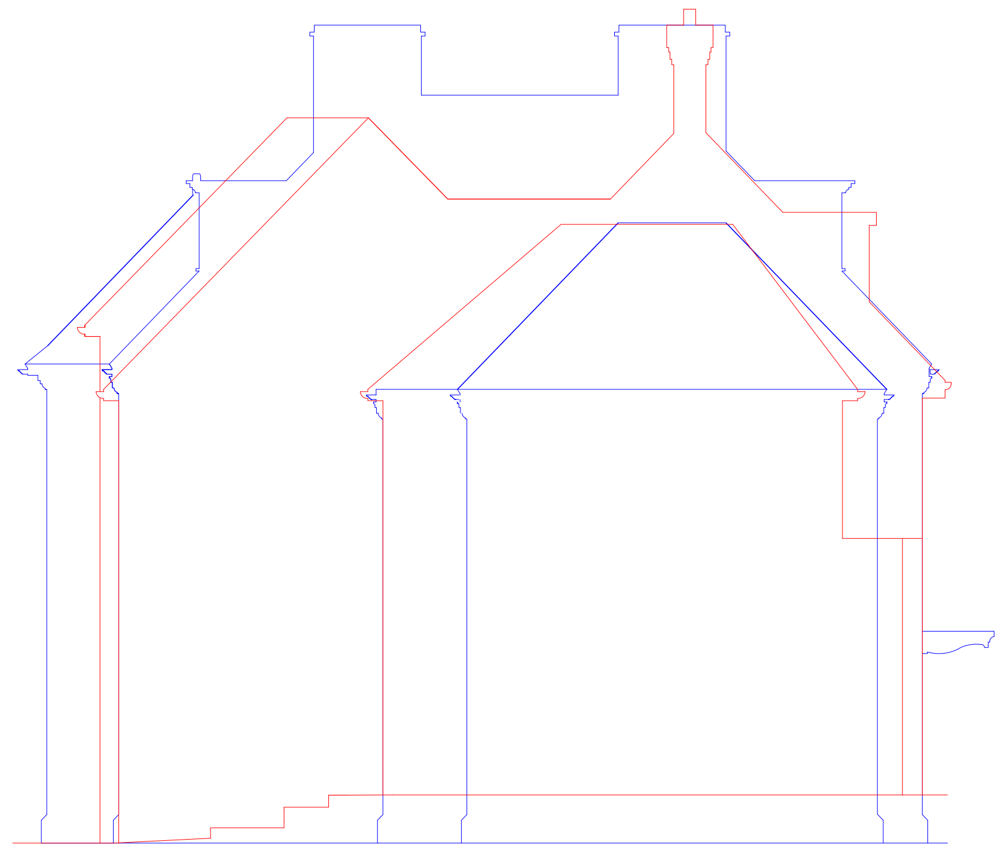
2 Approved Side Elevation - East
Scale: 1:100

Approved Ref: 2019/4220/P
(approval for full demolition and replacement)



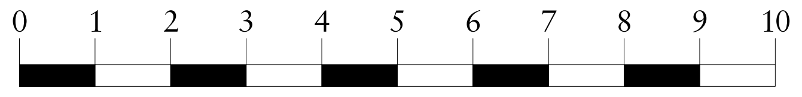
3 Proposed Side Elevation - East
Scale: 1:100

1 Existing Side Elevation - East
Scale: 1:100



4 Comparison Side Elevation - East
Scale: 1:100

Approved Design
Proposed Design



B	16/11/2020	Updated Window Design	MCW
A	13/11/20	Windows added to comparison	MCW
Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

Drawing Title
Side Elevation _ East

Date	Drawn	Checked
02/10/2020	MCW	JM

Scale
1:100 @ A1 / 1:200 @ A3

Issue Status
Planning Application

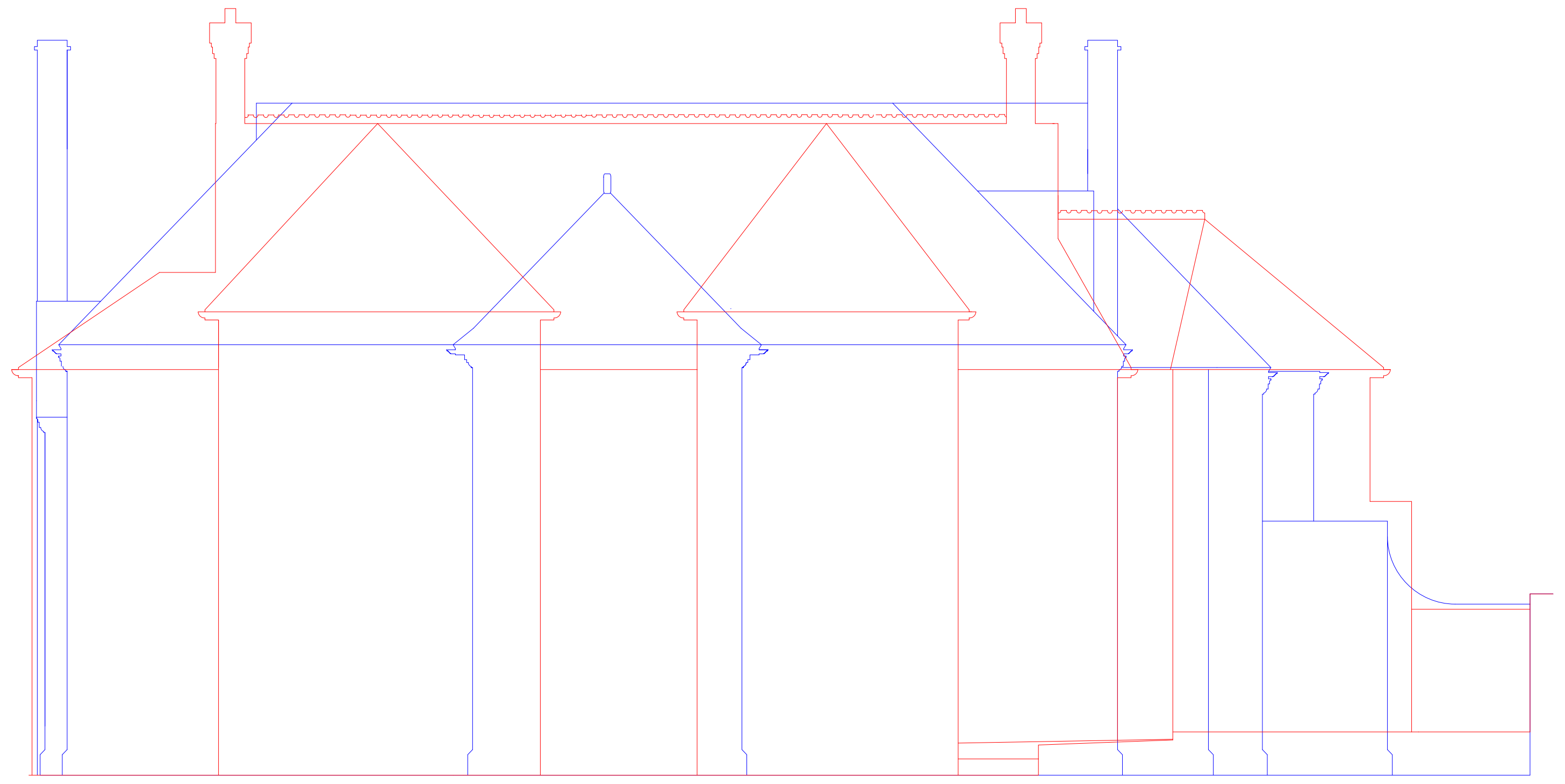
Project Number	Drawing Number	Revision
20022	PL-201	B

2 Approved Rear Elevation
Scale: 1:100

Approved Ref: 2019/4220/P
(approval for full demolition and replacement)

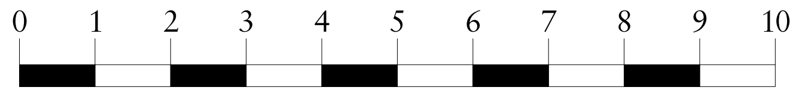
3 Proposed Rear Elevation
Scale: 1:100

1 Existing Rear Elevation
Scale: 1:100



4 Comparison Rear Elevation
Scale: 1:100

Approved Design
Proposed Design



A	17/11/20	Updated Window Design	MCW
Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

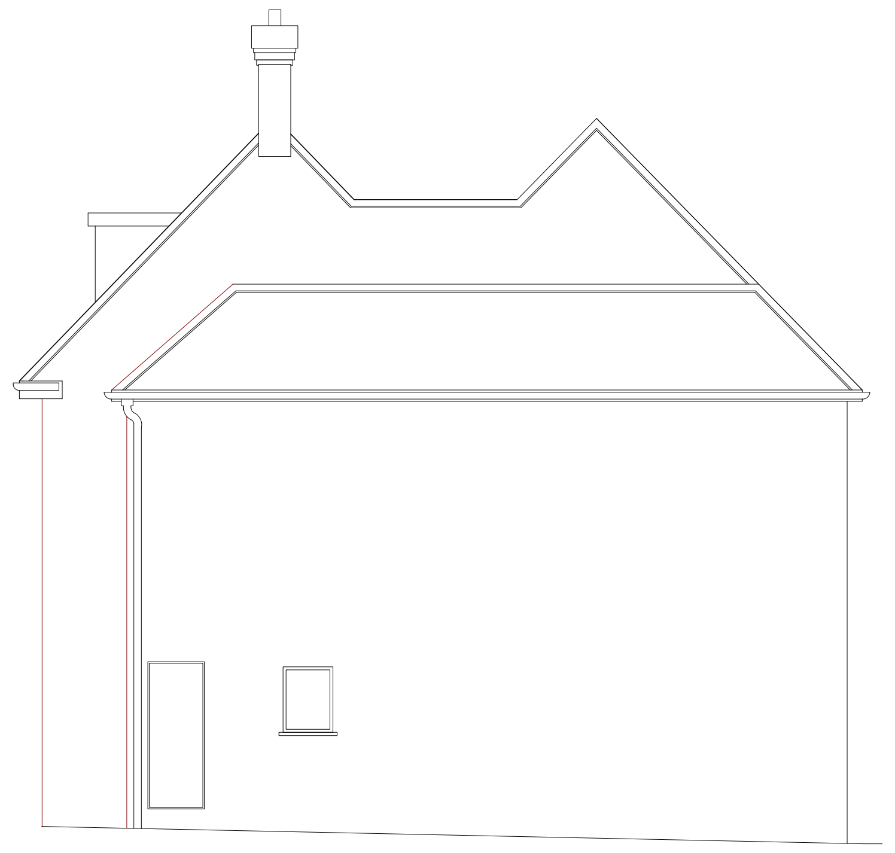
Drawing Title
Rear Elevation _ South

Date	Drawn	Checked
02/10/2020	MCW	JM

Scale
1:100 @ A1 / 1:200 @ A3

Issue Status
Planning Application

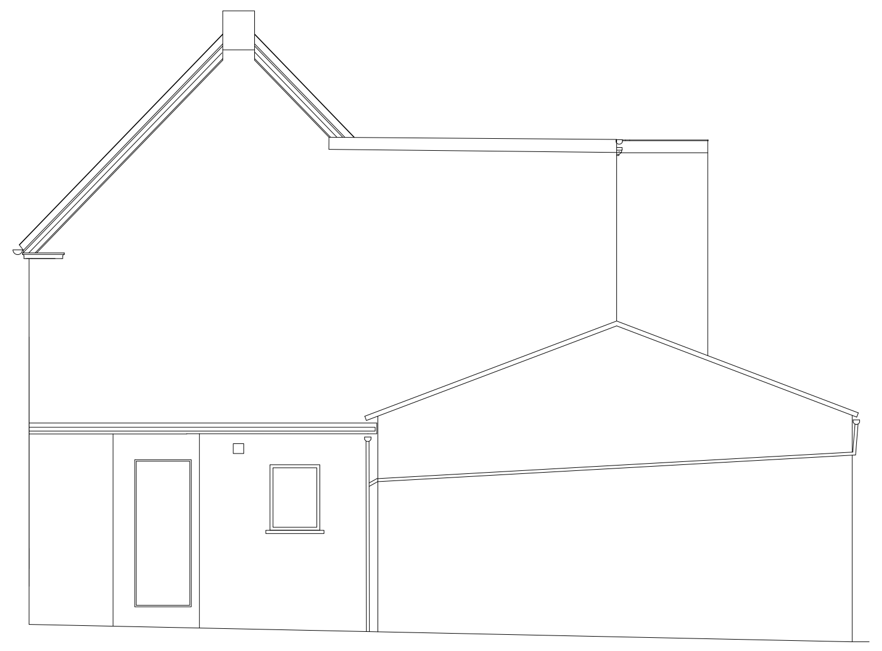
Project Number	Drawing Number	Revision
20022	PL-202	A



