Milvum Engineering Services Ltd

The Milvum Group Ltd.

71-75 Shelton Street

London WC2H 9JQ

t: +44 7472 611560

e: contact@milvumgroup.com

www.milvumgroup.com

BASEMENT IMPACT ASSESSMENT

32 CREDITON HILL
LONDON, NW6 1HP

Ref:	MES/2110/CA002
Rev:	02
Date:	November 2021
Prepared:	Heather Shaw BSc MSc DIC Giulia Forlati MEng PhD Chris Emm MEng
Reviewed:	Phillip Lewis BSc MSc CGeol FGS Corrado Candian MEng CEng MICE

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1.0 Non-Technical Summary

At the request of Connect Architects, on behalf of Arto and Lauren Thurlin, a Basement Impact Assessment (BIA) has been carried out at 32 Crediton Hill, London NW6 1HP in support of a planning application for a proposed new basement development to an existing three-storey semi-detached house. The proposed basement is to share the Party Wall with the existing basement to 34 Crediton Hill. Basement retaining walls will be formed using underpinning techniques.

The assessments have been undertaken by appropriately qualified professionals, including a Chartered Hydrogeologist (CGeol FGS) and Chartered Civil Engineer (CEng MICE).

The British Geological Survey (BGS) map of the area indicates that the site is underlain by the London Clay Formation. The London Clay formation typically comprises firm to stiff clay of medium to high strength and is a suitable bearing stratum for the proposed development's foundations, confirmed by the site investigation.

The London Clay has potential to shrink and swell with moisture variation, which may cause movement and damage to structures bearing upon it. The risk of movement and damage to this development due to moisture variation is negligible, considering the absence of trees or mature vegetation within close proximity of the proposed basement development, the absence of desiccated soils and the proposed depth of the basement.

The London Clay is designated Unproductive Strata. There is a very low risk of groundwater flooding or potential for impacting the wider hydrogeological environment. The site investigation indicates perched water within Made Ground which will require groundwater control methods during construction works to ensure stability.

The site and the adjacent properties have not been impacted by flooding. The SuDS proposals are to attenuate surface water discharge flow off-site, in accordance with best practice. There is a very low risk of flooding to the proposed development and the development will not impact on the wider hydrological environment.

There will be no impact to slopes due to the proposed development. The main site is level and is not situated in a wider hillside environment of slopes of 7° or more. At the rear of the site there is change in level downward to the adjacent cricket field / tennis courts, which will not be impacted by the proposed basement development.

Ground movements caused by the excavation and construction of the proposed development will be minimal. Damage impact to adjacent structures is assessed to be a maximum of Very Slight (Category 1 in accordance with the Burland Scale) with impact to the highway and underlying utilities assessed to be negligible.

It is recommended that structural movement monitoring is undertaken and mitigation actions implemented if movement trends indicate structural tolerances could be exceeded.

The BIA demonstrates that the proposed development will not cause advserse impacts relating to land stability, hydrogeology and surface water flow, and is at very low risk of flooding.

2.0 Introduction

At the request of Connect Architects, on behalf of Arto and Lauren Thurlin, the following assessments have been been carried out at 32 Crediton Hill, London NW6 1HP (the site) in support of a planning application for a proposed new basement development to an existing three-storey semi-detached house:

- a Desk Study;
- Screening and Scoping;
- a Site Investigation;
- a Generic Quantitative Risk Assessment (GQRA) for land contamination;
- a Ground Movement Assessment (GMA);
- a Flood Risk Assessment (FRA);
- a Drainage Strategy;
- and a Basement Impact Assessment (BIA).

The proposed basement is to share the Party Wall with the existing basement to 34 Crediton Hill. Basement retaining walls will be formed using underpinning techniques, cast in a traditional hit and miss sequence.

2.1 Purpose and Methodology of Assessment

The purpose of this assessment is to consider the impacts of the proposed basements on the local hydrological, geological and hydrogeological environments, including potential impacts on neighbouring properties and the wider area.

The information contained within this BIA has been produced specifically to meet the requirements set out by Camden Planning Guidance - Basements (CPG, January 2021) and the Local Plan 2017: Policy A5 Basements in order to assist the London Borough (LB) of Camden with their decision-making process.

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

- Desk Study;
- Screening;
- Scoping;
- Site Investigation and additional assessments identified during Scoping;
- Impact Assessment.

2.2 Authors

The assessment has been reviewed and approved by Chartered Civil Engineer Corrado Candian, MEng CEng MICE and Chartered Hydrogeologist Philip Lewis, BSc CGeol FGS, who both have more than 20 years' relevant experience of design and assessment of residential and commercial developments including basements.

The Supervising Engineer for the scheme is Davies Maguire, specifically Jessica Davies CEng MICE and Gareth Davies CEng MIStuctE, who have reviewed the relevant geo-structural information and provided confirmation of the suitability and buildability of the scheme, within the guidelines provided by LB Camden, as presented in their Construction Method Statement (CMS).

2.3 Sources of Information

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

- LB Camden Pre-Application Enquiry Response (2021/2252/PRE), 12 August 2021;
- Site walkover (13th and 17th September 2021).
- Ordnance Survey Mapping;
- British Geological Survey, Geology of Britain Viewer (online);
- Groundsure Mapping Report (ref GS-8177403), Historical Mapping Data;
- Groundsure Enviro + Geo Insights Report (ref GS-8177404), Geology and Subsurface Structure (Infrastructure and Utilities) Data;
- Connect Architecture Drawings of Existing and Proposed Development, October 2021;
- Construction Method Statement (DMAG-2164-CMS-P01), 27 October 2021;
- Thames Water Asset Location Search;
- Thames Water Sewer Flooding Enquiry Response, 17 September 2021;
- LB Camden Planning Records for 34 Crediton Hill;
- LB Camden, Planning Guidance: Basements, January 2021;
- LB Camden, The Local Plan 2017: Policy A5 Basements;
- LB Camden, Strategic Flood Risk Assessment (produced by URS), 2014;
- Fortune Green and West Hampstead Neighbourhood Plan, September 2015;
- Barton, The Lost Rivers of London, 1992.
- LB Camden, Camden Geological, Hydrogeological and Hydrological Study - Guidance for Subterranean Development (produced by Arup), 2010;
- CIRIA, C760 Embedded retaining walls - Guidance for Economic Design, 2017;
- Tomlinson, M.J. (2001) Foundation Design and Construction;
- ASUC, Guidelines for Safe and Efficient Basement Construction Directly Below or Near to Existing Structures, 2nd Edition, 2016;

2.2 Existing and Proposed Development

The site location and recent aerial photograph are presented in Figures 1 and 2, Appendix 1 and Appendix 3. Existing and proposed development plans are presented in Appendix 2.

The Application site fronts Crediton Hill, which forms the southwestern site boundary, and comprises a 3 storey semi-detached residential property with associated driveway and garden areas. The site occupies an area of 0.04 hectares and is roughly rectangular. Survey data indicates that the site is largely on relatively flat ground at an elevation of 63.0m OD. The far end of the rear garden slopes down to the rear boundary with the adjacent tennis club and cricket field at approximately 7 to 10°.

Across the wider area of Crediton Hill and adjoining streets, the slopes are less than 7°. This is confirmed by LB Camden mapping data (Appendix 3, Figure 7) and OS data which indicates a slope of <3° (a gradient of approximately 1:20) north to south along Crediton Hill.

No mature vegetation is present at the front of the site, which is largely paved over with small shrubs present in limited border areas. A pedestrian access side passage runs from the street to the rear garden, between 32 and 30 Crediton Hill, with concrete surfacing. The house is typically >5.0m from the footway (>7.5m from the highway), with the ground floor bay window at the southeastern edge of the house being 4.6m from the footway, 7.0m from the highway. The rear garden comprises a paved patio area extending approximately 5.0m from the house with a lawn beyond extending a further 10.0m approximately. Low level shrubs and hedges run along the borders, which are fenced to both sides.

Beyond the lawn, the garden continues a further 12.0m to 15.0m (due to the shape of the rear boundary, which extends further eastwards at the southern edge) and is overgrown with immature bushes. The ground slopes from the generally level ground of the lawn / house areas (at approximately 63.0m OD) down to the rear boundary at an angle of 7 to 10° (to approximately 61.0m OD). Several mature trees are present on the eastern boundary, believed to be Ash, Oak and Beech species (species have not been identified by an arboriculturist).

To the north and south the immediate neighbours are residential buildings of three storeys. Cumberland Lawn Tennis Club and a cricket field border the site to the east and Crediton Hill and further two and three storey residential buildings are located to the west.

The proposed development comprises the construction of a single storey basement beneath the full footprint of the existing house which is to share a Party Wall with the basement to 34 Crediton Hill.

The basement will be formed at approximately 3.50m below ground level (bgl) by reinforced concrete walls and slabs within the existing walls which extend in excess of 3.50m bgl and bear on corbelled brick footings. Where necessary, underpinning of the existing building's foundations will be undertaken.

The proposed structural arrangements are described in detail in the Construction Method Statement (CMS). In summary, within the existing walls (underpinned where necessary), basement liner walls will be cast and stiffly propped by the basement slab and ground floor slab in the permanent condition. The temporary works methodology also includes stiff propping of the retaining walls to ensure ground movements are limited to within the minimum practicable. The development will be founded upon thickened edges to the basement wall underpin stem bases, acting as strip foundations, with the basement slab being suspended over heave protection. Where necessary, underpinned excavations will continue below the proposed stem bases formation level until a suitable bearing capacity is identified in the underlying natural London Clay, with mass concrete fill being placed.

The existing trees will be retained and are >20.0m to 25.0m approximately from the proposed basement.

Figure 1: Site Location Plan

Figure 2: Aerial Photograph of the Application Site and Surrounding Area

3.0 Desk Study

The desk study has been researched with reference to the Groundsure Enviro + Geo Insight Report and historical mapping, presented in Appendix 3, in addition to other data sources as referenced.

3.1 Site History

The historical mapping indicates the site comprised a pond with a small island associated with Westend Hall until it was developed in its current form from at least 1915. The surrounding area was also predominantly open undeveloped land with several large residential properties to the southwest until the development of the area to include the current residential properties with tennis and cricket grounds (from approximately 1896) to the east.

A railway line has been present 250m south of the site since at least 1866 (still present today). A mound / hill feature associated with Treherne House was located 70m south of the site from at least 1866 until the area was levelled as part of the development of the present residential properties by 1915. Mapping indicates that this was a garden feature with a path running around the hill to the ‘summit’.

West End Hall with an associated pump was located 100m west of the site from 1870-71 along with Hampstead Iron Foundry marked on the 1896 map 250m west of the site. Both features were subsequently replaced by residential properties by 1915.

An Electric Lighting Station was located 250m southeast of the site from 1896 which was subsequently marked as an Electricity Depot by the 1950s and an electrical substation by the 1990s. A Depot with railway sidings was located 160m southeast of the site from 1915, subsequently marked as a Corporation Yard in the 1950s prior to being redeveloped into residential properties by the 1980s.

Electricity substations were located 180m north and 200m south from the 1970s until at least the 1990s. A garage was located 230m southwest of the site from at least the 1950s until the 1970s when it was marked as a Depot. This has subsequently been redeveloped into a commercial property.

No historical tanks are reported on site. Industrial processes are not indicated historically within close proximity of the site. The historical potentially contaminative land uses within the vicinity (250m) relate to the presence of the ‘mound’, Electricity Works, Depot and railway lines.

As indicated in the historical mapping, and by LB Camden in their Pre-Application Enquiry Response, a former pond was present on site, which has been backfilled for at least 100 years. Noting borehole and site investigation records from the adjacent 34 Crediton Hill planning application for the previously constructed basement, fill materials (Made Ground) can be anticipated to approximately 3.00m bgl with potential to be locally contaminated.

3.2 Geology

The British Geological Survey (BGS) map indicates that the site is underlain by the London Clay Formation (see Figure 3). A general stratigraphy of the London Basin is presented in Table 1.

Made Ground would normally be expected above the naturally occurring strata related to the historic development on site, and in this case can be anticipated to approximately 3.00m bgl as discussed in Section 3.1. Where present, Made Ground is expected to exhibit a certain degree of heterogeneity and the nature of the material can be expected to vary substantially in both composition and thickness over short distances.

The London Clay Formation is typically a firm to stiff, high plasticity silty clay, becoming very stiff with depth. Where encountered near surface and in proximity to vegetation, consideration of desiccation and potential for shrink swell movements to impact shallow foundations is required.

<table>
<tr><th>Period</th><th colspan="2">Series</th><th colspan="2">Deposits</th></tr>
<tr><td rowspan="4">Quaternary</td><td colspan="2" rowspan="2">Holocene</td><td colspan="2">Made Ground</td></tr>
<tr><td colspan="2">Alluvium</td></tr>
<tr><td colspan="2" rowspan="2">Pleistocene</td><td colspan="2">Langley Silt (Brickearth)</td></tr>
<tr><td colspan="2">River Terrace Deposits</td></tr>
<tr><td rowspan="11">Palaeogene</td><td rowspan="7">Eocene</td><td rowspan="3">Thames Group</td><td>London Clay Formation</td><td>Sub-Divisions A - D</td></tr>
<tr><td rowspan="2">Harwich Formation</td><td>Swanscombe Member</td></tr>
<tr><td>Oldhaven Member</td></tr>
<tr><td rowspan="6">Lambeth Group</td><td>Woolwich Formation</td><td>Upper Shelley Beds</td></tr>
<tr><td>Reading Formation</td><td>Upper Mottled Beds</td></tr>
<tr><td rowspan="2">Woolwich Formation</td><td>Laminated Beds</td></tr>
<tr><td>Lower Shelley Beds</td></tr>
<tr><td rowspan="4">Palaeocene</td><td>Reading Formation</td><td>Lower Mottled Beds</td></tr>
<tr><td colspan="2">Upnor Formation</td></tr>
<tr><td rowspan="2">Thanet Sand Formation</td><td colspan="2">Thanet Sand</td></tr>
<tr><td colspan="2">Bullhead Beds</td></tr>
<tr><td rowspan="3">Cretaceous</td><td rowspan="3">White Chalk Sub-Group</td><td rowspan="3">Seaford Chalk Formation</td><td colspan="2">Haven Brow Beds</td></tr>
<tr><td colspan="2">Cuckmere Beds</td></tr>
<tr><td colspan="2">Bell Tout Beds</td></tr>
</table>

Table 1: General Stratigraphy of the London Basin

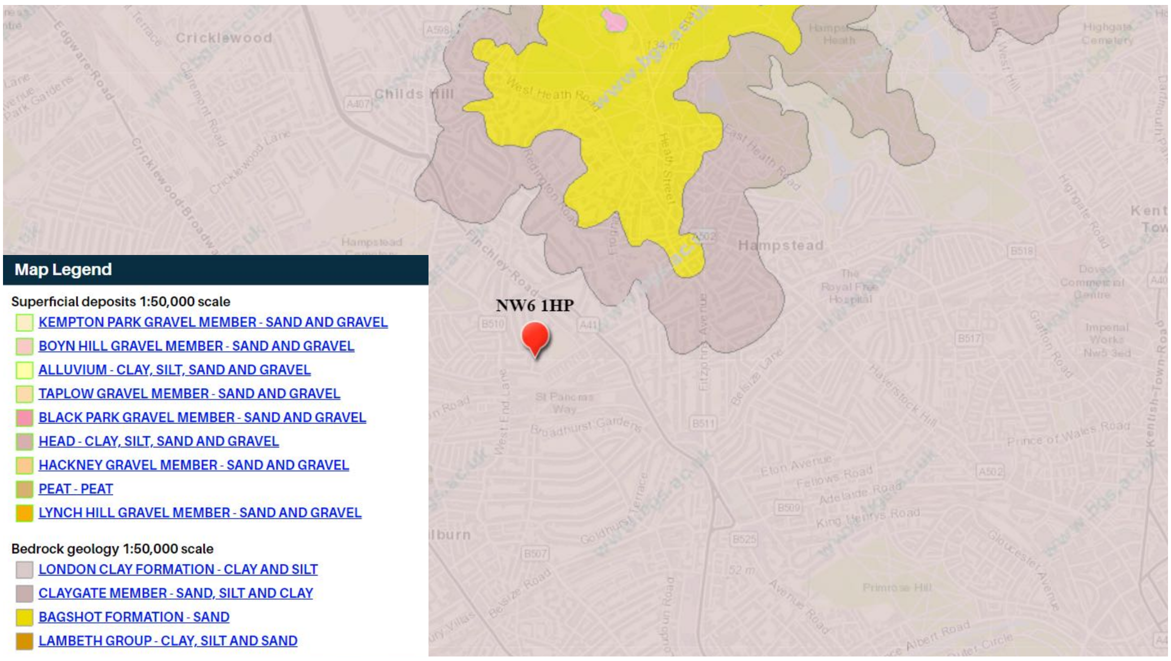

Figure 3: Geological Map of the Site Area (BGS Viewer)

3.3 Hydrogeology

The Environment Agency (EA) Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) and also their role in supporting surface water flows and wetland ecosystems:

- Principal Aquifers – layers that have a high permeability and are likely to support water supply and / or river base flow on a strategic scale.

- Secondary Aquifer (A) - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

- Unproductive Strata – predominantly impermeable or low permeability layers that have negligible significance for water supply or river base flow.

The aquifer designation beneath the site for the London Clay is Unproductive Strata. The London Clay is not considered likely to be vulnerable to pollutants or capable of supporting the migration of pollutants on or off site, due to its very low permeability.

LB Camden data (Appendix 3, Figure 12) indicates the site is not within a groundwater source protection zone.

3.4 Hydrology

With reference to Barton's (1992) The Lost Rivers of London, the site is approximately within 300m of two tributaries of the lost River Westbourne (Appendix 3, Figure 13). The easterly tributary, which is indicated to be the closest, is a culverted waterway, no closer than 150m to the east and south of the site. The westerly tributary is indicated as being >250m to the west of the site. Neither of these tributaries will have an impact on the site or the adjacent properties as a result of constructing the proposed development.

There are no current surface water features within 250m of the site. The former pond on the site has been backfilled for in excess of 100 years. The source for the pond is unknown, and may have been artificially filled as a feature of the gardens of the former West End Hall, or may have drained surface water run-off from upslope, to the north, prior to the development of the area and the introduction of surface water drainage and combined sewer along Crediton Hill.

The site is not within the catchment of the Hampstead Heath Pond Chain, which is more than 1km away to the east.

The site surface area immediately to the front and rear of the existing house is currently almost 100% of hardstanding, and therefore infiltration to ground will be limited to cracks / gaps in hard surfacing and leakage from drains, with the remaining rainfall discharged to the local sewer network. The proposed basement beneath the house does not change the impermeable site area.

The rear garden beyond the patio area is considered to be permeable.

The site is within a Critical Drainage Area (Group 3_010) but not within a Local Flood Risk Zone.

The following risk of flooding is reported (detailed in Section 11 and Appendix 3) for the proposed development area:

- Very low risk (<1 in 1,000 annual probability) – rivers and seas.
- Very low risk (<1 in 1,000 annual probability) – surface water.
- Very low risk (<1 in 1,000 annual probability) - reservoirs.
- Negligible (no shallow aquifer) – groundwater.
- Negligible (no recorded instances within 100m) – sewer surcharging.

A Flood Risk Assessment (FRA) and Drainage Strategy is provided in Section 11.

The site is within the London Management Catchment draining to the Tidal River Thames which is protected by The Water Framework Directive, an EU-led framework for the protection of inland surface waters, estuaries, coastal waters and groundwater through river basin-level management planning.

3.5 Utilities and Underground Infrastructure

As indicated in the search results presented in Appendix 3, there are no reported tunnels or utility infrastructure beneath the site. The standard utilities are present within Crediton Hill and the adjacent residential properties (e.g. mains water, foul and surface water sewers, gas, electricity, telecoms etc). Future development should carefully consider the route of existing utility connections across the site.

