61 REDINGTON ROAD

HAMPSTEAD

SURFACE FLOW AND FLOODING BASEMENT IMPACT ASSESSMENT

MR & MRS BURNS

DOCUMENT REFERENCE:

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WATER | ENVIRONMENT

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Authorisation and Version Control

Water Environment was commissioned by Mr & Mrs Burns to investigate the risks and assess the consequences of flooding on the site at 61 Redington Road as well as to develop a Sustainable Drainage Strategy for the proposed development.

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Document Version History

Rev	Date	Comments	Auth	Chck	Appr
P01	24/03/2022	First issue for design team comment	FdM	LS	GL
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C02	22/04/2022	Revision for updated plans	FdM	CB	GL

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NON-TECHNICAL SUMMARY

The proposed development is located at number 61 Redington Road, Hampstead, as shown on the location plan below.

The current property is arranged over four floors, including a lower ground floor, and is currently sub-divided into three separate residential properties. The proposed development involves internally refitting the property, which would be returned to a main dwelling with a single one-bedroom flat at lower ground floor. The proposals involve the excavation of the lower ground floor by approximately 1.3m at the rear and approximately 2m to the front. The lower ground floor will also be extended to the rear (horizontally) by approximately 4m.

The following assessments are presented within this report:

- Surface Flow and Flooding Desk Study
- Surface Flow and Flooding Basement Impact Screening
- Surface Flow and Flooding Basement Impact Assessment Scoping
- Additional Evidence/Assessments
    - Flood Risk Assessment
    - Surface Water Drainage and SuDS Assessment
- Surface Flow and Flooding Basement Impact Assessment

This assessment does not include consideration of Groundwater Flow or Land Stability, which will be provided by others and, together with this report, will provide an overarching Basement Impact

Assessment in accordance with Camden Basement guidance.The assessment is prepared by Water Environment Limited. Water Environment staff are skilled in the assessment of flood risk and groundwater, and are members of the Institution of Civil Engineers (ICE) and the Institute of Water and Environmental Management (CIWEM). All Water Environment Directors and Associates are Chartered Members of the ICE or CIWEM or both.

A Flood Risk Assessment has been conducted and concluded that there are no significant risks of flooding to the site from any source, and that the proposed development will not affect the risk of flooding elsewhere.

The Basement Impact Assessment (BIA) has identified negligible flood risk for the proposed development.

The assessment has identified the following potential hydrological impacts:

- Potential change in runoff rates due to an increase in the proportion of hard paved surfaces on the site. This requires a SuDS strategy to ensure there is no impact on downstream runoff flows or water quality.
- Potential changes in runoff due to climate change over the lifetime of the development. This requires a SuDS strategy to ensure there is no impact on downstream runoff flows or water quality.

A SuDS assessment has been conducted and concluded that, although surface water runoff rates will increase following development without mitigation, they can be attenuated to current, present day rates and discharged to existing connections. The detailed design of the drainage system should be undertaken in accordance with the recommendations in this BIA.

The BIA concludes that subject to compliance with recommendations detailed herein, the residual impacts on the wider hydrological environment are negligible.

ABBREVIATIONS

Acronym	Definition
AOD	Above Ordnance Datum
BGL	Below Ground Level
BGS	British Geological Survey
BIA	Basement Impact Assessment
DEFRA	Department for Environment Food and Rural Affairs
DTM	Digital Terrain Model
EA	Environment Agency
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
LASOO	Local Authority SuDS Officer Organisation
LBC	London Borough of Camden
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan

1 INTRODUCTION

General Information

1.1 The purpose of this assessment is to consider the effect on surface flow and flooding of the proposed basement extension at 61 Redington Road in Hampstead, London, NW3 7RP.

1.2 The existing property at 61 Redington Road is arranged over four floors including an existing lower ground floor (the basement). The property contains three separate residential units, each unit arranged over two or more floors. The proposal is to convert the building to form one family dwelling and a self-contained flat at lower ground floor level. This will involve excavation at basement level to increase floor to ceiling height, and rear extensions to enhance the appearance of the rear elevation.

1.3 As a result of the proposals, the current lower ground floor extent will increase, and will extend further below ground.

Scope of Study

1.4 The approach follows the procedure adopted by the London Borough of Camden (LBC) for the assessment of basements and lightwells. This report covers the 'Surface Flow and Flooding' elements of the basement impact assessment and is divided into four stages: Desk Study; Screening; Scoping; and Impact Assessment. The structure of this assessment is guided by Camden Basement guidance[1] and the Basement Impact Assessment (BIA) pro forma.

1.5 Whilst this report does include consideration of geology and below ground flows as part of the overall assessment of flood risk, the formal 'Subterranean (groundwater) Flow' and 'Land Stability' sections of the BIA will be completed by others.

1.6 The study includes a Flood Risk Assessment (FRA) and Sustainable Drainage Systems (SuDS) Assessment as part of the report. The scope of the FRA (see Chapter 3) and SuDS Assessment (see Chapter 6) is as follows:

- To provide a flood risk assessment for the site compliant with the guidelines set out in the National Planning Policy Framework (NPPF) and associated Planning Practice Guidance (PPG);
- To assess the risk and implications of flooding on the site including flooding from tidal, fluvial, groundwater, surface water runoff and artificial sources;
- To provide advice on the site design that will ensure safe operation of the site in any flood event;
- To consider the pre- and post-development drainage systems and calculate pre- and post-development runoff rates and volumes based on standard methodologies; and
- To provide advice and guidance on the management of surface water runoff at the site to ensure the risk of surface water flooding on the site and on nearby sites does not increase post-development.

Authors

1.7 Water Environment Limited has over 18 years of experience of consulting engineering in the water sector including flood risk assessment and drainage system design. Water Environment

[1] London Borough of Camden, Camden Planning Guidance: Basements, January 2021

staff are skilled in the assessment of flood risk and groundwater, and are members of the Institution of Civil Engineers (ICE) and the Institute of Water and Environmental Management (CIWEM). All Water Environment Directors and Associates are Chartered Members of the ICE or CIWEM or both.

1.8 Water Environment Limited is supplying the assessment covering Surface Water and Flooding for the Basement Impact Assessment.

Sources of Information

1.9 Baseline data have been drawn from the following sources:

- Current and historical Ordnance Survey mapping;
- Geological mapping and hydrogeological data taken from the British Geological Survey Geology of Britain, BGS Hydro and open data Web Map Services;
- Site ground investigation undertaken on 28th February 2022 by Ground and Water;
- Hydrological information from the Flood Estimation Handbook (FEH) web service;
- Flood risk mapping from the UK government Environmental Open Data Web Map Services and environmental information from DEFRA's Magic Map;
- LiDAR ground level information data from the Environment Agency;
- LBC Strategic Flood Risk Assessment[2] (SFRA), Preliminary Flood Risk Assessment[3] (PFRA) and Floods in Camden Report[4];
- LBC Planning Guidance (CPG) Basements[5], Local Plan Policy A5 and Camden Geological, Hydrogeological and Hydrological Study[6] (GHHS); and
- LBC Audit Process Terms of Reference.

[2] URS, London Borough of Camden SFRA, July 2014
[3] Drain London/London Borough of Camden, Preliminary Flood Risk Assessment, v0.2, April 2011
[4] London Borough of Camden, Floods in Camden Report of the Floods Scrutiny Panel, June 2003
[5] London Borough of Camden, Camden Planning Guidance: Basements, January 2021
[6] London Borough of Camden, Camden geological, hydrogeological and hydrological study – Guidance for subterranean development, Issue 01, November 2010

2 DESCRIPTION OF DEVELOPMENT

Location

2.1 The proposed development is located on Redington Road in Hampstead. The property is located on the western side of the road opposite the junction with Templewood Avenue as shown in Figure 1.

Figure 1: Location of proposed development

2.2 The site is located to the west of Hampstead. The red line boundary coincides with the property boundary, and the site is bounded by other residential properties on all sides, with Redington Road to the front (northeast).

Existing Site

2.3 The site is currently occupied by the property at 61 Redington Road. The existing accommodation is arranged over four floors, including lower ground floor, and is currently subdivided into three separate residential properties.

2.4 MIJA Survey Limited undertook a topographic survey of the site in December 2021. The survey shows that the site slopes away from the road with maximum site levels of 98.89m AOD in the northern corner. Spot levels at the drive entrances show that there is a slope up to the property boundary from the road of around 100 mm before levels fall away.

2.5 The garage driveway falls to a lower ground level of 96.34m AOD, which is approximately 600mm below the entrance level of 97.83m AOD. There is a slot drain at the garage entrance to collect surface water runoff. The driveway is enclosed by retaining walls, and the remainder of the front garden is at a level of between 98.47m AOD and 98.89m AOD. The front garden is mostly gravel and paving.

2.6 The survey shows steps leading up into the property at ground floor level with the top step at 98.81m AOD. Paving leads along the north-western edge of the property, providing access to the rear garden, at a level falling from 98.29m AOD to 96.75m AOD. A rainwater downpipe directs roof runoff into a gully.

2.7 To the rear of the property, ground levels fall from 96.56m AOD at the rear of the house to 95.86m AOD in the southern corner of the garden. The majority of the rear garden is laid to lawn, however there is an area of paving adjacent to the house on the southern side. Steps lead down from this paving to the lower-ground floor level.

2.8 The building survey indicates that at present the lower ground floor finished floor level varies from 96.14m AOD to the rear and 97.03m AOD to the front of the building. The ground floor level is 98.95m AOD, with first and second floor at 102.27m AOD and 105.42m AOD respectively.

Proposed Development

2.9 The proposed development involves an internal refit of the building such that the property would be sub-divided into two- a main family dwelling and single flat. The flat would be fully contained within the basement; with access from the side of the house at ground floor level (97.43m AOD). The proposed development reduces the number of residential units on site from three to two.

2.10 The proposals include extension of the basement to the rear and would deepen the basement such that the finished floor levels would be 95.34m AOD to the rear and 95.55m AOD to the front. This would require a lowering of the existing basement by approximately 800mm, with the final base of the structure being at 94.75m AOD.

2.11 The footprint of the building would also be extended to the rear at lower ground floor, with the first and second floors being extended over the existing building footprint.

3 DESK STUDY – SURFACE FLOW AND FLOODING

Geology

3.1 According to the 1:50,000 scale BGS mapping, the site appears to be located above the Claygate Member. The lower boundary of the Bagshot Sand lies uphill, 100m to the northwest, while the lower boundary of the Claygate Member is 100m to the southeast. The geology beneath the Claygate Member is London Clay. The geology is shown in Figure 2.

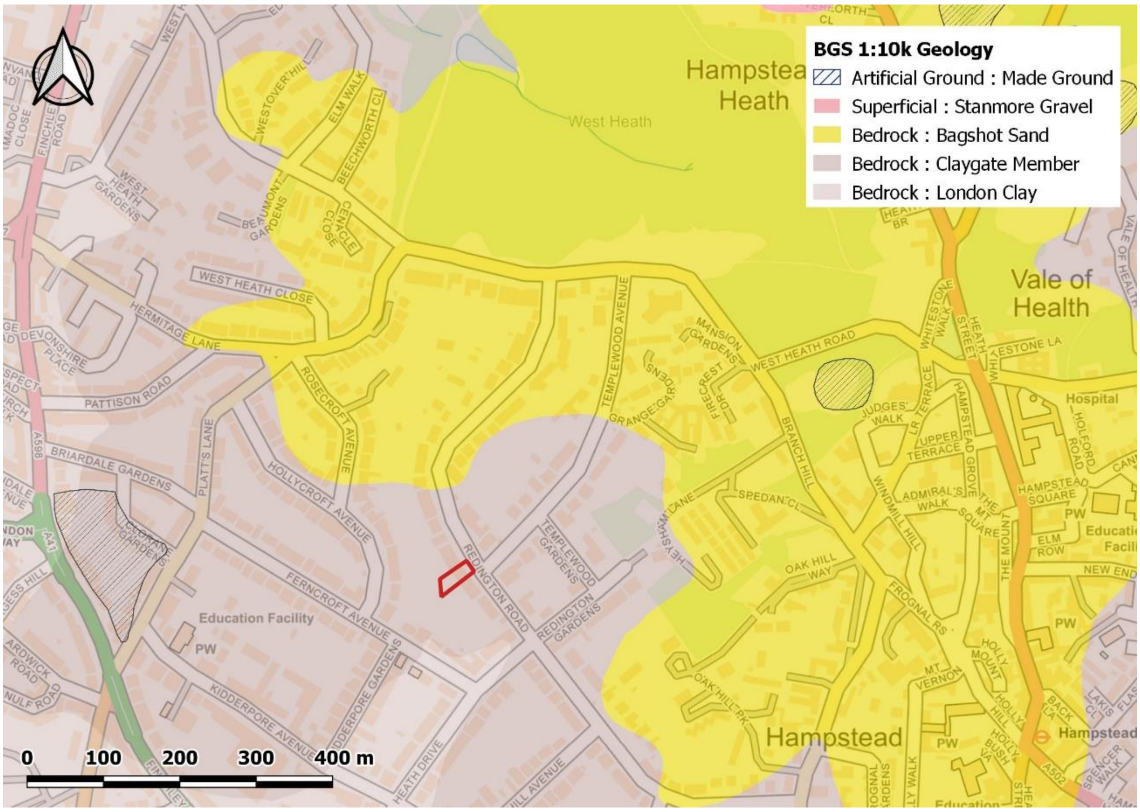


Figure 2: British Geological Survey Recorded Geology

3.2 There are no recorded superficial deposits at the site or nearby.

3.3 Whilst the BGS mapping provides an excellent resource for understanding the likely geology and general geological sequence within an area, this is not intended to be site specific and therefore on-site ground investigation is necessary to provide further information on the geology encountered directly beneath the site.

3.4 A site ground investigation was undertaken on 28th February 2022 and comprised of one borehole and two window samples. The ground investigation found that the geology at the site was Made Ground over London Clay, and did not encounter the Claygate Member at the site location. A 300mm thick layer of Head Deposits was encountered. The borehole did not encounter the deeper formations at the end depth of 8.45m BGL. All sub-surface strata were classified as CLAY.

Hydrogeology

3.5 The BGS 1:625,000 hydrogeological mapping defines the Bagshot Sand (as part of the Bracklesham/Barton Group) as a moderately productive aquifer, and the Claygate Member (as part of the Thames Group) as rock with essentially no groundwater.

3.6 The GHHS Figure 8 indicates that the site lies over a Secondary A Aquifer. The extent of this aquifer is defined by the areas where the Claygate Member and Bagshot Sand are the shallowest rock formations. The Claygate Member is defined as "Clay, Silt and Sand" and may be permeable in locations where the sand is dominant. According to the GHHS, Hampstead is one of these locations.

3.7 According to DEFRA's Magic Map, the Secondary A Aquifer is a minor bedrock aquifer with medium vulnerability (the aquifer has high vulnerability to the north and east). The Aquifer is not designated as a groundwater body under the Water Framework Directive (WFD), and there are no associated groundwater Source Protection Zones (SPZ).