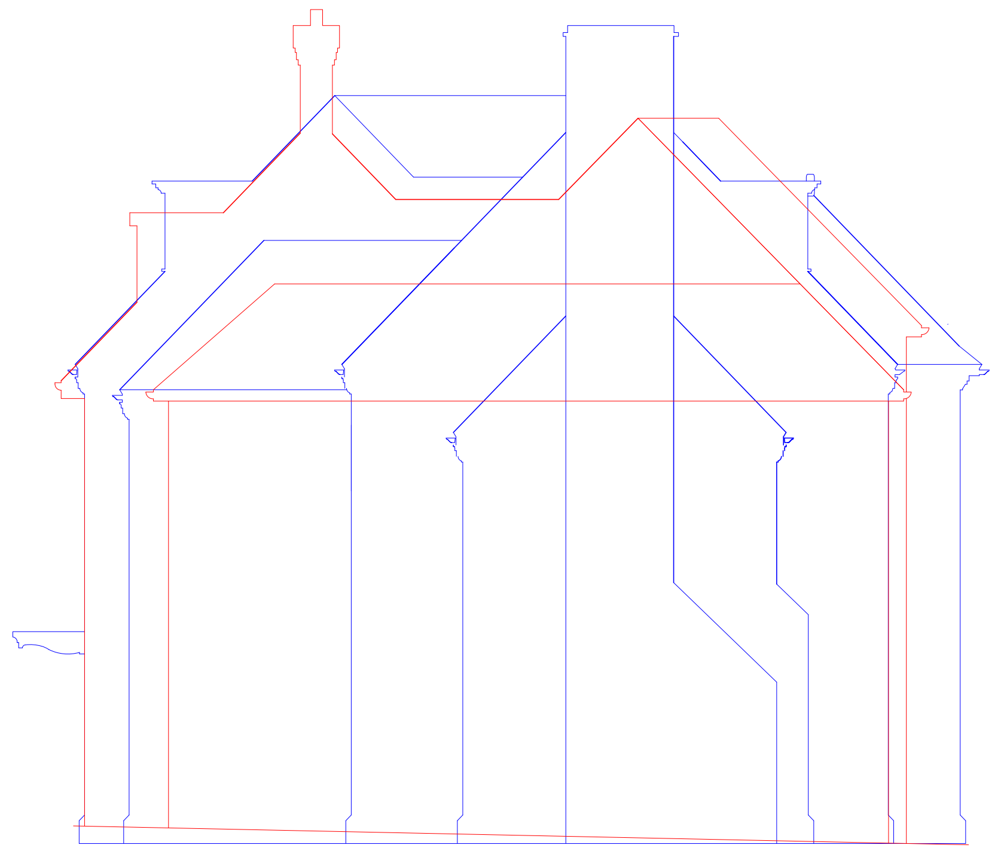
2 Approved Side Elevation - West
Scale: 1:100

Approved Ref: 2019/4220/P
(approval for full demolition and replacement)

3 Proposed Side Elevation - West
Scale: 1:100

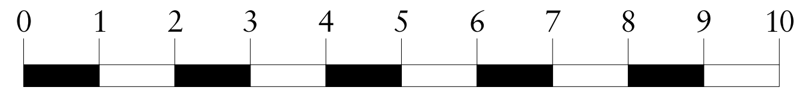


1 Existing Side Elevation - West
Scale: 1:100



4 Comparison Side Elevation - West
Scale: 1:100

Approved Design
Proposed Design



Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

Drawing Title
Side Elevation _ West

Date	Drawn	Checked
02/10/2020	MCW	JM

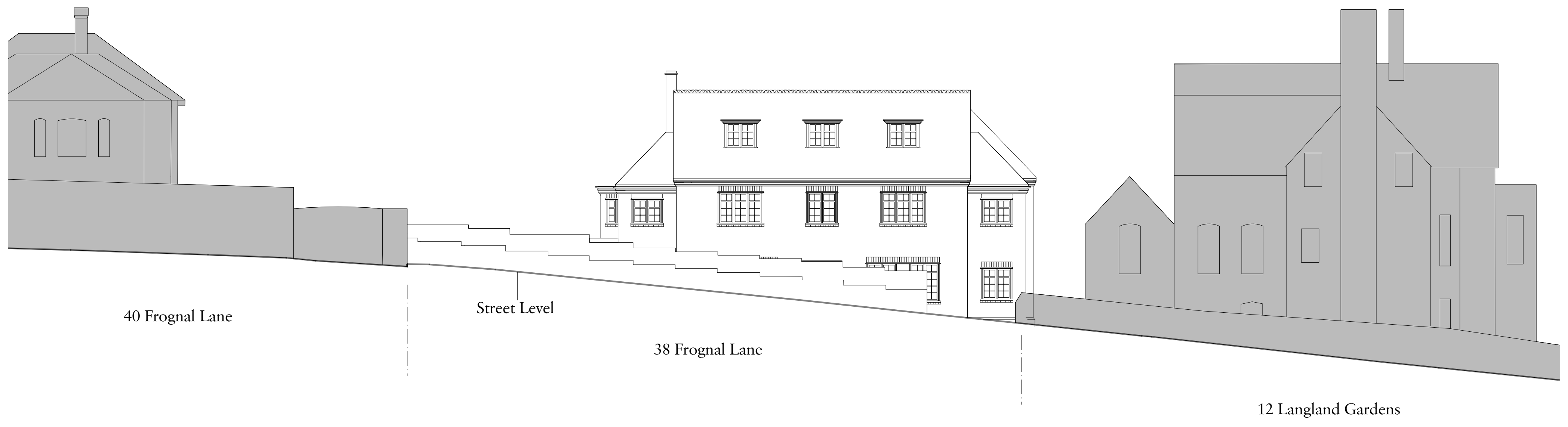
Scale
1:100 @ A1 / 1:200 @ A3

Issue Status
Planning Application

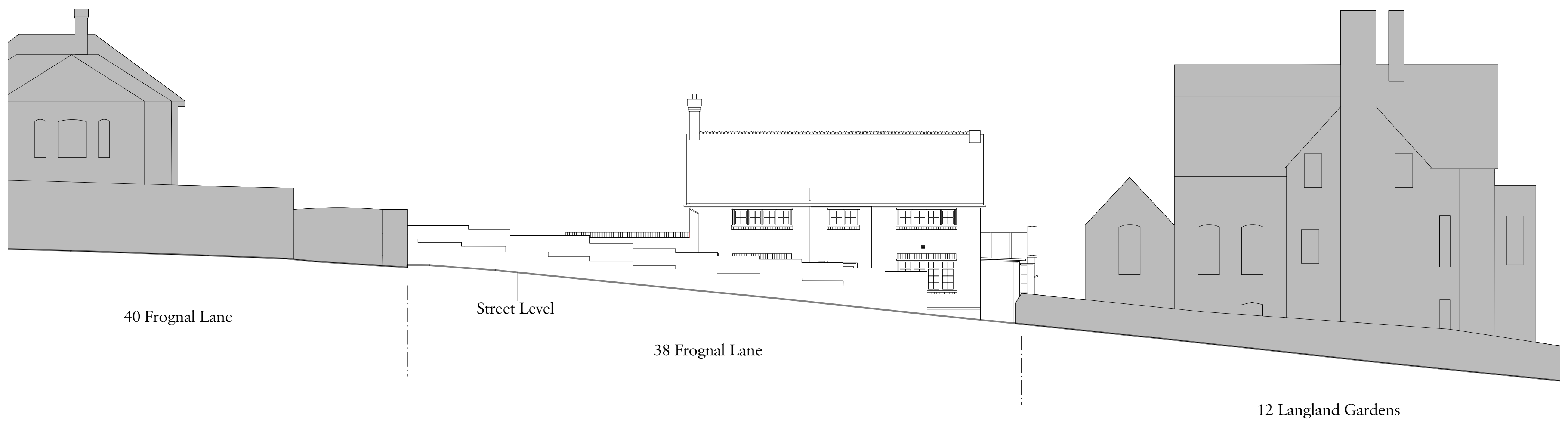
Project Number	Drawing Number	Revision
20022	PL-203	

2 Approved Street Elevation
Scale: 1:200

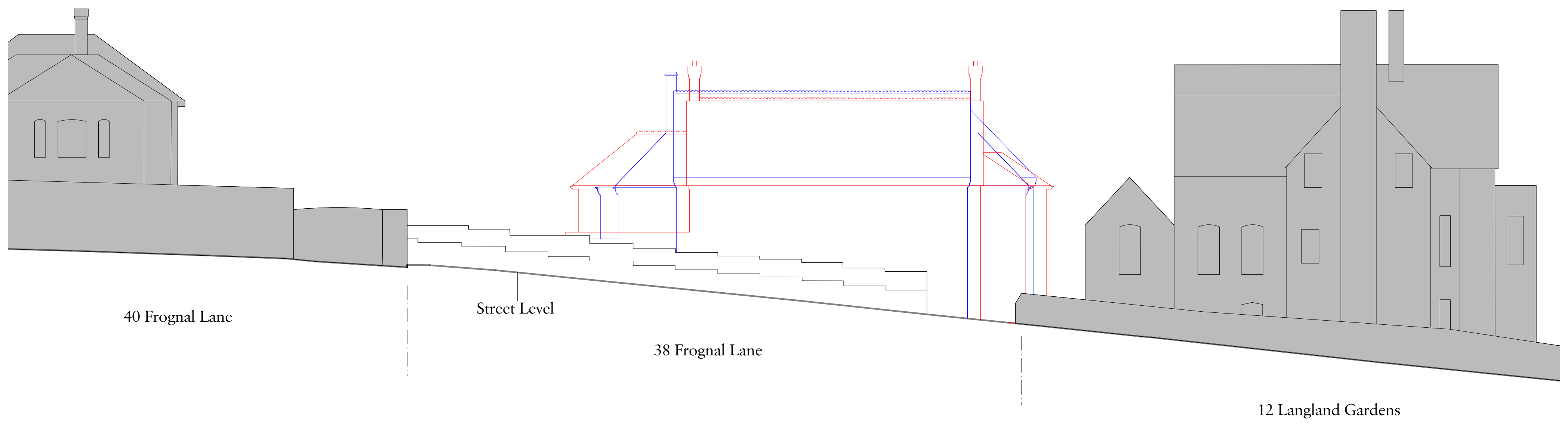
Approved Ref: 2019/4220/P
(approval for full demolition and replacement)