3.6 Geotechnical Risk / Unexploded Ordnance Risk

No risks relating to dissolution of the ground, slopes, historic mining, or worked ground have been identified from the Desk Study references. The walkover and topographic data indicate a slope approximately 7 to 10° remote from the proposed basement which is currently stable with no signs of distress.

Shrink / swell or subsidence movements to buildings placed on shallow foundations within cohesive deposits (ie London Clay) may occur. Shrink / swell risk to the proposed basement development is considered to be very low due to the depth of the proposed foundations.

An extract from WW2 Bomb Damage records (Appendix 3, Figure 7) has identified the potential risk of unexploded ordnance. The extract indicates that the neighbouring properties at 34 and 40 Crediton Hill sustained ‘general blast damage but not structural damage’. 36 and 38 Crediton Hill sustained ‘damage beyond repair’. A UXO risk map for London, provided by Zetica (Appendix 3), indicates the area is at generally medium to high risk from UXO. It is recommended that a detailed risk assessment and / or appropriate UXO risk mitigation is undertaken prior to intrusive works (e.g. site investigation and subsequent basement construction).

3.7 Environmental Database Search

A complete search of environmental registers is presented in Appendix 3. A summary of information is presented in Table 2.

Environmental Search	On-Site	Within 50m	Within 250m
Potentially Contaminative Land Uses – historical industrial sites including tanks, energy features, fuel sites, garages, infilled land	0	0	33
Environmental Permits, Incidents and Registers – including discharge consents, radioactive substance authorisations, hazardous substance consents and enforcements, site determined as contaminated land	0	0	3
Landfill and Waste Sites	0	0	6
Current Land Uses – including industrial sites, fuel sites, underground electrical cables, gas transmission pipelines	0	0	10
Designated Environmentally Sensitive Sites*	1	0	0
Mining, Quarrying** (Surface ground workings associated with the historical pond on site which was subsequently infilled prior to the current development)	1	0	0

Table 2: Environmental Database Search Summary

*SSSI Impact Risk Zone - Developed to allow rapid initial assessment of the potential risks to SSSIs posed by development proposals. They define zones around each SSSI which reflect the particular sensitivities of the features for which it is notified and indicate the types of development proposal which could potentially have adverse impacts. 32 Crediton Hill is within a SSSI Impact Risk Zone in regard to development of major infrastructure (including transportation, mineral extraction, energy generation and agriculture) but not in relation to residential development.

** Mining, Quarrying – Search results related to infilling of the historic pond feature. There have been no recorded mining activities on site.

Within 250m from the site, historical contaminative land uses relate to railways sidings, electrical substations and garages. Electrical substations, railways, tanks and garages are also located at distance greater than 250m.

3.8 Environmental Sensitivity

Overall, the site setting is considered to be of **low** environmental sensitivity, for the following reasons:

- The site is located in an urban, predominantly residential area;
- The final end use of the site will be residential;
- The site is underlain by Unproductive Strata;
- There are no known surface water features in proximity to the site boundary.

3.9 Preliminary Conceptual Site Model

The information presented within chapters 2 and 3 of this report has been used to complete a Preliminary Conceptual Site Model (PCSM) that details the potential contaminant sources, pathways and receptors, with regard to:

- Environment Agency/DEFRA; Priority Contaminants for the Assessment of Land (CLR8).

Whilst it is noted that this document has been withdrawn it is still considered pertinent to identifying potential sources of contamination. The PCSM is presented in Table 3.

Potential Contaminant Sources	On-site	• Infill material associated with historic pond on site. • Potential WW2 unexploded ordnance. • Made Ground associated with historic development.
	Off-site	• Made Ground associated with historic development. • Potential WW2 unexploded ordnance. • Unknown 'mound' 50m south (subsequently removed during development of residential properties), Electricity Works, Depot, railway lines and garages.
Associated Contaminant	On-site	• Heavy metals and inorganic contaminants including Asbestos Containing Materials (ACM). • Organic contaminants including hydrocarbons (e.g. diesel, petroleum and PAHs). • Possible generation of bulk ground gases & volatile vapours.
	Off-site	• Heavy metals and inorganic contaminants including Asbestos Containing Materials (ACM). • Organic contaminants including hydrocarbons (e.g. diesel, petroleum and PAHs). • Possible generation of bulk ground gases & volatile vapours.
Receptors		• Future site users. • Construction workers. • Buildings.
Pathways to Receptors		• Site underlain by low permeability London Clay. Migration via groundwater or migration of ground gasses is unlikely.

Table 3: Preliminary Conceptual Site Model

Potential for off-site sources of contamination (e.g. fill materials placed within surrounding developments) within soils and groundwater have been identified but with low potential for contaminated groundwater / ground gas / volatile vapours to migrate onto site that could impact future site users, construction and maintenance workers and buildings.

Potential for on-site sources of contamination (e.g. materials related to the infilled pond on site) within soils have been identified but with low potential to impact future site users, as the proposed basement will result in the majority of shallow soils being excavated and removed from site, and the permanent concrete basement structure will sever any pathways to receptors. Construction workers should be vigilant for the presence of contamination during development and follow best practice if encountered to mitigate any on-going risks and liabilities, as applicable.

3.10 Preliminary Risk Assessment (PRA)

The Preliminary Risk Assessment (PRA) considers the information provided in the previous sections, including the PCSM. The PRA and risk ratings assigned in Table 4 are based on the qualitative risk assessment matrices presented in CIRIA C552 which are reproduced in Appendix 8.

The likelihood of pollutant linkages being present between the potential contaminant sources, pathways and receptors identified in the PCSM are outlined in Table 4.

Based on the results of the PRA:

- The site is considered to be of **low** environmental sensitivity.
- The potential **low to moderate** risks identified are associated with bulk ground gases and volatile vapours from historic infill materials on site.
- The potential for the site to be designated as contaminated land (as defined in Part 2A of the Environmental Protection Act) is considered to be **low**. However, this is on the assumption that any planning conditions related to potential land contamination issues are dealt with to the satisfaction of the Local Authority as part of the development.

Further investigation and assessment of the site in relation to land contamination is considered necessary (see Sections 6, 8, 9 and 10).

Pathway Linkage	Likelihood of Pollutant Linkage	Consequences	Risk Rating	Reasoning
Future Site Users (Direct exposure pathway)				
Ingestion / Dermal Contact / Inhalation (Site Users)	Unlikely	Medium	Low	There will be hardstanding across the proposed development areas; Made Ground will be excavated and removed from site beneath the proposed basement area and as part of site enabling works, as required (e.g. from installation of drainage scheme etc); clean cover may be introduced to landscaped areas, if required. Maintenance and construction workers will adopt appropriate management procedures to mitigate potential risks. Workers will wear proper PPE which will avoid contact and inhalation of any contaminant.
Ingestion / Dermal Contact / Inhalation (Maintenance and Construction Workers)	Low	Medium	Low	

Pathway Linkage	Likelihood of Pollutant Linkage	Consequences	Risk Rating	Reasoning
Future Site Users (Indirect exposure pathway)				
Enclosed space accumulation of ground gas.	Unlikely	Severe	Moderate	Potential on and off-site sources of ground gas and volatile vapours have been identified associated with previous land uses. Migration should be precluded by low permeability London Clay, RC basement floor slab and structure, and appropriate gas impermeable membrane (if required).
Outdoor volatile vapour exposure	N/A	N/A	N/A	N/A
Ingress into potable water supply pipes	Low	Mild	Very Low	It is considered unlikely that upgraded water pipe material will be required. However, confirmation with the statutory undertaker is recommended.
Risks to Buildings via accumulation of ground gas and volatile vapours in enclosed spaces and sub-floor voids.	Unlikely	Severe	Moderate	Potential on and off-site sources of ground gas and volatile vapours have been identified associated with previous land uses. Migration should be precluded by low permeability London Clay, RC basement floor slab and structure, and appropriate gas impermeable membrane (if required).
Water Environment				
Contaminant migration on to neighbouring land	Unlikely	Mild	Very Low	It is considered unlikely that sources of contamination are present beneath the site at concentrations that are likely to impact neighbouring land. The site is underlain by London Clay, a very low permeability soil that should prevent migration of contaminants.
Contaminant migration from neighbouring land	Unlikely	Medium	Low	

Pathway Linkage	Likelihood of Pollutant Linkage	Consequences	Risk Rating	Reasoning
Contamination of groundwater	Unlikely	Mild	Very Low	It is considered unlikely that sources of contamination are present beneath the site at concentrations that are likely to impact groundwater. The site is underlain by London Clay, a very low permeability soil that should prevent migration of contaminants.
Contamination of surface water	Unlikely	Mild	Very Low	It is possible that during any construction phase there could be some limited run-off from stockpiles / earthworks. However, it is considered unlikely that such run-off would be contaminated, and control measures would be adopted. There are no immediate surface water features in the vicinity of the site.
Overall Risk Rating			**Low / Moderate**	

Table 4: Potential Pollutant Linkages

4.0 Screening

A screening process has been undertaken in accordance with the most recent guidance (CPG Basements, 2021) and the findings are described below.

4.1 Subterranean (Groundwater) Flow

Question	Response	Details
1a. Is the site located directly above an aquifer?	No	The site is located over the London Clay Formation, designated as Unproductive Strata. See 3.3 and Appendix 3.
1b. Will the proposed basement extend beneath the water table surface?	No	A continuous groundwater body is not considered to be present beneath the site. However, perched water is likely to be present within any Made Ground overlying the London Clay. See 3.3, 3.4 and Appendix 3.
2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line?	No	There are no current watercourses, wells or spring lines within 100m. See 3.4 and Appendix 3.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No	Catchment of the pond chains are >1km to the east. See 3.4.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No	The proposed basement beneath the house will not result in a change to impermeable site area.
5. As part of site drainage, will more surface water (e.g. rainfall and run-off) than a present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No	There is no increase in impermeable site area. Attenuated drainage will be implemented. See 11.
6. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond or spring line?	No	No local ponds within the surrounding area to the site. See Appendix 3.

4.2 Slope Stability

Question	Response	Details
1. Does the existing site include slopes, natural or man-made greater than 7° (approximately 1 in 8)?	Yes	There are slopes greater than 7° at the rear boundary, remote from the proposed basement.
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7° (approximately 1 in 8)?	No	See 2.2 and Appendix 2.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7° (approximately 1 in 8)?	No	There are no slopes greater than 7° adjacent to the site.
4. Is the site within a wider hillside setting in which the general slope is greater than 7° (approximately1 in 8)?	No	The wider hillside setting is typically 3° and <7°. See 2.2.
5. Is the London Clay the shallowest strata at the site?	Yes	The London Clay Formation is the shallowest natural strata. Made Ground is anticipated above the London Clay. See 3.1, 3.2 and Appendix 3.
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 2.2 and Appendix 2.
7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site?	No	No evidence on site and to immediately adjacent properties.
8. Is the site within 100m of a watercourse or a potential spring line?	No	There are no current watercourses, wells or spring lines within 100m. See 3.4 and Appendix 3.
9. Is the site within an area of previously worked ground?	Yes	There was a pond on site which was infilled prior to the development of the current property. See 3.1 and Appendix 3.
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?	Unknown	The site is located on the London Clay Formation, designated Unproductive Strata. However, groundwater control measures during construction may be required if perched water is present. See 3.3, 3.4 and Appendix 3.
11. Is the site within 5m of a highway or pedestrian right of way?	Yes	The proposed basement typically >5.0m way; however, approximately 4.6m from footway at its closest point. See 2.2.

12. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes	The adjacent property at No. 34 is known to have a basement. The foundations of No. 30 are assumed to be shallow. See 2.2.
13. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	Network Rail and Transport for London have been consulted. Utility records have been consulted. No tunnels within 250m. No utilities within the site boundary apart from domestic connections to the property. See Appendix 3.

4.3 Surface Water and Flooding

Question	Response	Details
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No	See 3.4 and Appendix 3.
2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	No	Proposed SuDS will provide betterment (attenuated discharge). See 11.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No	See 2.2 and Appendix 2.
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	Proposed SuDS will provide betterment (attenuated discharge). See 11.
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	There will be no changes to the quality of the surface water discharged.
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	A review of Environment Agency Flood Risk Map indicates the site is at very low risk of flooding from all sources, including surcharged sewers, surface water flow (pluvial), groundwater and rivers. See 3.4 and Appendix 3.

4.4 Non-Technical Summary of Screening Process

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

- Does the existing site include slopes, natural or man-made greater than 7° (approximately 1 in 8)?
- Is the London Clay the shallowest strata at the site?
- Is the site within an area of previously worked ground?
- 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?
- Is the site within 5m of a highway or pedestrian right of way?
- Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?

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

5.0 Scoping

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

5.1 The Change in the Proportion of Hard Surfaced / Paved (Impermeable) Areas

The proposed basement beneath the house will not result in any change in impermeable site area.

Whilst mitigation measures are not required, in accordance with best practice, considering the site location within a Critical Drainage Area, an attenuated drainage strategy is presented in Section 11.

5.2 Slope Stability

At the rear of the site, the ground slopes from the generally level front garden / house / rear lawn areas (at approximately 63.0mOD) down to the rear boundary at an angle of 7 to 10° (to approximately 61.0mOD). The existing slope is not observed to be distressed. The proposed basement will be constructed in excess of 15.0m to 20.0m laterally from the slope which is considered to be sufficiently remote to be beyond the zone of influence of any ground movements generated by the construction works. Further assessment of slope stability is therefore not necessary.

5.3 The London Clay as Bearing Strata, Shrink/ Swell Movements and Subsidence

The London Clay is typically firm to stiff and should provide sufficient bearing capacity for the proposed development. The volume change potential of the London Clay could result in shrink / swell movements impacting foundations, although this is unlikely considering the depth of the proposed basement.

A site investigation is required with appropriate geotechnical assessment to ensure a suitable foundation design, as presented in Sections 4 and 5.

5.4 The Presence of Worked Ground

The former pond on site has been infilled for in excess of 100 years. Foundations for the proposed development should be taken through Made Ground soils and into natural soils of a suitable bearing capacity to avoid potential for excessive settlements or differential settlements.

A site investigation is required with appropriate geotechnical assessment to ensure a suitable foundation design, as presented in Sections 4 and 5.

5.5 Groundwater / Hydrogeology

Considering the hydrogeological properties of the London Clay (i.e. a very low permeability formation, designated as Unproductive Strata) the presence of a continuous groundwater body is discounted. There will be no impacts to groundwater flow or the wider hydrogeological environment as a result of the proposed basement. However, there is potential for perched water to be present within the Made Ground or local seepage within the London Clay which may require groundwater control to be employed during construction to ensure stability is maintained.

A site investigation is required to determine the presence of perched water or groundwater, as presented in Section 4.

5.6 Proximity to the Public Highway

The public footway / highway is within 5.0m of the proposed development. A ground movement assessment will be required to assess potential impacts, as presented in Section 12.

5.7 Differential Depth of Foundations Relative to Neighbouring Properties

A Party Wall is shared with 34 Crediton Hill and 30 Crediton Hill is within 2.0m from the proposed basement beneath the house. 34 Crediton Hill has a basement to the same depth as the proposed basement; the foundation depths of 30 Crediton Hill are unknown but to be conservative it has been assumed they are conventional, shallow foundations at <1.00m bgl and that the basement construction will result in a differential depth of foundations between the properties.

A ground movement assessment will be required to assess potential impacts, as presented in Section 12.0.

6.0 Site Investigation

6.1 Introduction

A ground investigation was undertaken on 17th September 2021, comprising 3no window sampling (WSs) to a maximum depth of 6.00m below ground level (bgl) and 1no hand trial pit (HP) to a maximum depth of 1.35m bgl. The trial pit was undertaken to observe the existing structure's foundation arrangements.

The exploratory hole location plan is presented in Appendix 1. Exploratory hole logs are presented in Appendix 4.

Prior to undertaking the works, utility service locations were checked and identified by a specialist engineering surveyor by visual inspection with reference to available service plans, by manual lifting and inspection of utility manhole covers and with appropriate radio detection equipment. All works were supervised by a Specialist UXO Engineer, and a magnetometer survey was undertaken. The presence of potential UXO was not detected.

The window samplings were constructed at 100mm diameter. Insitu testing comprising Standard Penetration Tests (SPTs) were undertaken at 1.00m intervals.

Disturbed samples were generally taken at 0.50m intervals and changes in strata to the base of each exploratory hole. A selection of these were tested in the laboratory for: moisture contents and Atterberg Limits, to assess plasticity; and, pH and sulphate testing to assess a suitable design concrete class for foundations.

No groundwater was encountered within the exploratory holes during the site investigation.

Geotechnical laboratory results are presented in Appendix 5.

6.2 Ground Conditions

The ground conditions encountered were generally as anticipated from the Desk Study. No superficial deposits were encountered during the site investigation. Made Ground is underlain by the London Clay Formation. A summary of the encountered ground conditions is presented in Table 5.

Soil descriptions are provided in detail within the exploratory hole logs which are presented in Appendix 4. Interpreted geotechnical parameters are presented in Section 7.

Exp. Hole No.	Top mbgl	Thickness m	Top mbgl	Thickness m	Final Depth mbgl
	Made Ground		London Clay		
WS1	0.00	3.30	3.30	>2.70	6.00
WS2	0.00	4.70	4.70	>1.30	6.00
WS3	0.00	3.05	3.05	>2.95	6.00
HP1	0.00	>1.35	-	-	1.35

Table 5: Summary of Ground Conditions Encountered

Made Ground

A thick layer of Made Ground was encountered within the exploratory holes, in excess of 3.00m in thickness across the site. The maximum thickness of Made Ground recorded is 4.70m, in WS2.

The Made Ground typically comprises soft to firm gravelly clay with some silt and sand, with fragments of brick, coal and slate, and some ash. Between 2.00m and 4.70m bgl some decayed root traces and decaying plant matter were found, indicating reworked natural soil. A thin layer of organic matter was observed at the base of the Made Ground that may represent a relict soil or historic pond sediments.

London Clay Formation

The London Clay was encountered from the base of the Made Ground in all the exploratory holes, proven to >6.00m bgl which was the maximum depth of the boreholes.

The London Clay is characterised as a firm to stiff brown becoming mottled blue grey clay, with some sand partings noted.

Laboratory testing indicates the deposits to be of very high plasticity, with plasticity indices greater than 40.

SPT N values indicate medium to high strength / firm to stiff clays, with typical values ranging from 8 to 15, with stiffness increasing with depth.

6.3 Groundwater

No groundwater was encountered during the site investigation. Three rounds of monitoring were undertaken in September and October 2021, as summarised in Table 6.

Exploratory Hole / Date	22 September 2021	29 September 2021	5 October 2021
WS1	Dry	4.13m bgl / 58.84m OD	1.39m bgl / 61.58m OD
WS2	2.91m bgl / 60.10m OD	2.53m bgl / 60.48m OD	2.40m bgl / 60.61m OD

Table 6: Monitored Water Levels (m bgl / m OD)

The water levels within the standpipes are observed to rise with each monitoring visit. This is likely to represent either very slow seepages of perched water within the Made Ground or discrete groundwater units within partings of the London Clay, or surface water infiltration as a result of recent rain events. It is recommended that further groundwater assessment is undertaken in advance of construction to enable appropriate groundwater control methods to be employed to ensure stability during excavation and construction. This may involve a combination of monitoring and / or rising head tests within the standpipes to assess infiltration rates.

6.4 Existing Building Foundations

Trial Pit HP1 was hand excavated to identify the existing building's foundations. The trial pit followed the wall down to 1.35m bgl (approximately 61.65m OD) but did not reach the footings to the building. Records from the adjoining 34 Crediton Hill basement application indicate the original foundations to the Party Wall are very deep, such that no underpinning of the Party way was required to form the basement (i.e. original footings are at >3.5m bgl, >59.5m OD). It would be assumed that the footings to the rest of the subject property are also very deep, taken into the natural soils. However, for the purposes of preliminary design and assessment purposes, it has been assumed that underpinning will be required.