3.8 No groundwater was encountered during the site ground investigation, which was undertaken following a month in which 153% of the average February rainfall was recorded across the UK[7]. The borehole and trial pits found that the site is located over London Clay. Despite published geological and hydrogeological mapping, the Claygate Member and Bagshot Sand were not encountered during the site specific ground investigation. Seepage was noted within the borehole in the London Clay at around 6m BGL, and within a foundation excavation trial pit at around 0.7m BGL, but these are not considered to form part of any groundwater body.

Historical Records of Flooding

3.9 According to the available datasets, the site is not recorded as having flooded in the past from any source.

Flooding from Rivers and the Sea

3.10 The site is located within Flood Zone 1. The nearest fluvial watercourse with associated Flood Zone Mapping is the River Brent, located nearly 3km to the north-west. This is also the nearest classified river under the WFD.

3.11 The closest surface watercourses to the site are the stream on West Heath, which flows in a northerly direction and is located 600m north of the site, and the streams that feed Hampstead Ponds, which flow east and then south, from a point 1.2km to the north-east of the site. The catchment watersheds for these watercourses pass along West Heath Road, approximately 300m north of the site, and along Hampstead Grove and Holly Hill, west of Heath Street, approximately 700m east of the site. The site is therefore not at risk of flooding from these streams.

3.12 According to the Flood Estimation Handbook (FEH) web mapping service, the site lies towards the head of the natural catchment that reaches 0.5km^2 in size at West Hampstead fire station. The site is approximately 750m north of this location. Nineteenth century historical mapping from Vision of Britain shows a stream rising slightly to the west of this location, south of Mill Lane near where Sumatra Road now lies. The watershed is a further 300m north of the site.

3.13 Although Figure 11 of the GHHS shows the head of a historical tributary of the Tyburn running along the south side of the current location of Redington Road, there is not currently any watercourse at this location. The site lies close to the watershed of this catchment and is not at significant risk of flooding from this source.

3.14 The natural drainage catchments were extracted by analysing the Environment Agency 2m LiDAR for the area and are presented in Figure 3. The analysis agrees well with Figure 14 of the GHHS (for the Golders Hill Chain and Hampstead Chain catchments) and confirms the assessment that

[7] https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/summaries/uk_monthly_climate_summary_202202a.pdf

there is no risk of flooding from fluvial sources due to the location of the site close to the natural catchment watershed for the area.

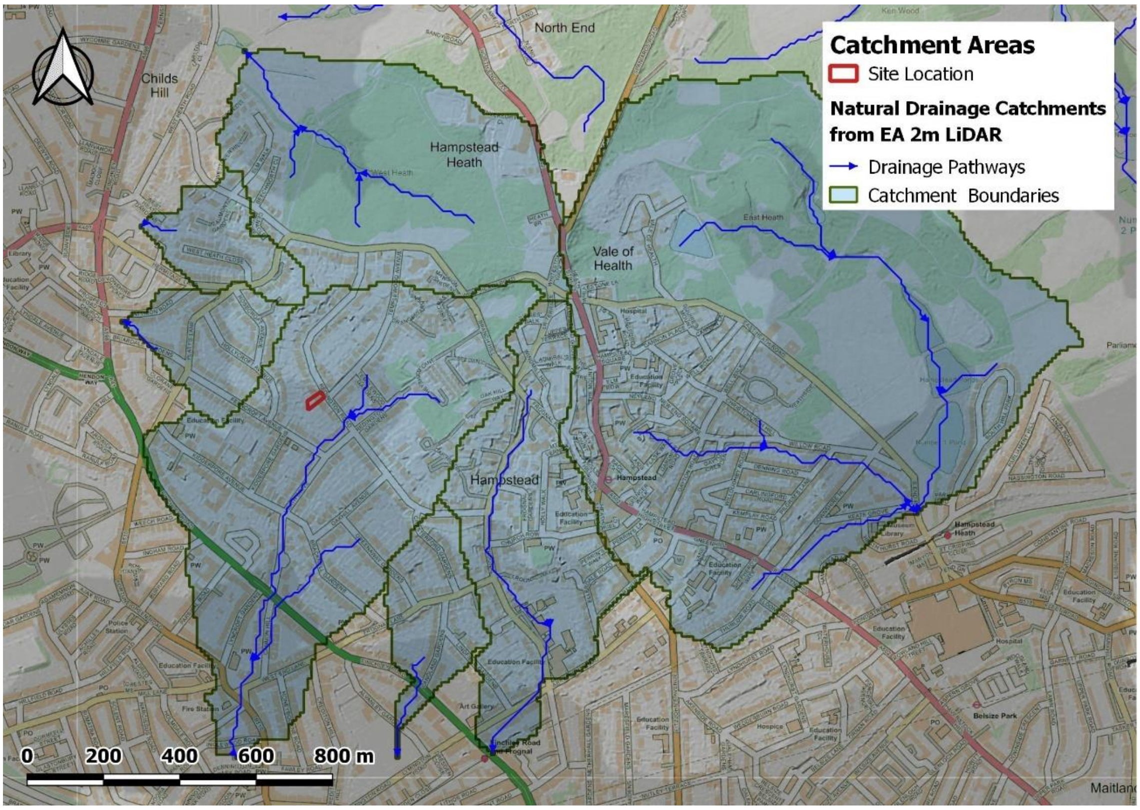


Figure 3: Hampstead Area Catchment Analysis

3.15 The site is not at risk of flooding from rivers or the sea.

Flooding from Surface Water

3.16 Flooding from surface water arises during intense rainfall events when flood waters are unable to infiltrate into the ground or discharge into local ditches or artificial drainage infrastructure. In an urban environment, the risk of flooding from surface water and from overloaded sewers is closely related, and both are included in the relevant surface water flooding datasets. Flooding events are typically of short duration (unless there is a drainage system blockage), but can be severe.

3.17 According to the GHHC Figure 15 historical mapping figure, the site is not recorded as being on a road that has flooded in the past or is at potential risk of surface water flooding. Templewood Avenue and Templewood Gardens are recorded to have flooded in 2002, however, Redington Road was not flooded, and this is consistent with the gradients in the area which would direct flow towards the natural valley base as shown in Figure 3. The site is not in a Critical Drainage Area.

3.18 The Gov.UK Risk of Flooding from Surface Water (RoFSW) map, presented in Figure 4, shows that the site, including Redington Road, is not at risk of flooding from surface water in the 0.1% annual exceedance rainfall event. Whilst flooding is shown within roads to the south of the site, including Templewood Gardens and to the rear of properties on Templewood Avenue, and at the junction of Redington Road and Redington Gardens, due to local topography the site itself is not shown to be at risk.

3.19 Access to land at less than 0.1% annual chance of flooding is available north along Redington Road or Templewood Avenue, and in multiple directions thereafter including east into Hampstead.

3.20 Taking account of all sources of information, it is concluded that the site is not at significant risk of flooding from surface water.

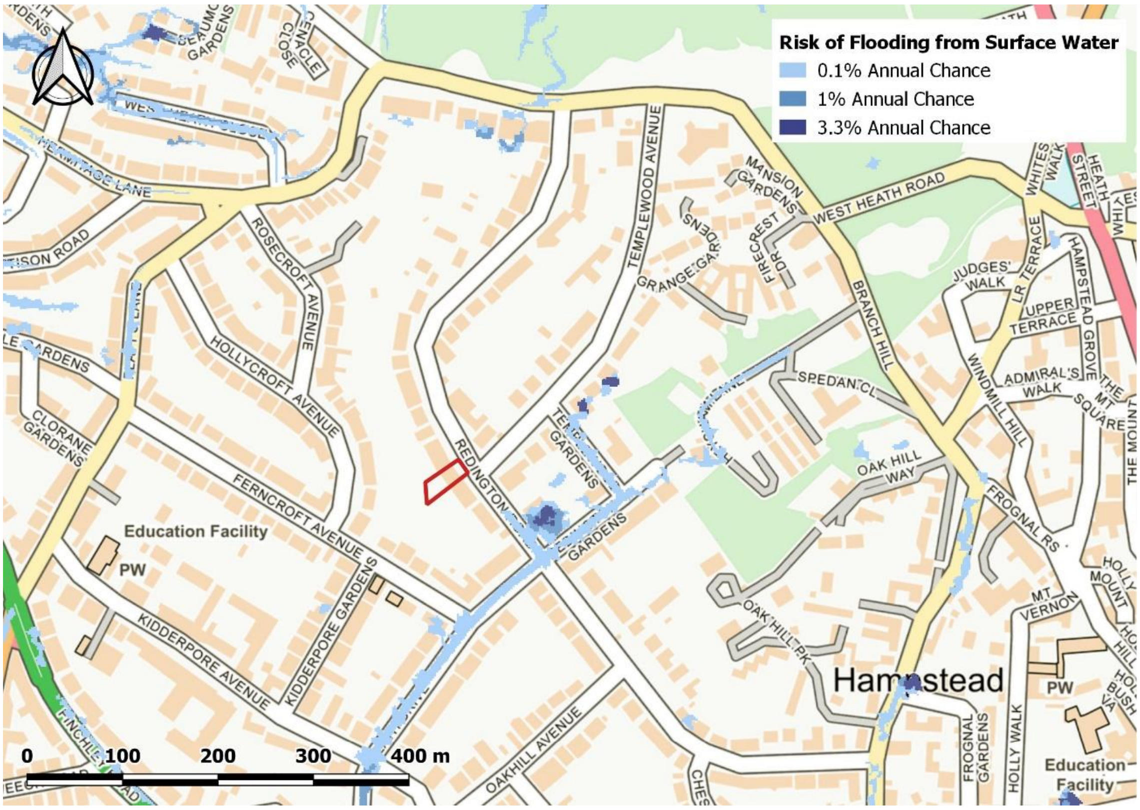


Figure 4: Gov.UK Risk of Flooding from Surface Water map

Flooding from Sewers

3.21 Sewer flooding generally results in localised short term flooding caused by intense rainfall events overloading the capacity of sewers. Typically, flooding would be expected to be similar and scale and hydraulics to surface water flooding.

3.22 Thames Water has confirmed that there have been no records of flooding at 61 Redington Road as a result of surcharging public sewers. The asset location information indicates that there is a public combined sewer running south-east along Redington Road, at a depth of 5.32m at the junction with Templewood Avenue. The invert level of this pipe is 91.98m AOD, over 3.3m below the lower ground floor finished floor level in the proposed extension of 95.34m AOD. A surcharge depth of at least 3.5m would be required to present a risk of flooding to the basement from sewers.

3.23 The proposed development is not at significant risk of flooding from sewers.

Flooding from Groundwater

3.24 The site ground investigation found that the site is located on Made Ground over a thin layer of Silt Head Deposits over London Clay. The geology at the site is generally impermeable. Groundwater was not encountered although seepage was observed at shallow depths in the London Clay. The site investigation was undertaken following prolonged heavy rainfall in the preceding month, with three named storms passing in the preceding week. The seepage is not likely to be the result of the presence of a significant body of groundwater.

3.25 The proposed basement is not at significant risk of flooding due to groundwater within the sub-surface strata. However, as recommended in the geotechnical report, the basement should be protected from ingress of perched groundwater from the surrounding unproductive strata, which is a standard precaution in basement construction.

3.26 The site lies around 100m from the potential spring line that occurs at the base of the Bagshot Sand. The site is downhill in relation to the potential spring line, and therefore groundwater emerging from the base of the Bagshot Sand could be expected to pass the site. However, slopes in the area are such that this would generally be expected to flow overland without ponding, either being collected into highway or local drainage, or following the pathways indicated by the RoFSW map.

3.27 The proposed development is not at significant risk of flooding from groundwater.

Flooding from Other Sources

3.28 According to the Gov.UK long term reservoir flood extents, presented in Figure 5, the site is not at risk of flooding as a result of reservoir failure on either a dry day or in combination with fluvial flooding.

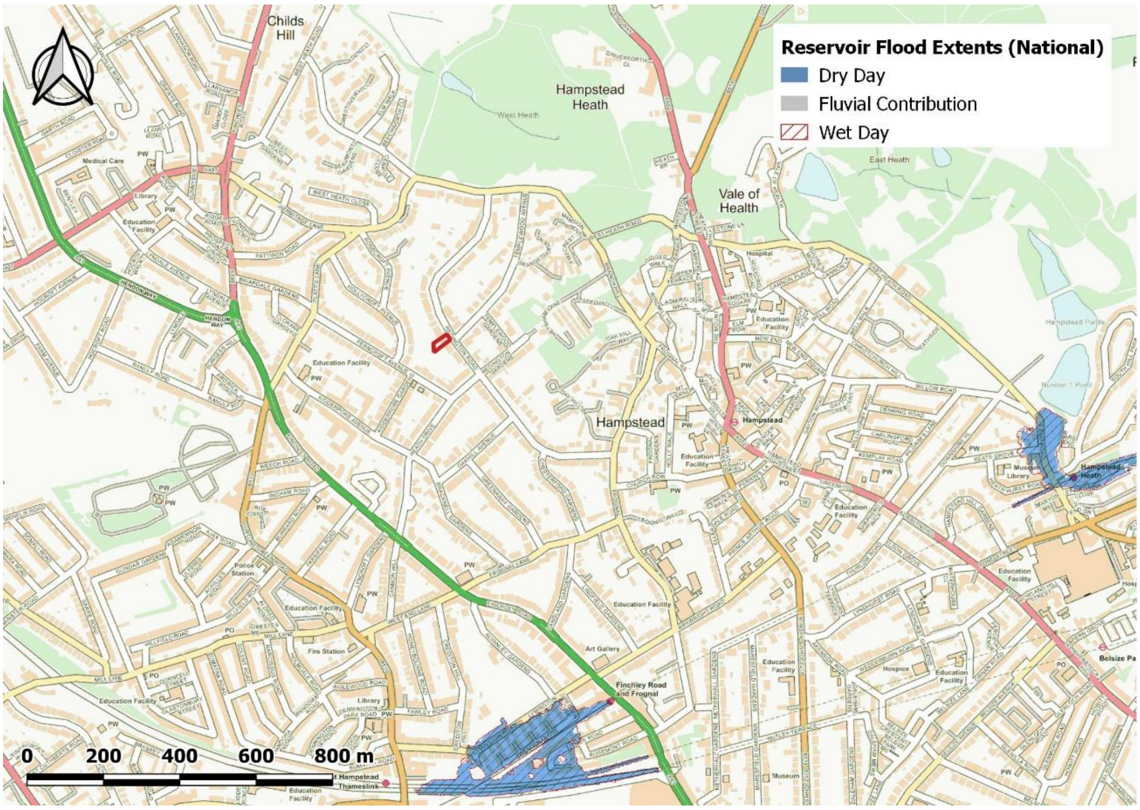


Figure 5: Gov.UK Risk of Flooding from Reservoirs map

3.29 The site lies outside the catchment areas of the various ponds on Hampstead Heath as shown in Figure 3. In addition, with the exception of the pond at Vale of Health, all of the ponds lie at a lower elevation than the general site level of 95m AOD. The Vale of Health pond is at 105m AOD, however any overtopping would pass east towards Hampstead Ponds and would not flow towards the site.