3 Proposed Street Elevation
Scale: 1:200



1 Existing Street Elevation
Scale: 1:200

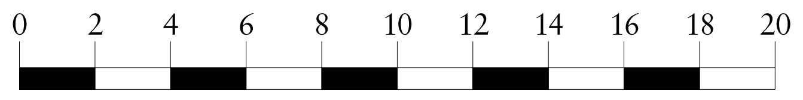


4 Comparison Street Elevation
Scale: 1:200

Approved Design
Proposed Design

40 Frognal Lane position from O/S.

12 Langland Gardens position from O/S.



Rev	Date	Details	By
A	17/11/20	Updated Window Design	MCW

Charlton Brown Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

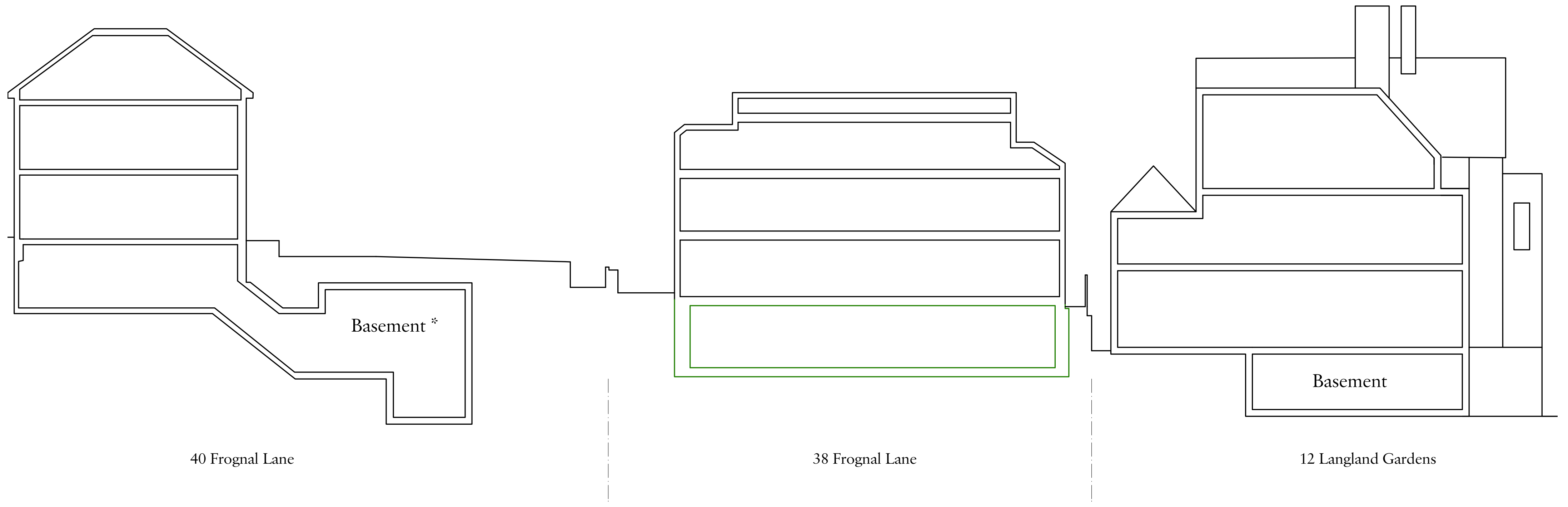
Drawing Title
Street Elevation

Date	Drawn	Checked
29/09/2020	MCW	JM

Scale
1:200 @ A1 / 1:400 @ A3

Issue Status
Planning Application

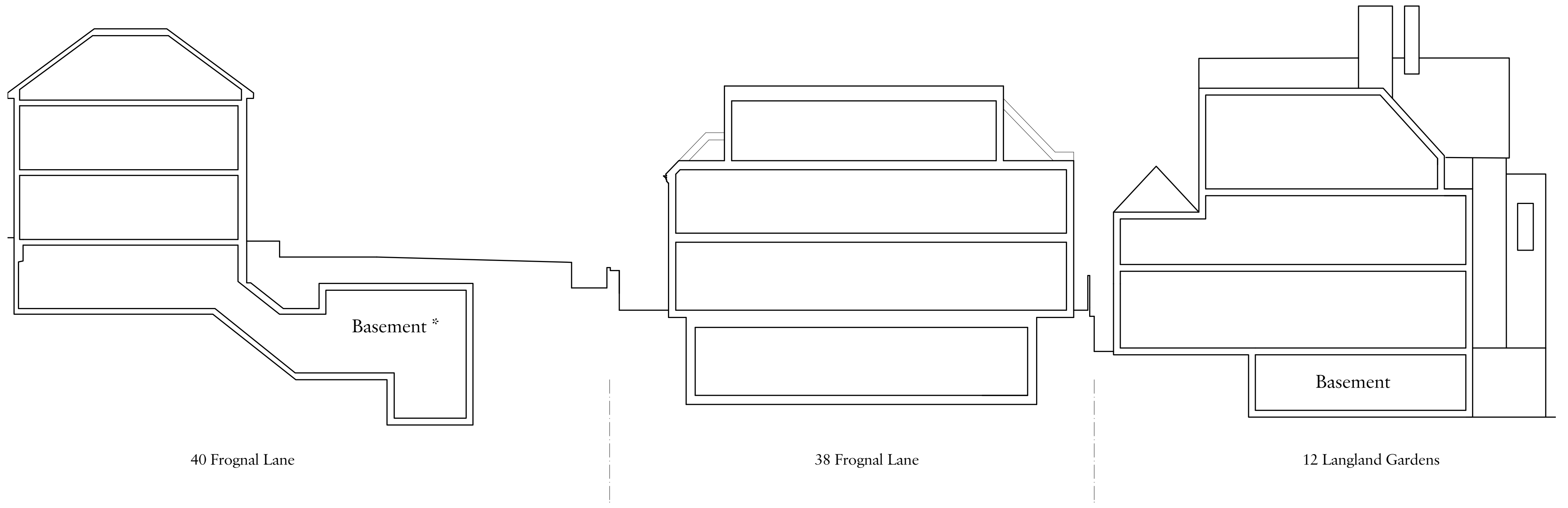
Project Number	Drawing Number	Revision
20022	PL-204	A



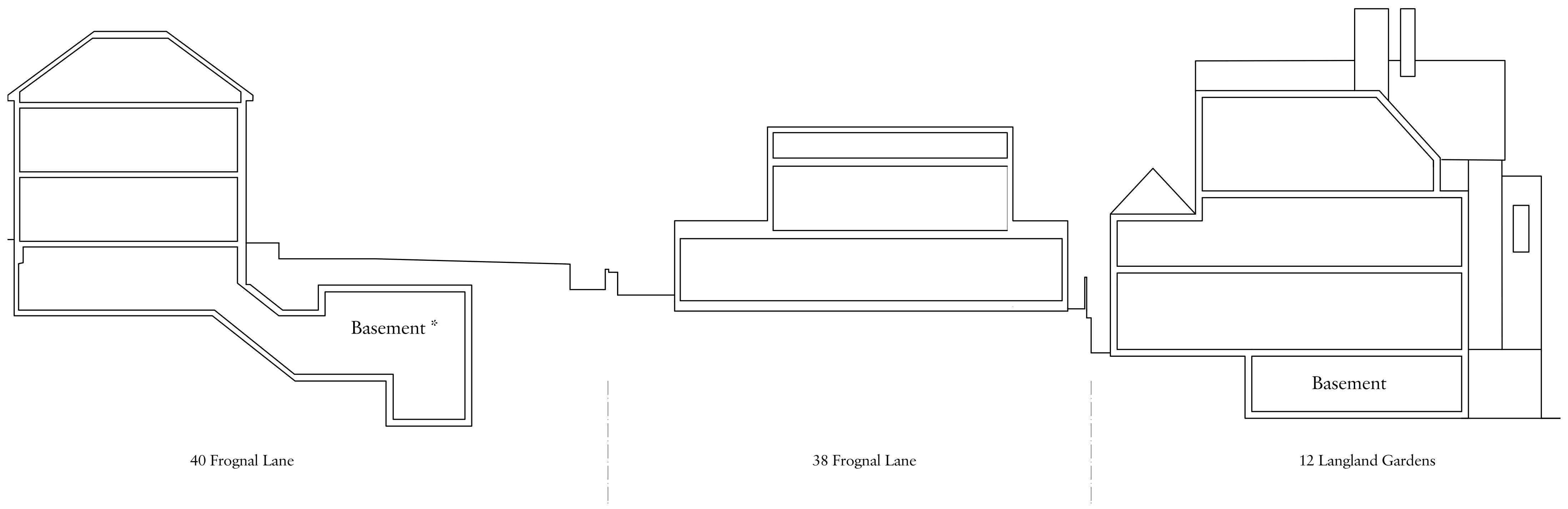
2 Approved + Consented Section
Scale: 1:200

Approved Ref: 2018/5502/P
(approval for full demolition and replacement)

Consent Ref: 2014/5915/P
(consent for basement level swimming pool excavation)
Expired on 11th May 2019



3 Proposed Section
Scale: 1:200

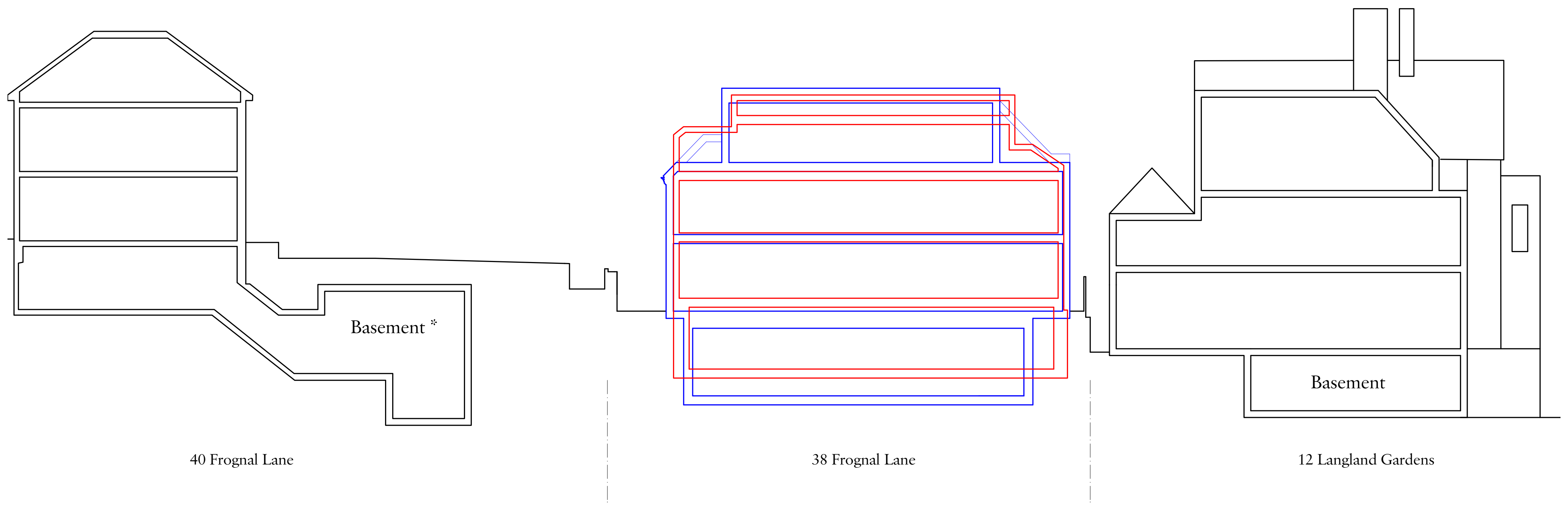


1 Existing Section
Scale: 1:200

40 Frognal Lane position from O/S.

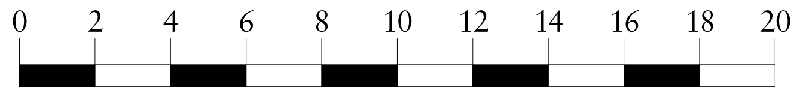
* Basement Plan derived from Planning
application ref: 2014/5915/P
Live consent until 1 May 2021

