GeoSmart Information

Environmental Thinking

SuDSmart Pro

Site address	77 Avenue Road London NW8 6JD
Site coordinates	526913, 183855
Report prepared for	Montagu Evans LLP 5 Bolton Street, London, W1J 8BA
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1. Executive summary

This report assesses the feasibility of infiltration SuDS in support of the Site development process. From April 6th 2015 SuDS are regulated by Local Planning Authorities and will be required under law for major developments in all cases unless demonstrated to be inappropriate. The Lead Local Flood Authority will require information as a statutory consultee on major planning applications planning with surface water drainage implications. The National Planning Policy Framework (NPPF) (2012) requires that new developments in areas at risk of flooding should give priority to the use of SuDS and demonstrate that the proposed development does not increase flood risk downstream to third parties.

Potential increase in run-off due to the development*1 Minimum attenuation assuming some off-site discharge.	Total run-off including climate change (+30%)*1 Maximum attenuation assuming no off-site discharge	Change in impermeable area on a previously developed / brownfield site (as a % of total area)
↑ -13 m^3	+87 m^3	↑ -24%

*1 for the 6 hour, 1 in 100 year event excluding mitigation

Low infiltration potential

The Site has a low potential for infiltration SuDS, according to the GeoSmart infiltration map. Guidance states that if infiltration SuDS are not possible, attenuation SuDS with a controlled discharge into nearby surface water feature or existing surface water drainage is recommended. Infiltration may not be practically feasible for this Site.

✓

Sustainable Drainage System summary

According to Section 9.3 of the London Borough of Camden development guidance (London Borough of Camden, 2015) and Policy 5.12 of the London Plan (Mayor of London, 2015) a reduction in the rate and volume of runoff to greenfield would be required for new development, for all storm events up to and including the 1 in 100 year 6 hour storm (including an allowance of 40% for climate change).

A minimum attenuation volume of 35 m^3 is required to comply with the London Plan Supplementary Planning Guidance and will provide sufficient attenuation for the Critical Storm Durations when limited to 2 l/s (the minimum discharge achievable using a hydro-brake and preference within Camden pro-forma).

The Site is located on impermeable London Clay bedrock with a low potential for infiltration. As a result of the low permeability at the Site, infiltration SuDS are likely to be unfeasible and due to the Site's distance away from a freely accessible surface water feature, attenuation storage features and a controlled discharge (2 l/s) to the local sewer system are considered the most appropriate for the Site. The Site is located within Flood Zone 1 and is not located within a source protection zone or a critical drainage area, where it is not considered to be at risk from fluvial flooding. Green roofs to intercept and attenuate rainwater, lined permeable paving (underlain by geo-cellular storage crates) and a Glass Reinforced Plastic (GRP) tank is proposed for the development.

Next steps

Site investigation is necessary to confirm the infiltration capacity and detailed design is required once the drainage concept is approved. See further information section at the end of this report.

2. Proposed SuDS scheme options layout

The proposed SuDS scheme layout is indicated below with further supporting information provided in subsequent sections to provide a minimum attenuation of 35 m³ for the development (attenuation required for all events up to a 1 in 100 year storm event (including a 40% allowance for climate change) when a restricted discharge of 2 l/s is applied. This would be in line with London Borough of Camden development policy, national guidance and London Plan guidance (LBC, 2010)(DEFRA, 2012).

PERMEABLE PAVING: 18.2M³

Permeable paving within access drive is 96m² (110m²-14m² of sloped area of access) underlain by:

- geo-cellular storage crates (to a depth of 200mm across 96 m²) have a 95% void ratio which could attenuate 18.2 m³. Shallow system utilised to ensure Root Protection Areas (RPA's) are not compromised. System should also be partially lined to avoid surface water migrating through the underlying geology and interacting with the basement and lightwells.

GREEN ROOF (ABOVE BASEMENT) (22 M²) TO ATTENUATE 3.92 M³

- The green roof substrate (400 mm) which has a 40% porosity, so substrate will hold c. 3.52 m³.
- The green roof reservoir board (20mm) which has a 95% void space to hold c 0.4 m³.