3.30 Likewise, there is a waterbody in the area surrounded by Whitestone Walk, Heath Street and West Heath Road that contains a waterbody (Whitestone Pond). This is at a level of 133m AOD, and is located on the watershed. The LiDAR analysis suggests that if this pond overtopped water would flow west to the West Heath catchment, or potentially east towards Vale of Health. The LiDAR suggests it is extremely unlikely this pond would discharge southwest towards the site, due to the watershed on the south side of West Heath Road, however if it did, the flow path would travel down Heysham Lane and Redington Gardens, crossing Redington Road 100m southeast of the site, where ground levels are around 3m lower. Due to the local gradients, it is not considered that the site is at significant risk of flooding from Whitestone Pond.

3.31 There are no other surface waterbodies in the area that could present a risk of flooding due to overtopping or embankment failure.

3.32 There are no other sources of flooding that present a risk to the site.

Climate Change

3.33 The projected impacts of climate change are likely to cause long term variations in the probability and risk of flooding. Risk of flooding from groundwater is generally likely to be reduced due to reduced winter rainfall and a move to more intense summer storms which cannot infiltrate into the ground, but risks from other sources are likely to increase. This will affect the site in terms of the likelihood of flooding from surface water and this has been taken into consideration throughout this assessment in accordance with the latest government guidance.

Impact on Flood Risk Elsewhere

3.34 In order for there to be a potential impact on the risk of flooding elsewhere, there must be a shared pathway between any potential off-site receptor and the proposed development site. Since the site is not at significant risk of flooding from rivers, surface water, sewers, groundwater or artificial waterbodies, there is no evidence of any pathway for a direct impact on flood risk elsewhere to occur as a result of development occupying flood storage or obstructing flood flows.

3.35 The only means for impacts on flood risk to occur is therefore where the source of flooding could be affected by the proposed development. In this case, the only sources that could be affected are surface water during intense rainfall event by increasing rates and volumes of direct runoff, or the creation of a groundwater flood risk due to obstruction of groundwater movement.

3.36 There is a potential for peak surface water runoff flows and volumes of runoff from the site to increase where proposed development increases the impermeable areas on the site or reduces the critical drain time. According to the topographic survey, the existing impermeable area on the site is 366m^2, formed of 241m^2 roof area and 125m^2 paved area. Following the proposed development, the combined area of roof and lightwells will occupy 325m^2. The driveway will remain, with a reduced area of 47m^2 due to the proposed change in the location of the garage entrance. The paving to the side of the house will be extended across the front of the property, occupying 49m^2, and a lower-ground level terrace is proposed, occupying a total area of 58m^2. Consequently, the total area of impermeable surfaces on the site will increase to 479m^2, an increase of 31%.

3.37 It is a requirement of CBC policy that all development includes sustainable drainage systems (SuDS) to ensure that rates of runoff from the site are not increased following development. As a result of compliance with this policy, there will be no adverse impact on the sewer network or downstream flood risk as a result of the proposals. In addition, national policy dictates that development should consider the effects of future climate change within the proposals.

3.38 The proposed development is not expected to generate any additional risk of groundwater flooding, since the increased depth of the basement does not result in any change in the strata that the basement would occupy. Both the existing basement and proposed basement extension are expected to be wholly within London Clay. Further, the site ground investigation found no evidence of significant groundwater flows in the sub-surface strata.

Summary of Flood Risk

3.39 The site is not at significant risk of flooding from any source.

3.40 The proposed basement extension will not increase the risk of groundwater flooding elsewhere due to the underlying ground conditions on site, which consist of non-water bearing strata, as shown by the site ground investigation.

3.41 There is a risk that the development could affect the risk of flooding downstream due to increased rates of runoff arising from increased proportions of man-made surfaces on the site and the future effects of climate change. It is therefore necessary to undertake a drainage assessment for the proposed development.

4 SCREENING – SURFACE FLOW AND FLOODING

Surface Water and Flooding

Question	Response	Details
1. Is the site within the catchment of the ponds chains on Hampstead Heath?	No	As detailed within Paragraph 3.14 and Figure 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	The site drainage will not materially alter following development. The number of bedrooms will reduce following development from 9 to 6 and therefore foul flows to existing connections are expected to reduce.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	Yes	The proportion of hard surfaces is anticipated to increase following development. In addition, there is an anticipated increase in runoff rates due to climate change.
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?	Yes	The increase in hard surfaces proposed on the site could result in changes to the surface water runoff profiles from the site.
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	The site drainage will not materially alter following development. Foul flows to the combined sewer will reduce.
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	No

Non-Technical Summary of Screening Process

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

- Potential change in runoff rates due to an increase in the proportion of hard paved surfaces on the site. This requires a SuDS strategy to ensure there is no impact on downstream runoff flows or water quality.
- Potential changes in runoff due to climate change over the lifetime of the development. This requires a SuDS strategy to ensure there is no impact on downstream runoff flows or water quality.

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

5 SCOPING – SURFACE FLOW AND FLOODING

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

- Potential change in runoff rates due to an increase in the proportion of hard paved surfaces on the site.
- Potential changes in runoff due to climate change over the lifetime of the development.

5.2 The proposed development will increase the impermeable areas on the site. The site drainage will not materially alter following development. However, in accordance with current policy, new development should consider increases in runoff both due to increases in hard surfaces, and accounting for climate change over the lifetime of the development.

5.3 A SuDS assessment has therefore been completed to address these two issues.

6 SUDS ASSESSMENT

Policy

6.1 Camden policy only requires a full SuDS strategy at planning application stage for major developments and / or development located in a local flood risk zone. The Camden Water and Flooding CPG states that:

> *"All developments must not increase the risk of flooding [and] Developments are required to utilise Sustainable Drainage Systems (using the drainage hierarchy) to achieve greenfield runoff rates, where feasible"*

6.2 Flood risk assessments are required for; sites over 1ha, major applications in areas at high risk of flooding, and basement developments on streets with a risk of flooding, where historic watercourses are present, or where there is an elevated risk of groundwater flooding. The proposed development does not fall into any of these categories. However, under the Basements CPG, an assessment of the impact on local drainage and flooding is required.

6.3 The Basements CPG states:

> *"The Council will require an adequate drainage plan and has a preference for the use of Sustainable Urban Drainage Systems (SUDS). Only where this cannot be achieved should surface/ground water be discharged to combined sewers."*

Site Runoff Characteristics

6.4 Greenfield runoff rates in the 100 year return period event, for the entire site, are 1.4 l/s, calculated using the IH124 calculation method.

6.5 Due to the site slope, approximately 43% of the current site area to the rear of the property is prevented from leaving the site by the ground profile and the presence of boundary treatments as shown in the topographic survey. Where runoff does pass the boundary, this is at greenfield rates or higher due to the paved area. Following development, the site area discharging in this direction will reduce to approximately 34%. Runoff in this direction will reduce by around 20% due to the reduction in area.

6.6 For the remainder of the site, surface water is assumed to be positively drained. Currently, hard surfaces make up 68% (366m^2) of the site drained area of 539m^2. The gravel area is assumed to be permeable and thus discharges at greenfield rates. The peak runoff rate to the road for the critical storm (5min duration) in the 100 year event is 19.6 l/s.

6.7 In the proposed case, the drained area increases to 619m^2, of which 77% (479m^2) is hard paved. For the critical storm, the peak runoff rate in the 100 year event is 24.0 l/s, which increases to 33.6 l/s when including an allowance of 40% for future climate change. This represents an increase of 4.4 l/s (22%) at present day, and 14.0 l/s (71%) in the future due to the impact of climate change.

Sustainable Drainage Principles

6.8 The aim of SuDS is to emulate natural drainage processes such that watercourses and storage areas receive the hydrological profiles under which they evolved, and that water quality in local ecosystems is protected or improved. The best practice guide states that SuDS will:

- Reduce the impact of additional urbanisation on the frequency and size of floods;
- Protect or enhance river and groundwater quality;

- Be sympathetic to the needs of the local environment and community; and
- Encourage natural groundwater recharge.

6.9 Figure 6 shows the hierarchy of SuDS techniques. The SuDS techniques that are proposed to manage surface water for the development will be discussed in relation to this hierarchy.

	SUDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife
Most Sustainable	Green roofs	✓	✓	✓
	Basins and ponds 1. Constructed wetlands 2. Balancing ponds 3. Detention basins 4. Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices 5. Soakaways 6. Infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains 7. Gravelled areas 8. Solid paving blocks 9. Porous paviors	✓	✓	
Least Sustainable	Tanked systems 10. Over-sized pipes/tanks 11. Box storage systems	✓		

Figure 6: SuDS Hierarchy[8]

6.10 Living roofs are not feasible for the development due to the pitched roof construction. In order to provide source control and retain rainwater on site for reuse, it is strongly recommended that any associated landscaped areas are designed as bioretention areas, tree pits and /or rain gardens to retain and utilise rainfall. Water butts should be installed on rainwater downpipes.

6.11 Basins, ponds, filter strips and swales are not suitable for use within the development due to a lack of available space.

6.12 The ground investigation indicates that the sub-surface geology is made up of London Clay which is not considered to be suitable for infiltration devices (e.g. soakaways) generally. However, it would be beneficial to undertake infiltration testing and a more detailed geological investigation post-planning to determine whether it would be possible to allow paved areas to infiltrate to ground.

6.13 Table 1 includes a summary of potential SuDS options for the site, with reference to the SuDS hierarchy.

[8] http://www.sustainabledrainagecentre.co.uk/suds-hierarchy_c2236.aspx Retrieved 02/11/2016

Table 1: Summary of proposed SuDS with reference to SuDS hierarchy

SUDS Technique	Practicable	Proposed	Notes
Green roofs, bioretention areas, tree pits	✓	✓	Pitched roof construction is not suitable for green roofs. Bioretention areas and tree pits should be incorporated where possible
Basins and ponds	×	×	Insufficient space available on the site
Filter strips and swales	×	×	Insufficient space available on the site
Infiltration devices	×	×	Ground conditions not considered to be suitable
Permeable surfaces and filter drains	✓	✓	Paved areas should be formed of permeable block paving with a suitable porous sub-base (subject to infiltration testing)
Tanked systems	✓	✓	Attenuation tanks to be used to provide additional attenuation storage where necessary.

Discharge Strategy

6.14 The discharge hierarchy should be considered and the relevant Planning Practice Guidance states:

> *"Generally the aim should be discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:*
>
> *1. Into the ground (infiltration);*
>
> *2. To a surface water body;*
>
> *3. To a surface water sewer, highway drain or another drainage system;*
>
> *4. To a combined sewer."*

6.15 The proposed drainage strategy should discharge water falling on paved areas to the ground if it is found to be feasible. This is subject to infiltration testing at the post-planning stage. Unfortunately, the site investigation available currently suggests that ground conditions are such that this is not likely to be possible, although the infiltration capacity of London Clay is highly locally variable. The only alternative option is to discharge at attenuated rates to existing connections, namely the Thames Water combined sewer. There is no need to apply to Thames Water for a connection to the existing on-site private demarcation chamber, since there is no increase in the number of properties on the development.

Proposed Surface Water Drainage System

6.16 Surface water runoff from the roof should initially be collected into water butts for use in irrigating garden areas, in accordance with the drainage hierarchy set out in the Camden Water and Flooding CPG.

6.17 The ground conditions on the site should be tested to determine whether it is feasible to discharge surface water from proposed paved areas directly to ground. This would remove the need to pump surface water from the rear terrace to the surface water collection system and would reduce the attenuation burden.

6.18 As a minimum, the final discharge from the site should be limited to the present-day existing 100 year return period runoff rate, where it is reasonably practicable to do so. For the critical storm, this means attenuating the calculated peak flow of 33.6 l/s down to 19.6 l/s (taking into account climate change over the lifetime of the development). This would require $3m^3$ of attenuation storage.

6.19 Management and maintenance of the SuDS should follow the manufacturers guidance and the CIRIA SuDS Guide. This will be finalised in the detailed drainage design of the site. It is typical that this is conditioned as part of granting planning permission.

7 IMPACT ASSESSMENT – SURFACE FLOW AND FLOODING

7.1 The BIA has concluded there is negligible risk of flooding from any source affecting the site.

7.2 Without adequate mitigation, surface water runoff rates will increase following development; however, they can be attenuated to current, present day rates and discharged to existing connections, with a storage requirement of $3m^3$. The detailed design of the drainage system should consider the use of bioretention areas within the landscaping to prevent runoff, as well as consider the potential for infiltration through the base of permeable paved surfaces. All paved areas should be of permeable construction, and water butts should be installed on all downpipes.

7.3 Subject to the recommendations above and detailed in Chapter 6, the assessment considers that the proposed development, through provision of a suitable SuDS strategy and adequate mitigation, would not increase peak runoff rates downstream and would not result in increased pressure on the wider drainage area infrastructure. There is potential at detailed design stage to provide betterment to the existing site conditions and reduce pressure on the wider area.

7.4 The BIA has concluded there are no likely impacts to the wider hydrological environment as a result of the proposed development.