12 Langland Gardens
position from O/S.



4 Proposed Front Elevation
Scale: 1:200

Approved Design
Proposed Design



Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL

Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

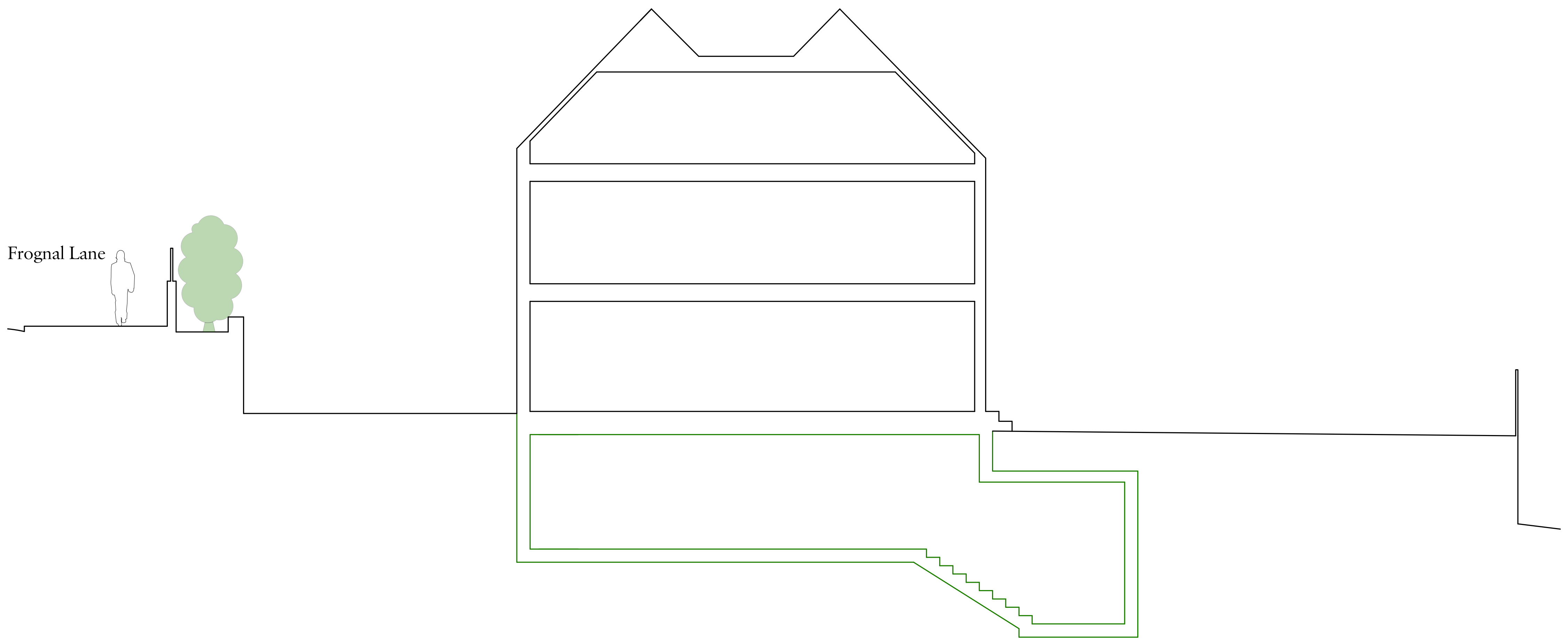
Drawing Title
Sections - AA

Date	Drawn	Checked
29/09/2020	MCW	JM

Scale
1:200 @ A1 / 1:400 @ A3

Issue Status
Planning Application

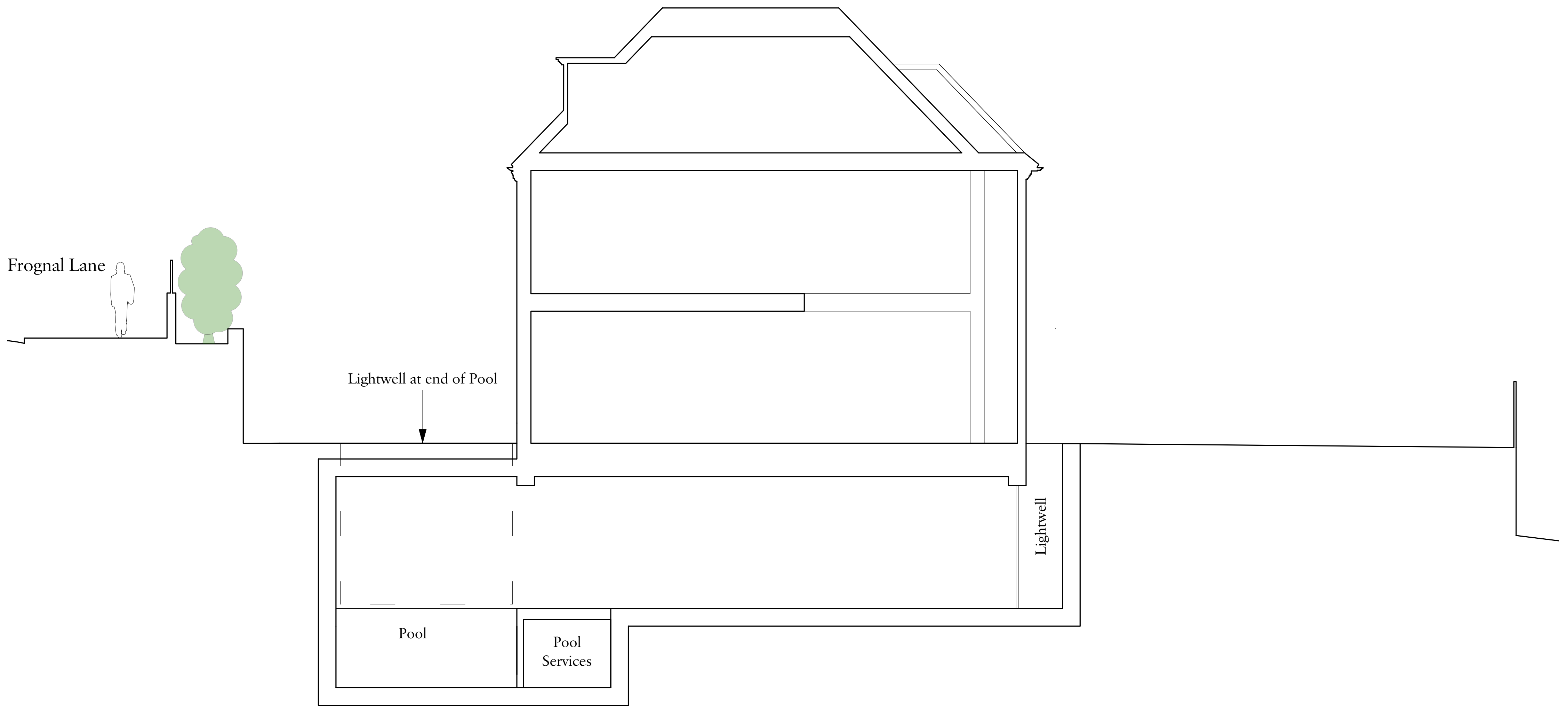
Project Number	Drawing Number	Revision
20022	PL-300	



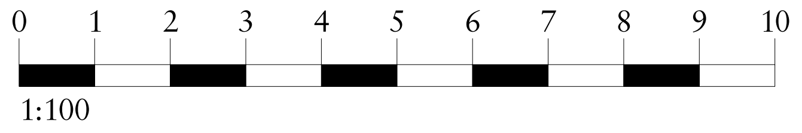
② Approved + Consented Section - BB
Scale: 1:100

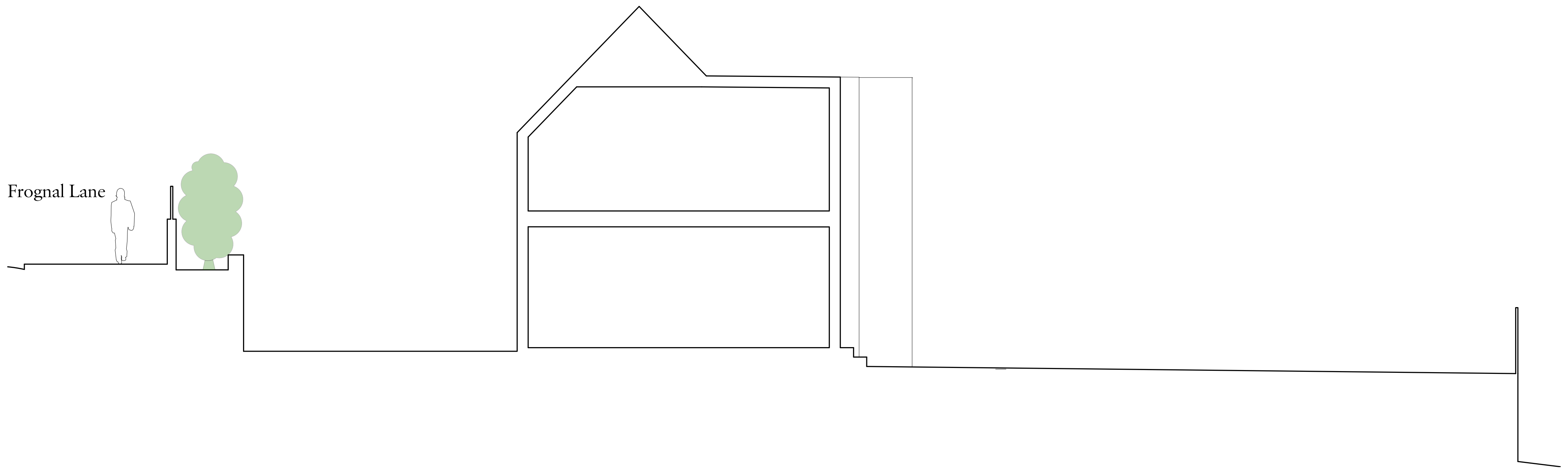
Approved Ref: 2018/5502/P
(approval for full demolition and replacement)

Consent Ref: 2014/5915/P
(consent for basement level swimming pool excavation)
Expired on 11th May 2019