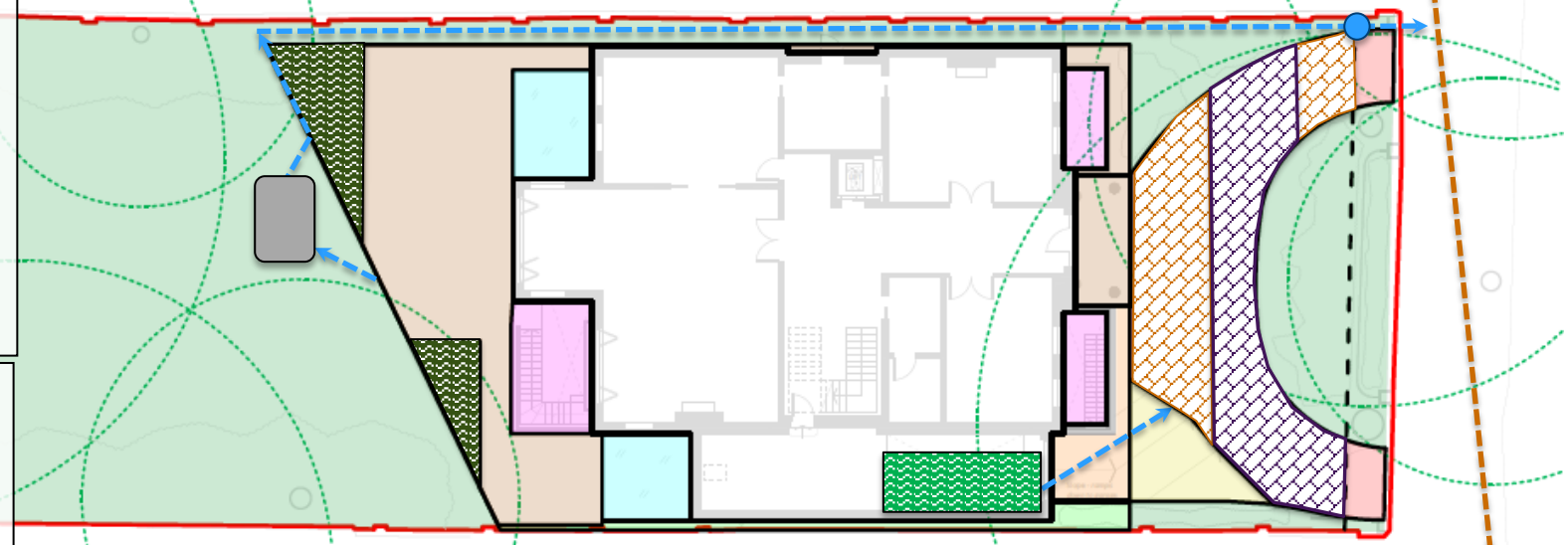
GREEN ROOF (ABOVE GARAGE) (26 M²) TO ATTENUATE 0.55 M³

- The green roof substrate (50 mm) which has a 40% porosity, so substrate will hold c. 0.05 m³.
- The green roof reservoir board (20mm) which has a 95% void space to hold c 0.5 m³.

GRP Attenuation Tank: 15M³

Attenuation tank volume of: 15 m³ to be positioned to fall outside the tree root protection areas defined by the arboriculturalist, within the rear garden area:

- Dimensions of 5m x 2m x 1.5m



Additional run-off from the development should utilise the existing drainage on the Site, depending on the capacity of the existing drainage system.

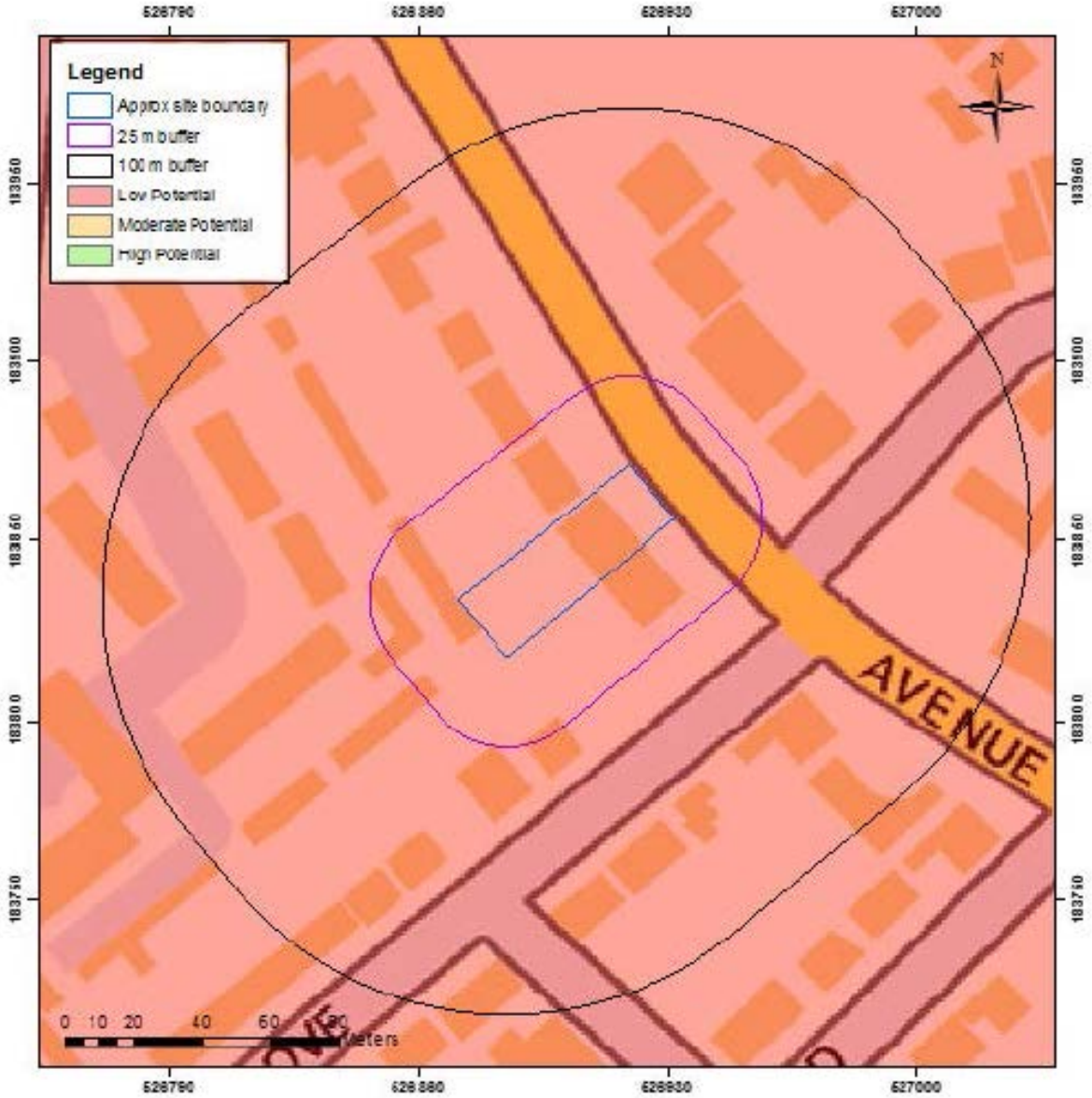
Pumping may be required from the GRP tank sited in the rear garden area.