APPENDIX A: DESK STUDY REFERENCES

Ordnance Survey mapping

- https://explore.osmaps.com/
- https://www.visionofbritain.org.uk/

BGS Geological mapping and hydrogeological data

- http://mapapps.bgs.ac.uk/geologyofbritain/home.html
- http://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSHydroMap
- https://www2.bgs.ac.uk/research/groundwater/datainfo/hydromaps/home.html

Site ground investigation undertaken on 28th February 2022 by Ground and Water

Hydrological information from the Flood Estimation Handbook (FEH) web service

- https://fehweb.ceh.ac.uk/

UK government Environmental Open Data and Magic Map

- https://environment.data.gov.uk/spatialdata/flood-map-for-planning-rivers-and-sea-flood-zone-3/
- https://environment.data.gov.uk/spatialdata/flood-map-for-planning-rivers-and-sea-flood-zone-2/
- https://environment.data.gov.uk/spatialdata/risk-of-flooding-from-surface-water-extent-1-percent-annual-chance/
- https://environment.data.gov.uk/spatialdata/risk-of-flooding-from-surface-water-extent-0-1-percent-annual-chance/
- https://environment.data.gov.uk/spatialdata/reservoir-flood-extents-wet-day/
- https://environment.data.gov.uk/DefraDataDownload/?Mode=survey

URS, London Borough of Camden SFRA, July 2014

Drain London/London Borough of Camden, Preliminary Flood Risk Assessment, v0.2, April 2011

London Borough of Camden, Floods in Camden Report of the Floods Scrutiny Panel, June 2003

London Borough of Camden, Camden Planning Guidance: Basements, January 2021

London Borough of Camden, Camden geological, hydrogeological and hydrological study – Guidance for subterranean development, Issue 01, November 2010

APPENDIX B: SITE SPECIFIC DATA

The following data for the site and surrounding area have been obtained:

- Site Investigation
- Thames Water Asset Location Data

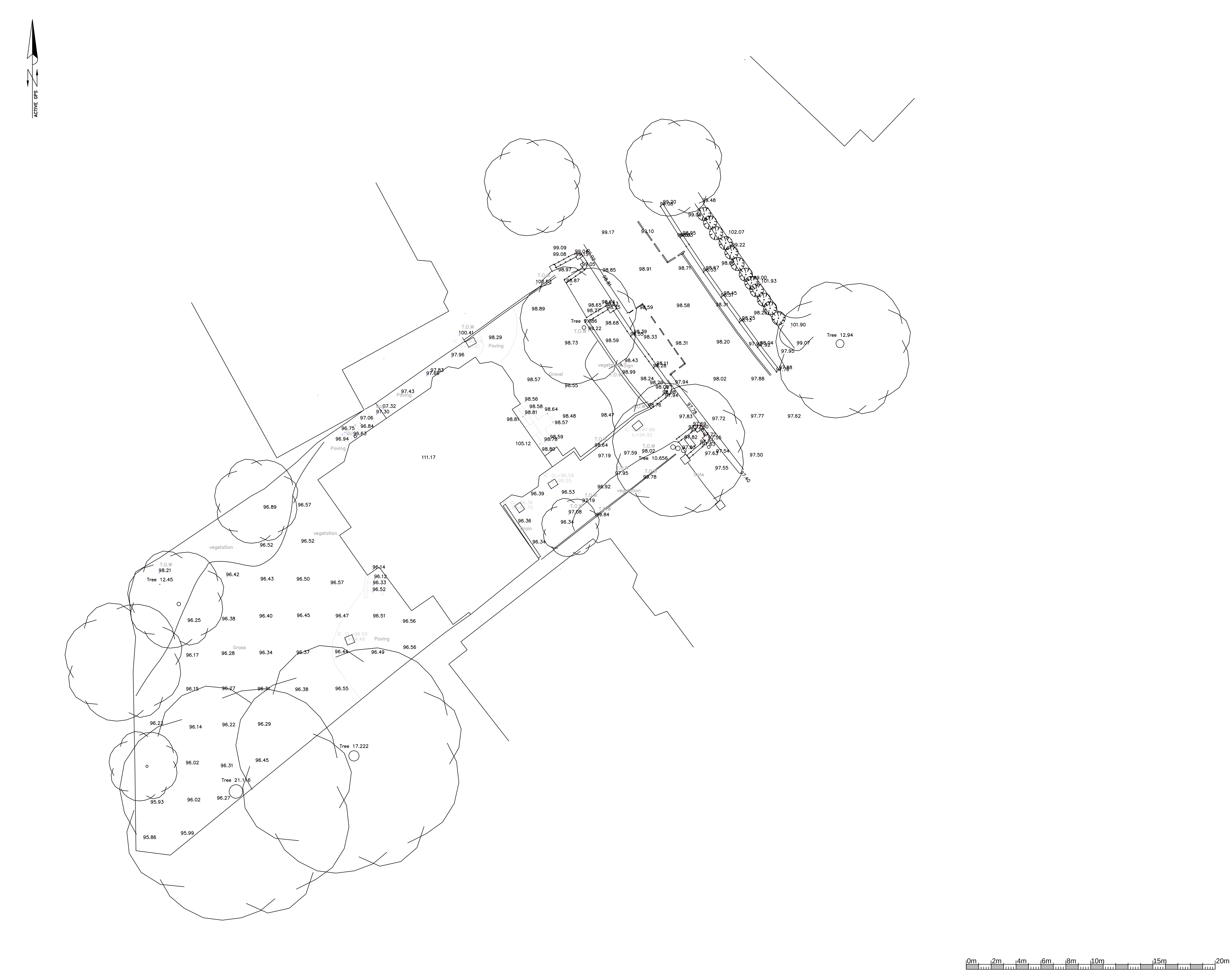
APPENDIX C: EXISTING AND PROPOSED DRAWINGS

Topographic Survey and Existing Floor Plans and Elevations

- Mija Survey Drawing No. 15000_01A (Topographic Survey)
- Mija Survey Drawing No. 15000_02B (Floor Plans)
- Mija Survey Drawing No. 15000_03B (Elevations)

Proposed Plans and Elevations

- Griggs Drawing No. 1571-PL02 (Lower Ground Floor)
- Griggs Drawing No. 1571-PL03 (Ground Floor)
- Griggs Drawing No. 1571-PL10 (Floor Plans)
- Griggs Drawing No. 1571-PL11 (Elevations)



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Fences shown are not necessarily legal boundaries.

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Abbreviations

AV	Air Valve	TBM	Temp. Bench Mark
ACU	Air Conditioning Unit	TP	Telegraph Pole
BB	Belisha Beacon	TL	Traffic Light
BK	Brick	TT	Tactile Paving
BO	Bollard	UTL	Unable To Lift
BS	Bus Stop	V	Vent
BT	British Telecom cover	VP	Vent Pipe
CBF	Close Board Fence	WC	Water Cover
CLF	Chain Link Fence	WM	Water Meter
CO	Column	WSC	Water Stop Cock
CONC	Concrete	WV	Water Valve
CP	Catch Pit	**Levels**	
CPS	Concrete Paving Slabs		
CTV	Cable Television Cover	ACL	Arch Crown Level
DK	Drop Kerb	ASL	Arch Spring Level
EC	Electric Cover	CL	Cover Level
EP	Electricity Pole	CPL	Coping Level
ER	Earthing Rod	DCL	Door Cill Level
FB	Flower Bed	DHL	Door Head Level
FE	Fire Escape	EL	Eaves Level
FH	Fire Hydrant	FFL	Finished Floor Level
FHR	Fire Hose Reel	FL	Floor Level
FP	Flag Pole	IL	Invert Level
GC	Gas Cover	PL	Parapet Level
GP	Gate Post	RL	Ridge Level
GU	Gully	SSL	Structural Slab Level
GV	Gas Valve	TFL	Top of Fence Level
IC	Inspection Cover	TTL	Top of Tree Level
IR	Iron Railings	TWL	Top of Wall Level
JB	Junction Box	UBL	Underside of Beam Level
KO	Kerb Outlet	UBXL	Underside of Boxing Level
LB	Litter Bin	UDL	Underside of Duct Level
LL	Low Level	UJL	Underside of Joist Level
LLF	Larch Lap Fence	UPL	Underside of Pipe Level
LP	Lamp Post	URSJL	Underside of RSJ Level
LW	Light Well	USL	Generic Underside Level
MB	Multi-Bole	WCL	Window Cill Level
MH	Manhole	WHL	Window Head Level
MK	Marker	**Heights**	
MT	Meter		
OH	Overhead	AC	Arch Crown
PM	Parking Meter	AS	Arch Spring
PB	Post Box	DC	Floor to Door Cill
P/R	Post & Rail	DH	Door Cill to Head
PT	Post	HT	Height
P/W	Post & Wire	UBX	Underside of Boxing
RE	Rodding Eye	UD	Underside of Duct
RET	Retaining	UJ	Underside of Joist
RS	Road Sign	UP	Underside of Pipe
RSJ	Rolled Steel Joist	URSJ	Underside of RSJ
RWP	Rain Water Pipe	US	Generic Underside
SC	Stop Cock	WC	Floor to Window Cill
TCB	Telephone Call Box	WH	Window Cill to Head

Notes

Spot Level +20.00
Arch
Gate
Contours 25.50
Hedge
Foul Pipe
Storm Pipe
Top of Bank
Bottom of Bank
DATUM 12.24 Datum Point
Photo Point
Panoramic Photo Point
ID E=XXXX.XXX N=YYYY.YYY H=ZZZ.ZZZ Survey Station
ID E=XXXX.XXX N=YYYY.YYY H=ZZZ.ZZZ Scan Target

Grid & Datum

Survey Grid
The Survey Grid is in relation to Ordnance Survey Network.

Survey Datum
The Survey is based on Ordnance Survey Datum (Newlyn).

Trees

All trees sizes and heights are approximate and species have been identified to the best of the Surveyors knowledge. Where guaranteed tree species becomes important, the services of an Arborist should be employed.

Notation : Diameter of Trunk / Height / Spread

Trees with bole diameters below the specified minimum size may have not been Surveyed.

Individual tree canopies are shown in a separate layer named RCB_CANOPY, which for presentation purposes has been turned off.

Drainage

Where drainage covers have been lifted, data has been recorded for each individual manhole from the surface and connections to other manholes, pipes or gullys are assumed. Where information is required by accessing the manhole or tracing to other manholes then a services trace will be needed.

Rev	Notes	Date	CAD
A	Scale bar added	23.03.22	

Client
Griggs

Drawing Title
TOPOGRAPHICAL SURVEY

Project
61_
Redington Road
,Hamstead

Scale Bar
Scale in Metres 1:200 @ A2

Surveyor: R.A | Checked: P.C. | Status: FINAL

Issue Date: 14/12/21 | CNG Ref: 15000_01 | Rev: A

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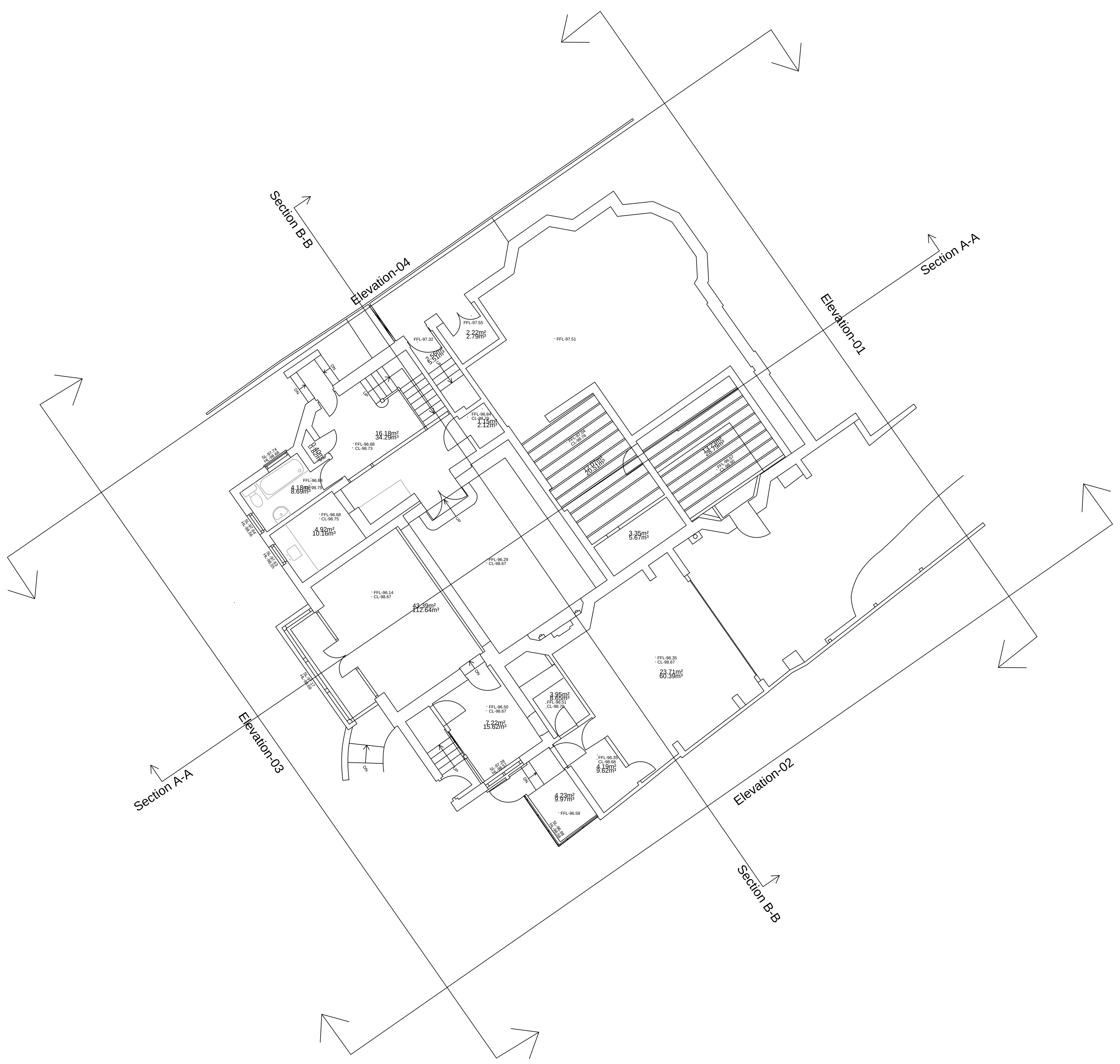
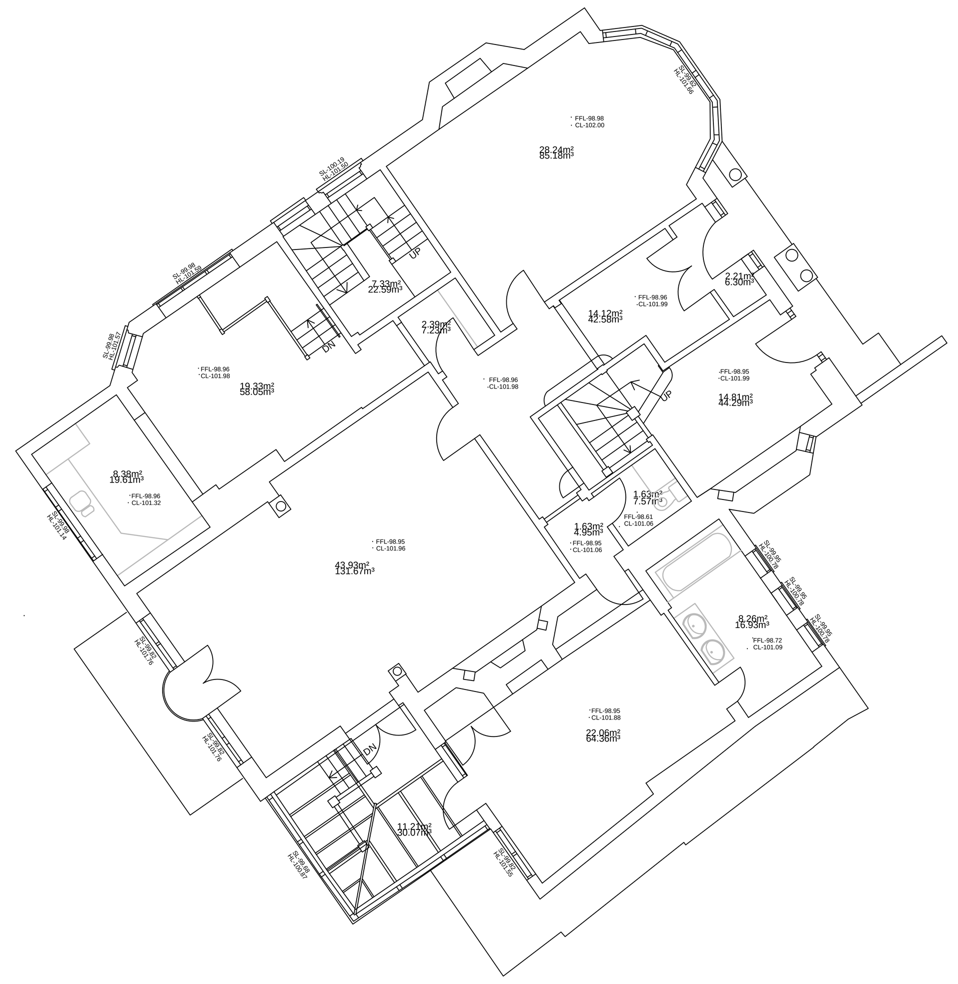
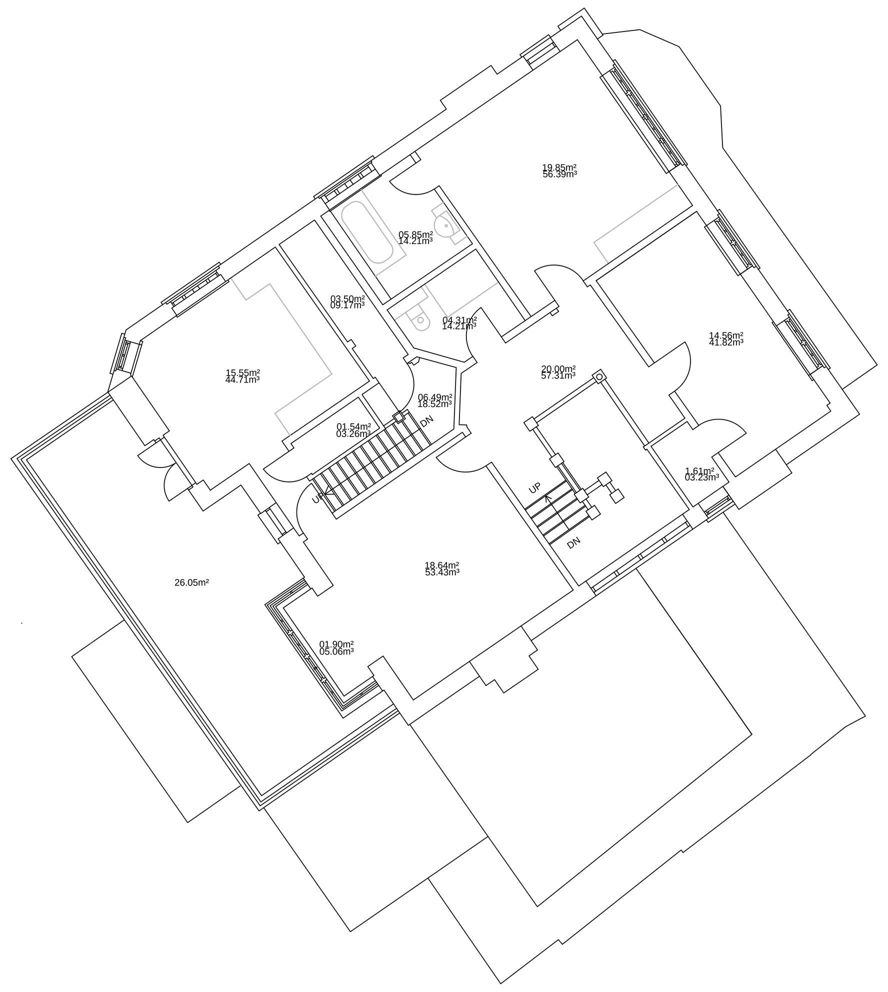