7.0 Preliminary Geotechnical Assessment

7.1 Geotechnical Parameters

A ground model based on the in-situ and laboratory testing is provided in Table 7. Values indicated are characteristic soil parameters. A reasonably conservative ground profile has been adopted for preliminary assessment purposes.

Stratum	From	To	Thick	γ	C_u	c'	Ø'	E'_v	$E_{u,v}$
	(mbgl)	(mbgl)	(m)	(kN/m^3)	(kPa)	(kPa)	(°)	(MPa)	(MPa)
Made Ground	0.0	3.0 – 4.7	3.0 – 4.7	18	-	-	28	-	-
London Clay	3.0 – 4.7	>6.0	>3.0	20	40 +9z	0	23	$0.8E_{u,v}$	$400C_u$

z = increase in Cu per m depth.

Table 7: Geotechnical Parameters

Preliminary foundation options have been assessed, based on the currently proposed building development.

7.2 Underpinned Retaining Wall, Strip and Pad Foundations

A preliminary assessment of bearing capacity has been undertaken by a number of methods to provide a sensitivity check, in accordance with:

- BS 8004-1986. A factor of safety of 2.5 has been considered.
- BS-EN-1997-1 (Eurocode 7) and National Annex to BS-EN-1997-1 for combinations 1 and 2 of Design Approach 1.

The thickened edges of the underpinned retaining walls will act as strip foundations, to be formed at approximately 3.50m to 4.70m bgl for the basement. The bearing capacity of the London Clay at formation (i.e. >3.00m bgl) is assessed to be a minimum of 100kPa.

In order to control ground movements foundations should be sized appropriately to limit settlements to <8mm. This will ensure impacts to neighbouring properties are within the predicted limits (as further discussed in Section 12.0).

7.3 Design Concrete Class

Seven soil samples were analysed to determine the design concrete class in accordance with BRE Special Digest 1:2005 (Table C2). Samples were tested from within the Made Ground and London Clay. The laboratory results are presented in Appendix 5. The preliminary Design Sulphate Class is DS-2, the preliminary ACEC class is AC-2 and the DC class is DC-2. The soil results are summarised in Table 8.

Parameter	Observed Range	Number of Tests	Characteristic Value
Water Soluble Sulphate (mg/l)	20 to 1,000	7	1,000
pH	7.9 to 8.6	7	8.5

Table 8: Laboratory Test Results (Soils)

8.0 Generic Quantitative Risk Assessment

8.1 Assessment of Soil Analytical Results

Introduction

The development proposals comprise construction of a new single storey basement beneath the footprint of the existing three-storey semi-detached house and includes a ground floor rear extension, a partial first floor extension and the construction of a new outbuilding ancillary to the main house at the end of the garden. On this basis, the most appropriate end use scenario for assessment is considered to be residential (without home grown produce).

This section provides a Generic Quantitative Risk Assessment (GQRA) that considers only the shallow soil horizon. No statistical analysis has been completed and recorded concentrations have been compared directly to 'Suitable 4 Use Levels' (S4ULs) considering a residential (without home grown produce) end use.

The LQM/CIEH 'Suitable 4 Use Levels' (S4ULs) applied have been developed in accordance with developments in UK human health risk assessment since 2009, in particular the additional land uses and exposure assumptions presented in Defra's C4SL guidance. The S4ULs are all based on Health Criteria that represent minimal or tolerable levels of risks to health as described in the Environment Agency's SR2 guidance, ensuring that the resulting assessment criteria are 'suitable for use' under planning.

In addition to the S4ULs the provisional Category 4 Screening Levels (pC4SL) developed by CL:AIRE for DEFRA in response to the new definitions within the Contaminated Land Statutory Guidance (ref. DEFRA, April 2012) have also been considered within the assessment. C4SL are, '*designed to reflect a more pragmatic approach to contaminated land risk assessment (albeit still strongly precautionary)*'.

It should be noted that C4SL have not yet been developed for a comprehensive range of contaminants and as such greater emphasis is placed on the S4ULs in determining potential risks to future site users.

8.2 Risk Assessment

Assessment of Potential Risks to Future Site Users (Soil Contamination)

In total seven samples of the shallow soils (between 0.80m to 3.90m bgl) were collected during the ground investigation. These comprised six samples of Made Ground and one sample of the natural soils (London Clay Formation).

The samples were analysed for a range determinands including, asbestos, heavy metals, petroleum hydrocarbons (including using the criteria working group methodology (TPH CWG) and Polycyclic Aromatic Hydrocarbons (PAH)).

Asbestos Containing Materials (ACM)

Three samples of the Made Ground soils (0.80m to 1.90m bgl) were screened for the presence of Asbestos Containing Materials (ACM). No ACM were detected.

Discussion of Results (Soil Contamination)

Recorded concentrations of contaminants (e.g. heavy metals, petroleum hydrocarbons etc) were generally found to be below relevant criteria considering a residential end use. However, elevated concentrations of Lead and PAH species were recorded in one of the Made Ground soil samples analysed from WS2 (1.80m to 1.90m bgl).

No elevated concentrations were recorded in the samples of natural soils analysed.

Reference to the proposed development plans suggests that over the majority of the development area there will be hard surfacing or buildings which would sever any direct contact pathways to potentially contaminated soils. In addition, a large proportion of the soils will be removed during the basement excavation i.e. the proposed development will mitigate potential risks to future site users.

A section of the existing rear garden will be retained but the results of the chemical analysis suggest that soils in this area do not contain elevated concentration of contaminants and as such it is unlikely that the identified contaminants would pose a risk to future site users. However, it would be prudent to undertake further sampling, testing and assessment of the shallow soils in the rear garden to confirm this.

Maintenance and construction personnel involved in below ground works should be vigilant for potential risks (i.e. latent contamination not encountered during the investigation) and adopt appropriate management procedures.

The results are presented in Appendix 5.

Ground Gas Risk Assessment

A ground gas risk assessment based on three rounds of monitoring (22 September to 5 October 2021) has been undertaken to assess potential risks associated with bulk ground gases (carbon dioxide and methane) and volatile vapours to future site users and buildings.

The assessment has been undertaken in accordance with the CIRIA Report C665, BS8485:2015, NHBC guidance and The VOCs Handbook, as appropriate.

Monitoring results are summarised in Table 9, with a ground gas risk assessment worksheet provided in Appendix 5.

Exploratory Hole	Screened Lithology	Max CH_4 (% v/v)	Max CO_2 (% v/v)	O_2 (% v/v)	Max Flow Rate (l/hr)	Gas Screening Value
WS1	Made Ground & London Clay	1.90	3.90	16.20 – 20.40	0.10	<0.007 (CH_4 1.90E-03, CO_2 3.90E-03)
WS2	Made Ground & London Clay	<0.10	4.30	14.30 – 16.90	0.10	<0.007 (CO_2 4.70E-03)

Table 9: Ground Gas Monitoring Results Summary.

Flow rates of <0.10 l/hr were recorded in all monitoring wells during all rounds of monitoring but for the purposes of the risk assessment have been adjusted to 0.10 l/hr. Review of the monitoring data indicates that monitoring was completed during periods of moderate high to low atmospheric pressure (1019 to 991mbar). In addition, the third round was completed during a period of falling pressure (992 to 991 mbar).

Based on the results of the ground gas monitoring the risks posed by bulk ground gases would be considered to be very low (CIRIA CS1). However, Methane concentrations were found to be elevated (>1% v/v) in monitoring well WS1 during two of the monitoring rounds.

Although the majority of the potential source of the ground gas (infilled pond materials) will be removed from beneath the property to facilitate basement development, a potential off-site source will remain over the wider area where the historic pond feature extended.

On this basis it is recommended that a conservative approach is adopted and a Characteristic Situation 2 (CS2) risk assumed. This would require basic ground gas protection measures to be applied within the design of the proposed new buildings.

Volatile Vapours

Recorded concentrations of volatile vapours were <0.10 to 0.10ppm in all rounds completed. On this basis the potential risks associated with volatile vapours in relation to new buildings and future site users are considered to be very low.

8.3 Conclusions

Generic Quantitative Risk Assessment (GQRA)

The results of the GQRA have indicated that soil contaminant concentrations are generally below relevant assessment criteria considering residential end use.

Elevated concentrations of Lead and PAH have been recorded in one sample of the Made Ground soils but the basement excavation will remove a large proportion of the Made Ground and the inclusion of additional hard surfacing within the development will generally mitigate potential risk to future site users. However, it would be prudent to undertake further sampling, testing and assessment of the shallow soils in the rear garden to confirm this.

Based on the monitoring undertaken, a ground gas risk assessment has been completed and the potential risks from bulk ground gases on future site users and buildings is considered to be consistent with CS2 i.e. low risk. In accordance with current best practice guidance basic ground gas protection measures should be considered within new building design.

8.4 Recommendations

Based on the proposed development and conclusions presented above, the following recommendations are provided:

- It is recommended that basic ground gas protection measures are adopted to mitigate potential risks to future site users and the built environment. The mitigation measures should be designed based on the final development layout.
- Further testing and assessment of the shallow soils in the rear garden should be undertaken to confirm risks to future site users, and to design appropriate mitigation measures to be implemented if required.
- Should any suspected latent areas of contamination be identified during development then it is recommended that works in this area are postponed enabling consultation with an appropriately qualified environmental consultant.
- It is recommended that maintenance and construction workers involved in below ground works adopt safe management procedures including the use of appropriate PPE.

9.0 Preliminary Waste Characterisation

9.1 Introduction

The Landfill (England and Wales) Regulations (2002, as amended), the Hazardous Waste (England and Wales) Regulations (2005, as amended) and the Waste (England and Wales) Regulations (2011) have changed the way in which waste materials have traditionally been managed (i.e. landfill disposal). If materials are to be discarded from site, appropriate characterisation and classification are required prior to disposal, to determine whether a waste should be described as either non-hazardous or hazardous. The process of classification is based around the List of Wastes (England) Regulations in conjunction with the Environment Agency Guidance Document WM3 (edition 1 v.1.1.GB, 2021). Waste Acceptance Criteria (WAC) are often confused as a means of classification when, in actuality, they represent criteria that wastes must satisfy for disposal in target landfill types (i.e. non-hazardous waste may be described as inert if it satisfies the appropriate WAC; however, hazardous waste can never be classified as inert even if it satisfies the WAC for an inert landfill).

Certain categories of waste material are termed 'absolute entries' within the List of Wastes Regulations (2005) and are automatically classified as inert or hazardous e.g. glass packaging and acid tars respectively.

9.2 Source of Potential Wastes

The waste materials on site are considered to comprise the Made Ground soils that occupy the upper 3.00m to 4.70m bgl. In general, this material could be thought of as 'Construction and Demolition Wastes (including Excavated Soil from Contaminated Sites)' and as such soils could be described as inert, non-hazardous or hazardous, dependant on its source and chemical characteristics.

The source of the Made Ground materials appear to comprise a mixture of reworked material considered to have been derived from historical, local construction and demolition, with a significant proportion considered to be associated with the pond infill materials.

9.3 Basic Waste Characterisation

Made Ground

On a purely visual basis, a proportion of the Made Ground would appear to conform with 'soils and stones' excluding topsoil, peat and excluding soil and stones from contaminated sites (European Waste Catalogue Code 17 05 04). However, organic and 'peaty' soils were recorded and where soil and stones are not automatically classified as inert they will always be treated as so called 'mirror entries' of the List of Waste Regulations (European Waste Catalogue Code 17 05 03 mirror hazardous or 17 05 03 mirror non-hazardous). An assessment of the composition of the soil is required to determine the concentrations of potentially dangerous substances that maybe present in the soils to allow the waste to be classified accordingly.

As such, chemical analysis has been completed on samples of Made Ground soils in general accordance with the Environment Agency document Disposal of Waste to Landfill (ref. https://www.gov.uk/guidance/dispose-of-waste-to-landfill, January 2020). The results have been used to aid in basic waste characterisation utilising the information presented within the WM3 document for Hazardous wastes.

In addition, three samples of Made Ground soils were tested for the presence of Asbestos Containing Materials with none detected.

Based on the available laboratory results Made Ground soils could conform with non-hazardous wastes. However, it is recommended that a preliminary waste characterisation is undertaken and confirmed by the receiving facility.

In addition, it is recommended that maintenance and construction workers involved in below ground works are provided with this information so that they can adopt appropriate management procedures to mitigate potential risks.

Natural Ground Deposits

The natural soils (London Clay Formation) are likely to be listed as inert (soils and stones, European Waste Catalogue Code 17 05 04). Again, this will need to be confirmed by the receiving facility.

Given the scarcity of inert landfill cells it may be more appropriate (depending on timescales and feasibility etc) to source an alternative use for the soils (such as fill materials or daily cover) or to dispose to non-hazardous landfill.

9.4 Waste Acceptance Criteria (WAC) Testing

It is recommended that the contractor undertakes WAC testing (and possibly additional chemical analysis) to confirm that Made Ground soils would meet the waste acceptance criteria for stable non-reactive hazardous waste in non-hazardous landfill.

10.0 Updated Conceptual Site Model & Pollutant Linkage Assessment

10.1 Introduction

The desk study (including Preliminary Risk Assessment) information summarised in Section 3.0 of this report has been updated based on the results of the ground investigation, laboratory testing and risk assessment herein and is presented in the following sections.

10.2 Conceptual Site Model (CSM)

Geological & Hydrogeological Model

The ground investigation data indicates that the ground conditions comprise Made Ground overlying the London Clay Formation.

Groundwater was not recorded during the ground investigation works but was recorded at depths of between 1.39m and 4.13m bgl during return monitoring. The recorded water is considered to be representative of perched and discrete groundwater units.

Following development, the site area will comprise no change in hard surfacing, and a large proportion of the rear garden area will be retained and thus there is anticipated to be no change in the proportion of rainfall infiltration and direct recharge of groundwater beneath the site.

Direct recharge of groundwater via rainfall infiltration will also be dependent on the Soil Moisture Deficit (SMD) and rates of Evapotranspiration (EP).

The major variation following development will be removal of the majority of the Made Ground soils beneath the house and proposed outbuilding during basement excavation.

Implication for Migratory Pathways

Conceptually the removal of Made Ground will reduce the potential for leaching of contaminants from the Made Ground and remove the potential source of ground gas. However, the historic pond extended over the wider area and thus potential off-site sources will remain.

10.3 Pollutant Linkage Assessment

Based on the results of the Generic Assessment of the analytical results, ground gas monitoring and the information presented in the Conceptual Site Model above the plausible pollutant linkages have been summarised in Table 10.

Pathway Linkage	Present Not Present	Yes No
Future Site Users (Direct exposure pathway)		
Ingestion/Dermal Contact/Inhalation (Site Users).		**No**
Ingestion/Dermal Contact/Inhalation (Maintenance and Construction Workers).		**Yes**
Elevated concentrations of Lead and PAH were recorded but will be removed during development and within the existing garden area elevated concentrations were not recorded in soils. However, further testing and assessment should be undertaken, and if required appropriate mitigation adopted (e.g. clean cover system in the rear garden). As per best practice construction/maintenance workers should use of appropriate personal protective equipment.		
Future Site Users (Indirect exposure pathway)		
Enclosed space accumulation of ground gas.		**Yes**
Outdoor volatile vapour exposure		**No**
Elevated concentrations of Methane have been identified during monitoring and are interpreted to pose a low risk to future site users.		
Potable water supply pipes		**No**
The selection of any new potable water supply pipes should be confirmed with the statutory undertaker.		
Risks to Buildings via accumulation of ground gas and volatile vapours in enclosed spaces and sub-floor voids.		**Yes**
Elevated concentrations of Methane have been identified during monitoring and are interpreted to pose a low risk to future site users. Appropriate mitigation should be adopted (e.g. gas membrane).		
Water Environment		
Contaminant migration on to neighbouring land		**No**
The contaminant source will be removed to facilitate development during basement excavation.		
Contaminant migration from neighbouring land		**No**
Contamination of groundwater		**No**
Contamination of surface water		**No**
No surface water features have been identified within 250m of the site.		

Table 10: Plausible Pollutant Linkages

10.4 Source-Pathway-Receptor Model

Bulk Ground Gases

The results of the GQRA and the subsequent updated CSM suggest that there would be a requirement for basic ground gas protection measures at the site.

Soils Within the Rear Garden

Further testing and assessment should be undertaken, and if required appropriate mitigation adopted (e.g. clean cover system in the rear garden).

11.0 Flood Risk Assessment and Drainage Strategy

11.1 Sources of Flooding

Fluvial (Rivers and Seas)

The Environment Agency's Flood Map for Planning (Figure 4) shows the site to be in flood zone 1. This is defined as '*land having a less than 1 in 1,000 annual probability of river or sea flooding*' and the property can therefore be considered to have a very low probability of fluvial flooding.

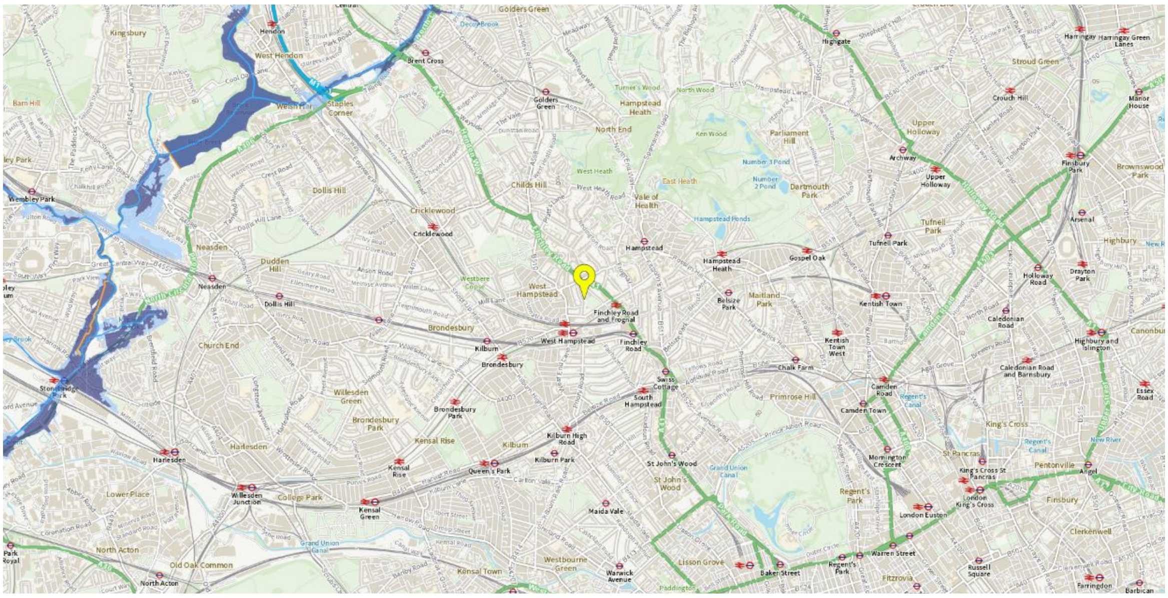

Figure 4: EA Flood Map for Planning[1]

Pluvial (Surface Water)

The Long-Term Flood Risk Map for Surface Water (Figure 5) does not show the subject property to be at risk of flooding from surface water. It can therefore be considered to be at very low risk of surface water flooding, considered to be land that each year this area has a chance of flooding of less than 0.1% (1 in 1,000).

With reference to LB Camden's Strategic Flood Risk Assessment (SFRA), and the Guidance to Subterranean Development (Figure 15, Appendix 3), Crediton Hill did not flood in 1975 nor 2002.

[1] https://flood-map-for-planning.service.gov.uk/confirm-location?easting=525700&northing=185110

Figure 5: Long-Term Flood Risk Map - Surface Water[2]

Reservoir

The Long-Term Flood Risk Map for Reservoir Flooding (Figure 6) does not show the subject property to be in the extent of flooding that could occur in the event of breach failure of a reservoir. This is considered to be the largest area that might be flooded if a reservoir were to fail and release the water it holds. Since this is a prediction of a credible worst-case scenario, it's unlikely that any actual flood would be this large.