Source control SuDS such as permeable paving and green roofs are to be incorporated in order to improve the water quality and act as a form of treatment. The green roof in particular is considered a requirement under Policy DP22 within the Camden Development Policies 2010-2025 (LBC, 2010).

* Note drawings are schematic only and not to scale

3. SuDS Infiltration Suitability Map (SD50)

The GeoSmart SuDS Infiltration Suitability Map (SD50) screens the suitability for infiltration drainage in different parts of the site and indicates where further assessment is recommended. The map combines information on the thickness and permeability of the underlying material and the depth to the high groundwater table. The report provides the attenuation volumes and run-off rates that will need to be considered. It supports conceptual site drainage assessment and the planning of further site investigation. The first part of the report addresses the constraints on the infiltration potential of the site, the second part provides the attenuation and storage volume requirements and the final sections provide options for the SuDS strategy and background information.



Potential suitability for infiltration SuDS

(Based on the GeoSmart SuDS Infiltration Suitability Map (SD50))

Low infiltration potential There is a low potential for infiltration SuDS in parts of the Site. Comments: It is likely that the underlying geology at the Site, or in areas of the site, is relatively impermeable which would limit the effectiveness of a proposed infiltration SuDS scheme. Recommendations: Infiltration SuDS should be focused in more suitable parts of the site. If a site investigation confirms that infiltration SuDS are not possible at the Site then attenuation SuDS with a controlled discharge into a nearby surface water feature or existing surface water drainage is recommended.	✓
Moderate infiltration potential There is a moderate potential for infiltration SuDS in parts of the Site. Comments: It is likely that the permeability of the underlying material at the site would be suitable for infiltration drainage. However, there may be constraints on the use of infiltration SuDS as a result of any of the following: a high water table, the limited thickness of the receiving formation, the potential for a significant range in permeability in the underlying geology and confirmation of the infiltration capacity is recommended. Recommendations: A site investigation is recommended to investigate groundwater levels and formation thickness and to confirm that infiltration rates at the Site are sufficient to accommodate an infiltration SuDS feature. If a site investigation confirms that infiltration SuDS are possible at the Site then various options can be considered for infiltration SuDS and these include infiltration trenches, soakaways, swales, permeable pavements and infiltration basins without outlets.	✗
High infiltration potential There is a high potential for infiltration SuDS in parts of the Site. Comments**:** It is likely that the underlying geology at the Site is highly permeable and an infiltration SuDS scheme should be possible at the Site. Groundwater levels are expected to be sufficiently deep at the site. Recommendations**:** A site investigation is recommended to confirm the high infiltration capacity and the depth of the winter water table. Various options can be considered for infiltration SuDS and these include infiltration trenches, soakaways, swales, permeable pavements and infiltration basins without outlets.	✗

Underlying geology at the site

Geology present		Potentially permeable?
Superficial Geology	None Recorded	N/A
Bedrock Geology	London Clay Formation	✘

4. Site analysis

Site information

The purpose of this report is to assess the potential for disposing of surface water through a sustainable drainage system (SuDS) for the Site of 77 Avenue Road, London, NW8 6JD (the Site). The Site is located in a predominantly residential setting. According to topographic survey for the Site, the land slopes from northeast towards the southwest with elevations ranging from 58.99 mAOD to 49.73 mAOD (Coupdeville, 2008). Site plans and drawings are provided in Appendix A.

Development

The Site is currently used within a residential capacity. At present there is a single building with car park and landscaped areas. The proposed development is for a replacement dwelling of a similar size to the original with additional accommodation and services provided beneath the ground.