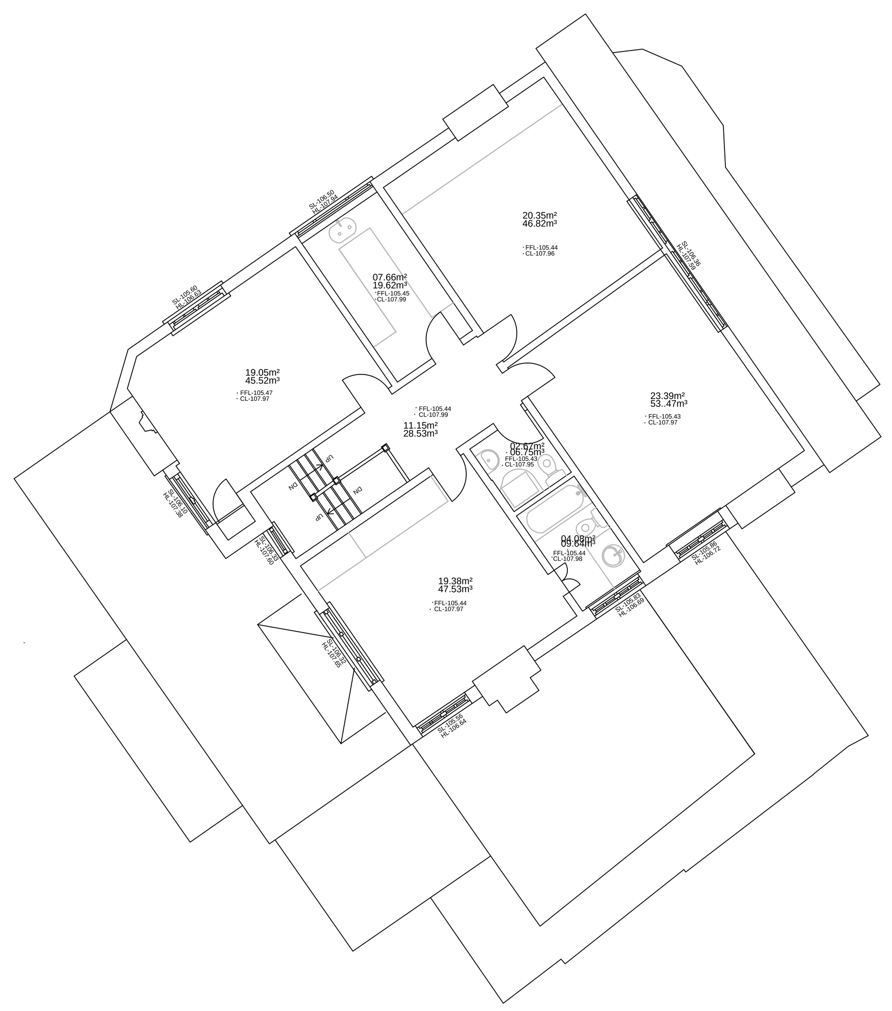
Lower Ground Floor



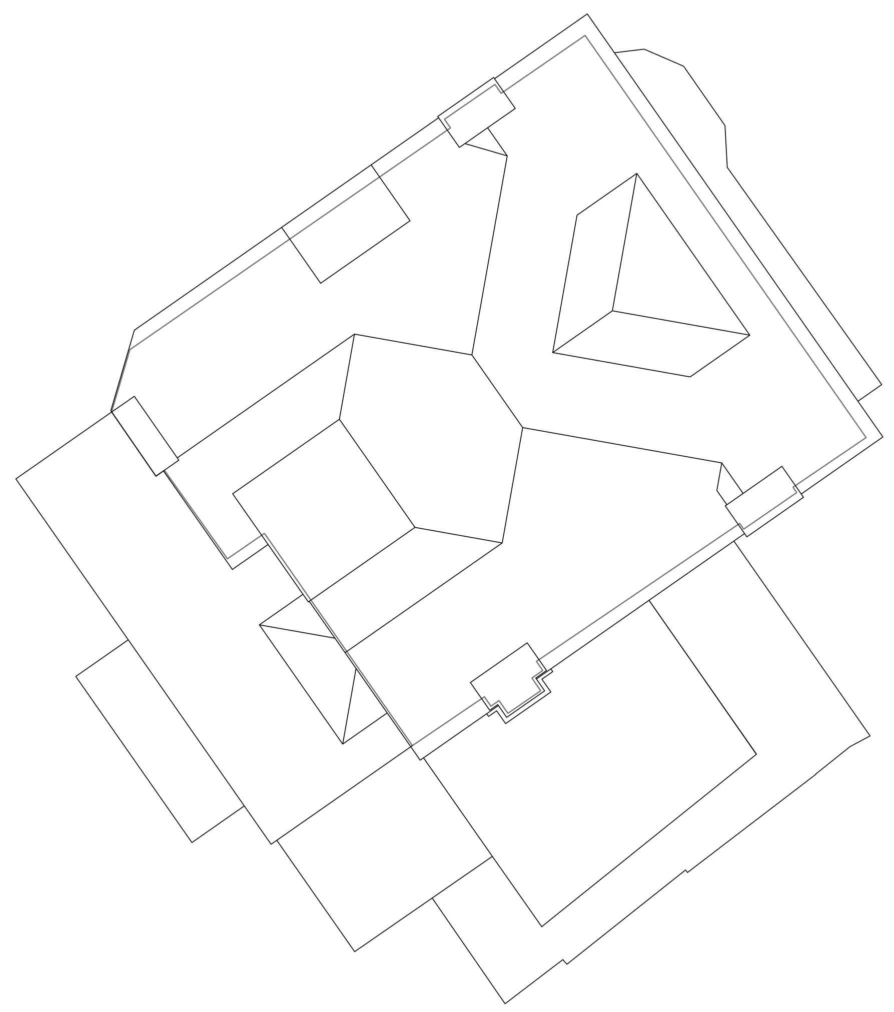
Ground Floor



First Floor



Second Floor



Roof

É RCB Geomatics Ltd

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Abbreviations

AV Air Valve
ACU Air Conditioning Unit
BB Belisha Beacon
BK Brick
BO Bollard
BS Bus Stop
BT British Telecom cover
CBF Close Board Fence
CLF Chain Link Fence
CO Column
CONC Concrete
CP Catch Pit
CPS Concrete Paving Slabs
CTV Cable Television Cover
DK Drop Kerb
EC Electric Cover
EP Electricity Pole
ER Earthing Rod
FB Flower Bed
FE Fire Escape
FH Fire Hydrant
FHR Fire Hose Reel
FP Flag Pole
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IC Inspection Cover
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JB Junction Box
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LL Low Level
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MB Multi-Bole
MH Manhole
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OH Overhead
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PB Post Box
P/R Post & Rail
PT Post
P/W Post & Wire
RE Rodding Eye
RET Retaining
RS Road Sign
RSJ Rolled Steel Joist
RWP Rain Water Pipe
SC Stop Cock
TCB Telephone Call Box

TBM Temp. Bench Mark
TP Telegraph Pole
TL Traffic Light
TT Tactile Paving
UTL Unable To Lift
V Vent
VP Vent Pipe
WC Water Cover
WM Water Meter
WSC Water Stop Cock
WV Water Valve

Levels

ACL Arch Crown Level
ASL Arch Spring Level
CL Cover Level
CPL Coping Level
DCL Door Cill Level
DHL Door Head Level
EL Eaves Level
FFL Finished Floor Level
FL Floor Level
IL Invert Level
PL Parapet Level
RL Ridge Level
SSL Structural Slab Level
TFL Top of Fence Level
TTL Top of Tree Level
TWL Top of Wall Level
UBL Underside of Beam Level
UBXL Underside of Boxing Level
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UJL Underside of Joist Level
UPL Underside of Pipe Level
URSJL Underside of RSJ Level
USL Generic Underside Level
WCL Window Cill Level
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Heights

AC Arch Crown
AS Arch Spring
DC Floor to Door Cill
DH Door Cill to Head
HT Height
UBX Underside of Boxing
UD Underside of Duct
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US Generic Underside
WC Floor to Window Cill
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Notes

Spot Level +20.00
Arch
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Line Type

Building
Wall
Beam
Fence
Stud Wall
Door
Window
Kitchen/Surface
Furniture
Roof Line
Balustrade

Symbology

10.00 Ceiling Height (m)
10.00f False Ceiling Height (m)
11.79 Beam Height (m)
SL=10.78 Sill Level (m)
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AH Access Hatch
BR Boiler
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HW Hot Water Tank
RAD Radiator
RL Roof Light
RWP Rain Water Pipe
SL Sky Light
SP Soil Vent Pipe

Rev	Notes	Date	CAD
A	Scale Bar added.	23.03.22	
B	Roof Plan added	27.03.22	

Client
MJS Projects(March Ltd)

Drawing Title
MEASURED BUILDING SURVEY

Project
61_Redington Road,Hamstead

Scale Bar
Scale in Metres 1:100 @ A0

Surveyor: R.A. | Checked: P.C. | Status: FINAL
Issue Date: 20/12/21 | CNG Ref: 15000_02 | Rev: B

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info@mijasurvey.com | www.mijasurvey.uk

Datum - 93m

Elevation-01

Datum - 93m

Elevation-02

Datum - 93m

Elevation-03

Datum - 93m

Elevation-04

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

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Rev	Notes	Date	CAD
A	Scale Bar added.	23.03.22	
B	Brick arches added over windows	27.03.22	

Client
MJS Projects(March Ltd)

Drawing Title
MEASURED BUILDING SURVEY

Project
61_Redington Road,Hamstead

Scale Bar
Scale in Metres 1:100 @ A0

Surveyor: R.A. | Checked: P.C. | Status: FINAL
Issue Date: 20/12/21 | CNG Ref: 15000_03 | Rev: B

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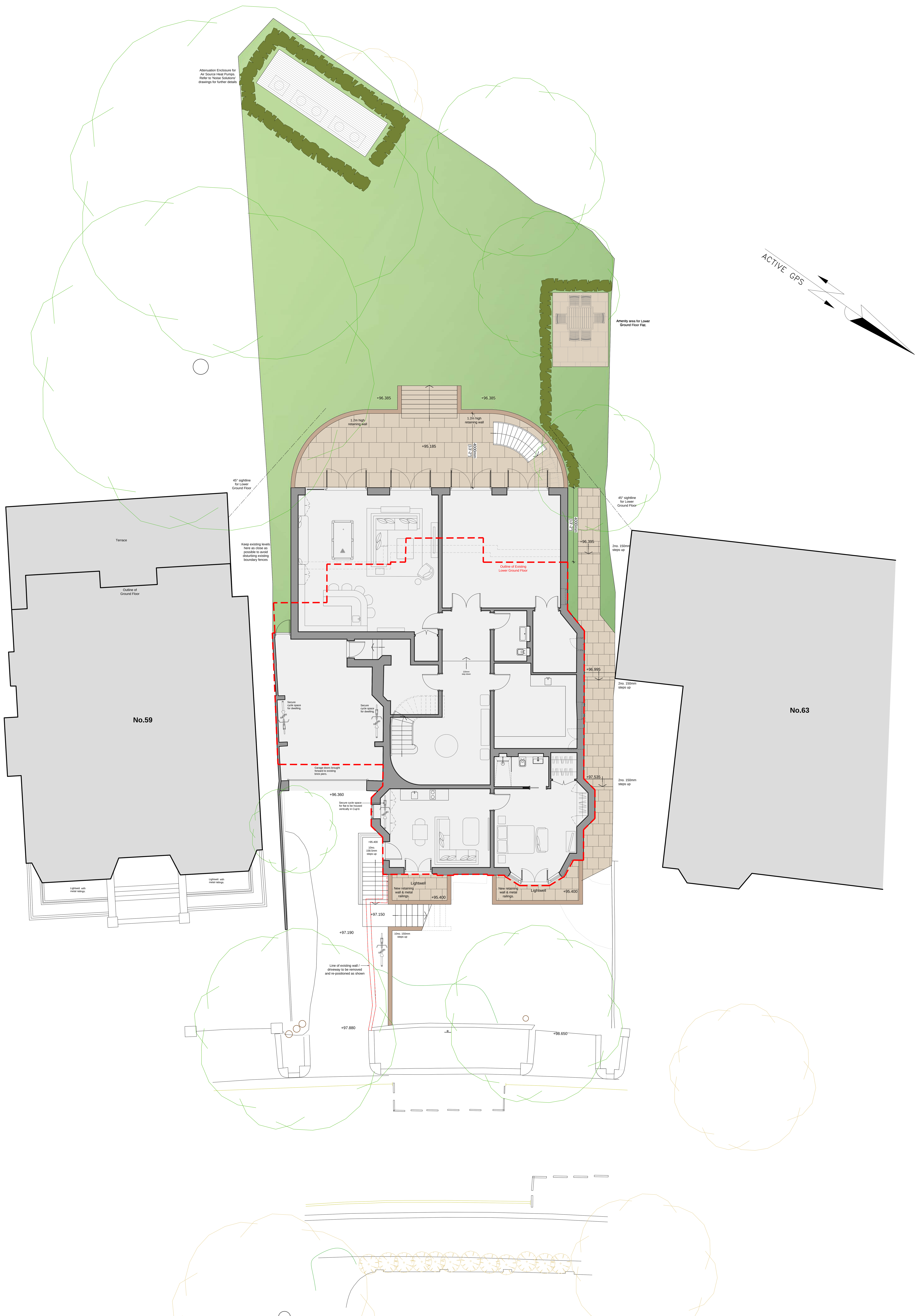

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

NOTES:

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This drawing is to be read together with the specification and related drawings.