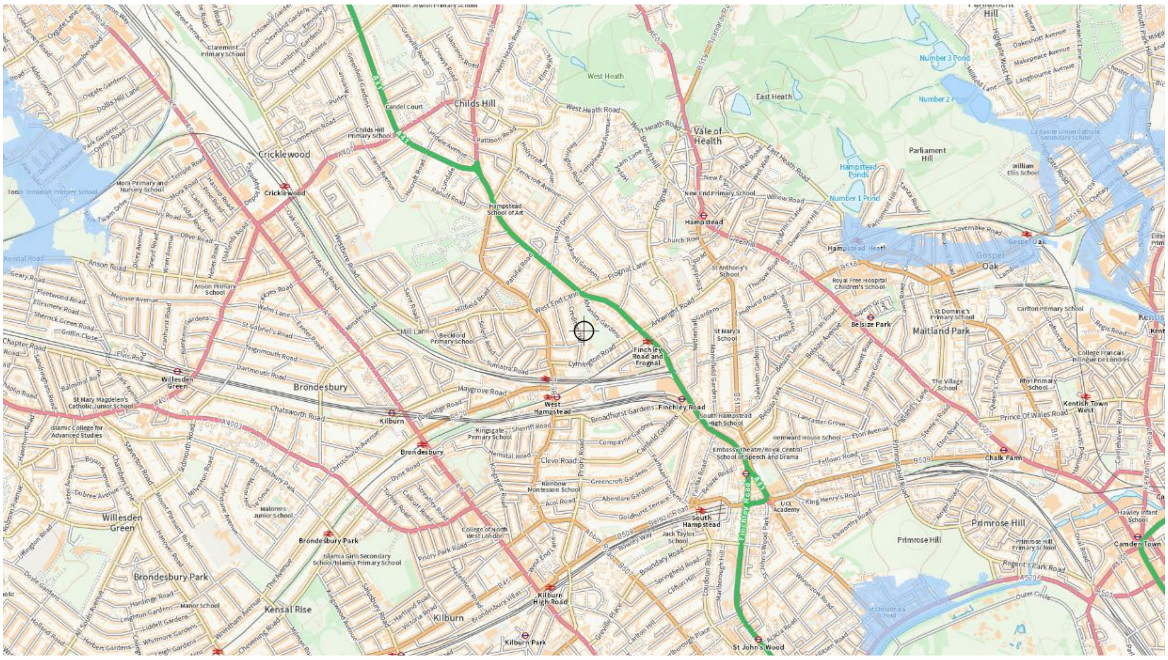

Figure 6: Long-Term Flood Risk Map - Reservoir[3]

[2] https://check-long-term-flood-risk.service.gov.uk/map?easting=525700&northing=185110&map=SurfaceWater

[3] https://check-long-term-flood-risk.service.gov.uk/map?easting=525700&northing=185110&map=Reservoir

Groundwater

A desk top study has been undertaken to review online data sets. British Geological Survey (BGS) maps do not record superficial deposits at or in the vicinity of the property location but do show bedrock geology to be London Clay Formation comprising Clay, Silt and Sand. The bedrock is designated[4] as '*unproductive*' and so similarly has an aquifer designation status relating to groundwater vulnerability[5] of '*unproductive*'.

The property is not located within a groundwater source protection zone.

Soilscape[6] mapping shows the property to be in an area with '*slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils*' with '*impeded drainage*' to '*stream network*'.

Due to the low permeability and unproductive nature of the underlying bedrock geology, it is considered that there is a negligible risk of ground water egress. The absence of superficial deposits recorded in the area suggest that near ground soils will comprise either made ground or weathered bedrock and will therefore similarly not contain groundwater other than in localised sand layers where perched water may accumulate via infiltration of surface water sources.

Figure 4e in SFRA[7] presents a map showing areas where there is an '*Increased Potential for Elevated Groundwater*'. The property is not located within such an area. The map also shows the locations of historic flooding from groundwater sources and Environment Agency groundwater flood incidents. The property is similarly not in proximity to these areas with the nearest being at Lyncroft Gardens, approximately 0.4km to the Northwest.

Sewer

Sewer records have been obtained from Thames Water (Appendix 3) which show that drainage in proximity to the property is to a combined water sewer located under the highway (Crediton Hill) to the west of the subject land. This is shown to be 940mm x 610mm in size and is therefore expected to be an egg-shaped sewer. The depth of sewer between nearest chambers on the main line is between 4.97m (mh 6100) and 5.73m (mh 6002).

Thames Water were also contacted to establish whether they hold any records of historical flooding in the area of the property address. Their response confirms that '*the flooding records held by Thames Water indicate that there have been no incidents of flooding in the requested area as a result of surcharging public sewers*'.

11.2 Risk of Flooding to and from the Development

From a review of the sources of flooding presented in the foregoing, it is considered that there is a low risk of flooding from all sources.

The predicted effects of climate change generally result in exacerbation of current day flooding due to increases in the rate and volume of flood water that can occur and the reduced frequency of flood events.

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[4] https://data.gov.uk/dataset/616469ae-3ff2-41f4-901f-6686feb1d5b6/aquifer-designation-dataset-for-england-and-wales

[5] https://data.gov.uk/dataset/42d7d021-538c-46e2-abbb-644e01c63551/groundwater-vulnerability-maps-2017-on-magic

[6] http://www.landis.org.uk/soilscapes/#

[7] LBC SFRA Report by URS, ref 47070547, Rev 2, dated July 2014

However, it is not considered that the effects of climate change will significantly alter the potential for flooding from the sources discussed other than locally in respect of surface water run-off management.

It follows that mitigation measures other than those inherent to standard building practice are not required. However, a drainage strategy should be considered in line with best practice and appropriate polices.

11.3 Drainage Strategy

Chapter 9 of The London Plan 2021 includes Policy SI 13 relating to Sustainable Drainage. It presents the following drainage hierarchy:

1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation);
2) rainwater infiltration to ground at or close to source;
3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens);
4) rainwater discharge direct to a watercourse (unless not appropriate);
5) controlled rainwater discharge to a surface water sewer or drain;
6) controlled rainwater discharge to a combined sewer.

The SFRA provides guidance in relation to surface water management. Figure 4c of the SFRA presents a map showing the infiltration potential across LB Camden based on BGS data. The property is in an area shaded to signify 'opportunities for bespoke infiltration SuDS'.

In relation to householder paving to front gardens, it is noted that permitted development rights changed in 2008. Current guidance directs that either permeable construction is used for new driveway areas or otherwise that they are laid to shed to permeable areas such as lawn or border where runoff can drain naturally.

Where roof areas are to be increased, the use of green roof construction should be considered. This is unlikely to be practical for pitched roof areas, but the use of rainwater harvesting for re-use in the property is likely to be viable, subject to technical and financial considerations.

In each case, these methods of source control provide good interception but cannot be relied on for management of extreme events where high intensity or prolonged rainfall occurs. Therefore, the need to implement another form of SuDS technique may be required to balance discharge from the property drainage system so that the status quo of existing flow is maintained or ideally reduced.

The drainage system should also be appraised for the effects of climate change over the lifetime of the development. Current guidance for peak rainfall intensity increase allowances states that drainage system should be design to make sure there is no increase in the rate of runoff discharged from the site for the upper end allowance. Planning Practice Guidance for the National Planning Policy Framework assigns a 100 year design life to residential development. Therefore, the upper end allowance of 40% should be applied to rainfall intensities when assessing the drainage system.

The existing permeable areas at the property have been estimated to be 160m^2, whilst impermeable areas are approximately 220m^2. The proposals would not result in a net increase in impermeable area; however, to be conservative, an increase of impermeable areas of approximately 10% has been considered (i.e. 250m^2).

On the basis that the existing drainage is unrestricted, a pre-development discharge rate of approximately 3l/s would occur under a rainfall intensity of 50mm/hr. Section 9.13.12 of The London plan 2021 advises that 'development proposals should aim to get as close to greenfield run-off rates as possible depending on site conditions'. LBC Local Plan Policy CC3 also advises that development is required to 'utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible'.

Draianage calculations are presented in Appendix 6. A greenfield runoff rate of qbar = 3.8l/s/ha has been determined, which for the overall site area of approximately 0.038ha (380sqm) is equivalent to 0.14l/s. This is a very low rate that would not be practical to achieve due to the low size of flow control aperture that would be needed which would be inherently susceptible to blockage.

Therefore, the lowest practical flow rate should be used. If a geo-cellular tank of 0.8m high and 3m x 4m = 12m^2 plan area is used, it could be sited under the driveway area. A capacity of 9.12m^3 would be available (allowing standard 95% void capacity). Allowing 1l/s discharge rate, controlled by a Hydrobrake Optimum unit, the attenuation volume needed to balance run-off from 250m^2 under 1 in 100 year rainfall intensities that have been increased by 40% for the predicted effect of climate change is 9.4m^3. Therefore, the tank would be adequate as some nominal surcharging via filling of connecting pipes and chambers could be accommodated.

In principle, the above is a viable drainage strategy that demonstrates that a crated tank and Hydrobrake flow control can manage runoff for 1 in 100 year + 40% rainfall and restrict discharge to approximately 1/3 of the pre-development peak rate. The use of permeable paving for the driveway (re)construction would provide water quality and amenity benefits.

11.4 FRA and Drainage Strategy – Non-Technical Summary

From a review of the sources of flooding that could influence the proposed works at 32 Crediton Hill, it has been determined that there is a very low risk of flooding to the development. It is not considered that the proposals would result in an increased risk of flooding at the property location or surrounding area or that the effects of climate change will significantly change the current day regime.

The management of surface water will be undertaken utilising attenuation SuDS to improve the off-site run-off rate and provide water quality and amenity benefits.

12.0 Ground Movement Assessment

12.1 Introduction

On the basis of the records from the construction of the adjacent basement at 34 Crediton Hill, existing original foundations for the building have been taken to in excess of 3.50m bgl along the Party Wall, and have been assumed to have been taken to a similar depth for the remainder of the subject site. The neighbouring buildings, which were constricted at the same time and in the same style, are therefore anticipated to also have deep foundations, taken through the Made Ground (pond infill) into the London Clay Formation.

Deep foundations to both the subject building and neighbouring buildings would reduce both the magnitude of ground movements generated by the proposed basement beneath the house and the impacts of those movements on nearby structures. On that basis, by inspection, damage to neighbours is likely to be Negligible (Category 0 in accordance with the Burland scale). Indeed for 34 Crediton Hill, with the existing basement comprising reinforced concrete liner walls, basement slab and ground floor slab, with a formation level at or very close to the proposed formation level of the proposed basement, no further assessment is considered necessary.

However, in order to undertake a conservative assessment, foundations to the other neighbouring buildings have been assumed to be shallow for the purposes of the BIA. It has also been assumed that underpinning will be required to form the main basement, which will result in an over-estimate of movements generated during construction.

With regard to the slope at the rear of the property, this is located >15.0m to 20.0m from the proposed basement. On the basis that the maximum zone of influence of likely ground movements from basement construction is approximately four times the depth of the basement foundations (i.e. a maximum of 14m) then no assessment of impacts has been made for movements generated from the construction on the slope.

12.2 Assessment Methodologies

A ground movement assessment (GMA) has been completed utilising industry standard software (Oasys XDisp). Using the data from the analysis, an assessment has been made of the potential impact on neighbouring buildings in accordance with the Burland Scale. Calculations and GMA outputs are provided in Appendix 7.

12.3 Ground Movements Generated by Proposed Development

The following construction processes are likely to give rise to the majority of ground movements:

1. Installation of the underpins.
2. Excavation of the new basement.

Based on the guidance provided in CIRIA C760 for embedded retaining walls, ground movements resulting from installation of underpinned walls and excavation in front of the walls have been estimated. Whilst its noted that the guidance is intended for use with embedded walls, the methodology provides predicted ranges of movement that are consistent with movements generated during underpinning.

In order to be conservative, the depth of existing foundations has been ignored and the depth of underpinning and excavation has been taken from ground level. This approach should over-estimate movements compared to those generated by the actual works.

For movement due to the underpin installations, the magnitudes of the movements are dependent on the total retaining wall depth. Maximum vertical movements occur at the wall itself. C760 indicates movements will be 0.05% of the wall depth, with negligible vertical movement at one and a half times the wall depth from the wall. On this basis, maximum vertical movements due to wall installation of <3mm are predicted with vertical movements extending to a maximum of <7m from the wall.

Anticipated maximum horizontal movements due to wall installation are 0.05% of the wall depth, with negligible horizontal movement one and a half times the wall depth from the wall. Maximum horizontal movements are therefore predicted to be <3mm with horizontal movements extending to a maximum of <7m from the wall.

For movements due to excavation in front of the retaining wall, the magnitudes of the movements are dependent on the excavation depth. Based on the Contractor adopting a stiffly propped method of excavation, C760 indicates maximum vertical movements of 0.10% of excavation depth, with negligible movement three and a half times excavation depth from the wall. Maximum vertical movements due to excavation of <4mm are predicted, extending <13m from the wall.

Anticipated maximum horizontal movement due to excavation are 0.15% of the excavation depth, with negligible horizontal movements four times the excavation depth from the wall. Maximum horizontal movements are predicted to be <6mm, extending 14m from the wall.

A summary of ground movement predictions obtained using Oasys XDisp are reported in Appendix 7, presented as contour plots. The calculations take account of the combined vertical and horizontal movements from both installation and excavation. The predicted ground movements are at the average elevation of 63.00m OD (i.e. ground level).

12.4 Adjacent Structures, Highway and Utility Assets

Five buildings are identified as being within the potential zone of influence from the proposed basement construction works:

- 15 Crediton Hill
- 17 Crediton Hill
- 19 Crediton Hill
- 28 Crediton Hill
- 30 Crediton Hill
- 34 Crediton Hill
- 36 Crediton Hill

The potential damage impacts to the buildings within the zone of influence have been assessed. A indicated in 12.1, the full depth reinforced concrete basement at 34 Crediton Hill is considered to mitigate risk of damage to that property and 36 Crediton Hill to the north.

The footway (with underlying utilities) is located 4.6m from the proposed basement at the closest point; the highway with underlying utilities is located 7.0m from the proposed basement at its closest point. The most sensitive utilities to movement are considered to be the 4" cast iron water main, approximately 11.0m from the proposed basement, and the brick egg combined sewer, approximately 10.0m from the proposed basement. The other utilities are considered to be relatively flexible.

Although not integral to the purpose of this assessment, it should be noted that during the construction works the adjacent structures will be monitored for movements as required by Party Wall Agreements and any highway or utility asset protection agreements. The results of this monitoring provide a comprehensive feedback loop to the assessment models. This will allow contingency actions to be undertaken, if necessary, to limit movements.

12.5 Sensitivity Analysis

To provide a sensitivity check of the methodology adopted, the movement values predicted have been compared with:

- the typical range of movements reported by underpinning contractors, which is between 5mm and 10mm vertical / horizontal for an underpin constructed in a single lift;
- consideration of a 'low stiffness' construction methodology (i.e. without the use of temporary propping to restrain movements), which indicates approximately 16mm to 18mm vertical / horizontal movements (if ignoring the depth of existing foundations). The conservative 'low stiffness' range of movements could be considered a worst-case scenario, if propping was omitted for instance.

12.6 Estimates of Ground Movement using Oasys XDisp

Whilst the CIRIA C760 approach is considered conservative, it has been adopted as the underlying method of analysis precisely for this reason: the actual ground movements generated during the works should be less onerous than those predicted. The geometries of the site have been imported into XDisp and ground movements modelled based on C760.

The displacement profiles and damage assessments derived using XDisp assume greenfield movements and predict movements at ground level. In relation to all buildings, the movements derived will be an overestimate of movement both with respect to adjacent foundations and assets, which are located at a depth greater than existing street levels. The XDisp contour outputs are reported in Appendix 7.

12.7 Estimates of Movement due to Heave

The excavation of a maximum 3.50m of soil will generate an unloading of around <70kPa in the main building. Given that the new building will have a suspended basement slab, it is likely that the ground within the excavation will experience a net unload, rather than load, and will therefore heave rather than settle. This will result in a measure of short term heave and long term swelling of the underlying London Clay, which theoretically takes a number of years to complete.

A proportion of the soil heave pressure will be dissipated in the short term / during excavation, before the base slab is cast, due to undrained deformation and other short term effects. In the long term, as the clay swells, the base slab will have a pressure exerted on it.

The magnitude of the long term ground heave pressures exerted on the slab will depend on the magnitude of heave deformation / stress relaxation which occurs prior to the base slab being constructed, the type of heave protection or size of void below the slab, and how much the slab deflects as a result of the applied heave pressures. If no relaxation occurs before the base slab is cast, no heave protection is placed (or void left) and the slab is not allowed to deflect (i.e. the base slab is wished in place and fully rigid) then the total heave pressure will be exerted on the slab.

If the ground is allowed to heave / relax prior to casting the base slab, or the slab is flexible, or if heave protection or a void is provided, then the soil heave pressure will reduce towards zero.

For a normal construction programme, it may be assumed that 50% of soil heave pressure will be dissipated prior to construction of the slab. As such 50% of potential heave will remain after excavation. It is likely that heave forces will be reduced, given the history of unloading and loading from previous basement developments; however, to be conservative its recommended to allow for 50% of the total unloading pressure to be applied to the base slab i.e. 35kPa. The effective soil heave pressure can be relieved by providing a void beneath the base slab which the soil can swell into without coming into contact with the slab, i.e. the slab is not cast directly onto the ground (e.g. utilising Cellcore, which is a honeycomb of interlocking expanded polystyrene sections designed to collapse at a pre-determined load).

In addition, the slab should be designed to withstand water pressure. As 6.3, it is recommended that further assessment is made to evaluate groundwater to inform both temporary works control measures and permanent structural design. Notwithstanding this, there are no unusual risks presented by the groundwater conditions that cannot be effectively mitigated by the correct design and construction process.

Experience suggests that heave movements tend largely to be restricted to within the basement excavation when excavations are created within embedded retaining walls. Whilst no embedded walls will be utilised, the existing deep foundations will mitigate heave movements to an extent around the perimeter of the basement, so it is not anticipated that the changes in loading at basement level will have a significant impact on the neighbouring structures. It should also be noted that CIRIA C760 empirical movement calculations are considered to include short term heave movements, as applicable.

12.8 Impact Assessment of Neighbouring Buildings, Highway and Utilities

The ground movements have been used to assess the resultant potential damage that may be experienced by neighbouring structures. The methodology proposed by Burland and Wroth, and later supplemented by the work of Boscardin and Cording, has been used, as described in CIRIA C760 (and preceding CIRIA publications). The 'Burland Scale' damage categories are presented in Table 11.

Based on the ground movements calculated, the following impacts are predicted in accordance with the Burland Scale:

- 15 Crediton Hill – Displacements less than the limit sensitivity
- 17 Crediton Hill – Displacements less than the limit sensitivity
- 19 Crediton Hill – Displacements less than the limit sensitivity
- 28 Crediton Hill – Displacements less than the limit sensitivity
- 30 Crediton Hill – Category 1 (Very Slight)
- 34 Crediton Hill – Category 0 (Negligible)
- 36 Crediton Hill – Displacements less than the limit sensitivity

A indicated in 12.1, the full depth reinforced concrete basement at 34 Crediton Hill is considered to mitigate risk of damage to that property and 36 Crediton Hill to the north.

The maximum movements predicted to be experienced at footway are 3mm vertically / 4mm horizontally; the maximum movements at the highway 2mm vertically / 3mm horizontally. This magnitude of movement will cause negligible impact to surfacing or underlying utilities.

The maximum movement at the Thames Water assets is predicted to be <1mm vertically / horizontally, causing negligible impact.