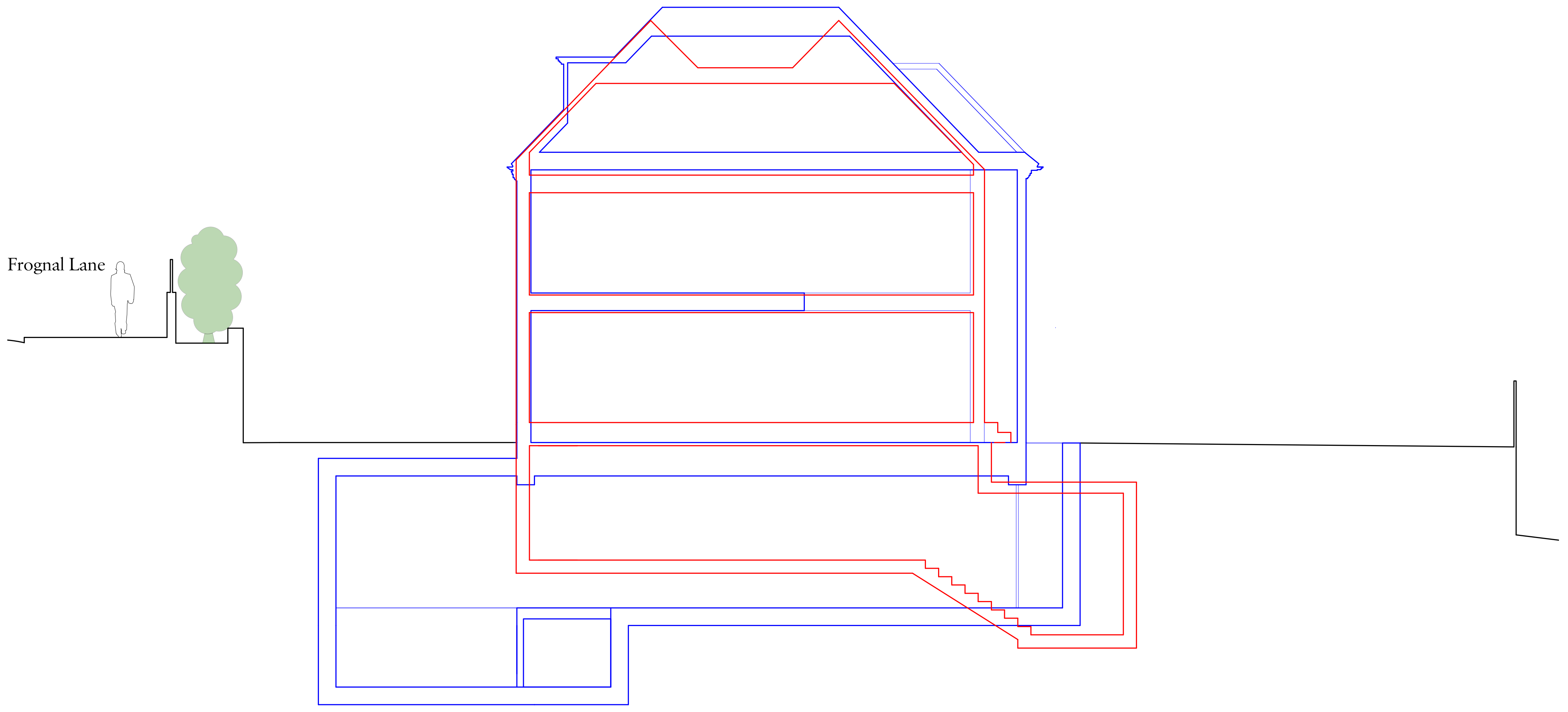


③ Proposed Section - BB
Scale: 1:100





① Existing Section - BB
Scale: 1:100



④ Comparison Section - BB
Scale: 1:100

Approved Design
Proposed Design

Rev	Date	Details	By

Charlton Brown
Architecture & Interiors

The Belvedere, 2 Back Lane, Hampstead, London, NW3 1HL
Telephone +44(0)20 7794 1234
Email office@charltonbrown.com
Website www.charltonbrown.com

Client
MRPP

Project
38 Frognal Lane, NW3

Drawing Title
Sections - BB

Date	Drawn	Checked
02/10/2020	MCW	JM

Scale
1:100 @ A1 / 1:200 @ A3

Issue Status
Planning Application

Project Number	Drawing Number	Revision
20022	PL-305	

Appendix 4: Ground Movement and Damage Impact Assessment

TRAIN & KEMP
CONSULTING ENGINEERS

Basement Impact Assessment Appendix 4

Ground Movement and Building Damage

Assessment

for

Redevelopment of

38 Frognal Lane, NW3 6PP

Job No: 14604 1 October 2020

Revision 0

Train & Kemp (Consulting Engineers) LLP | 10 Kennington Park Place London SE11 4AS | Limited Liability Partnership No. OC305768

Designated Members
M.W. Stone BEng CEng FIStructE T.A. Roberts IEng AMIStructE G.J.G. Tyldesley BEng CEng MIStructE

Consultant N.C. Train BSc CEng FIStructE FICE FCIArb

Tel: 020 7582 1276 www.trainandkemp.co.uk

bsi. ISO 9001:2015 Quality Management

CONTENTS

0 NON TECHNICAL SUMMARY

0.1 As required in Camden CPG on Basements, a Ground Movement and Building Damage Assessment has been completed on the proposed basement at 38 Frognal Lane.

0.2 The proposed basement is part of a rebuild of the detached house on the site. The basement is single storey with a deeper front section for a swimming pool and a shallower rear section, which forms a leisure suite.

0.3 The site is founded on Claygate Members overlying London Clay and the basement will be formed with a contiguous piled perimeter wall, with the depths adjusted to suit the swimming pool and leisure suite. The piled wall will be propped in both the temporary and permanent conditions. A waterproof concrete box will be constructed within the piled wall.

0.4 A ground movement assessment has been undertaken in accordance with CIRIA Report C580, as the industry standard on such movement. The effect of both the deep and shallow basements on the adjacent properties at No 40 Frognal Lane and No 12 Langland Gardens has been completed with the analysis in Appendix 2 and presentation of the potential damage in the graphs in Section 6.

0.5 The assessment has established that the movement in the adjacent properties will be limited to Damage Category 1, Very Slight, and hence complies with LB Camden acceptability criteria.

1 INTRODUCTION

1.1 Introduction

1.1.1 This Ground Movement and Building Damage Assessment, GM&BD, has been prepared in support of a planning application for the redevelopment of 38 Frognal Lane NW3 6PP, which includes a basement extension.

1.1.2 This GM&BD has been prepared in accordance with LB of Camden Planning Guidance on Basements, March 2018.

1.1.3 Reference is made to LB Camden Geological, Hydrogeological and Hydrological Study, GHHS, 2010

1.2 Authorship

1.2.1 This GM&BDA has been prepared by Norman Train, a Chartered Civil Engineer and Chartered Structural Engineer with experience in ground movement and damage assessment

2.0 LOCATION AND SITE DESCRIPTION

2.1 Location

2.1.1 The site is on the slopes falling from the high ground of Hampstead Heath towards the Finchley Road to the southwest. For the purposes of this assessment the orientation of Frognal Lane is taken as east west with No 38 being on the south side; No 40 Frognal Lane and No 12 Langland Gardens are to the east and west respectively.

2.1.2 As shown on T&K drawing 14604-01 in Appendix 1, the site is a parallelogram with the road frontage along Frognal Lane being 25m by some 30m deep, front to rear, giving a plot area of 650m^2

2.2 Topography and Levels

2.2.1 The topographical survey shows that the gradient to this part of Frognal Lane is 1 in 10. This gradient is also repeated on Langland Gardens to the south west of the site.

2.2.2 The site is located opposite the junction to Chesterford Gardens with the ground rising to the north and east. The adjacent house to the east on Frognal Lane is No 40 which is some 3m higher. The adjacent house to the west is No 12 Langland Gardens; which is some 2m lower.

2.2.3 The site is level and it is clear that the ground has been terraced with retaining walls to the back of the pavement and to the front sections of the eastern and western boundaries. The natural fall of the ground means that the level difference is less pronounced towards the rear, where the differences are accommodated within banking and steeper slopes to the perimeter flower beds rather than formal retaining walls.

2.2.4 The forecourt off Frognal Lane is at +90.9m OD with the rear garden at +90.5m OD. The passageways to the east and west of the house are +91.3m OD and +90.6m OD respectively, with the maximum height of the eastern and western retaining walls at their northern front ends being 2m and 1m high respectively.

2.3 Existing Site and Building

2.3.1 38 Frognal Lane is a detached two storey house with pitched roof that has a single storey attached garage to the east. To the rear is a single storey extension that wraps around onto its western side. There is no basement.

2.3.2 The gravel forecourt does not have any formal drainage.

2.3.3 As shown on T&K Drawing 14604-01 in Appendix 1, there are three trees in the rear garden and three along the front.

2.3.4 Both the foul and surface water connect to the adopted drainage on Frognal Lane which is a combined system.

2.4 Adjacent Buildings

2.4.0 Reference: T&K Drawing 14604-01 Site Location and Clearance to Adjacent Properties in Appendix 1.

2.4.1 No 40 Frognal Lane is a grade listed detached three storey house with a lower ground floor as a semi basement. No 40 Frognal Lane is 19m to the east of No 38 and its lower ground floor is at +92m OD. There is also a current planning permission for a basement swimming pool in the garden to No 40 which would be 5.5m clear at a depth of +86.5m OD. The swimming pool would be a reinforced concrete box with perimeter concrete piles.

2.4.2 No 12 Langland Gardens is 2.5m to the west of No 38 and is split level. The upper ground floor is at +88.8m OD and the lower ground floor, with access from Langland Gardens, is at +86.2m OD.

2.4.3 Next to No 12 Langland Gardens is Lindfield House, the back garden of which extends across the whole of the rear boundary to No 38. There are timber outhouses within 2m of this southern boundary, but with the slope of the ground these are estimated to be at +89m OD.

3.0 SCHEME

3.0.0 References: Carlton Brown Architect Drawings 20022 P 099 to 108

3.1 Proposed Redevelopment

3.1.1 The proposed redevelopment comprises the demolition of the existing house and the construction of a new two storey house of similar proportions over an extended basement. The front of the basement, beneath the forecourt, will be a swimming pool with the remainder being a leisure suite.

3.1.2 The impervious area will increase from 200m^2 to 230m^2.

3.1.3 As a rebuild, the house will be constructed bottom upwards. The leisure suite will have columns at around 5m centres, both ways, to support the ground floor and superstructure. The columns will be supported on piles.

3.2 Basement

3.2.1 The swimming pool beneath the forecourt will be 4.8m deep internally; the leisure suite behind will be 3m deep internally. The excavated depths will be +84.4m OD and +86.2m OD respectively.

3.2.2 The basement will have lightwells to the eastern end of the swimming pool and to the southern side of the leisure suite.

3.2.3 The basement will require the construction of a contiguous piled perimeter wall with an inner box of waterproof concrete. As a mitigation against disruption of the groundwater flow, an externally pea shingle layer will be installed around the outside of the piles will act as the groundwater interceptor and redistributor.

4.0 GROUND CONDITIONS AND SITE INVESTIGATIONS

4.0.0 References: The two site investigations are given in BIA Appendix 2.

4.1 Published Ground Conditions

4.1.1 The British Geology Survey, Map of the Geology of UK, indicates that the site is underlain by Claygate Members overlying London Clay which outcrops further to the south on Langland Gardens.

4.1.2 GHHS Fig 8, Aquifer Designation Map, shows that the Claygate Members are classified as a Secondary A Aquifer. London Clay is classified as an unproductive aquifer.

4.1.3 GHHS Fig 9, Slope Angle Map, shows that there are no slopes greater than 7° in the vicinity of the site.

4.2 Soil Ltd 2014

4.2.1 Soils Ltd completed a site investigation in 2014 comprising two window samplers to a depth of 6m in the forecourt. This established that the Claygate Members extend to a greater depth than 6m.

4.2.2 Standpipes were installed in both window samplers with the groundwater measured in December 2013 and January 2014. Initially the depth to the water was 2.0m [east] and 2.8m [west] rising after a month to 0.8m [east] and 1.5m [west]. Being on the forecourt, the locations were at the same level,18m apart, so the gradient of the phreatic surface across the site in early 2014 was 1 in 20.

4.3 Soil Ltd 2020

4.3.1 Soils Ltd site investigation in 2020 comprised a 20m borehole in the forecourt and two 10m window samplers in the rear garden. The 20m borehole gives strength parameters for the pile design. The 10m window samplers established the depth of the London Clay, which ranges between 5.5m and 7.8m in depth.

4.3.2 Standpipes were installed in all three holes

5.0 GROUND MOVEMENT ASSOCIATED WITH BASEMENT CONSTRUCTION

5.0.0 Reference: CIRIA Report C580: Embedded Retaining Walls- Guidance for Economic Design; 2003

5.1 Ground Movements with Basements

5.1.1 Basement excavation leads to ground movements and with time this can lead to damage and cracking within the zone of influence of the excavation. Assessing the potential damage to buildings requires a Ground Movement Assessment, GMA, to be undertaken first, followed by categorising of the resulting damage to buildings.

5.1.2 There are two types of movement.

5.1.2.1 The removal of the soil mass within the basement causes the ground beneath to recover and heave as an upward movement. This can be modelled assuming Boussinesq elastic stress distribution and is greatest in the middle of the excavation. Whilst this recovery will also extend outside the basement, the zone is small.

5.1.2.2 The sides of the excavation tend to rotate into the hole with both horizontal movement and settlement of the ground outside the basement. The settlement is a downward movement. Field measurements of the movements outside basements are presented in CIRIA C580 figures 2.8, 2.9 & 2.11 for stiff clays and 2.12 for sands. The movement to the sides of the excavation is sensitive to the propping or stiffness of the walls

5.1.3 Since the field measurements will include the effects of any heave from the removal of the soil mass, the recovery does not have to be considered separately.