Geology, permeability and thickness

British geological Survey (BGS) records confirm the underlying geology as London Clay Formation (impermeable strata) where overlying superficial geology is not recorded (BGS, 2018). The closest borehole records held by the BGS relate to a location c.150 m to the south east of the Site. The borehole logs show clay to a depth of 30 m at which point drilling ceased, it is not known to what depth beyond this the clay continues.

Depth to groundwater

Based on a borehole record obtained for a Site located c.150 m south east of the Site (BGS Reference: TQ28SE353), no water was struck during the drilling process.

The presence of groundwater immediately beneath the Site is unlikely due to the Site's location away from a watercourse and the underlying impermeable bedrock geology; however this should be confirmed by a site investigation.

Guidance

'It is essential that the consideration of sustainable drainage takes place at the land acquisition due diligence stage'

LASOO (2015), Practice Guidance, Local Authority SUDS Officer Organisation.

Ground conditions

A site specific review of underlying ground conditions is recommended where focused infiltration methods are recommended, to ensure this does not cause ground instability as a result of landslide or collapse associated with dissolution or shallow mining. Hazards that should be considered include soluble rocks, landslides, compressible ground, collapsible ground, shrink-swell clays, running sand and shallow mining.

Water quality

The site does not lie within a source protection zone. In this case an assessment of the quality of infiltrating runoff and the possibilities for pre-treatment is not required. Infiltration systems should not be used where there is a risk of contaminating groundwater by infiltrating polluted runoff or where receiving groundwater is particularly sensitive.

Hydrology and drainage

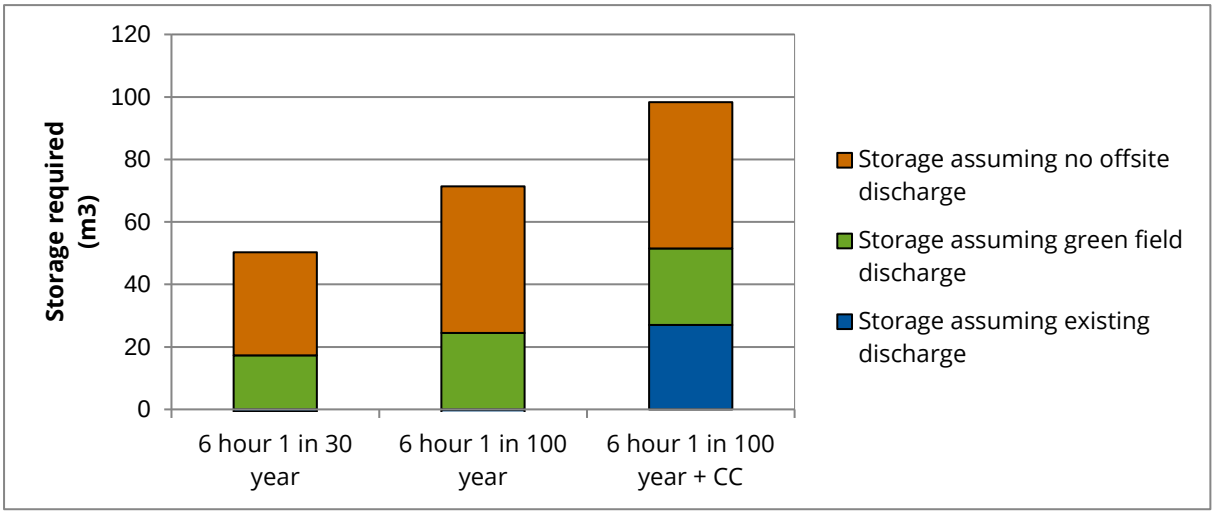
Site plans indicate a pond which is located within the western section of the Site. The closest watercourse to the Site other than this is the Regent's Canal and is located c.795 m to the south east of the Site at the closet point.

Flood risk

The Site is located within Flood Zone 1, which has a low risk of fluvial flooding (Environment Agency, 2018). The Site is also at negligible risk of pluvial (surface water) flooding (Environment Agency, 2018) and a negligible risk of groundwater flooding (GeoSmart, 2018).

5. Storage, volume and peak flow rate

Suggested minimum and aspirational storage requirements for an infiltration or attenuation SuDS scheme for the development footprint are set out below with more detail provided in subsequent sections. Storage volumes may be reduced (but not below the minimum level) if the design incorporates off-site discharge.



Attenuation scenario	Attenuation requirement (m^3)	Explanation
Minimum	32	Storage required to meet London Plan Supplementary Planning Guidance to ensure runoff is reduced by no less than 50% of the existing Site run-off (LBC, 2015).
Recommended	35	Storage required to meet the scope of the London Plan (Mayor of London, 2015) that flow is limited to the calculated greenfield rate. London Borough of Camden also expect sites to achieve greenfield run-off rates once SuDS have been installed (LBC, 2015). Providing an attenuation volume of 35 m^2 would comply with the London Plan Supplementary Planning Guidance and will provide sufficient attenuation for the Critical Storm Duration (2 hours) when flow rates are restricted to 2 l/s (as recommended within the London Plan), which is the minimum discharge achievable using a hydro brake and preference within Camden pro-forma) (See Appendix B)
Maximum	98	Storage required assuming no off site drainage for the 6 hour 1 in 100 year event, including the maximum effects of climate change (cc). *Note: discharge off site will reduce this, any increase as a result of cc is less for buildings with a limited design life.*

Surface water run-off

Reduction in run-off will help mitigate flood risk both on and off site. Further information on the surface water run-off calculations is provided in Section 6 'Background Information'.