It is recommended that structural movement monitoring is undertaken during the works and mitigation actions implemented if movement trends indicate predicted impacts and structural movement tolerances could be exceeded.

Category of damage	**Description of typical damage (ease of repair is underlined)**	**Approximate crack width (mm)**	**Limiting tensile strain, ε_{lim} (%)**
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible	<0.1	0.0 to 0.05
1 Very slight	**Fine cracks that can easily be treated during normal decoration.** Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection	<1	0.05 to 0.075
2 Slight	**Cracks easily filled. Redecoration probably required.** Several slight fractures showing inside of building. Cracks are visible externally and **some repointing may be required externally** to ensure weathertightness. Doors and windows may stick slightly.	<5	0.075 to 0.15
3 Moderate	**The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable lining. Repointing of external brickwork and possibly a small amount of brickwork to be replaced.** Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5 to 15 or a number of cracks >3	0.15 to 0.3
4 Severe	**Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows.** Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Services pipes disrupted.	15 to 25, but also depends on number of cracks	>0.3
5 Very severe	**This requires a major repair, involving partial or complete rebuilding.** Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	Usually >25, but depends on numbers of cracks	

Table 11: Damage Categories on the Burland Scale

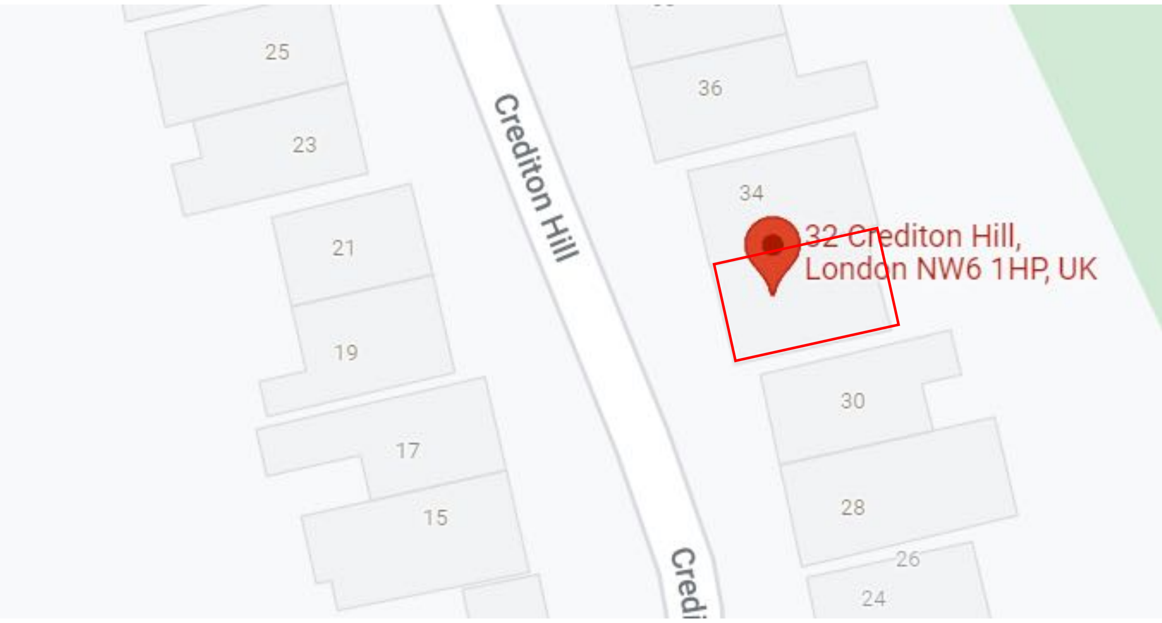


Figure 7: Neighbouring Buildings to the Site

13.0 Basement Impact Assessment

The purpose of this assessment is to consider the potential impacts from basement development on the local hydrology, geology and hydrogeology and any resulting impacts to stability of adjacent structures. The assessments have been undertaken by appropriately qualified professionals in accordance with the guidance.

13.1 Geology and Land Stability

The site is underlain by the London Clay Formation. This formation typically comprises firm to stiff clay of medium to high strength and is a suitable bearing stratum for the proposed development's foundations. This has been confirmed by the site investigation.

The risk of movement and damage to this development due to shrink and swell of the London Clay is negligible, considering the depth of the proposed foundations.

Ground movements caused by the excavation and construction of the proposed development have been demonstrated by assessment to be minimal, assuming the adoption of best practice construction methodologies and stiff propping of the basement. Damage Impact to adjacent structures will be limited to a maximum of Very Slight (Category 1 in accordance with the Burland Scale). It is recommended that structural movement monitoring is undertaken and mitigation actions implemented if ground movement trends indicate structural movement tolerances could be exceeded.

Movements to the highway / utilities are considered to be very small, such that they would cause negligible impact. Consultation with relevant asset owners is recommended to ensure that appropriate design and mitigation measures can be provided for the development such that impacts to the highway and utilities are maintained within the agreed limits.

There will be no impacts to the slope at the rear of the property.

13.2 Hydrogeology and Groundwater Flooding

The London Clay is designated as Unproductive Strata. There is a very low risk of groundwater flooding or potential for impacting the wider hydrogeological environment.

It is recommended that further groundwater monitoring is undertaken in advance of construction to enable appropriate groundwater control methods to be employed to ensure stability during excavation and construction. The Construction Method Statement requires appropriate propping and mitigation measures to be implemented, including the use of sump pumping, which will be controlled by the Contractor and supervised by the Engineer, and there will be no impacts to stability during construction or in the permanent case as a result of encountering shallow perched water.

13.3 Hydrology and Surface Water Flow

The site and the adjacent properties have not been impacted by flooding. There is a very low risk of flooding to the proposed development and the proposed development will not impact the wider hydrological environment. The proposed drainage strategy should provide betterment and reduce the risk of surface water flooding or sewer surcharging on site and in the immediate vicinity.

The SuDS proposals allow for a suitable attenuated drainage scheme with off-site discharge flow rates limited to the minimum practicable in accordance with best practice.

13.4 Residual Risks and Mitigation

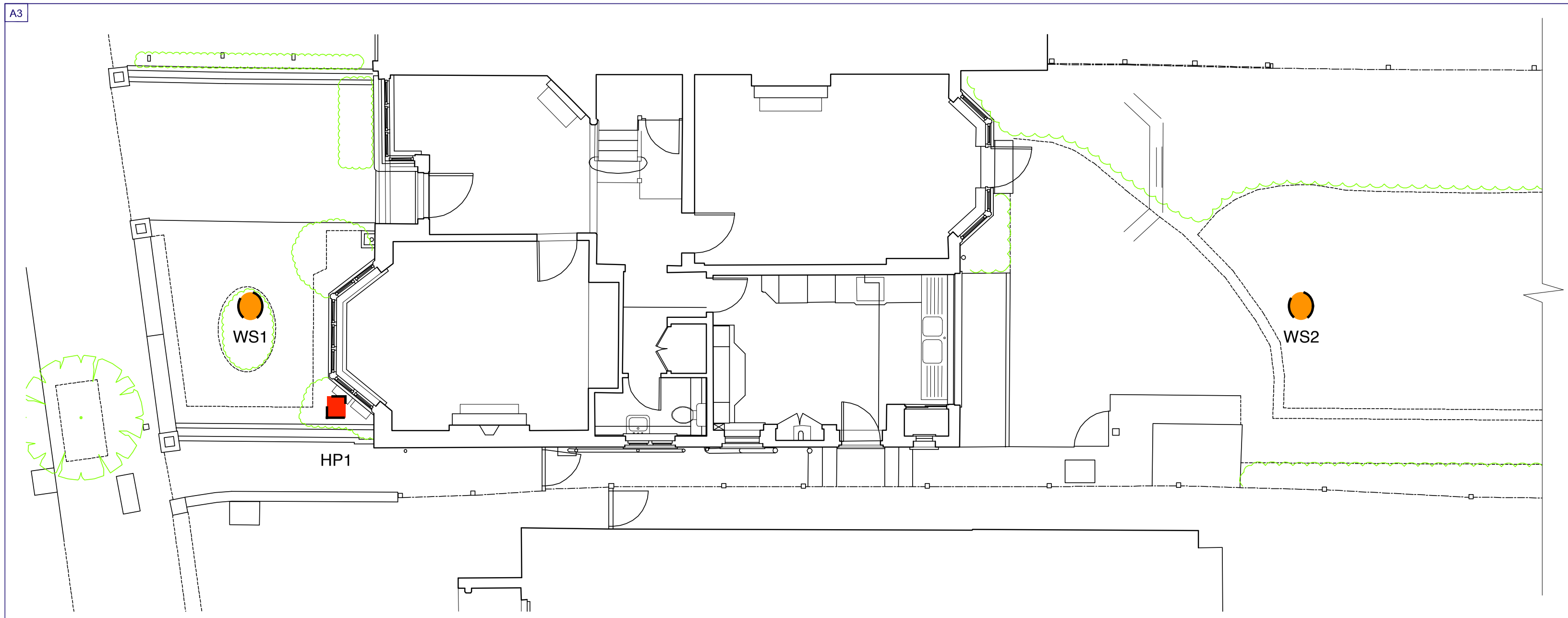
Monitoring of the borehole standpipes indicates the presence of perched water. It is recommended that additional assessment is completed in advance of construction to inform the temporary groundwater control methodology design.

As a contingency, and in accordance with best practice, a structural movement monitoring plan should be set out at design stage. Monitoring should include precise levelling, reflective survey targets or other appropriate instrumentation as determined by the Engineer being installed on adjacent structures and the highway. This should be agreed under the Party Wall Act and as part of any asset protection agreements required.

Appendix 1 Site Location and Exploratory Hole Plan

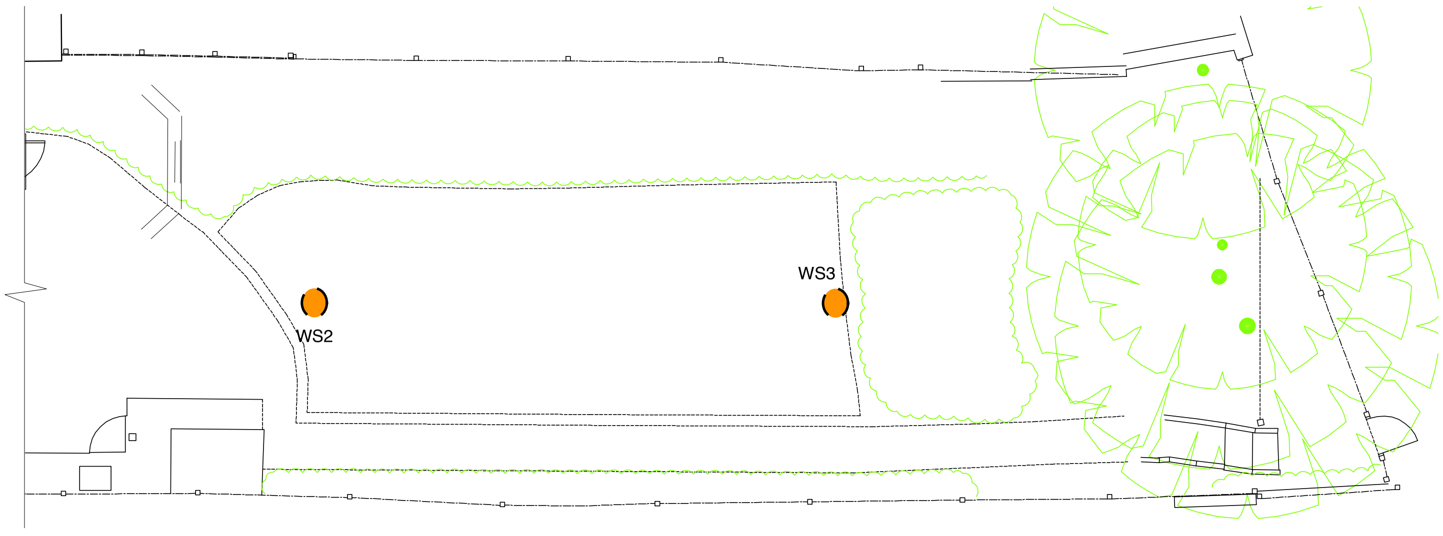
Figure 1 Site Location

Figure 2: Exploratory Hole Plan (over page)



1 SITE PLAN - AS EXISTING

Scale: 1:100



2 SITE PLAN - AS EXISTING

Scale: 1:100

KEY:
- Existing
- Proposed
- Demolition
- Boundary

0 0.5 1m 3m 5m 10m

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
Any discrepancies between drawings and or other documents shall be referred to the architects.

Compliance
All appropriate work to comply with the relevant requirements of the Building Regulations. All materials specified on this drawing are to be used strictly in accordance with the manufacturers recommendations, correct code of practice and where relevant British Board of Agrément Certificate.

Rev	Date	Description

CONNECT ARCHITECTURE

Project: 32 Crediton Hill, London, NW61HP

Client: Mr. & Mrs. Thurlin

Title: **SITE PLAN: AS EXISTING**

Status: INFORMATION

Date:	Scale:	
11-04-21	1:100 @A3	
Job No:	Drawing No:	Rev:
330	E-001	000

A3

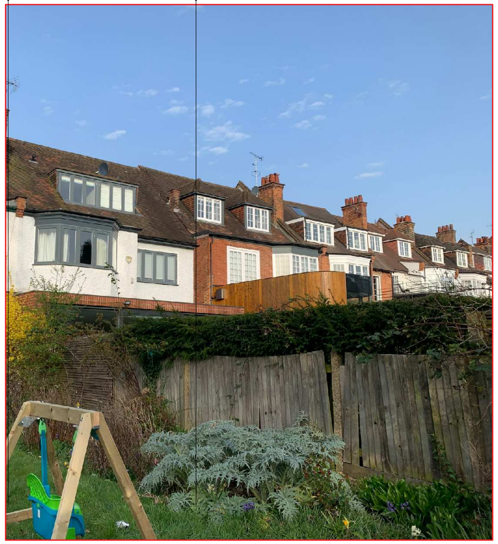
Appendix 2 Proposed Development Drawings

A3

30 CREDITON HILL

30 CREDITON HILL | 32 CREDITON HILL | 34 CREDITON

34 CREDITON



1 REAR ELEVATION - AS EXISTING

NTS

34 CREDITON HILL | 32 CREDITON HILL | 30 CREDITON HILL

2 ENTRANCE ELEVATION - AS EXISTING

NTS

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
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Compliance
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Rev	Date	Description
001	19-01-21	Chimney breast removed

CONNECT ARCHITECTURE

Project: 32 Crediton Hill London NW61HP

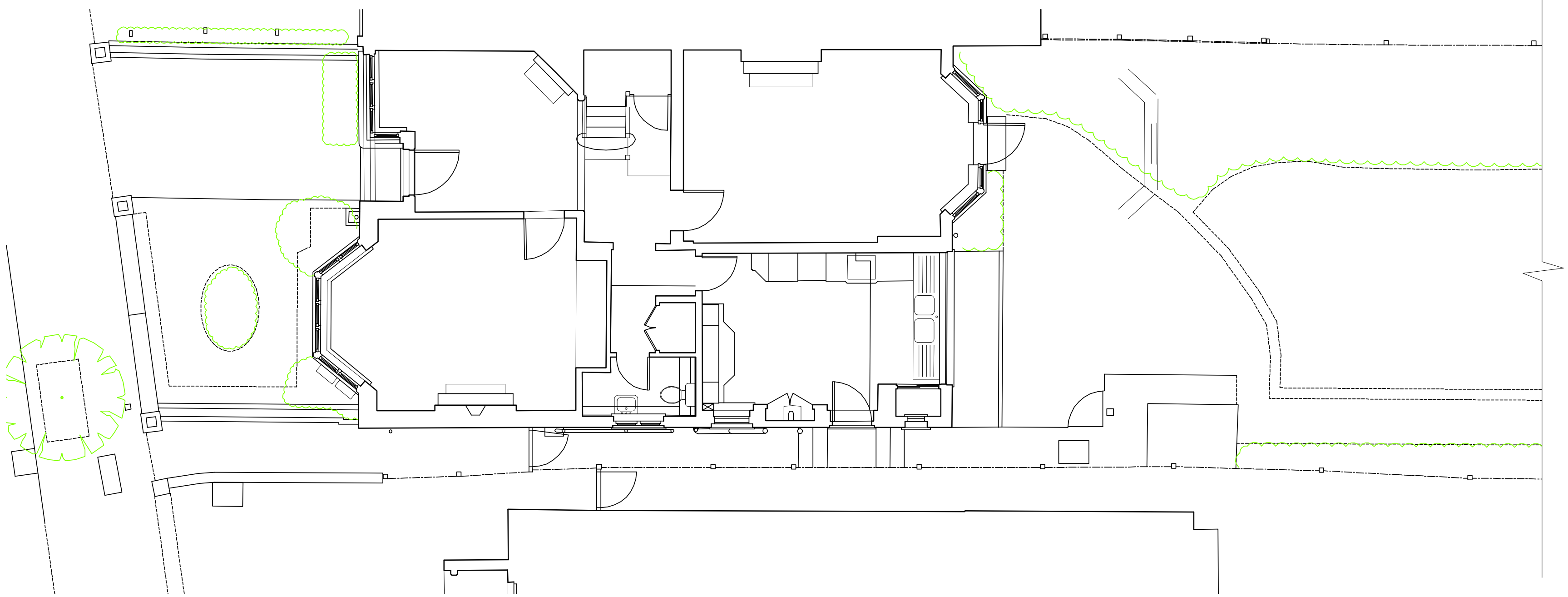
Client: Mr. & Mrs. Thurlin

Title: **SITE PHOTOGRAPHS: AS EXISTING**

Status: INFORMATION

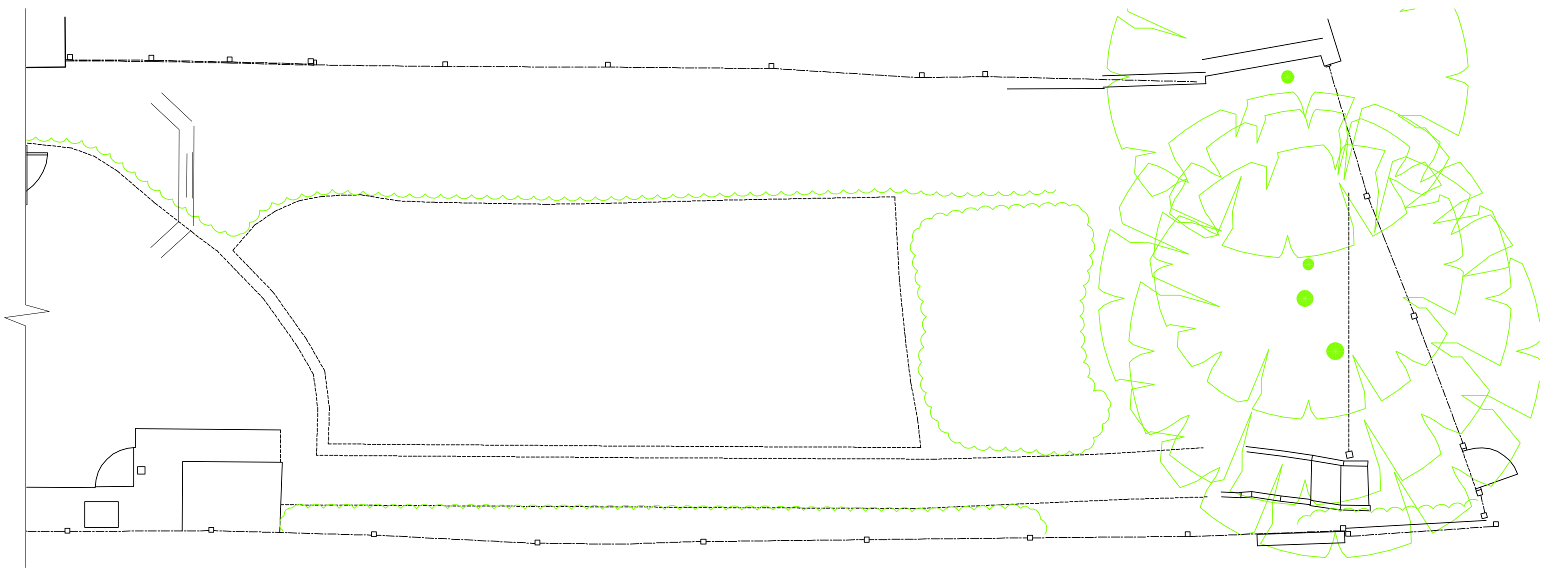
Date:	Scale:	
11-04-21	NTS @A3	
Job No:	Drawing No:	Rev:
330	P-300	000