5.1.4 Based on the fieldwork, CIRIA C580, Tables 2.2 and 2.4 give guidance on the potential movement in stiff clays. There are two aspects to this movement:

5.1.4.1 The relaxation of the soil mass outside the excavation;

5.1.4.2 The settlement associated with the wall construction itself.

5.1.5 Each aspect can be resolved into vertical and horizontal components giving four value sets, each of which has its own zones of influence.

5.1.6 The build up of the resulting horizontal and vertical movements are given in Appendix 2 assuming:

5.1.6.1 The strains are uniformly distributed over the zone of influence

5.1.6.2 The strains tabulated in C580 are:

5.1.6.2.1 at the surface, reducing linearly to zero at the base of the excavation or walling element. This means that on a slope, where the adjoining building is at a different level, it is the net difference in level rather than the excavation depth that defines the zone of influence

5.1.6.2.2 perpendicular to the excavation. Whilst only applicable to the horizontal strains at excavation corners or changes in the depth of the wall, if the orientation is at an angle, it is the perpendicular component horizontal strain that is appropriate.

5.2 Movement associated with Contiguous Pile Construction

5.2.1 C580, Section 2.5.1 states that there is little ground movement with the installation of isolated bored piles. However, with sequential construction to form a wall there is movement in the adjacent ground. This is greatest with secant walls, with contiguous piles having a lesser effect.

5.2.2 As 5.1.2.2, the movements associated with the excavation are sensitive to the propping and stiffness of the perimeter wall. The contiguous piles will be held with wailers and props in the construction phase and by the capping beam and lid in the completed works. This means that high support stiffness values can be taken from Table 2.4.

5.2.3 The recommended movements for contiguous piles in Table 2.2 with high support excavation in Table 2.4 are:

Element	C580 Table	Horizontal		Vertical	
		ε %	Zone of Influence	ε %	Zone of Influence
Contiguous Piles	2.2	0.04	1.5 piles	0.04	2 piles
Excavation [High Support Stiffness]	2.4	0.15	4 excavations	0.1	3.5 excavations

5.3 Ground Movement Analysis and Results

5.3.1 The depth of the contiguous piles to the Leisure Suite and Swimming Pool basements are taken as 10m and 15m respectively.

5.3.2 The extent of the deeper piles to the pool is shown on T&K drawing 14604-01 in Appendix 1. The clearance of the closest point in the Leisure Suite and Pool to both No 12 Langland Gardens and No 40 Frognal Lane are given as the four locations for analysis. The depth of the foundations of both buildings is taken as 0.8m below the respective floor levels. As 3.2.1, the depth of No 38 basement excavations are taken as +86.2m OD and +84.4m OD

5.3.3 Whilst the proposed swimming pool to No 40 is also indicated on T&K 14604/01, it has not been built yet and as reinforced concrete the Burland Categories are not applicable. Consequently it has not been analysed.

Location	Ref	Clear-ance m	Angle to Perp	Level		No 38 Basement	
				Floor	Foundation		Level
12 Langland Gdns	LG/1	2.5	Perp	+88.8m OD	+88.0m OD	Leisure	+86.2m OD
	LG/2	6	45^o	+88.8m OD	+88.0m OD	Pool	+84.4m OD
40 Frognal Lane	FL/1	19	Perp	+92.0m OD	+91.2m OD	Leisure	+86.2m OD
	FL/2	23	45^o	+92.0m OD	+91.2m OD	Pool	+84.4m OD

Proposed No 40 Pool	[FL/3]	5.5			+86.5m OD	Pool	+84.4m OD

5.3.4 The two key results that are required in assessing the damage of adjoining brick buildings are:
- 5.3.4.1 Horizontal Strain ε_H.
- 5.3.4.2 Vertical Differential Settlement Δ/L. Note it is the differential settlement and not the total settlement that causes the cracks.

5.3.5 The Horizontal Strain ε_H and Vertical Differential Settlement Δ/L are the two boxed values in the individual analysis sheets in Appendix 2. Both values are dimensionless and presented as %.

6.0 DAMAGE ASSESSMENT OF ADJACENT PROPERTIES

6.1 Burland Scale

6.1.1 In brittle materials with limited tensile strength, such as brickwork, damage occurs when the tension strains exceed a critical value and cracks form. A limiting strain, ε_{lim}, can be defined for different sizes of cracks, or damage classifications. In brickwork, five categories of damage are defined as.

Category of Damage	Description of Damage	Approx Crack Width	Limiting Strain ε_{lim}
0. Negligible	Hairline	0.1mm	0.05%
1. Very Slight	Fine cracks addressed during decoration	1mm	0.075%
2. Slight	Cracks easily filled with redecoration	<5mm	0.15%
3. Moderate	Patch brick repairs	5mm to 15mm	0.3%
4. Severe	Extensive repairs	15mm to 25mm	Over 0.3%
5. Very Severe	Major rebuilding	>25mm	

6.1.2 Reinforced concrete can resist tension and has ductility and the above correlation of crack width and limiting strains does not hold.

6.1.3 The two primary sources of cracking are vertical distortions from differential settlement and tapering cracks arising from the horizontal tension strains from the settlement/rebound wave. Burland suggested that the façade of the building can be considered as a large deep beam with the bending and diagonal strains within it depending on its proportions, i.e. ratio of the Length/Height, L/H. On tall narrow buildings, with L/H below unity, diagonal cracking from differential settlement predominates whereas on long squat buildings or terraces, tension cracks due to bending predominates.

6.1.4 The two types of cracking relate to vertical and horizontal strains. Utilising the concept of the limiting strains, envelopes of increasing damage can be developed combining the two types of movement for various building proportions. This is of limited value and it is more useful in practice to develop envelopes of different damage categories for a given façade proportion. The two axes on the Burland Scale charts are vertical differential settlement, Δ/L, and horizontal strains ε_H on to which different crack severity envelopes can be plotted

6.1.5 The vertical differential settlement and horizontal strains from the Ground Movement Analysis in Appendix 2 is presented on the charts for No 12 Langland Gardens and No 40 Frognal Lane

6.2 LB Camden Damage Acceptance Criteria

6.2.1 LB of Camden CPG on Basements, Para 4.33 requires any potential damage to neighbouring properties is no higher than category 1, Very Slight.

6.3 No 12 Langland Gardens Upper Ground Floor

6.3.1 The western half of No 12 is three storeys with a width of 8m and a height of 10m giving a L/H ratio of just under 1.

<u>12LG/1 Leisure Suite Basement</u>

6.3.2 The horizontal strain ε_H and vertical differential settlement Δ/L from Appendix 2 are 0.053% and 0.004% respectively.

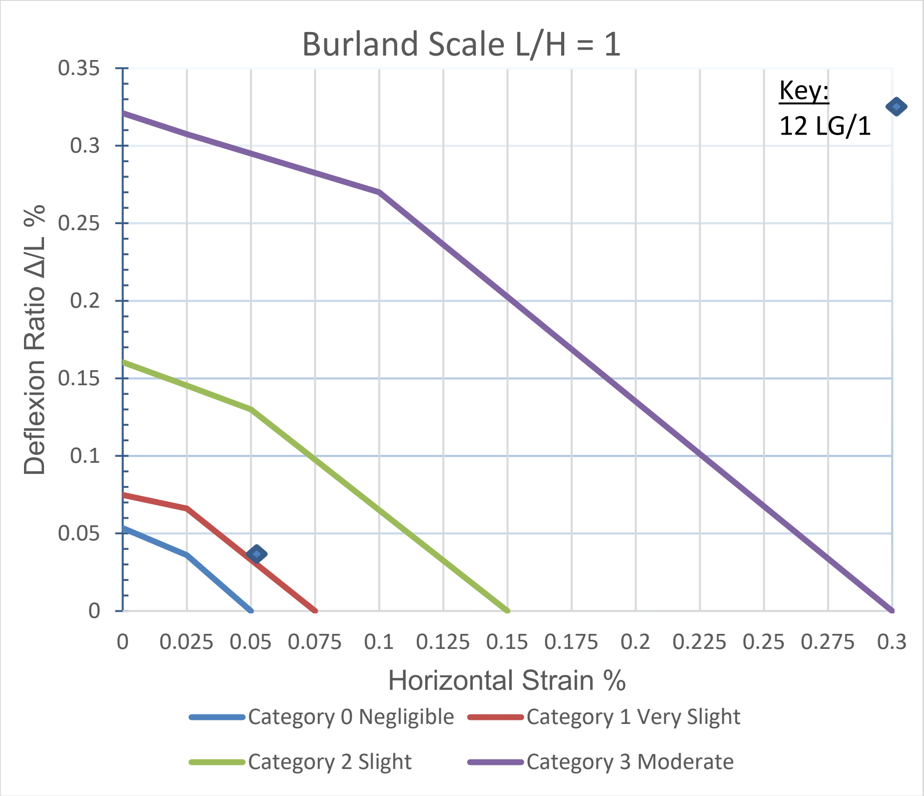


Fig 1 Leisure Suite Basement on No 12 Langland Gardens

6.3.3 As Fig 1, the predicted movement within No 12 Langland Gardens Upper Ground Floor due to the Leisure Suite Basement is on the envelope for Burland Category 1, Very Slight.

12LG/2 Swimming Pool Basement

6.3.4 The horizontal strain ε_H and vertical differential settlement Δ/L from Appendix 2 are 0.045% and 0.002% respectively.

6.3.5 As Fig 2, the predicted movement within No 12 Langland Gardens Upper Ground Floor due to the Swimming Pool Basement is within the envelope for Burland Category 1, Very Slight.

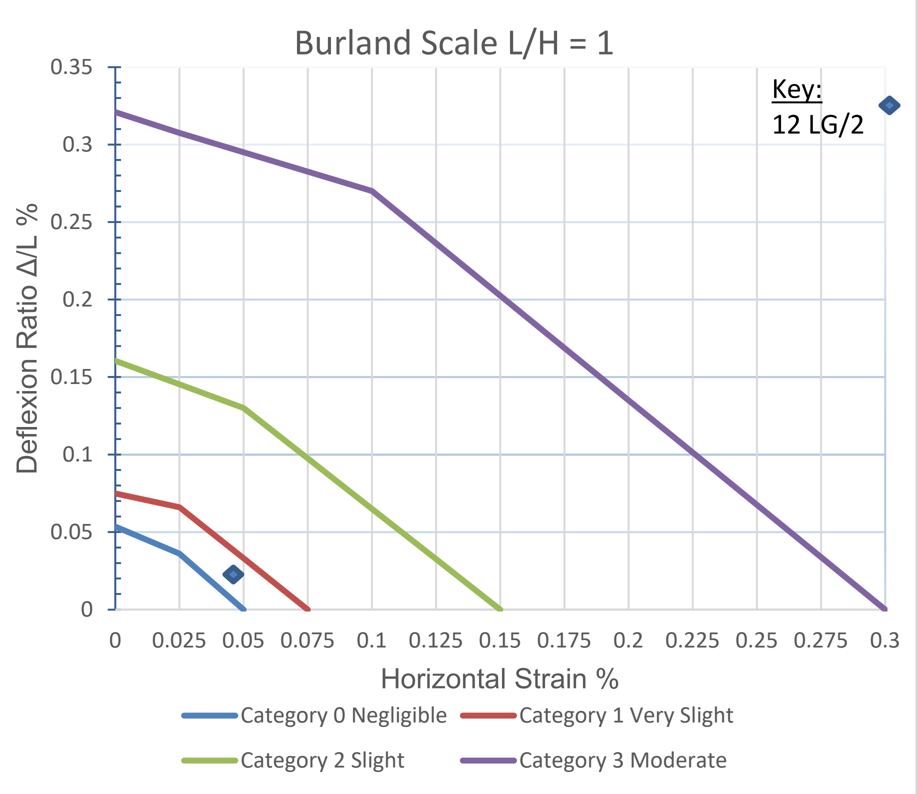


Fig 2 Swimming Pool Base on 12 Langland Gardens

6.4 No 40 Frognal Lane

6.4.1 The main house is three storeys with a width of 9m and a height of 10m giving a L/H ratio of just under 1.

40FL/1: Leisure Suite Basement

6.4.2 The horizontal strain ε_H and vertical differential settlement Δ/L from Appendix 2 are 0.024% and 0.002% respectively.