The Non-Statutory Technical Guidance for SuDS (DEFRA, March 2015) states: Guidance

"Where reasonably practicable, for Greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the Greenfield runoff volume for the same event. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the Greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event."

Table 1: Change in impermeable area associated with the development

Total site area 1,180 m^2

Impermeable area (and as a percentage of the total area of the proposed development footprint of 1200 m^2)	
Pre-development	Post-development
547 m^2 (46%)	531 m^2 (45%)
Impermeable Land use: Residential dwelling Permeable Land use: landscaped areas	New impermeable land use: 531 m^2 residential dwelling and driveway New permeable land use: Landscaped areas and permeable paving

Guidance

"The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event' and 'flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development"

(DEFRA, March 2015, non-statutory guidance).

Peak discharge rates

The table below presents peak discharge rates for a range of storm events used to assess the impact of the proposed development and select the maximum permitted discharge rate. Further information on the calculation and control of peak discharge rates is provided in Section 6 'Background Information'.

Table 2: Peak discharge rates associated with the development

Rainfall event	Greenfield run-off rates	Existing run-off rates[1] (l/s)	Potential run-off rates without attenuation	Potential minus existing (l/s)
QBAR	0.5	N/A	N/A	N/A
6 hour 1 in 1 year	0.4	0.5	0.5	0.0
6 hour 1 in 10 year	0.8	1.7	1.7	0.0
6 hour 1 in 30 year	1.2	2.3	2.3	0.0
6 hour 1 in 100 year	1.7	3.3	3.3	-0.1
6 hour 1 in 100 year + 20% CC	N/A	N/A	3.9	0.6
6 hour 1 in 100 year + 30% CC	N/A	N/A	4.6	1.2

[1] Assumes 100% run-off from impermeable surfaces. Assumes Greenfield run-off from permeable surfaces calculated using the IoH124 method.

Relevant local and regional plan policy should be consulted to determine restrictions on run-off from previously developed sites. In some cases greenfield rates may be requested. In practice it is difficult to restrict discharge rates at any one control point to less than 5 l/s. Although 2 l/s is normally the lowest flow restriction based upon widely available flow control devices available, these normally require suitable upstream mitigation and interception to avoid blockage of the drainage system over time.

Total discharge volumes

The table below presents discharge volumes for a range of storm events used to assess the impact of the proposed development and calculate the required storage volumes. Further information on the calculation of total discharge volumes is provided in Section 6 'Background Information'.

Table 3: Total discharge volumes associated with the development

Rainfall event	Greenfield run-off volume (m^3)	Existing run-off volume[2] (m^3)	Potential run-off volume without attenuation (m^3)	Potential minus existing (m^3)
QBAR	15	N/A	N/A	N/A
6 hour 1 in 1 year	7	11	10	-0.2
6 hour 1 in 10 year	24	36	36	-0.6
6 hour 1 in 30 year	33	50	50	-0.8
6 hour 1 in 100 year	47	71	70	-1.1
6 hour 1 in 100 year + 20% CC	N/A	N/A	84	13
6 hour 1 in 100 year + 30% CC	N/A	N/A	98	27

[2] Assumes 100% run-off from impermeable surfaces. Assumes Greenfield run-off from permeable surfaces calculated using the IoH124 method.

Climate change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high-intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the National Planning Policy Framework (NPPF) recommends that the effects of climate change are incorporated into Flood Risk Assessments (Flood Risk Assessments: Climate Change Allowances Guidance, 2016).

Table 4: Peak rainfall intensity allowance in small and urban catchments

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

6. Run-off destination

Options for the destination for the run-off generated on-site have been assessed in line with the prioritisation set out in the Building Regulations Part H document (HM Government, 2010) and DEFRA's Draft National Standards for SuDS (2011). Flow attenuation using infiltration SuDS (discharge to ground) is generally the preferred option. If discharge to ground is not available, run-off discharge to surface water is the other preferred method. Only if these two options are impractical should discharge to the sewer network be considered.

Discharge to ground

As discussed in Section 3 the site has a low potential for infiltration. Based on the available geological information from the British Geological Society and the GeoSmart SuDS infiltration map, discharge to ground is unlikely to be feasible due to the permeability of the bedrock geology.

A Site investigation comprising trial pits is recommended to confirm the depth to groundwater and allow infiltration tests to be undertaken to ascertain the presence of any localised superficial deposits on the Site.