REVISIONS:

Rev:	By:	Chk:	Date:	Description:

Project:
61 Redington Road,
Hampstead, London,
NW3 7RP.

Title:
Proposed Site Plan.
Lower Ground Floor.

Drawn:	Checked:	Date:	Scale:	Size:
KAT		Mar 2022	1:100	A1

Project No:	Drawing No:	Revision:
1571	PL02	-

PLANNING

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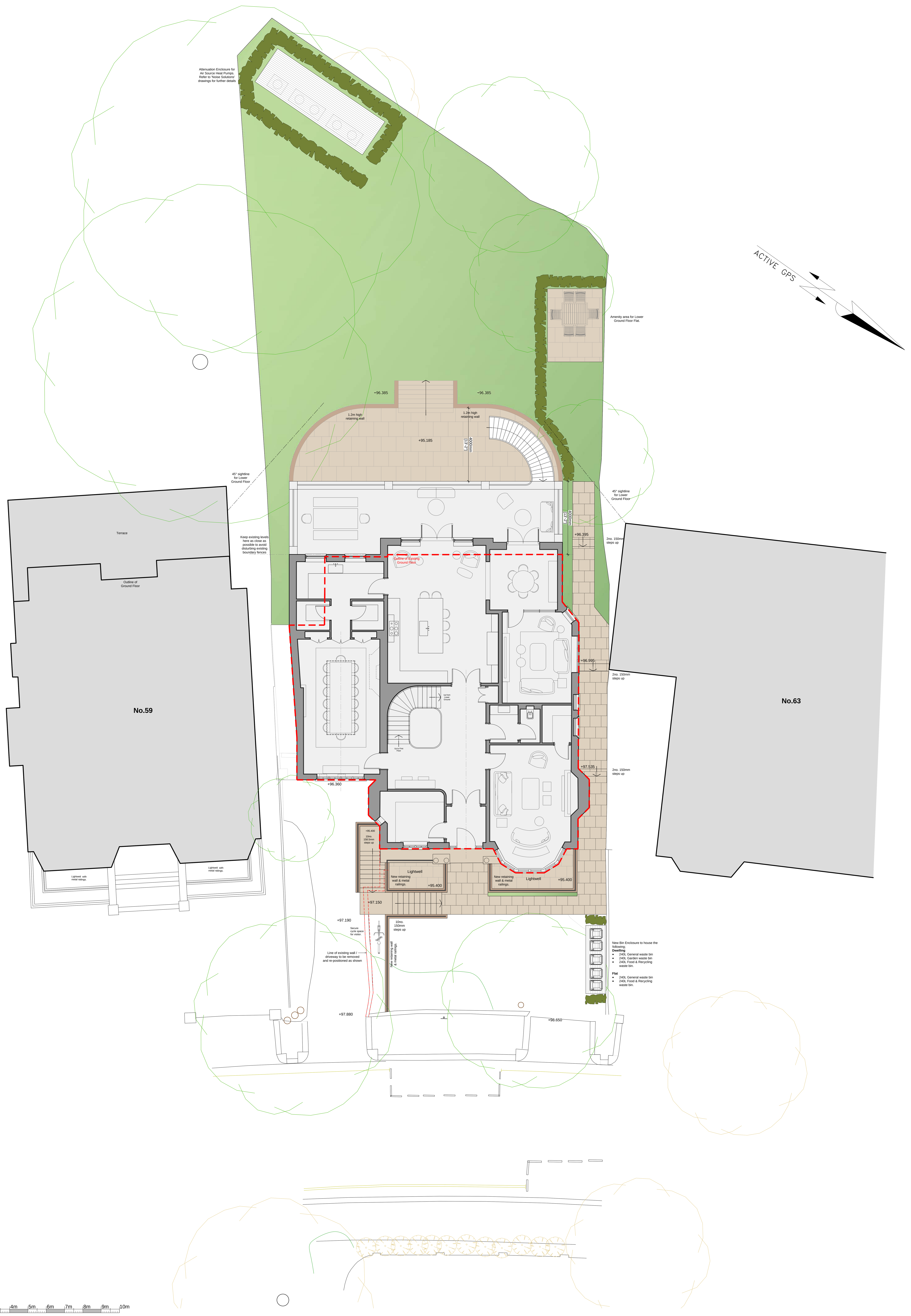

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REVISIONS:

Rev:	By:	Chk:	Date:	Description:

Project:
61 Redington Road,
Hampstead, London,
NW3 7RP.

Title:
Proposed Site Plan.
Ground Floor.

Drawn:	Checked:	Date:	Scale:	Size:
KAT		Mar 2022	1:100	A1

Project No:	Drawing No:	Revision:
1571	PL03	-

PLANNING

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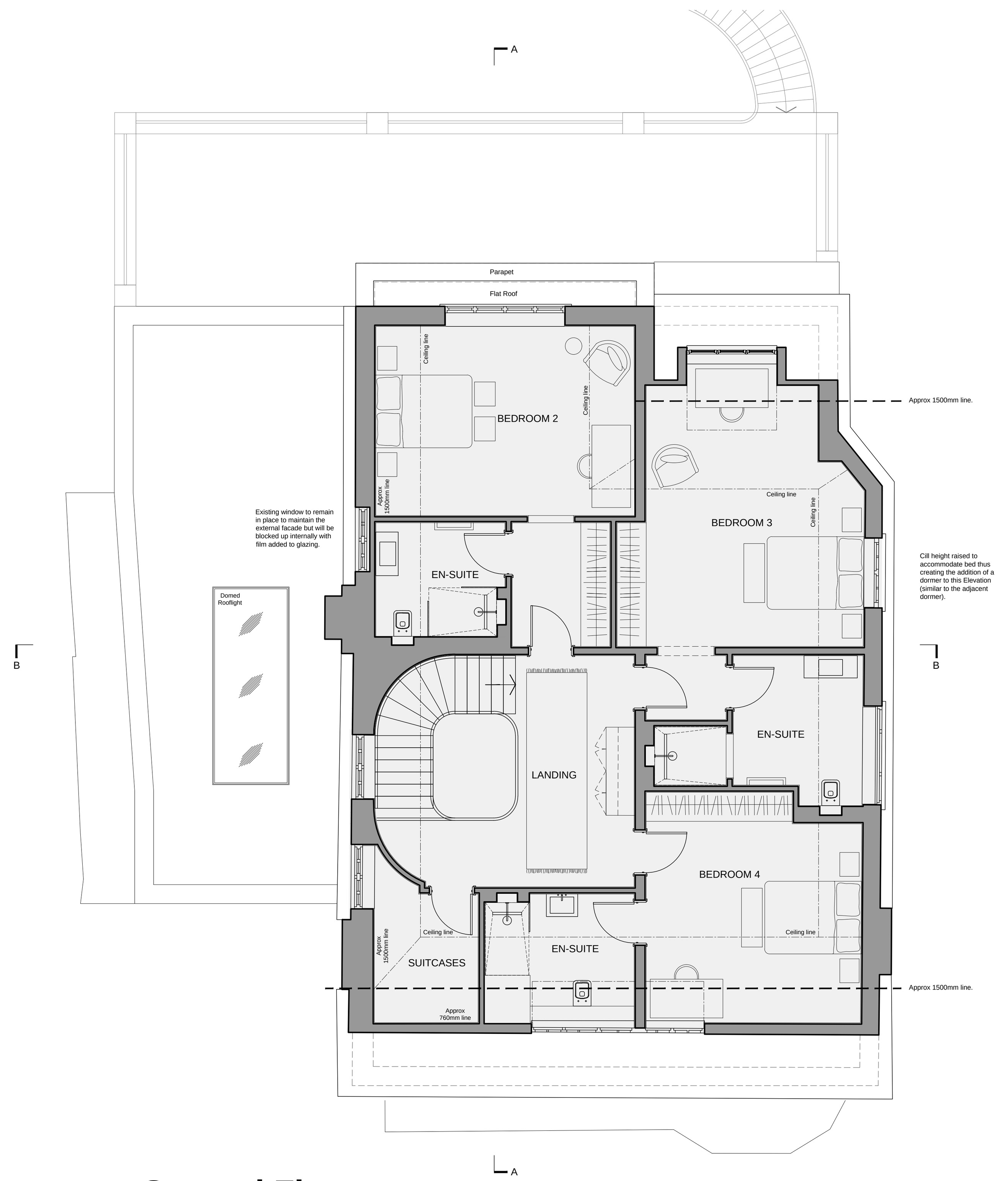
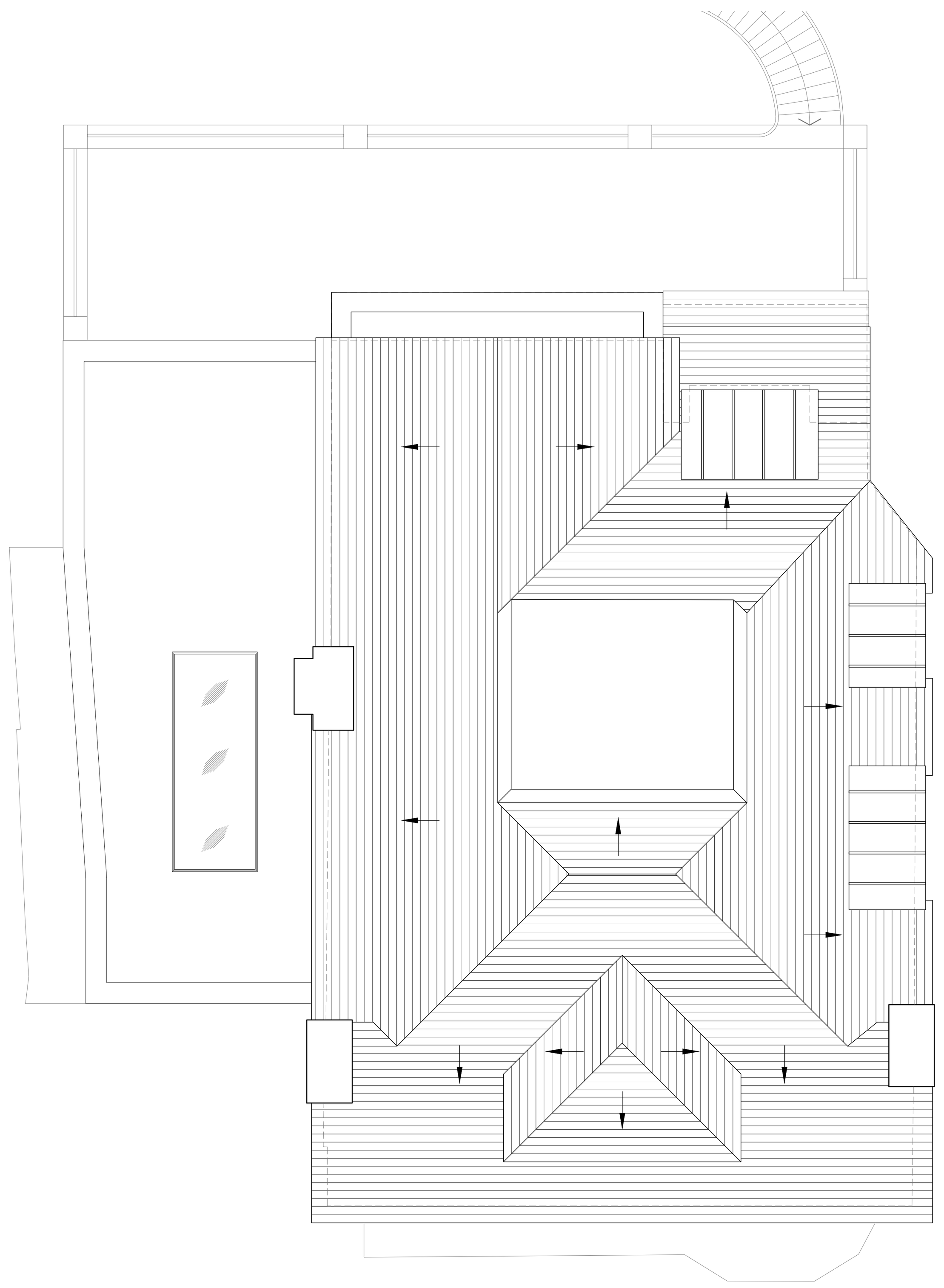
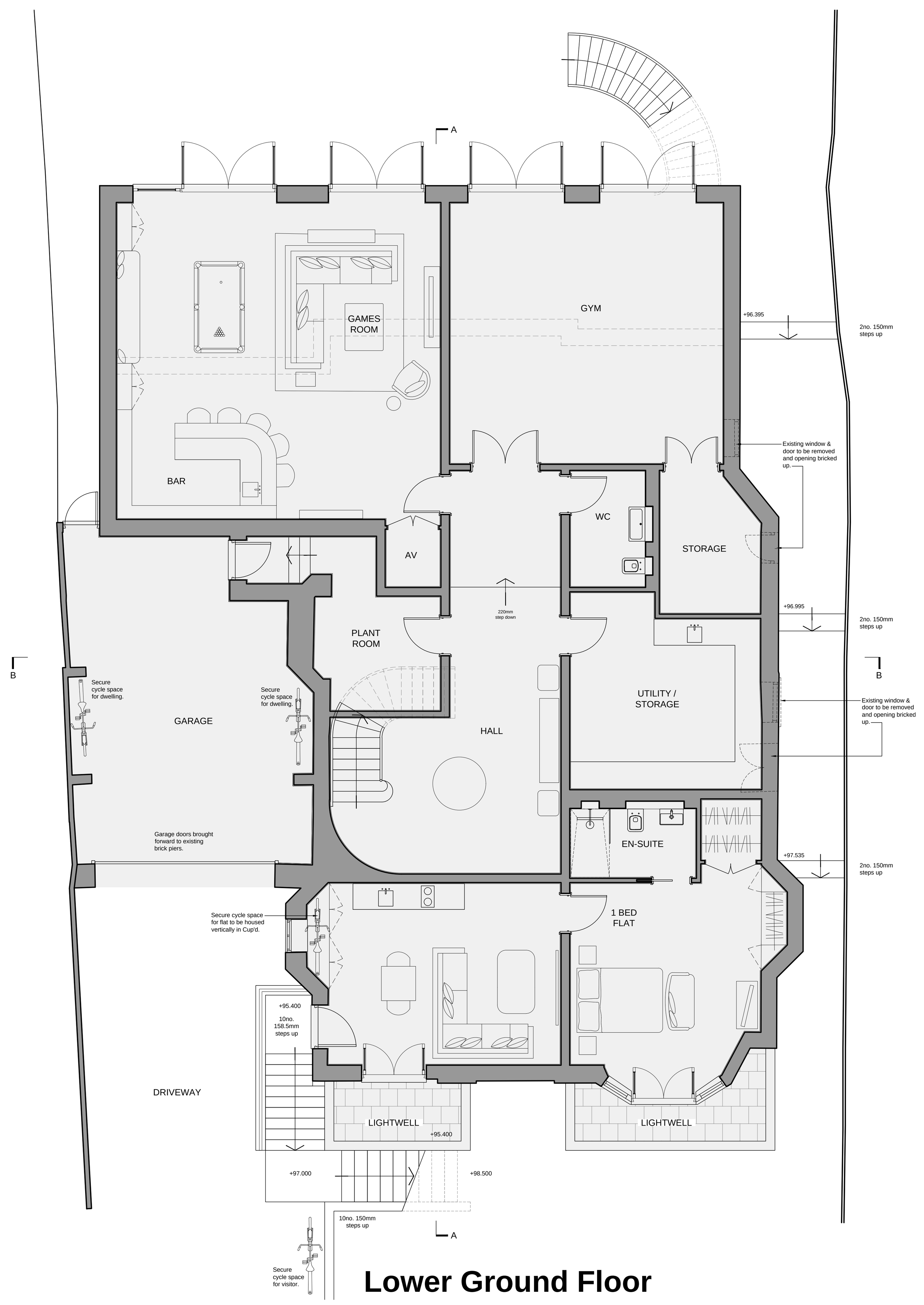
First Floor