A3



1 SITE PLAN - AS EXISTING

Scale: 1:100



2 SITE PLAN - AS EXISTING

Scale: 1:100

KEY:

- Existing
- Proposed
- Demolition
- Boundary

0 | 0.5 | 1m | 3m | 5m | 10m

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
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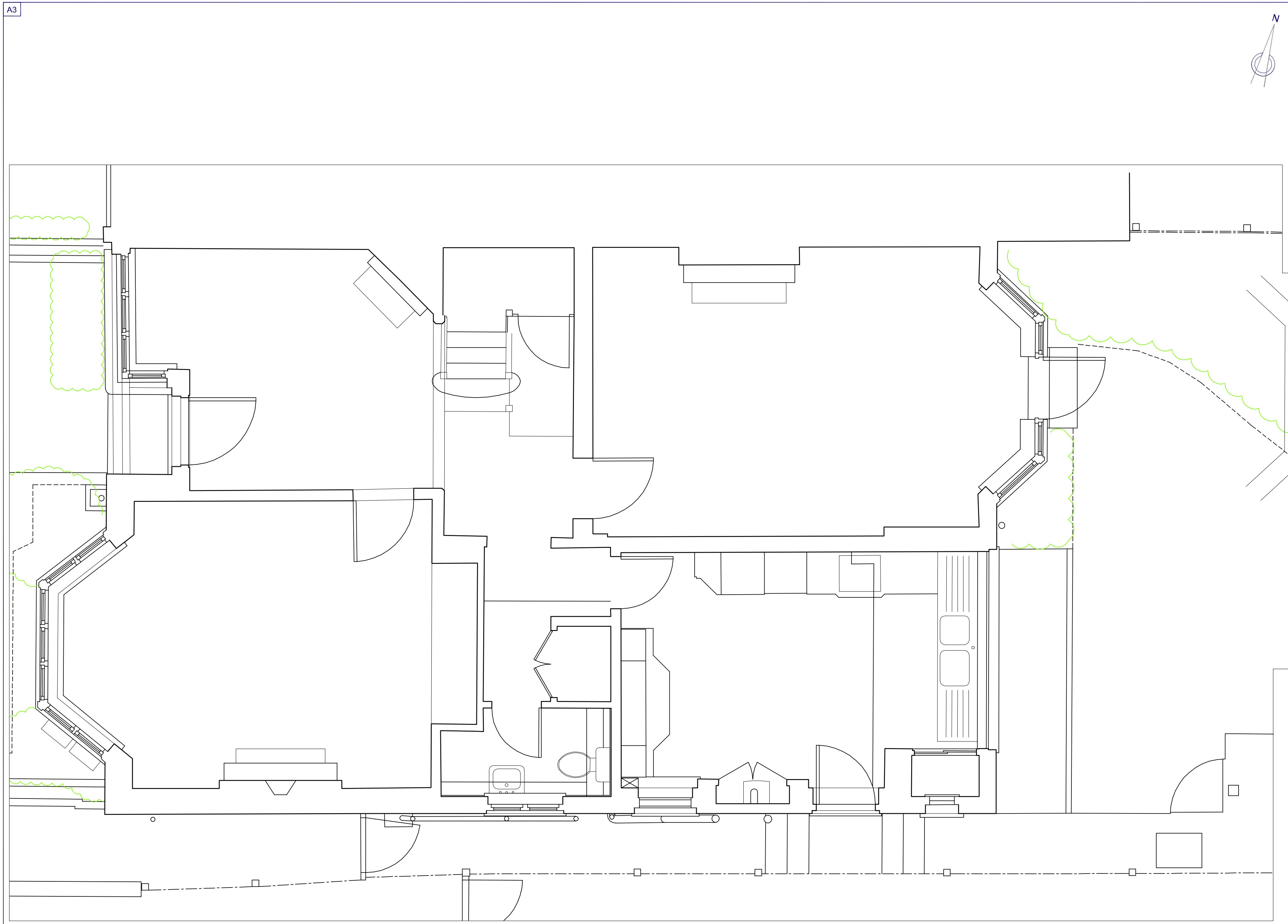
Rev	Date	Description

CONNECT ARCHITECTURE

Project:	32 Crediton Hill London NW61HP
Client:	Mr. & Mrs. Thurlin
Title:	**SITE PLAN: AS EXISTING**
Status:	INFORMATION
Date: 11-04-21	Scale: 1:100 @A3
Job No: 330	Drawing No: E-001 / Rev: 000

A3



1 GROUND FLOOR PLAN - AS EXISTING

Scale: 1:50

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
Any discrepancies between drawings and or other documents shall be referred to the architects.

Compliance
All appropriate work to comply with the relevant requirements of the Building Regulations. All materials specified on this drawing are to be used strictly in accordance with the manufacturers recommendations, correct code of practice and where relevant British Board of Agrément Certificate.

Rev	Date	Description

CONNECT ARCHITECTURE

Project:
32 Crediton Hill
London
NW61HP

Client:
Mr. & Mrs. Thurlin

Title:
GROUND FLOOR PLAN: AS EXISTING

Status:
INFORMATION

Date:	Scale:	
11-04-21	1:50 @A3	
Job No:	Drawing No:	Rev:
330	E-002	000

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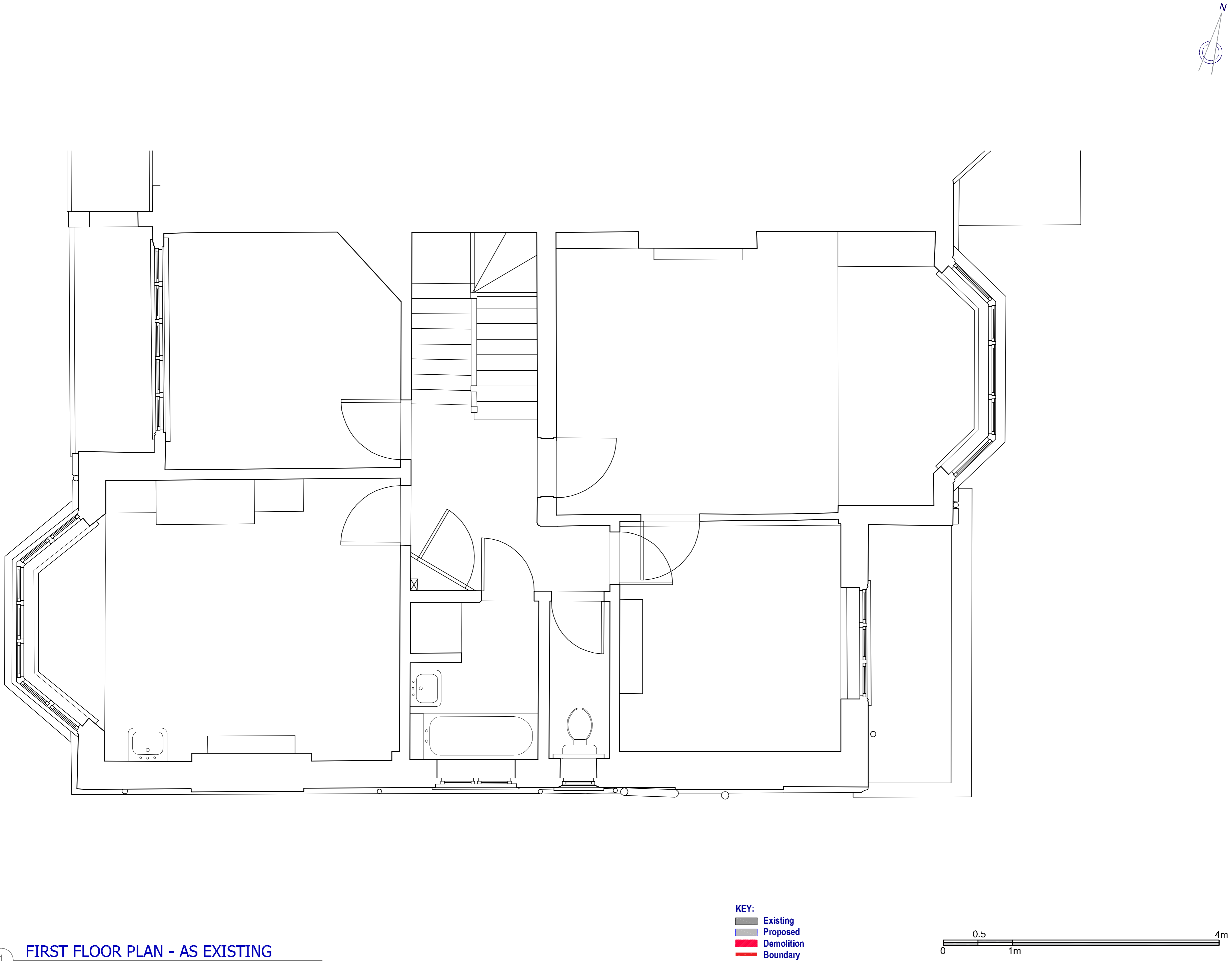


1 FIRST FLOOR PLAN - AS EXISTING

Scale: 1:50

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
Any discrepancies between drawings and or other documents shall be referred to the architects.

Compliance
All appropriate work to comply with the relevant requirements of the Building Regulations. All materials specified on this drawing are to be used strictly in accordance with the manufacturers recommendations, correct code of practice and where relevant British Board of Agrément Certificate.

Rev	Date	Description

CONNECT ARCHITECTURE

Project: 32 Crediton Hill, London, NW61HP

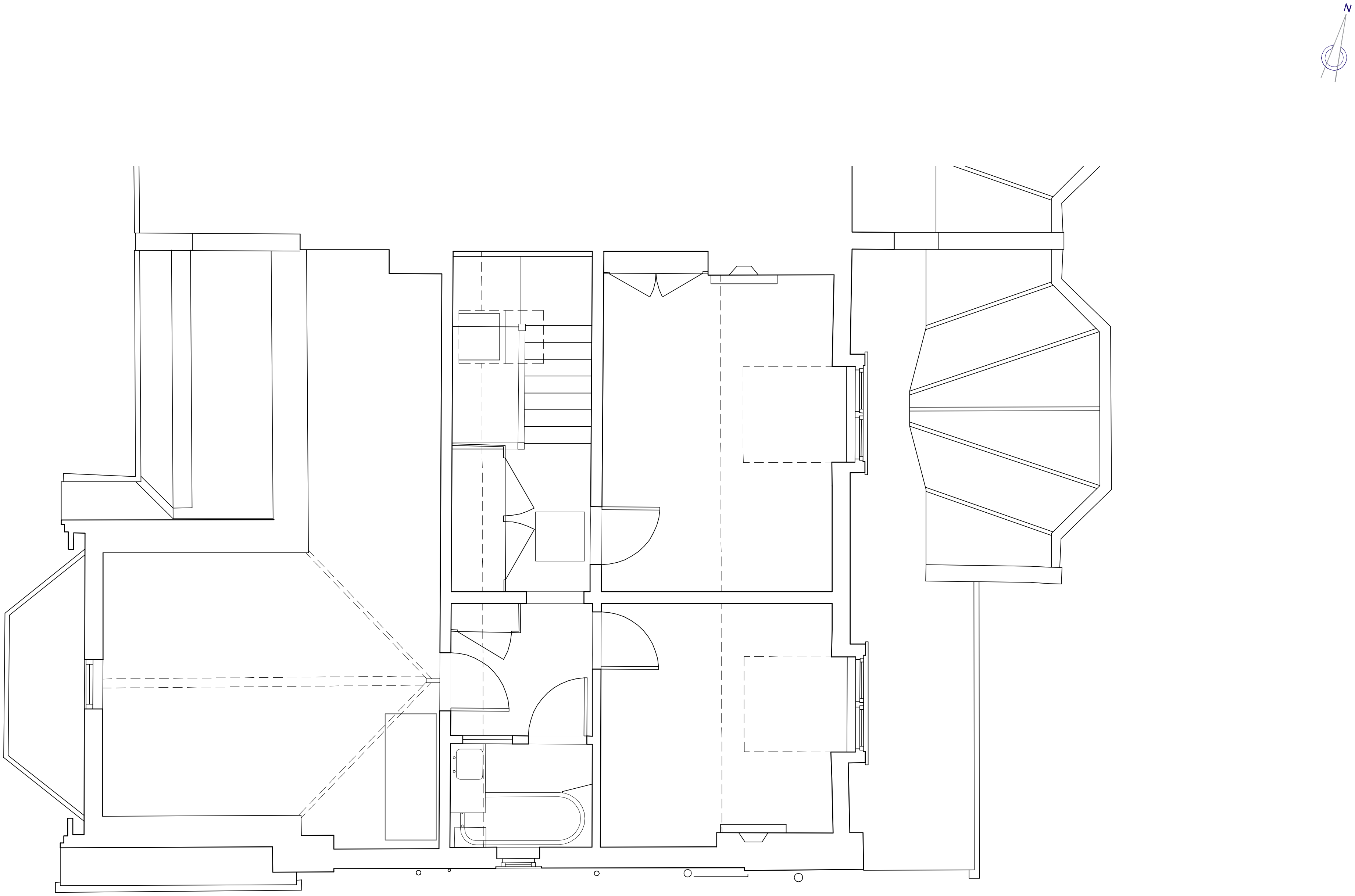
Client: Mr. & Mrs. Thurlin

Title: **FIRST FLOOR PLAN: AS EXISTING**

Status: INFORMATION

Date:	Scale:	
11-04-21	1:50 @A3	
Job No:	Drawing No:	Rev:
330	E-003	000

A3



1 SECOND FLOOR PLAN - AS EXISTING

Scale: 1:50

KEY:

- Existing
- Proposed
- Demolition
- Boundary

0 0.5 1m 4m

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
Any discrepancies between drawings and or other documents shall be referred to the architects.

Compliance
All appropriate work to comply with the relevant requirements of the Building Regulations. All materials specified on this drawing are to be used strictly in accordance with the manufacturers recommendations, correct code of practice and where relevant British Board of Agrément Certificate.

Rev	Date	Description
001	19-01-21	Chimney breast removed
002	19-04-21	Dimensions added
003	28-04-21	Designs updated

CONNECT ARCHITECTURE

Project:
32 Crediton Hill
London
NW61HP

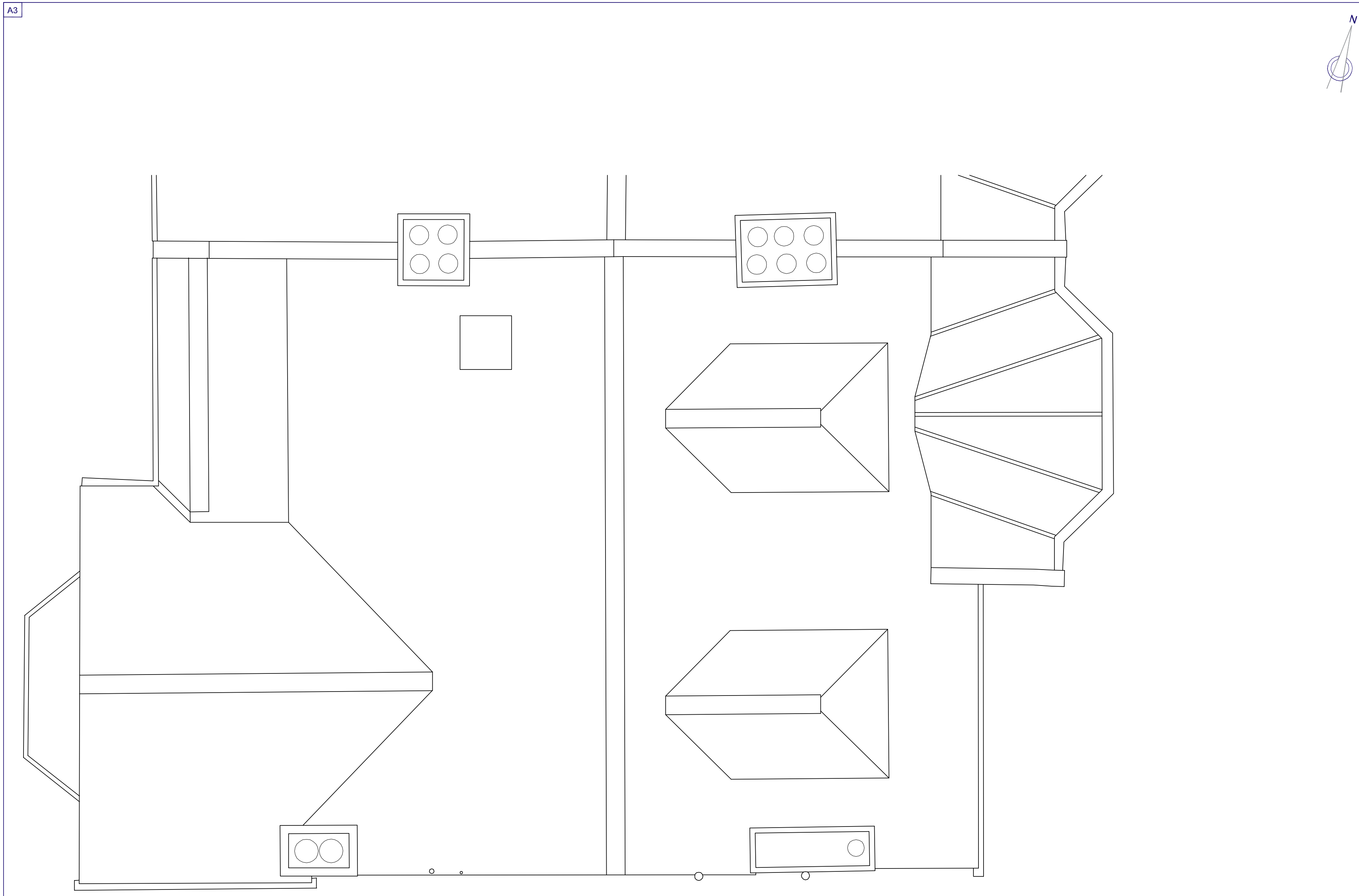
Client:
Mr. & Mrs. Thurlin

Title:
SECOND FLOOR PLAN: AS EXISTING

Status:
INFORMATION

Date:	Scale:	
11-04-21	1:50 @A3	
Job No:	Drawing No:	Rev:
330	E-004	000

A3



Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
Any discrepancies between drawings and or other documents shall be referred to the architects.

Compliance
All appropriate work to comply with the relevant requirements of the Building Regulations. All materials specified on this drawing are to be used strictly in accordance with the manufacturers recommendations, correct code of practice and where relevant British Board of Agrément Certificate.