Discharge to surface watercourse

A pond is located within the southern section of the Site but this does not appear to discharge into any watercourse. Discharge to surface watercourses would not be feasibly practical as a connection to watercourses would involve crossing into other properties and public areas.

Discharge to sewer

Discharge to sewer is likely to be the optimum sustainable drainage option for the new development area. It is understood that the existing Site is currently drained to the main sewer located along the eastern boundary of the Site along Avenue Road.

Consultation with the local sewer undertaker should be undertaken as it is likely that if SuDS were implemented on the Site, discharge to sewer would be the only reasonably practical option for discharge.

As there will be an increase in the number of buildings on the Site, it is likely a Thames Water pre-development enquiry will be required to agree proposed surface water discharge rates from the Site. Foul discharge rates may also be required by Thames Water; however this feature and pre-development enquiry are not included within this report. Discharge to the sewer should be controlled, and onsite attenuation would be required. The ground levels on the site fall to the south west which is away from the existing drainage network, located towards the north east along Avenue road.

7. Water quality

A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution. This can be effectively managed by an appropriate "train" or sequence of SuDS components that are connected in series. The frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5-10 mm of rainfall (first flush) should be adequately treated with SuDS.

The minimum number of treatment stages will depend on the sensitivity of the receiving water body and the potential hazard associated with the proposed development SuDS Manual (CIRIA, 2015). The proposed development is a combination of low (roof water) to medium hazard (runoff from car parking and road). The site does not lie within a source protection zone and therefore additional treatment stages are not required.

Table 5: Level of hazard

Hazard	Source of hazard
Very Low	Residential Roof drainage
Low	Residential, amenity uses including low usage car parking spaces and roads, other roof drainage.
Medium	Commercial, industrial uses including car parking spaces and roads (excluding low usage roads, trunk roads and motorways).
High	Areas used for handling and storage of chemicals and fuels, handling of storage and waste (incl. scrap-yards).

The extent of treatment depends on land use, level of pollution prevention in the catchment and the natural protection afforded by underlying soil layers. A high hazard site will require more treatment then low hazard. The treatment processes provided by different SuDS components will have varying capabilities for removal of different types of contaminants.

Table 6: Minimum water quality management requirements for discharges to receiving water bodies and groundwater

Hazard	Requirements for discharge to surface water and groundwater
Very Low	Removal of gross solids and sediments only
Low	Simple index approach
Medium	Surface water: Simple index approach, Groundwater: Simple index approach and Risk Screening
High	Guidance and risk assessment process in HA (2009). Discharge may require environmental permit or license. Obtain pre-permitting advice from environmental regulator. Risk assessment likely to be required.

8. Sustainable drainage systems

It is recommended the drainage system has the capacity to accommodate the 1 in 100 year event before any flooding occurs. Drainage from areas outside the development footprint will continue to use the existing drainage arrangements.

Based on the preceding sections of this report it is considered likely that attenuation SuDS will be a suitable option for this Site, subject to confirmation by Site testing. The proposed drainage strategy has been summarised in Section 2 of this report and as a minimum should provide a total storage of 32 m^3, sufficient to attenuate 50% of the existing brownfield site run-off for the 6 hour, 1 in 100 years event in line with the London Borough of Camden's minimum requirements set out within the Camden Planning Guidance SPD (LBC, 2015).

However, London Borough of Camden's developer guidance (LBC, 2015), London Borough of Camden's policy DP23: Water within the Camden Development Policies 2010-2025 document (LBC, 2010), the London Plan: Policy 5.13 (MOL, 2015) and DEFRA non statutory guidance (DEFRA, 2015) states that developers should aim for runoff rates to be restricted to the greenfield runoff rate unless it is proven to be impractical for the Site. Therefore, it is recommended that **35 m^3 of attenuation is provided** on the Site to comply with both local and the national policies. 35 m^3 would comply with the London Plan Supplementary Planning Guidance and will provide sufficient attenuation for the Critical Storm Durations when limited to 2 l/s (the minimum discharge achievable using a hydro brake and preference within Camden pro-forma)(See Appendix B)

Potential SuDS options for this Site are set out below subject to confirmation by detailed design and testing. The SuDS features below would provide c. **37.7 m^3** of attenuation, the freeboard would allow for the reduction in capacity of the systems over time due to siltation between maintenance. Table 21.2 of the CIRIA SuDS manual (C753) confirms a maximum potential loss of storage within SuDS systems due to siltation of 3% over 50 years (*3% of 37.7m^3 for roofs and low density housing drainage is 1.1m^3 over 50 years and 2.2 m^3 over the developments lifetime of 100 years*).

1. Permeable paving is proposed over 96 m^2 with geo-cellular storage underlying this (95% void ratio) to provide a form of source control and attenuation for surface run-off. An area of 96 m^2 could consist of permeable paving with a 200mm depth of geo-cellular storage with 95% void space, would result in c. **18.2 m^3** of attenuation with restricted discharge to the sewer.

    - The permeable paving is to be lined in the area nearest to the property as shown within section 2 to avoid any migration of surface water runoff through the underlying geology, to prevent interaction with the basement and lightwells.