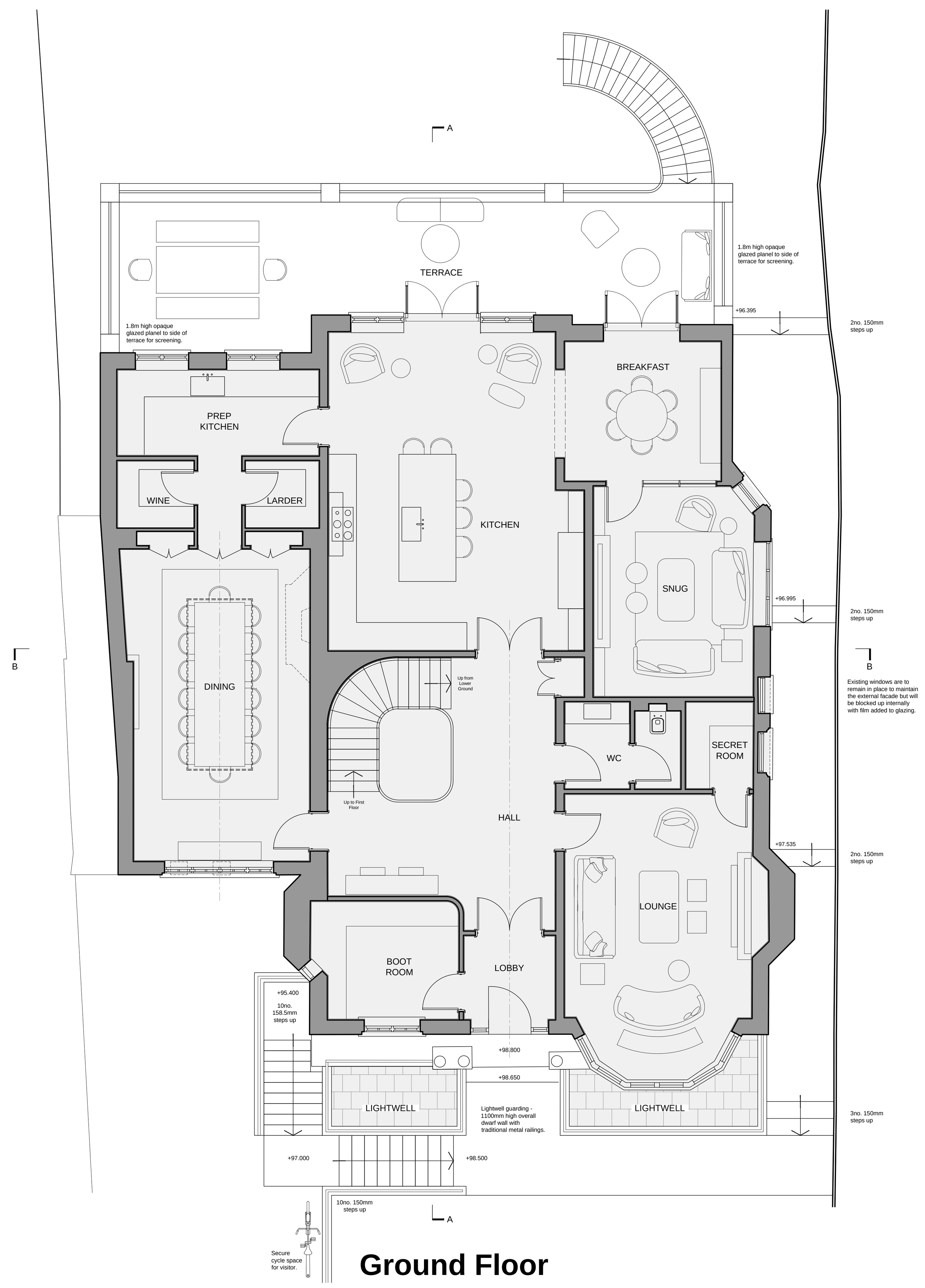
Second Floor



Roof Plan



Lower Ground Floor



Ground Floor

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

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GROSS INTERNAL
Lower Ground - 234mį (2,520sqft)
Ground - 219mį (2,357sqft)
First - 155mį (1,668sqft)
Second - 132mį (1,421sqft)
Total - 740mį (7,965sqft)

Garage - 38mį (409sqft)

PLANNING

Project:
61 Redington Road,
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NW3 7RP.

Title:
Proposed Floor Plans

Drawn:	Checked:	Date:	Scale:	Size:
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Project No:		Drawing No:		Revision:
1571		PL10		-

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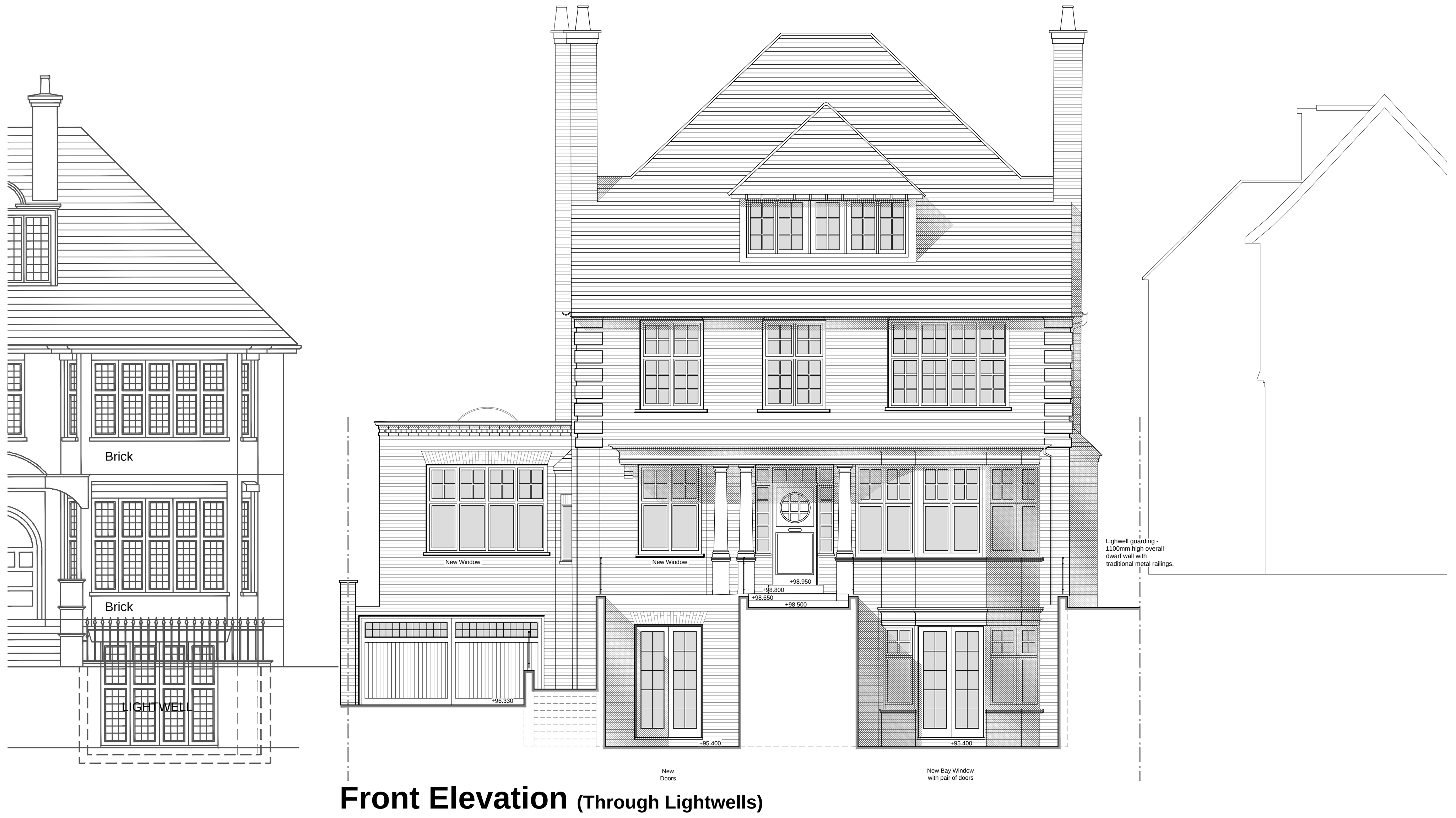
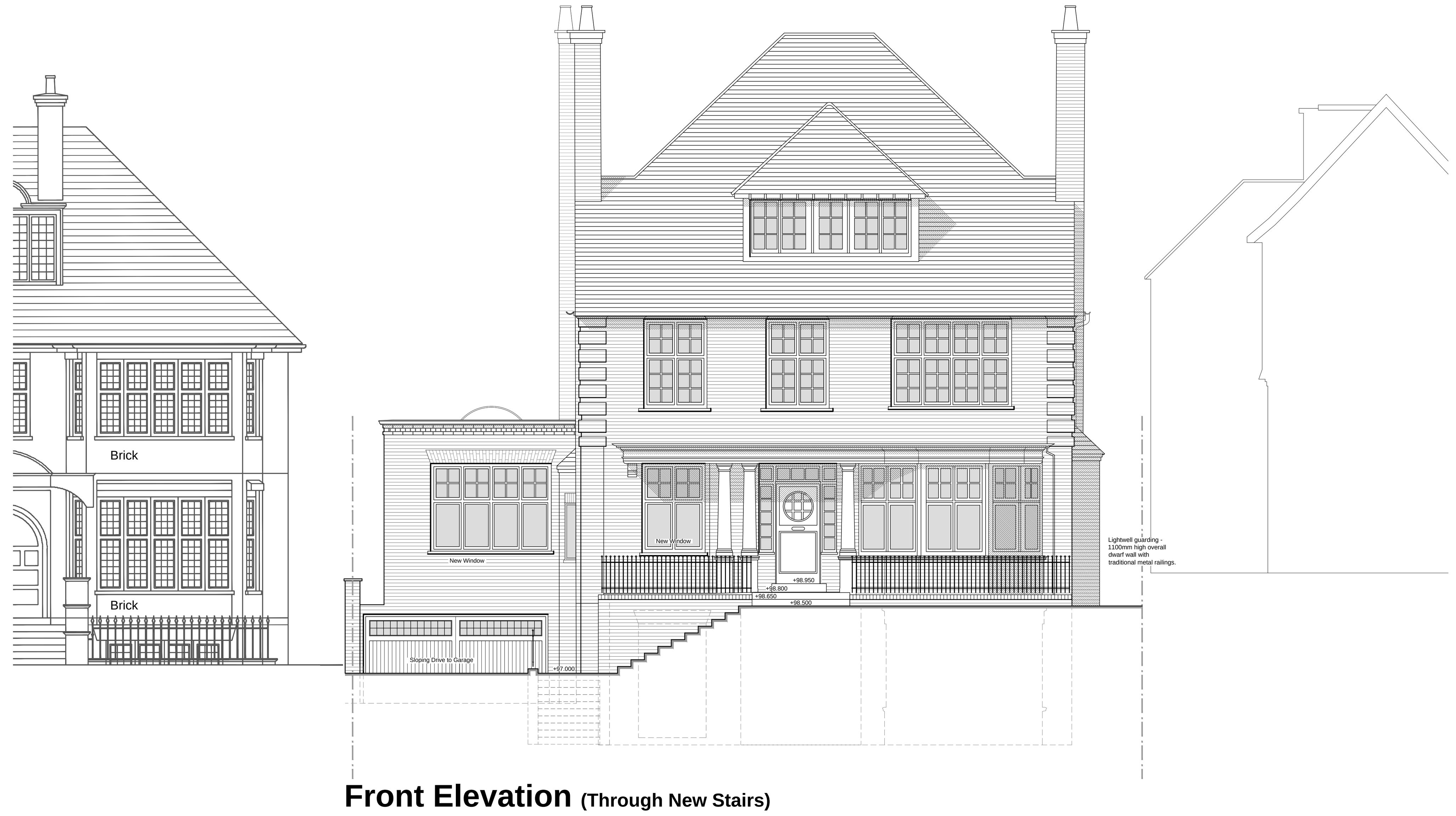


Front Elevation (Through Lightwells)



Front Elevation (Through New Stairs)


Flank Elevation


Side Elevation

Rear Elevation

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

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REVISIONS:

Rev:	By:	Check:	Date:	Description:

PLANNING

Project:
61 Redington Road,
Hampstead, London,
NW3 7RP.

Title:
Proposed Elevations.