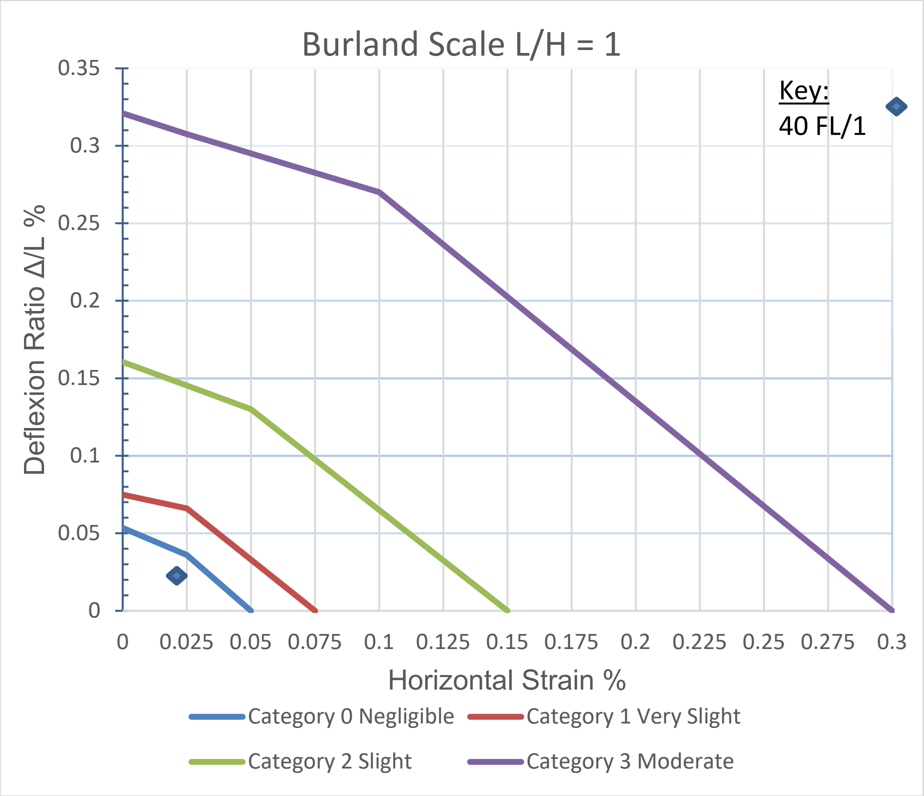


Fig 3 Leisure Suite Basement on No 40 Frognal Lane

6.4.3 As Fig 3, the predicted movement within No 40 Frognal Lane Lower Ground Floor due to the Leisure Suite Basement is within Burland Category 0, Negligible.

40FL/2: Swimming Pool Basement

6.4.4 The horizontal strain ε_H and vertical differential settlement Δ/L from Appendix 2 are 0.042% and 0.002% respectively.

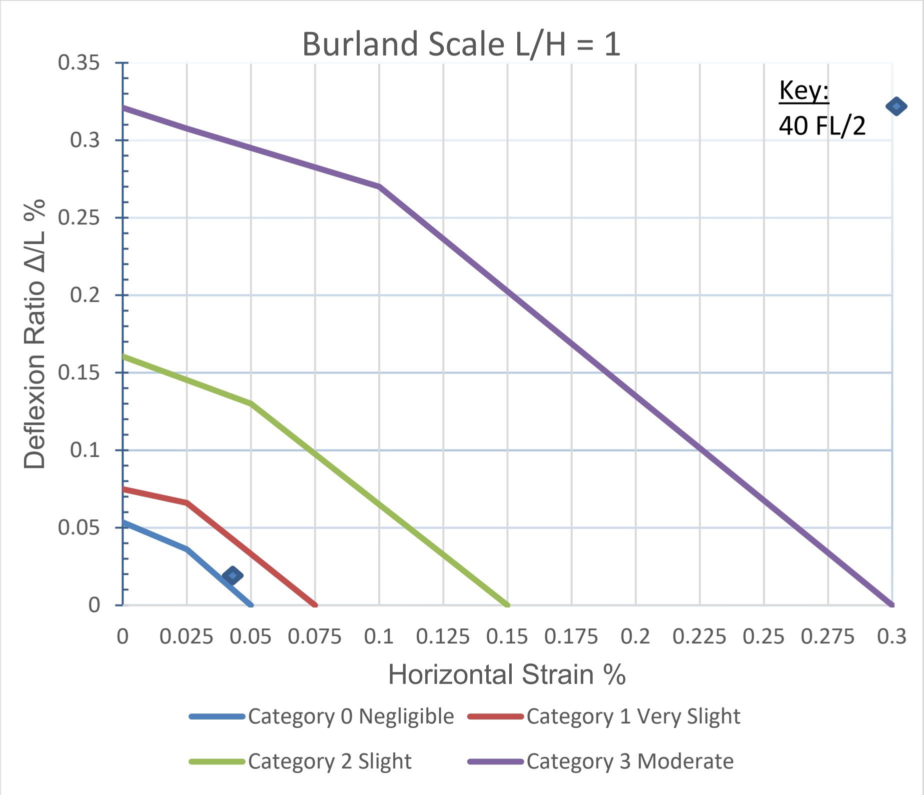


Fig 4 Swimming Pool Base on No 40 Frognal Lane

6.4.5 As Fig 4, the predicted movement within No 40 Frognal Lane Lower Ground Floor due to the Swimming Pool Basement is on the envelope to Burland Category 0, Negligible.

6.5 Monitoring

6.5.1 The maximum movements generated in Appendix 2 are 5mm horizontally and 3mm vertically. These are too small for any meaningful surveying monitoring regime.

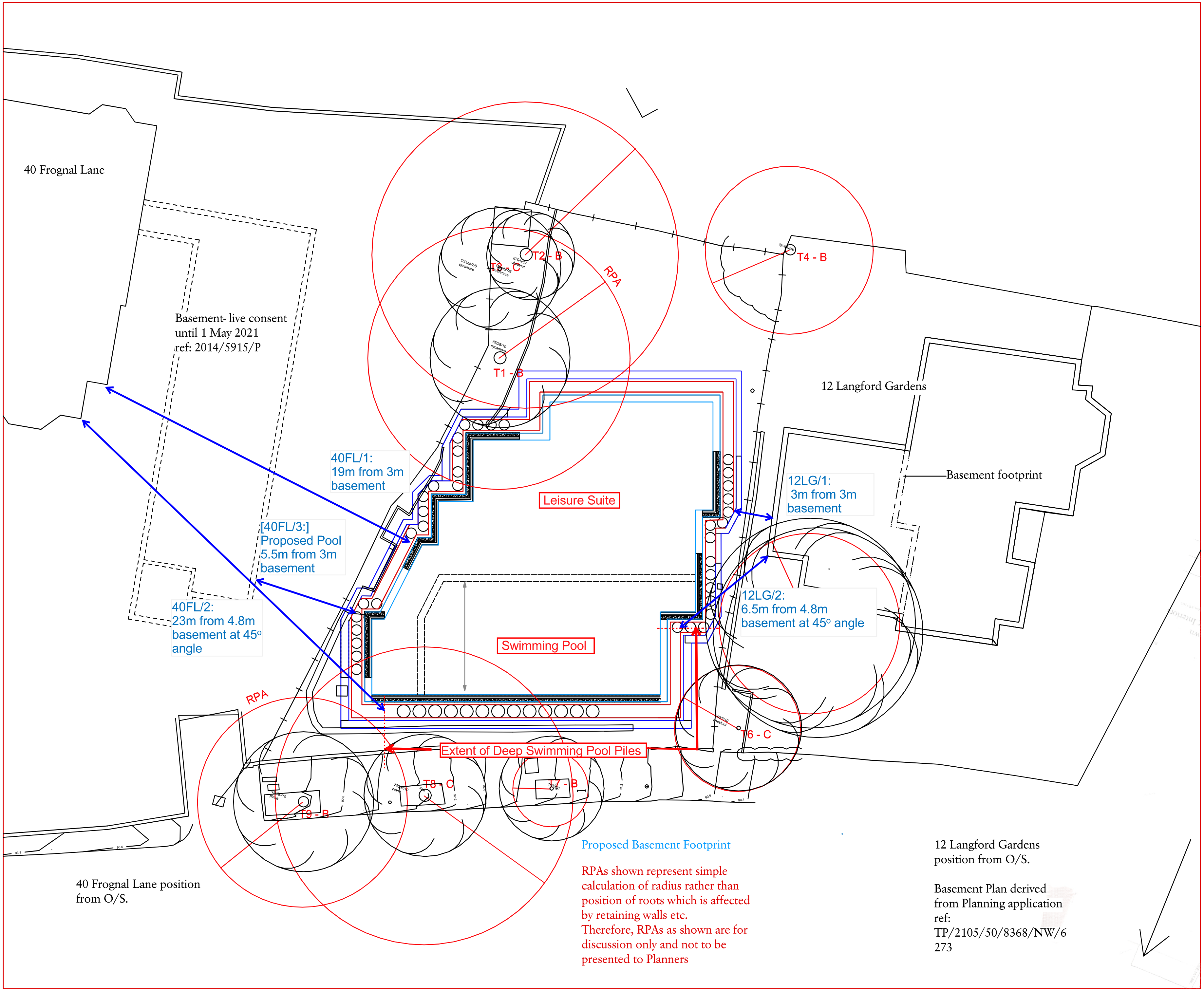
6.5.2 The basement will require party wall awards which in turn will require condition surveys. If the adjoining owner's surveyor wishes for any existing cracks to be monitored with DEMEC gauge or Tell-tale crack monitors, this will be undertaken as part of the award.

7.0 CONCLUSION

7.1 As shown on Figs 1 to 4, the impact of the proposed basement on the adjacent houses is within the acceptance criteria set out in LB Camden CPG on Basements.

N C Train BSc, C.Eng, FIStructE, FICE, FCIArb

Appendix 1 T&K Drawing 14604/01 Site Layout with Clearance to Adjacent Properties



Proposed Basement Footprint

RPAs shown represent simple calculation of radius rather than position of roots which is affected by retaining walls etc. Therefore, RPAs as shown are for discussion only and not to be presented to Planners

12 Langford Gardens
position from O/S.

Basement Plan derived
from Planning application
ref:
TP/2105/50/8368/NW/6
273

Important note

All dimensions in millimetres. Where dimensions are not given, drawings must not be scaled and the matter referred back to Charlton Brown Architects.

All dimensions and conditions are to be checked on site by the contractor prior to preparing drawings or commencing any work. The contractor is responsible for checking that there is no conflict between site dimensions and drawn dimensions.