    - Unlined areas are proposed (although these should be wrapped in a geo-textile membrane to prevent weed growth and siltation) to provide the input of water to the root system. A layer of material needs to ideally be laid

between the clay and the uppermost surface to act as a storage/drainage channel (LBC, 2015).

2. According to client provided plans, a grass (green) roof/raised lawn is proposed for the development which is compliant with policy DP22: Promoting sustainable design and construction within the Camden Development Policies 2010-2025 document (LBC, 2010). Two separate areas are proposed with a total green roof covering of 48 m^2.

    - green roof (above basement) (22 m^2) could attenuate **3.92 m^3**
        - The green roof substrate (400 mm) which has a 40% porosity so substrate will hold c. 3.52 m^3.
        - The green roof reservoir board (20mm) which has a 95% void space to hold c 0.4 m^3.
    - green roof (above garage) (26 m^2) could attenuate **0.55 m^3**
        - The green roof substrate (50 mm) which has a 40% porosity so substrate will hold c. 0.05 m^3.
        - The green roof reservoir board (20mm) which has a 95% void space to hold c 0.5 m^3.

3. A Glass Reinforced Plastic (GRP) attenuation tank is proposed to provide an attenuation volume of **15 m^3**, positioned to fall outside the tree root protection areas in the rear garden, defined by the arboriculturalist.

    - Dimensions of 5m x 2m x 1.5m would provide the required volume of attenuation storage of 15 m^3.

Use of the recommended SuDS for the development should ensure the proposed development is able to comply with Policy 5.12 of the London Plan, the Mayor's Supplementary Planning Guidance (SPG) on Sustainable Design and Policies DP22 and DP23 of London Borough of Camden's Development Policies 2010-2025 document (LBC, 2010). The proposed SuDS features after mitigation would follow the drainage hierarchy established within the London Plan (MOL, 2015).

Initial recommendation: Source control SuDS to reduce run-off with primary discharge to the onsite pond or the sewer.

Various options can be evaluated when considering Source control SuDS which include permeable paving and green roofs.

PERMEABLE PAVING TO ATTENUATE 18.2M^3

Permeable paving is intended for the area at the front of the property. Suitable aggregate materials (angular gravels with suitable grading as per CIRIA, 2015) will improve water quality due to their filtration capacity. Plastic geo-cellular systems beneath these surfaces will increase the void space and storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles. 96 m² of permeable paving is proposed for the Site. As the Site is situated above impermeable London Clay bedrock, permeable paving may need to be lined in certain areas with a controlled discharge into the

sewer line once the disposal route has been investigated. Due to the presence of trees within close proximity to the proposed permeable paving, depth of the underlying geo-cellular storage is to remain shallow in order to reduce any impact the proposed features would have.

A mixture of lined and unlined permeable paving within access drive is 96m^2 (110m^2-14m^2 of sloped area of access) underlain by:

- geo-cellular storage crates (to a depth of 0.20m across 96 m^2) have a 95% void ratio could attenuate 18.2 m^3. Shallow system utilized to ensure Root Protection Areas (RPA's) are not compromised and lined and unlined areas to protect basement and lightwells and to feed underlying tree root network.

GREEN ROOFS TO ATTENUATE UP TO 4.47 M^3

Interception via green roofs will enable the storage of run-off and infiltrate collected water gradually into the underlying substrate; this provides various levels of storage depending on the surface area of the feature and the thickness / type of the substrate being use. The different types of green roof include the following:

- Extensive roofs, have low substrate depths (and therefore low loadings on the building structure), simple planting and low maintenance requirements; these tend not to be accessible.

- Intensive roofs (or roof gardens) have deeper substrates (and therefore higher loadings on the building structure) that can support a wide variety of accessible planting but which tend to require more intensive maintenance.

Green roofs can also provide improvements to water quality as they intercept water at the source, and the layering of the substrate can incorporate filtration measures to remove pollutants from the system.

It should be noted the extra loading imposed on the underpinning roof structure which varies with the type of green roof, but it is typically within a range of 0.7-5.0kN/m². Intensive roofs with trees together can impose loads up to 10 kN/m². The distributed load should account for a saturated growing medium (and snow loadings, if appropriate).

As the growing medium within green roofs are likely to struggle to meet interception requirements during cold, wet winter periods when they are likely to be saturated for much of the time. The amount of rainfall that can be absorbed by a green roof before runoff takes place is very dependent on antecedent conditions. Thus, any assumptions regarding green roof performance during design storms should take a conservative position. With this in mind, additional attenuation should be provided as a precaution in the event of complete saturation of the green roof.

It is also worth adding that although green roofs absorb most of the rainfall that they receive during frequent events, there will always be a need to discharge excess water to the building's drainage system. The hydraulic performance of green roofs once saturated tends to be fairly similar to standard roofs. Therefore, the hydraulic design of green roof drainage should follow the advice in BS EN 12056-3:2000. Useful information is also provided in BS

6229:2003. Detailed guidelines for the planning, execution and upkeep of green roof sites are contained within GRO (2014).