Drawn:	Checked:	Date:	Scale:	Size:
KAT		Feb 2022	1:100	A1

Project No:	Drawing No:	Revision:
1571	PL11	-

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APPENDIX D: CALCULATIONS

The following calculations have been referenced within the body of this report:

- D21 Runoff Calculations

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D21 RUNOFF CALCULATIONS | COVER SHEET

Job No.	22023	
Job Name	61 Redington Road	
Engineer	Fiona de Mauny	FdM
Checked By	Claire Burroughs	CB
Date	17.03.2022	

Site Characteristics

Site Area (ha) 0.094

	Overall		Discharging from site			
Existing Pervious Surfaces (ha)	0.0574	61%	0.0173	32%	β	30%
Existing Impervious Surfaces (ha)	0.0366	39%	0.0366	68%	α	100%
Total:	0.094	Total:	0.0539			

	Overall		Discharging from site			
Proposed Pervious Surfaces (ha)	0.0461	49%	0.014	23%	β	30%
Proposed Impervious Surfaces (ha)	0.0479	51%	0.0479	77%	α	100%
Proposed Green Roof	0	0%	0	0%	γ	0%
Total:	0.094	Total:	0.0619			

Peak Rate of Runoff

Existing Site	BROWNFIELD	
Detailed Modelling Used?	No	e.g. Microdrainage, HydroCAD, Multiple Catchments
Runoff Calculation Method (Existing)	Wallingford/Modified Rational	Calculation Sheets Attached
Runoff Calculation Method (Proposed)	Wallingford/Modified Rational	Calculation Sheets Attached
Allowance for Future Climate Change	To 2115 UE 40%	
Surface Water Management Strategy	Attenuated on Site	

	1yr	30yr	100yr		
Existing Discharge Rate	6.6	15.5	19.6	l/s	
IoH Greenfield Discharge Rate (full site)	0.4	1.0	1.4	l/s	
Detailed modelling output/FEH:				l/s	
Limiting Discharge Rate	6.6	15.5	19.6	l/s	
Post-Development Discharge Rate	8.1	19.0	24.0	l/s	
Including Climate Change	11.3	26.6	33.6		
Detailed modelling output:				l/s	
Proposed Discharge Rate	6.6	15.5	19.6	l/s	
Bespoke Limiting Discharge Rate	6.6	6.6	6.6		
Design discharge rate:	6.6	15.5	19.6	l/s	Existing Rates
Minimum Storage Required	0.9	2.2	2.8	m^3	

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IH124 : Greenfield Peak Runoff

22023	61 Redington Road	
Calculations By: FdM	Checked By: CB	Date: 17.03.2022

Catchment Area	AREA	ha	0.094
Standard average annual rainfall 1941 - 1970	SAAR	mm	660
Soil Index (from FSR or Wallingford Procedure WRAP maps)*	SOIL		0.47

*SOIL is the SPR for the soil type, and for larger sites is a weighted sum of the individual soil classes for the site, where:

$$SOIL = \frac{0.1A_{SOIL1} + 0.3A_{SOIL2} + 0.37A_{SOIL3} + 0.47A_{SOIL4} + 0.53A_{SOIL5}}{AREA}$$

For smaller sites, use the SPR for the local soil type, as follows:

SOIL TYPE	1	2	3	4	5
AREA	0	0	0	0.094	0
SPR	0.1	0.3	0.37	0.47	0.53

SOIL: 0.47

$$QBAR = 0.00108 \,.\, (0.01AREA)^{0.89} .\, SAAR^{1.17} .\, SOIL^{2.17}$$

* The site area is less than 50ha. Since the IoH124 methodology is not calibrated for sites less than 50ha in area, the calculation should be undertaken based on a 50ha site area and proportionately adjusted based on the ratio of the site size to 50ha.

$QBAR_{50ha}$	l/s	225.33
QBAR/ha	l/s/ha	4.51
$QBAR_{site}$	l/s	0.42

Hydrological Area	fig 4.2	6

Return Period (years)	Growth Factor (table 4.3)	Discharge rate l/s
1	0.85	0.36
2	0.88	0.37
10	1.62	0.69
30	2.3	0.97
50	2.62	1.11
100	3.19	1.35

Figures and table references from CIRIA C753 The SUDS Manual © CIRIA 2015

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Wallingford Procedure : Existing Peak Runoff

22023	61 Redington Road	
Calculations By: FdM	Checked By: CB	Date: 17.03.2022

Site Characteristics

Site Area	AREA	ha	0.094
Drained Catchment Area	AREA	ha	0.0539
Approximate Longest Drainage Path	L	m	25
Difference in Ground Levels	ΔH	m	0.25
Slope	Slope (S)		1: 100
Permeable Surfaces (Rational Method runoff coefficient = 0.4)		ha	32%
Impermeable Surfaces (Rational Method runoff coefficient = 0.95)		ha	68%
Area Weighted Rational Method Runoff Coefficient			0.773

Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40

Time of Concentration

Recommended Tc Method: SCS: Sheet Flow
Tc Method Choice: SCS: Sheet Flow

Sheet Flow

Surface Description			Paving or Brick
Slope			Shallow
Roughness Coefficient	(Manning's n)		0.018
Flow Length, L		m	25
M2-24hr		mm	37.70
Land Slope		m/m	0.01000
Tc		hr	0.05

Time of Concentration	T_c	min	3.0
Critical Storm Duration (minimum 5min)	T_{crit}	min	5.0

Critical Storm Rainfall and Runoff

$Z1_{TC}$ 0.38 *Wallingford Procedure Figure 3.6
$M5\text{-}T_{crit}$ 7.7
C 0.773

Discharge Rate
Q = 2.78CiA

Return Period (years)	Z2*	Depth (mm)	Intensity (mm/hr)	Discharge Rate l/s
1	0.62	4.7	56.7	6.57
2	0.79	6.1	72.7	8.42
10	1.20	9.2	110.6	12.82
30	1.45	11.1	133.6	15.48
50	1.60	12.2	146.8	17.02
100	1.84	14.1	169.1	19.60

*Wallingford Procedure Table 3.2

Wallingford Procedure : Developed Peak Runoff

22023	61 Redington Road	
Calculations By: FdM	Checked By: CB	Date: 17.03.2022

Site Characteristics

Site Area	AREA	ha	0.094
Drained Catchment Area	AREA	ha	0.0619
Approximate Longest Drainage Path	L	m	25
Difference in Ground Levels	ΔH	m	0.25
Slope	Slope (S)		1: 100
Permeable Surfaces (Rational Method runoff coefficient = 0.4)		ha	23%
Impermeable Surfaces (Rational Method runoff coefficient = 0.95)		ha	77%
Green Roof of gradient of up to 15°, and depth of 20-40mm , c=		0.7 *	0%
Area Weighted Rational Method Runoff Coefficient			0.83

*in line with Table 10.1 of CIRIA C644

Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40

Time of Concentration

Recommended Tc Method: SCS: Sheet Flow

Tc Method Choice: SCS: Sheet Flow

Sheet Flow

Surface Description			Paving or Brick
Slope			Shallow
Roughness Coefficient	(Manning's n)		0.018
Flow Length, L		m	25
M2-24hr		mm	37.70
Land Slope		m/m	0.01000
Tc		hr	0.05

Time of Concentration	T_c	min	3.0
Critical Storm Duration (minimum 5min)	T_{crit}	min	5.0

Critical Storm Rainfall and Runoff

$Z1_{TC}$ 0.38 *Wallingford Procedure Figure 3.6

$M5\text{-}T_{crit}$ 7.7

C 0.826

Discharge Rate $Q = 2.78CiA$

Return Period (years)	Z2*	Depth (mm)	Intensity (mm/hr)	Discharge Rate l/s	Future Rate l/s
1	0.62	4.7	56.7	8.05	11.27
2	0.79	6.1	72.7	10.33	14.46
10	1.20	9.2	110.6	15.71	22.00
30	1.45	11.1	133.6	18.98	26.57
50	1.60	12.2	146.8	20.86	29.20
100	1.84	14.1	169.1	24.02	33.63

*Wallingford Procedure Table 3.2

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MRM 100 year Event Storage Calculator

22023	61 Redington Road	
Calculations By: FdM	Checked By: CB	Date: 17.03.2022

Site Parameters

Drained Catchment Area	AREA	ha	0.0619
Approximate Longest Drainage Path	L	m	25
Difference in Ground Levels	ΔH	m	0.25
Slope	Slope (S)		1: 100
Permeable Surfaces (Rational Method runoff coefficient = 0.4)		ha	23%
Impermeable Surfaces (Rational Method runoff coefficient = 0.95)		ha	77%
Green Roof of gradient of up to 15°, and depth of 20-40mm , c=		0.7 *	0%
Area Weighted Rational Method Runoff Coefficient			0.83

*in line with the FLL Guidelines on Planning, Execution and Upkeep of Green Roof Sites, 2002

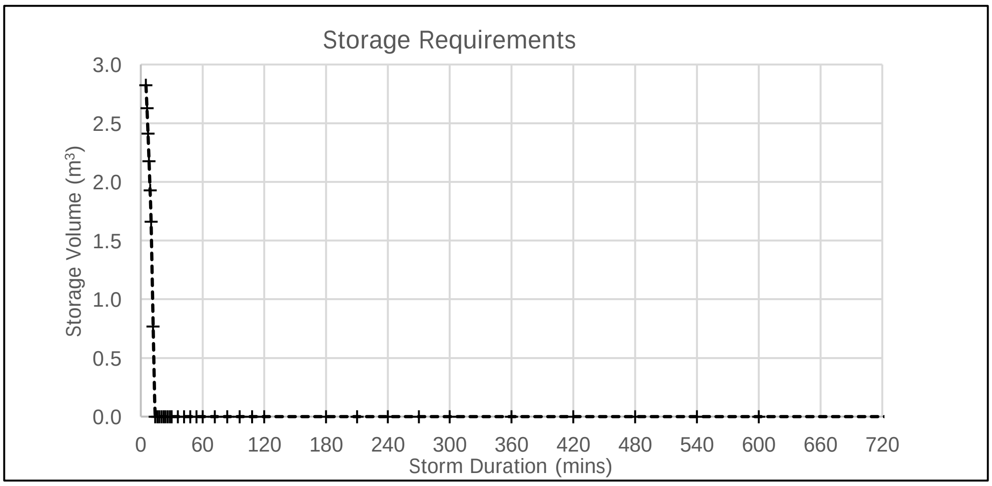
Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40
Time of Concentration	T_c	min	3.0

Maximum Storm Runoff Storage Volume (modified rational method)

	5	
T_d	5.0	min
$Z1_{TD}$	0.38	*Wallingford Procedure Figure 3.6
$M5\text{-}T_d$	7.7	mm
C	0.83	
$Z2_{100}$	1.85	*Wallingford Procedure Table 3.2
$M100\text{-}T_d$	14.2	mm
Intensity	170.6	mm/hr
Q_d	24.2	l/s
$Q_{d,\text{climate change}}$	33.9	l/s
$Q_{\text{limiting discharge}}$	19.6	l/s

Maximum storage required m^3 2.8



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MRM 30 year Event Storage Calculator	22023	61 Redington Road	
	Calculations By: FdM	Checked By: CB	Date: 17.03.2022

Site Parameters

Drained Catchment Area	AREA	ha	0.0619
Approximate Longest Drainage Path	L	m	25
Difference in Ground Levels	ΔH	m	0.25
Slope	Slope (S)		1: 100
Permeable Surfaces (Rational Method runoff coefficient = 0.4)		ha	23%
Impermeable Surfaces (Rational Method runoff coefficient = 0.95)		ha	77%
Green Roof of gradient of up to 15°, and depth of 20-40mm , c=		0.7 *	0%
Area Weighted Rational Method Runoff Coefficient			0.83

*in line with the FLL Guidelines on Planning, Execution and Upkeep of Green Roof Sites, 2002

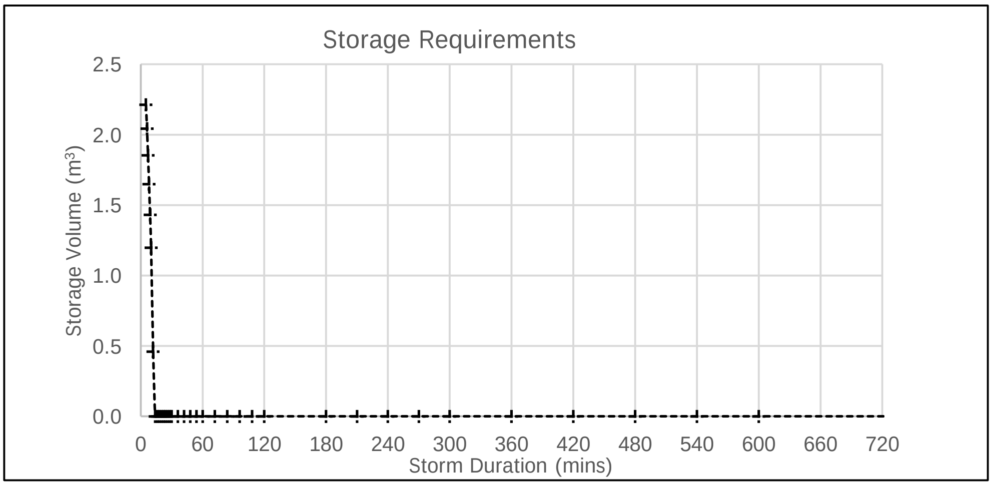
Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40
Time of Concentration	T_c	min	3.0

Maximum Storm Runoff Storage Volume (modified rational method)

T_d	5.0	min
$Z1_{TD}$	0.38	*Wallingford Procedure Figure 3.6
$M5\text{-}T_d$	7.7	mm
C	0.83	
$Z2_{30}$	1.46	*Wallingford Procedure Table 3.2
$M30\text{-}T_d$	11.2	mm
Intensity	134.4	mm/hr
Q_d	19.1	l/s
$Q_{d,climate\ change}$	26.7	l/s
$Q_{limiting\ discharge}$	15.5	l/s

Maximum storage required	m^3	2.2



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MRM 1 year Event Storage Calculator	22023	61 Redington Road	
	Calculations By: FdM	Checked By: CB	Date: 17.03.2022

Site Parameters

Drained Catchment Area	AREA	ha	0.0619
Approximate Longest Drainage Path	L	m	25
Difference in Ground Levels	ΔH	m	0.25
Slope	Slope (S)		1: 100
Permeable Surfaces (Rational Method runoff coefficient = 0.4)		ha	23%
Impermeable Surfaces (Rational Method runoff coefficient = 0.95)		ha	77%
Green Roof of gradient of up to 15°, and depth of 20-40mm , c=		0.7 *	0%
Area Weighted Rational Method Runoff Coefficient			0.83

*in line with the FLL Guidelines on Planning, Execution and Upkeep of Green Roof Sites, 2002

Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40
Time of Concentration	T_c	min	3.0

Maximum Storm Runoff Storage Volume (modified rational method)

T_d	5.0	min
$Z1_{TD}$	0.38	*Wallingford Procedure Figure 3.6
$M5\text{-}T_d$	7.7	mm
C	0.83	
$Z2_1$	0.61	*Wallingford Procedure Table 3.2
$M1\text{-}T_d$	4.7	mm
Intensity	56.5	mm/hr
Q_d	8.0	l/s
$Q_{d,climate\ change}$	11.2	l/s
$Q_{limiting\ discharge}$	6.6	l/s

Maximum storage required	m^3	0.9