In the event of any detail or dimensional conflict between Charlton Brown Architects drawings, the matter must be referred back to Charlton Brown Architects for clarification

Rev	Date	Details	By

TRAIN & KEMP

10 Kennington Park Place London SE11 4AS
Tel: +44 (0) 20 7582 1276
www.trainandkemp.co.uk

Client
MRPP

Project
38 Frognal Lane, NW3

Drawing Title
Site Layout with basement clearances to adjacent properties

Date	Drawn	Checked
07/10/20	NCT	

Scale
1:200 @ A3

Ground Movement & Building Damage Assessment

Project Number	Drawing Number	Revision
14604	01	

Appendix 2 Ground Movement Analysis

08/10/2020 Job No: 14604

38 Frognal Lane NW3 6PP
Ground Movement with 12LG-1 Leisure Suite Basement

C580
Table

2.2	Pile Type:	Contiguous		Depth	10	m	Zone of Influence		
	Horizontal Strain	0.04%	at pile reducing to zero over		1.5		pile lengths =	15	m
	Vertical Strain	0.04%	at pile reducing to zero over		2		pile lengths =	20	m
2.4	Excavation	Propped High Level		Depth	4.3	m			
	Horizontal Strain	0.15%	at pile reducing to zero over		4		excavation depths=	17.2	m
	Vertical Strain	0.10%	at pile reducing to zero over		3.5		excavation depths=	15.05	m

<u>No 12 Langland Gardens</u> Length 8 m Height 10 m L/H= 0.8

Clearance from basement 3 m

No 12 UG Foundation	88.0	m OD
No 38 Leisure Excavation	86.2	m OD
Depth Difference	1.8	m

		Horizontal Movement							Vertical Movement								
		Pile	10 m		Excavation	1.8 m		Σ	Pile			Excavation			Σ	Diff	Dist
Position	Clear	Portion	ε	mm	Portion	ε	mm	mm	Portion	ε	mm	Portion	ε	mm	mm	mm	m
Contig Wall	*0 m*	*0.00*	*0.040%*	*4.0*	*0.0*	*0.150%*	*2.7*	*6.7*	*0.00*	*0.040%*	*4.0*	*0.0*	*0.100%*	*1.8*	*5.8*		
Building Face	3 m	0.20	0.032%	3.2	1.7	0.087%	1.6	4.8	0.15	0.034%	3.4	1.7	0.052%	0.9	4.3		
																1.0	2
2 m into Bldg	5 m	0.33	0.027%	2.7	2.8	0.046%	0.8	3.5	0.25	0.030%	3.0	2.8	0.021%	0.4	3.4		
																1.2	4
6 m into Bldg	9 m	0.60	0.016%	1.6	Beyond Zone	0.000%	0.0	1.6	0.45	0.022%	2.2	Beyond Zone	0.000%	0.0	2.2		
																0.4	2
8 m into Bldg	11 m	0.73	0.011%	1.1	Beyond Zone	0.000%	0.0	1.1	0.55	0.018%	1.8	Beyond Zone	0.000%	0.0	1.8		
																2.5	8.0

<u>Horizontal Displacement</u>

Building Face to 6 m Horizontal Diff 3.2 mm

Av Horizontal ε $\boxed{0.053\%}$

<u>Vertical Displacements</u>

Over a Distance of 6 m Vertical Difference Building Face to 2 m into Bldg 1.0 mm

Av slope= ΣDiff/ΣDist = 0.032% Av Diff on 2 m into Bldg 0.6 mm

Differential Settlement Δ= 0.3 mm

Δ/ΣDist= $\boxed{0.004\%}$

08/10/2020

38 Frognal Lane NW3 6PP

Ground Movement with 12LG-2 Swimming Pool Basement

Job No: 14604

C580 Table

2.2	Pile Type:	Contiguous	Depth	15 m	Zone of Influence		
	Horizontal Strain	0.04%	at pile reducing to zero over	1.5	pile lengths =	22.5	m
	Vertical Strain	0.04%	at pile reducing to zero over	2	pile lengths =	30	m
2.4	Excavation	Propped High Level	Depth	6.1 m			
	Horizontal Strain	0.15%	at pile reducing to zero over	4	excavation depths=	24.4	m
	Vertical Strain	0.10%	at pile reducing to zero over	3.5	excavation depths=	21.35	m

No 12 Langland Gardens   Length 8 m   Height 10 m   L/H= 0.8

Angle of basement corner to wall θ = 45 °

Clearance from basement 6.5 m

No 12 UG Foundation	88.0	m OD
No 38 Pool Excavation	84	m OD
Depth Difference	3.6	m

		Horizontal Movement								Vertical Movement							
		Pile	15 m		Excavation	3.6 m		Σ	Pile			Excavation			Σ	Diff	Dist
Position	Clear	Portion	ε	mm	Portion	ε	mm	mm	Portion	ε	mm	Portion	ε	mm	mm	mm	m
Contig Wall	*0 m*	*0.00*	*0.040%*	*6.0*	*0.0*	*0.150%*	*5.4*	*11.4*	*0.00*	*0.040%*	*6.0*	*0.0*	*0.100%*	*3.6*	*9.6*		
Building Face	6.5 m	0.29	0.028%	4.3	1.8	0.082%	3.0	7.2	0.22	0.031%	4.7	1.8	0.048%	1.7	6.4		
																1.0	2
2 m into Bldg	8.5 m	0.38	0.025%	3.7	2.4	0.061%	2.2	5.9	0.28	0.029%	4.3	2.4	0.033%	1.2	5.5		
																1.9	4
6 m into Bldg	13 m	0.56	0.018%	2.7	3.5	0.020%	0.7	3.4	0.42	0.023%	3.5	3.5	0.001%	0.0	3.5		
																0.4	2
8 m into Bldg	15 m	0.64	0.014%	2.1	Beyond Zone	0.000%	0.0	2.1	0.48	0.021%	3.1	Beyond Zone	0.000%	0.0	3.1		
																3.3	8.0

Horizontal Displacement

Building Face to 8 m   Horizontal Diff Δ_H 5.1 mm   perpendicular to wall

Component of Horiz Diff at angle θ= $\Delta_H \cos\theta$ = 3.6 mm

Av Horizontal ε $\boxed{0.045\%}$

Vertical Displacements

Over a Distance of 8 m   Vertical Difference   Building Face to 2 m into Bldg 1.0 mm

Av slope= ΣDiff/ΣDist = 0.042%   Av Diff on 2 m into Bldg 0.8 mm

Differential Settlement Δ= 0.1 mm

Δ/ΣDist= $\boxed{0.002\%}$

08/10/2020

Job No: 14604

38 Frognal Lane NW3 6PP
Ground Movement with 40FL-1 Leisure Suite Basement

C580
Table

2.2 Pile Type: Contiguous Depth 10 m Zone of Influence
Horizontal Strain 0.04% at pile reducing to zero over 1.5 pile lengths = 15 m
Vertical Strain 0.04% at pile reducing to zero over 2 pile lengths = 20 m

2.4 Excavation Propped High Level Depth 6.1 m
Horizontal Strain 0.15% at pile reducing to zero over 4 excavation depths= 24.4 m
Vertical Strain 0.10% at pile reducing to zero over 3.5 excavation depths= 21.35 m

<u>No 40 Frognal Lane</u> Length 9 m Height 10 m L/H= 0.9
Clearance from basement 19.0 m
Angle of basement corner to wall θ = 0 °

No 40 LG Foundation 91.2 m OD
No 38 Leisure Excavation 86 m OD
Depth Difference 5.0 m

		Horizontal Movement								Vertical Movement							
		Pile	10 m		Excavation	5.0 m		Σ	Pile			Excavation			Σ	Diff	Dist
Position	Clear	Portion	ε	mm	Portion	ε	mm	mm	Portion	ε	mm	Portion	ε	mm	mm	mm	m
Contig Wall	*0 m*	*0.00*	*0.040%*	*4.0*	*0.0*	*0.150%*	*7.5*	*11.5*	*0.00*	*0.040%*	*4.0*	*0.0*	*0.100%*	*5.0*	*9.0*		
Building Face	19.0 m	Beyond Zone	0.000%	0.0	3.8	0.008%	1.4	1.4	0.95	0.002%	0.2	Beyond Zone	0.000%	0.0	0.2		
																0.2	3
3 m into Bldg	22 m	Beyond Zone	0.000%	0.0	Beyond Zone	0.000%	0	0.0	Beyond Zone	0.000%	0.0	Beyond Zone	0.000%	0.0	0.0		
																0.0	3
6 m into Bldg	25 m	Beyond Zone	0.000%	0.0	Beyond Zone	0.000%	0	0.0	Beyond Zone	0.000%	0.0	Beyond Zone	0.000%	0.0	0.0		
																0.2	6.0

<u>Horizontal Displacement</u>

Building Face to 6 m Horizontal Diff Δ_H 1.4 mm perpendicular to wall
Component of Horiz Diff at angle θ= $\Delta_H\cos\theta$ = 1.4 mm
Av Horizontal ε $\boxed{0.024\%}$

<u>Vertical Displacements</u>

Over a Distance of 6.0 m Vertical Difference Building Face to 3 m into Bldg 0.2 mm
Av slope= ΣDiff/ΣDist = 0.003% Av Diff on 3 m into Bldg 0.1 mm
Differential Settlement Δ= 0.1 mm
Δ/ΣDist= $\boxed{0.002\%}$

08/10/2020

Job No: 14604

38 Frognal Lane NW3 6PP
Ground Movement with 40FL-2 Swimming Pool Basement

C580
Table

2.2	Pile Type:	Contiguous		Depth	10	m	Zone of Influence		
	Horizontal Strain	0.04%	at pile reducing to zero over		1.5		pile lengths =	15	m
	Vertical Strain	0.04%	at pile reducing to zero over		2		pile lengths =	20	m
2.4	Excavation	Propped High Level		Depth	6.1	m			
	Horizontal Strain	0.15%	at pile reducing to zero over		4	excavation depths=		24.4	m
	Vertical Strain	0.10%	at pile reducing to zero over		3.5	excavation depths=		21.35	m

No 40 Frognal Lane Length 9 m Height 10 m L/H= 0.9 No 40 LG Foundation 91.2 m OD
Clearance from basement 23.0 m No 38 Pool Excavation 84.4 m OD
Angle of basement corner to wall θ = 45 ° Depth Difference 6.8 m

			Horizontal Movement										Vertical Movement					
			Pile	10 m		Excavation	6.8 m		Σ	Pile			Excavation			Σ	Diff	Dist
Position	Clear		Portion	ε	mm	Portion	ε	mm	mm	Portion	ε	mm	Portion	ε	mm	mm	mm	m
Contig Wall	*0*	*m*	*0.00*	*0.040%*	*4.0*	*0.0*	*0.150%*	*10.2*	*14.2*	*0.00*	*0.040%*	*4.0*	*0.0*	*0.100%*	*6.8*	*###*		
Building Face	23.0	m	Beyond Zone	0.000%	0.0	3.4	0.023%	5.3	5.3	Beyond Zone	0.000%	0.0	3.4	0.003%	0.2	0.2		
																	0.2	3.5
3.5 m into Bldg	26.5	m	Beyond Zone	0.000%	0.0	3.9	0.004%	1.02	1.0	Beyond Zone	0.000%	0.0	Beyond Zone	0.000%	0.0	0.0		
																	0.0	3.5
7 m into Bldg	30	m	Beyond Zone	0.000%	0.0	Beyond Zone	0.000%	0	0.0	Beyond Zone	0.000%	0.0	Beyond Zone	0.000%	0.0	0.0		
																	0.0	2
9 m into Bldg	32	m	Beyond Zone	0.000%	0.0	Beyond Zone	0.000%	0	0.0	Beyond Zone	0.000%	0.0	Beyond Zone	0.000%	0.0	0.0		
																	0.2	9.0

Horizontal Displacement

Building Face to 9 m Horizontal Diff Δ_H 5.3 mm perpendicular to wall

Component of Horiz Diff at angle θ= $\Delta_H\cos\theta$ = 3.8 mm

Av Horizontal ε 0.042%

Vertical Displacements

Over a Distance of 9.0 m Vertical Difference Building Face to 3.5 m into Bldg 0.2 mm

Av slope= ΣDiff/ΣDist = 0.003% Av Diff on 3.5 m into Bldg 0.1 mm

Differential Settlement Δ= 0.1 mm

Δ/ΣDist= 0.002%

Appendix 5: Structural Engineer's Statement and Calculations

As a rebuild, the house will be constructed in a sensible and orthodox manner from the bottom upwards. The leisure suite will have columns at around 5m centres, both ways, to support the ground floor slab and superstructure. These basement columns will be supported on piles within the basement box.

The basement will require the construction of a contiguous piled perimeter wall with an inner box of waterproof concrete.

The ground movement analysis assumes the basement walls are held stiff. This will be achieved during construction by wailer and bracing. In the permanent solution the walls will have capping beams and the lid to the basement.

As orthodox construction, there are no unusual features that require preliminary design calculations.