Rev	Date	Description

CONNECT ARCHITECTURE

Project:
32 Crediton Hill
London
NW61HP

Client:
Mr. & Mrs. Thurlin

Title:
ROOF PLAN: AS EXISTING

Status:
INFORMATION

Date:	Scale:	
11-04-21	1:50 @A3	
Job No:	Drawing No:	Rev:
330	E-005	000

KEY:
- Existing
- Proposed
- Demolition
- Boundary

0 0.5 1m 4m

1 ROOF PLAN - AS EXISTING
Scale: 1:50

A3

1 ENTRANCE ELEVATION - AS EXISTING

Scale: 1:100

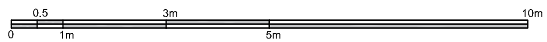
2 REAR ELEVATION - AS EXISTING

Scale: 1:100

3 SIDE ELEVATION - AS EXISTING

Scale: 1:100

KEY:
- Existing
- Proposed
- Demolition
- Boundary



Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
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Rev	Date	Description
002	19-04-21	Skylight added
003	28-04-21	Designs updated
004	29-04-21	Garden door added to canted bay

CONNECT ARCHITECTURE

Project: 32 Crediton Hill London NW61HP

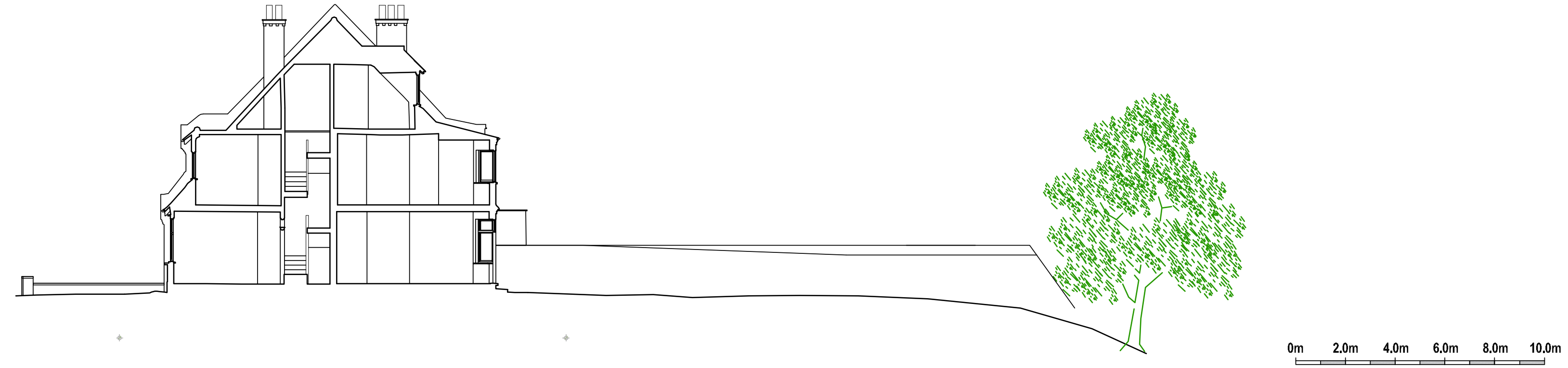
Client: Mr. & Mrs. Thurlin

Title: **ELEVATIONS: AS EXISTING**

Status: INFORMATION

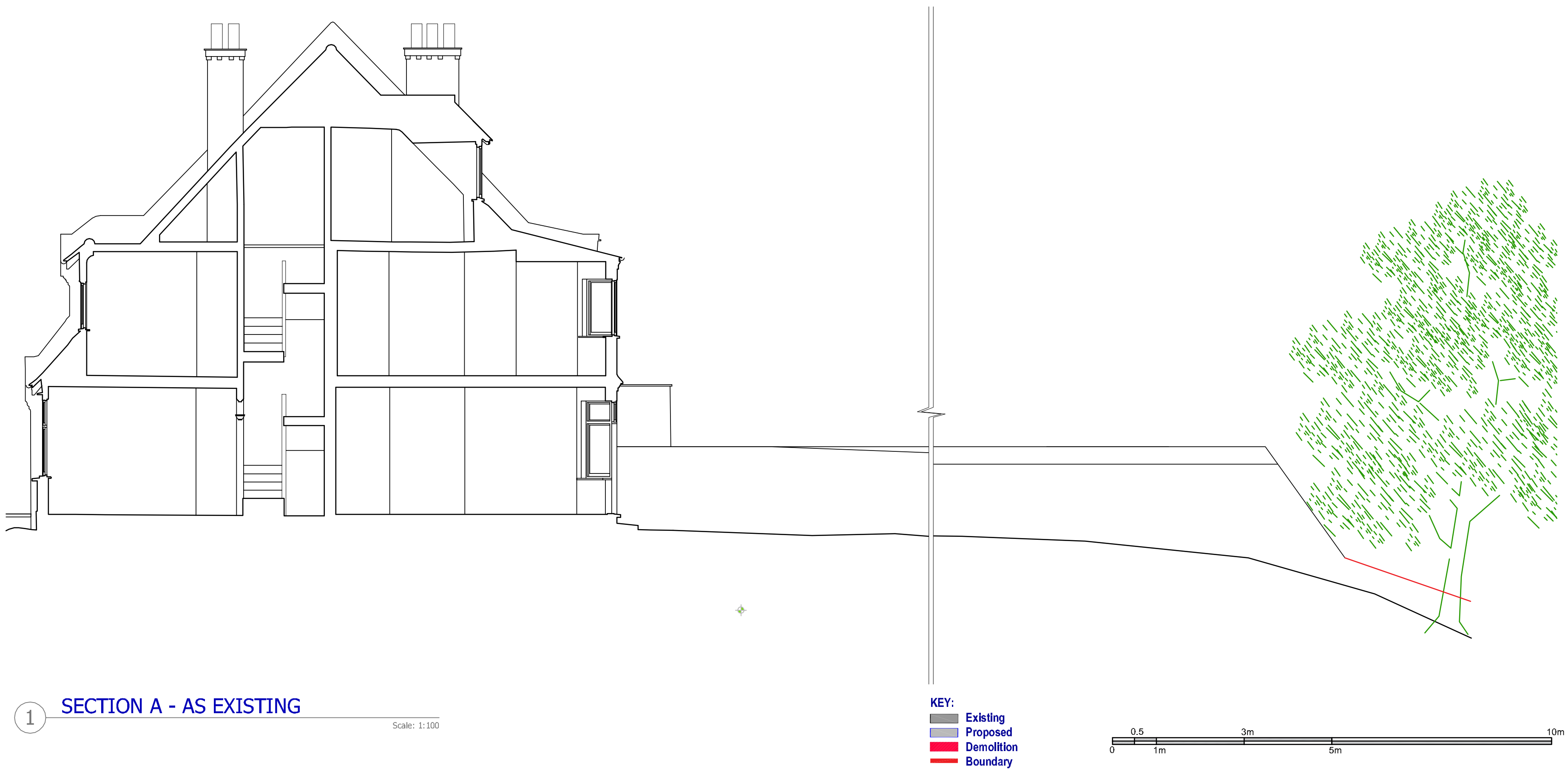
Date:	Scale:	
11-04-21	1:100 @A3	
Job No:	Drawing No:	Rev:
330	E-010	000

A3



1 SECTION A - AS EXISTING

Scale: 1:200



1 SECTION A - AS EXISTING

Scale: 1:100

KEY:
- Existing
- Proposed
- Demolition
- Boundary

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
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Compliance
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Rev	Date	Description

CONNECT ARCHITECTURE

Project:
32 Crediton Hill
London
NW61HP

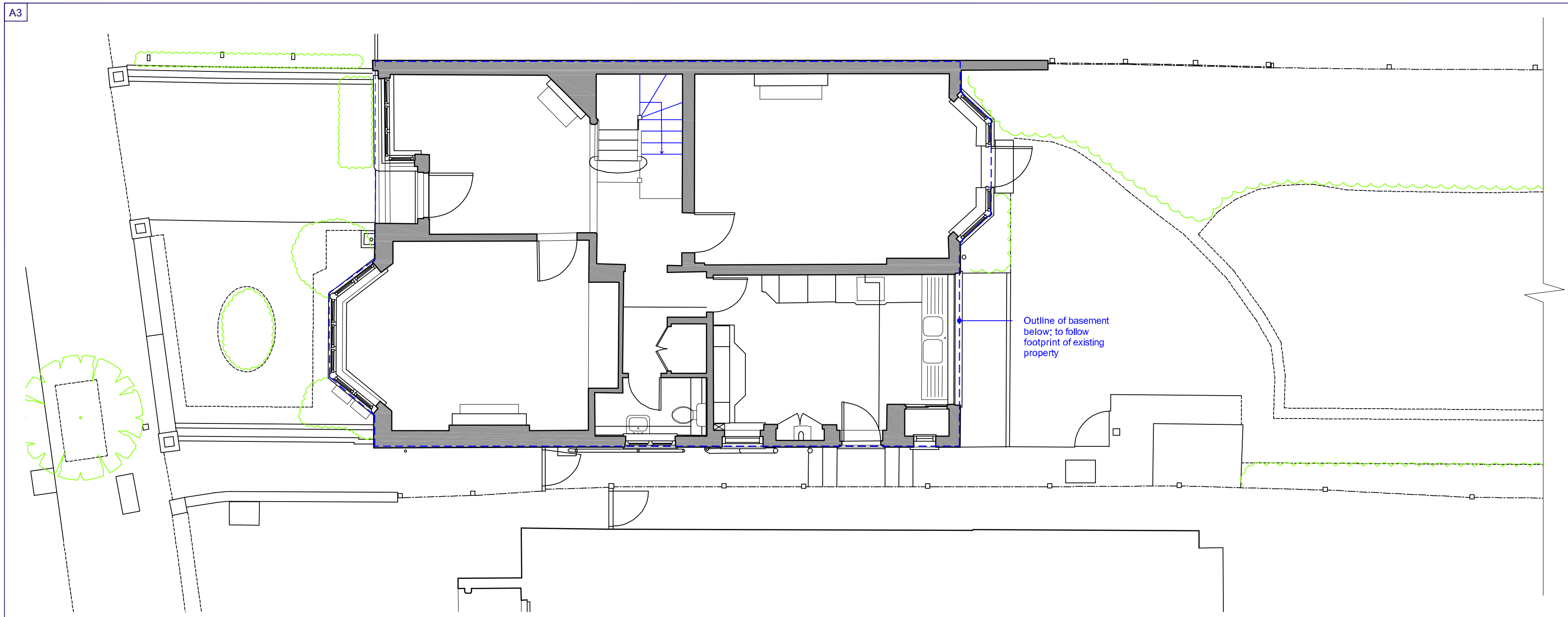
Client:
Mr. & Mrs. Thurlin

Title:
SECTION A-A: AS EXISTING

Status:
INFORMATION

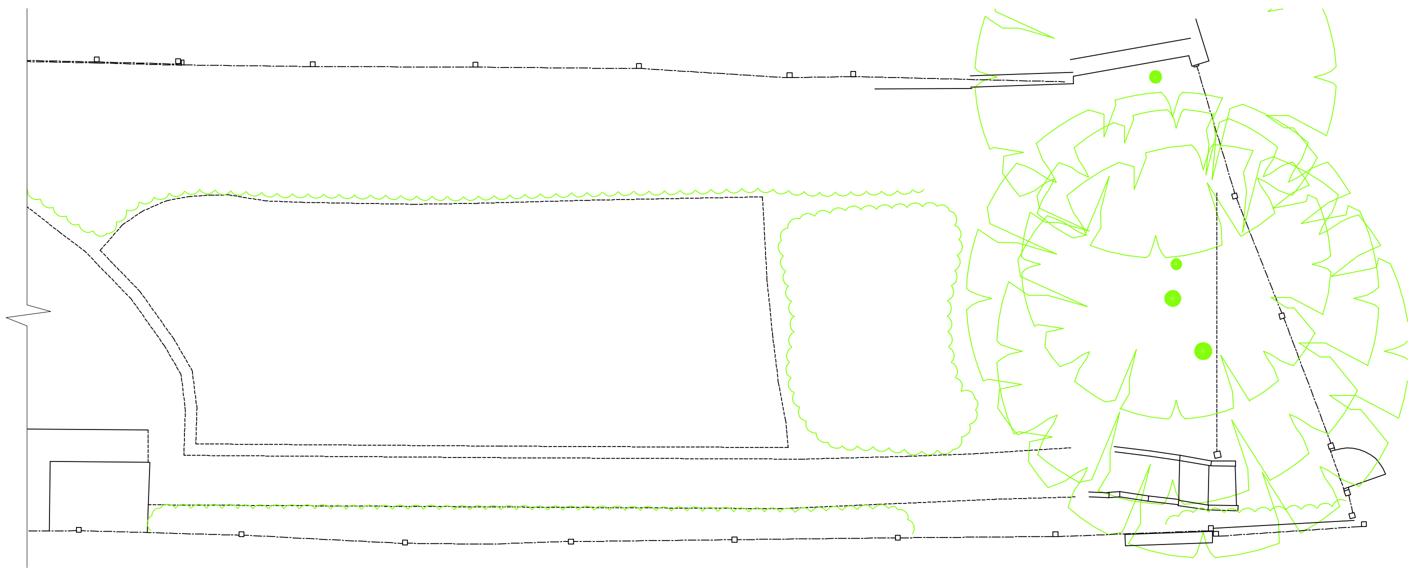
Date:	Scale:	
11-04-21	1:100, 1:200 @A3	
Job No:	Drawing No:	Rev:
330	E-020	000

A3



1 SITE PLAN - AS PROPOSED

Scale: 1:100



2 SITE PLAN - AS PROPOSED

Scale: 1:100

KEY:
- Existing
- Proposed
- Demolition
- Boundary

0 | 0.5 | 1m | 3m | 5m | 10m

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
Any discrepancies between drawings and or other documents shall be referred to the architects.

Compliance
All appropriate work to comply with the relevant requirements of the Building Regulations. All materials specified on this drawing are to be used strictly in accordance with the manufacturers recommendations, correct code of practice and where relevant British Board of Agrément Certificate.

Rev	Date	Description

CONNECT ARCHITECTURE

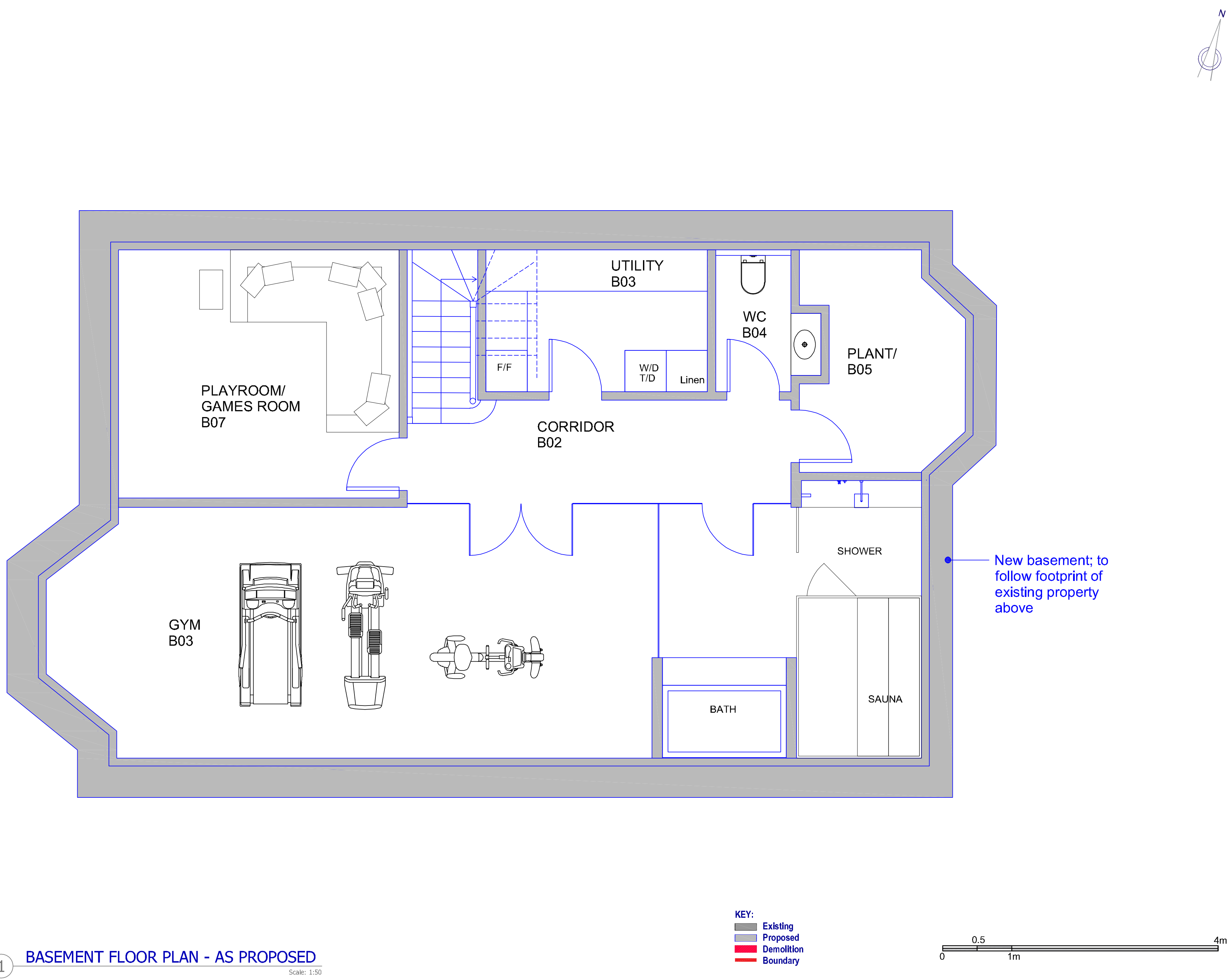
Project:
32 Crediton Hill
London
NW61HP

Client:
Mr. & Mrs. Thurlin

Title:
SITE PLAN:
AS PROPOSED

Status:
INFORMATION

Date:	Scale:	
11-10-21	1:100 @A3	
Job No:	Drawing No:	Rev:
330	P-001	000



1 BASEMENT FLOOR PLAN - AS PROPOSED

Scale: 1:50

A3

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
Any discrepancies between drawings and or other documents shall be referred to the architects.

Compliance
All appropriate work to comply with the relevant requirements of the Building Regulations. All materials specified on this drawing are to be used strictly in accordance with the manufacturers recommendations, correct code of practice and where relevant British Board of Agrément Certificate.

Rev	Date	Description

CONNECT ARCHITECTURE

Project:
32 Crediton Hill
London
NW61HP

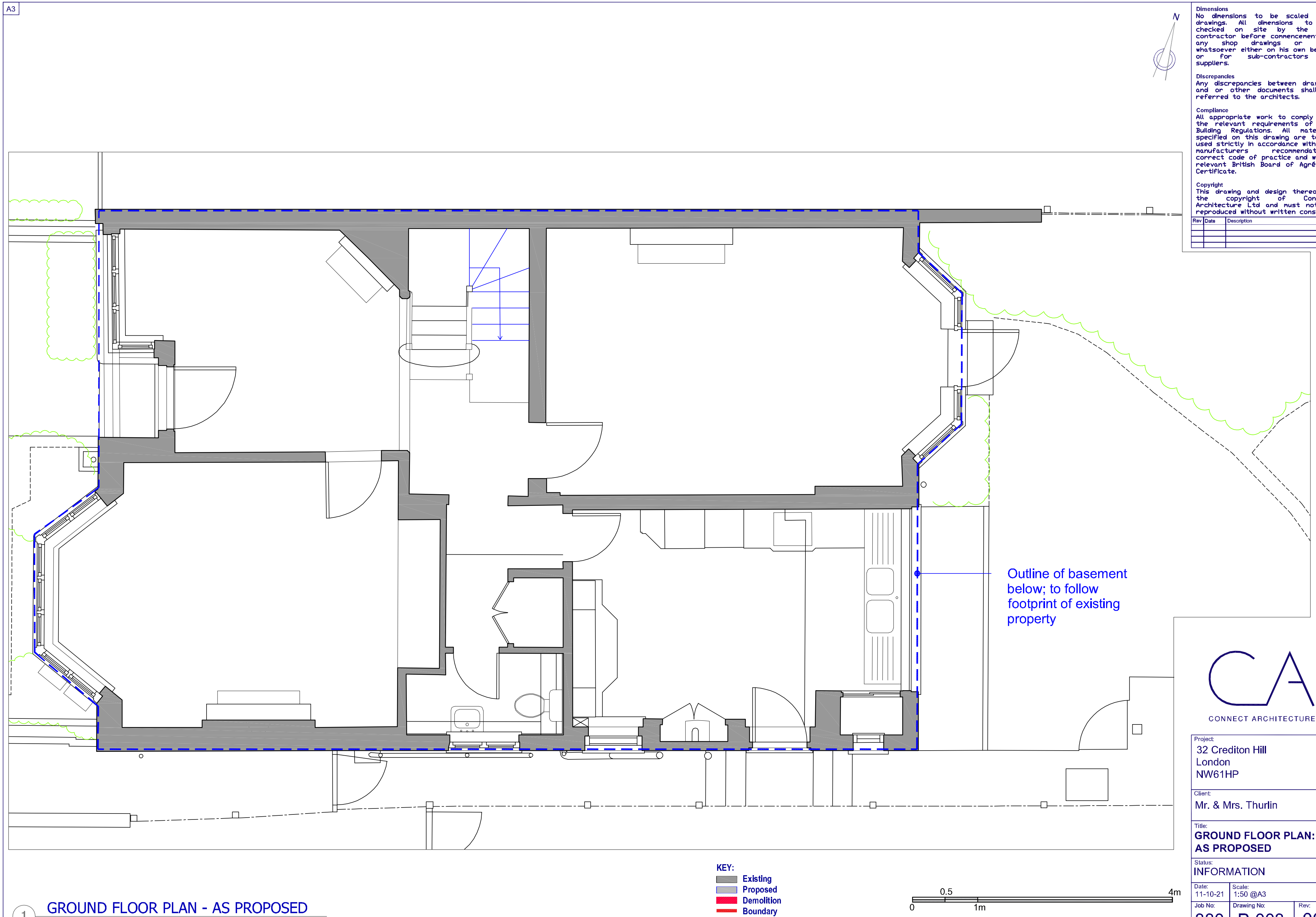
Client:
Mr. & Mrs. Thurlin

Title:
BASEMENT FLOOR PLAN: AS PROPOSED

Status:
INFORMATION

Date:	Scale:	
11-10-21	1:50 @A3	
Job No:	Drawing No:	Rev:
330	P-002	000

A3



1 GROUND FLOOR PLAN - AS PROPOSED

Scale: 1:50

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

Discrepancies
Any discrepancies between drawings and or other documents shall be referred to the architects.

Compliance
All appropriate work to comply with the relevant requirements of the Building Regulations. All materials specified on this drawing are to be used strictly in accordance with the manufacturers recommendations, correct code of practice and where relevant British Board of Agrément Certificate.

Rev	Date	Description

CONNECT ARCHITECTURE

Project: 32 Crediton Hill London NW61HP

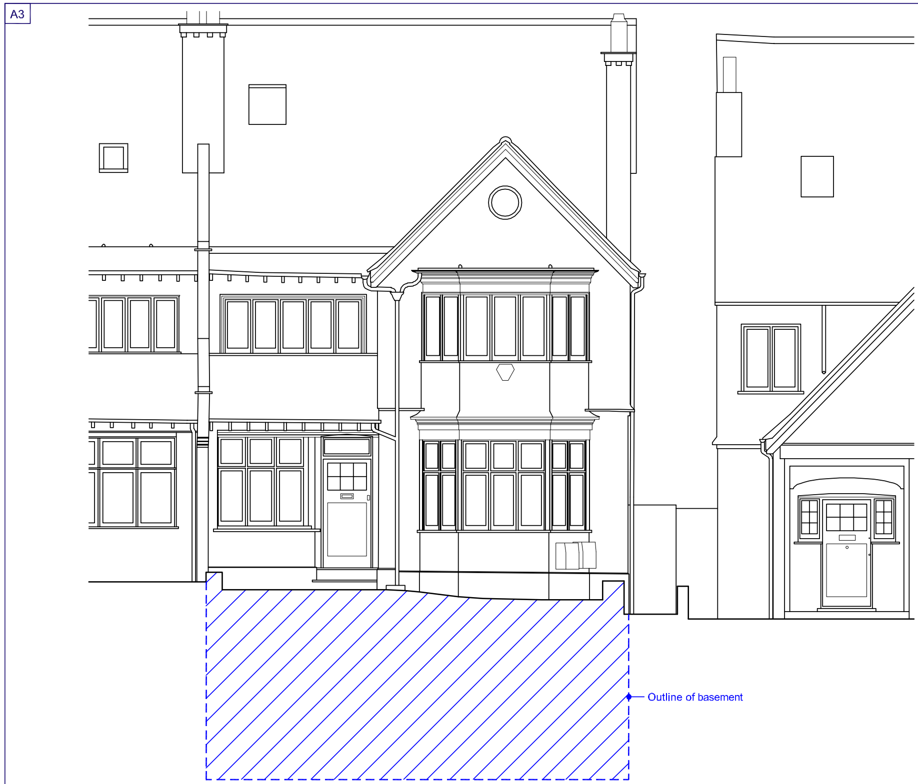
Client: Mr. & Mrs. Thurlin

Title: **GROUND FLOOR PLAN: AS PROPOSED**

Status: INFORMATION

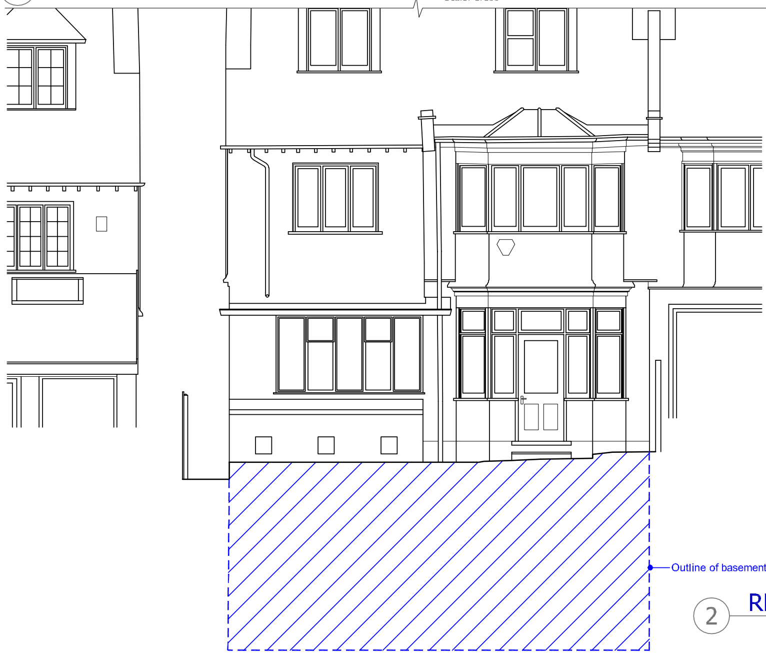
Date:	Scale:	
11-10-21	1:50 @A3	
Job No:	**Drawing No:**	**Rev:**
330	P-003	000

A3



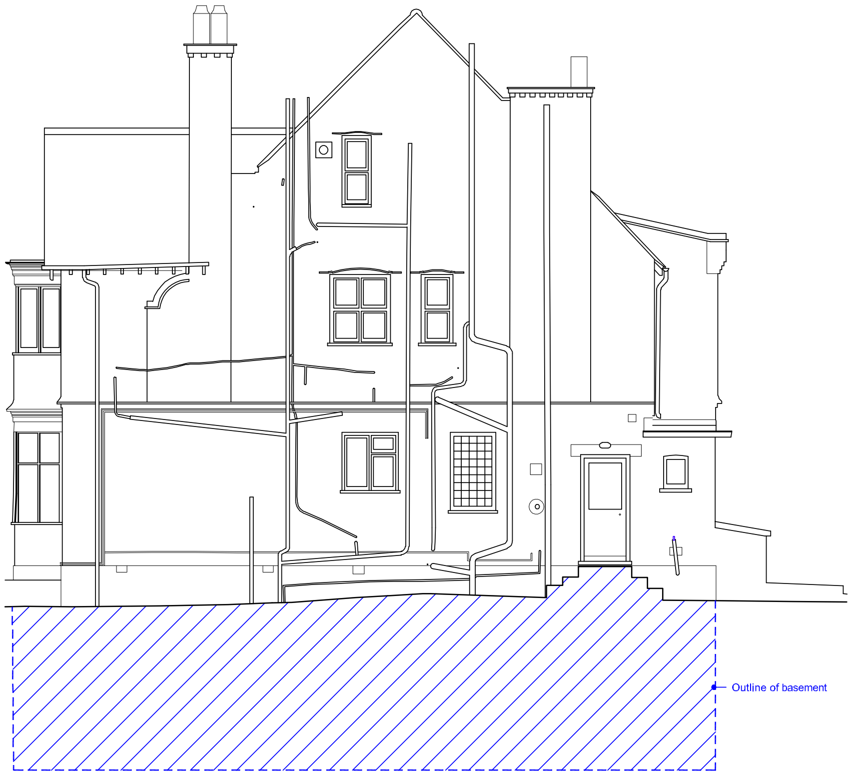
2 REAR ELEVATION - AS PROPOSED

Scale: 1:100



2 REAR ELEVATION - AS PROPOSED

Scale: 1:100



3 SIDE ELEVATION - AS PROPOSED

Scale: 1:100

0 0.5 1m 3m 5m 10m

KEY:
- Existing
- Proposed
- Demolition
- Boundary

Dimensions
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Rev	Date	Description

CONNECT ARCHITECTURE

Project:
32 Crediton Hill
London
NW61HP

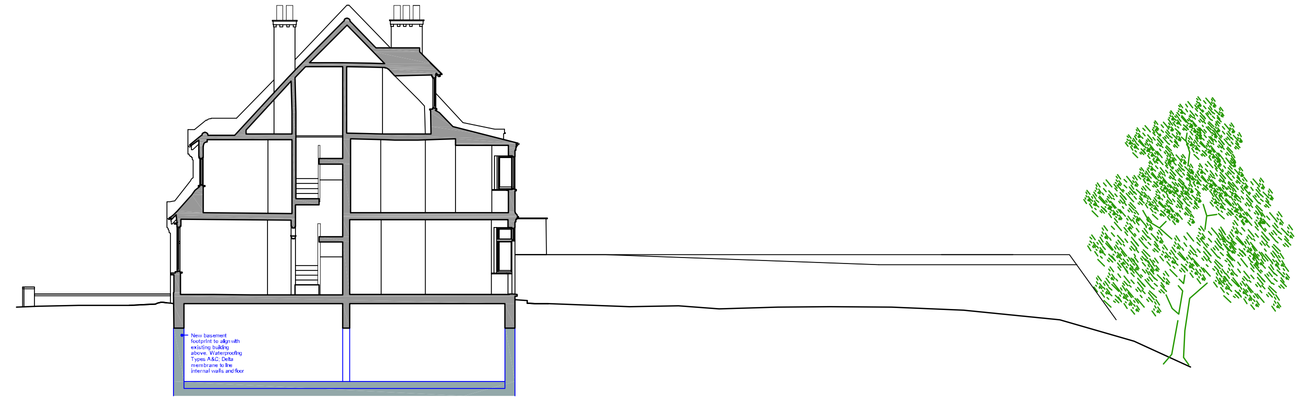
Client:
Mr. & Mrs. Thurlin

Title:
ELEVATIONS: AS PROPOSED

Status:
INFORMATION

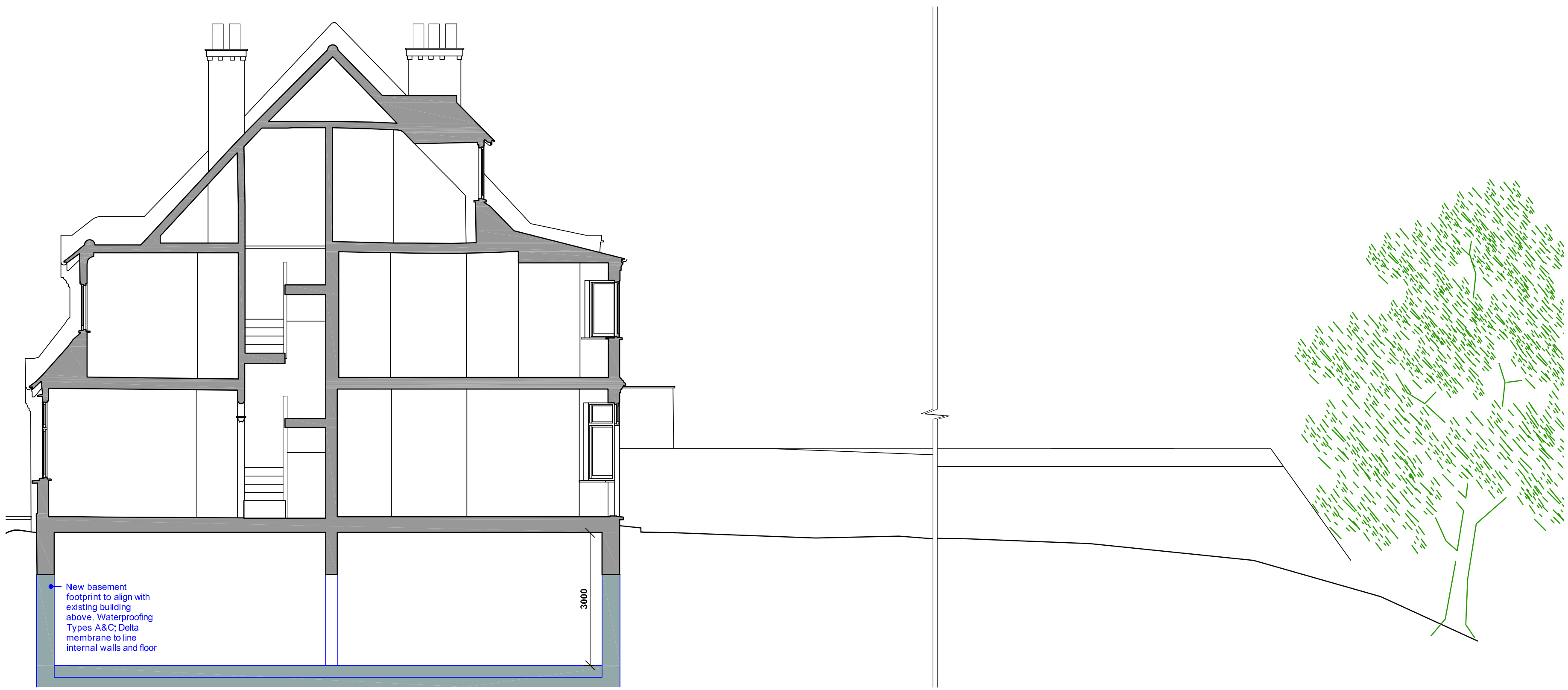
Date:	Scale:	
11-10-21	1:100 @A3	
Job No:	Drawing No:	Rev:
330	P-004	000

A3



1 SECTION A - AS PROPOSED

Scale: 1:200



2 SECTION A - AS PROPOSED

Scale: 1:100

KEY:
- Existing
- Proposed
- Demolition
- Boundary

0 0.5 1m 3m 5m 10m

Dimensions
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Rev	Date	Description

CONNECT ARCHITECTURE

Project:
32 Crediton Hill
London
NW61HP

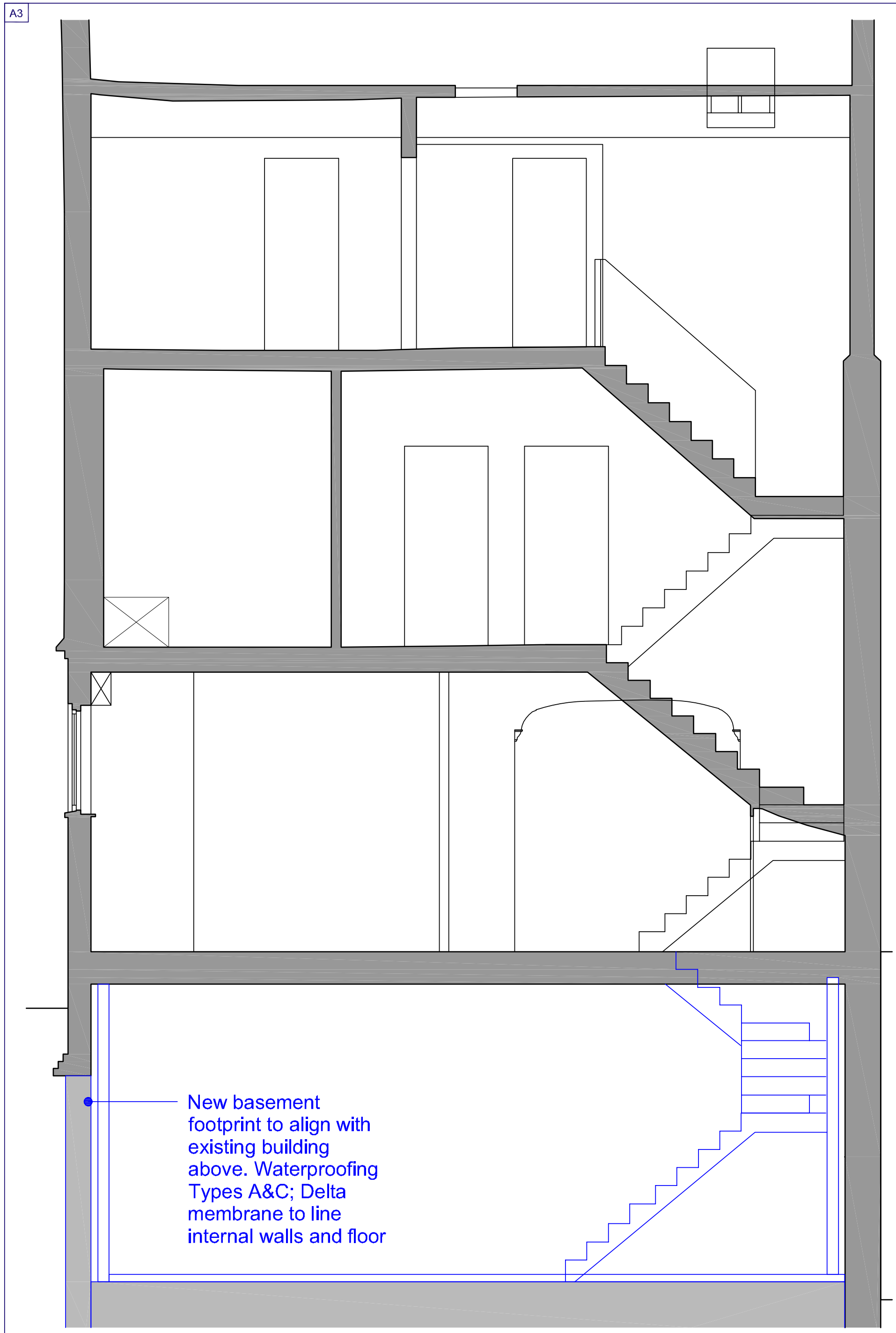
Client:
Mr. & Mrs. Thurlin

Title:
SECTION A: AS PROPOSED

Status:
INFORMATION

Date:	Scale:	
11-10-21	1:100, 1:200 @A3	
Job No:	Drawing No:	Rev:
330	P-005	000

A3



2 SECTION B - AS PROPOSED

Scale: 1:50

3 SECTION C - AS PROPOSED

Scale: 1:50

Dimensions
No dimensions to be scaled from drawings. All dimensions to be checked on site by the main contractor before commencement of any shop drawings or work whatsoever either on his own behalf or for sub-contractors or suppliers.

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Compliance
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Rev	Date	Description

CONNECT ARCHITECTURE

Project:
32 Crediton Hill
London
NW61HP

Client:
Mr. & Mrs. Thurlin

Title:
SECTIONS B-C: AS PROPOSED

Status:
INFORMATION

Date:	Scale:	
11-10-21	1:50 @A3	
Job No:	Drawing No:	Rev:
330	P-006	000