As stated above, grass roof/raised lawn is proposed for the development. Camden Development Policies 2010-2025, policy DP22 requires some form of green roof/living walls to be considered for new developments (LBC, 2010). The green roof on the Site will cover:

GREEN ROOF (ABOVE BASEMENT) (22 M^2) TO ATTENUATE 3.92 M^3

- The green roof substrate (400 mm) which has a 40% porosity so substrate will hold c. 3.52 m^3.
- The green roof reservoir board (20mm) which has a 95% void space to hold c 0.4 m^3.

GREEN ROOF (ABOVE GARAGE) (26 M^2) TO ATTENUATE 0.55 M^3

- The green roof substrate (50 mm) which has a 40% porosity so substrate will hold c. 0.05 m^3.
- The green roof reservoir board (20mm) which has a 95% void space to hold c 0.5 m^3.

GRP ATTENUATION TANK TO ATTENUATE UP TO 15M^3

Attenuation tank volume of 15 m^3 to be positioned to fall outside the tree root protection areas defined by the arboriculturalist, which may require pumping of surface water runoff to the onsite drainage network in the north of the Site.

Table 21.2 of the CIRIA SuDS Manual (C753) (2015) confirms there could be a maximum potential loss of storage after 50 years of 3% for the GRP tank and geo-cellular crate systems through sediment loading and therefore the freeboard provided by the attenuation within the drainage system would cater for this.

- Dimensions of 5m x 2m x 1.5m

FLOW CONTROL

Flow control systems will be required for the Site. This is usually a device (i.e. hydrobrake) used for controlling water flow into a connecting feature, such as a sewer, to define a specific flow performance. The design consists of an intake, a volute and an outlet and the configuration is critical to ensure discharge control. For drainage areas which are less then 3ha, outlet throttle diameters would have to be small (<150mm diameter) to achieve outflow rates which could result in blockage.

For most SuDS features, a flow control device will comprise a fixed orifice or a throttle such as a short pipe. A Vortex Control is usually a self-activating vortex flow device which directs water into a volute to form a vortex. For the Site, rainwater down pipes from the development roof should drain directly into the attenuation feature to reduce infill from potential flood water. A non-return flap value is also required for the outflow pipes to reduce the risk of backflow from a sewer during a flood event.

SuDS maintenance

Regular maintenance is essential to ensure effective operation of the soakaway(s) over the intended lifespan of the proposed development. The SuDS Manual (C753) (CIRIA, 2015) provides a maintenance schedule for SuDS with details of the necessary required actions as shown in Table 7 overleaf.

Table 7: SuDS operation and recommended maintenance requirements

Asset type	Maintenance schedule (and frequency)
Permeable Pavements	Regular maintenance: • Brushing and vacuuming (three times per year). • Trimming any roots and surrounding grass and weeds that may be causing blockages (annually or as required). Monitoring: • Initial inspection (monthly). • Inspect for poor performance and inspection chambers (annually).
Glass Reinforced Plastic Tank and Geo-cellular crate attenuation systems	Regular maintenance: • Inspect and identify any areas that are not operating correctly. If required, take remedial action. • Remove debris from the catchment surface (where it may cause risks to performance). • Where infiltration to tank is proposed (in line with the permeable paving arrangement) check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary. • Remove sediment from pre-treatment structures and/or internal forebays. Monitoring • Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed. • Survey inside of tank for sediment build-up and remove if necessary.
Green Roof	Regular inspection: • Inspect all components (soil substrate, vegetation, drainage, irrigation systems, membranes and roof structure, waterproofing, structural stability (annually and after severe storms) • Inspect soil substrate for evidence of erosion channels (annually and after severe storms). • Inspect drain inlets for unrestricted run-off (annually and after severe storms). • Inspect underside of roof for leakage (annually and after severe storms). Regular maintenance: • Remove litter and debris from inlet drains (six monthly, annually or as required). • Cleaning of clippings (six monthly or as required). • Trimming of grasses and removal of nuisance weeds and invasive vegetation (six monthly or as required). • Replace dead plants (annually or as required). Monitoring: • Stabilise any erosion channels with extra soil substrate (as required).

	• Identify sources of erosion and control (as required). • Investigate and repair drain inlet if inlet has settled, cracked or moved (as required).

9. Further information and what to do next

Site investigation is necessary to confirm the infiltration capacity and detailed design is required. Further SuDS options can be assessed in conjunction with the developer. The following table includes a list of products by GeoSmart:

Recommendations for next steps		
	Additional assessment: SuDSmart Report	The SuDSmart Report range assesses which drainage options are available for a Site. They build on technical detail starting from simple infiltration screening, and work up to more complex SuDS Assessments detailing alternative options. Please contact info@geosmartinfo.co.uk for further information.
	Additional assessment: FloodSmart Report	The FloodSmart Report range provides clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at a site. Our consultants assess available data to determine the level of risk based on professional judgement and years of experience. Please contact info@geosmartinfo.co.uk for further information.
✓	Additional assessment: EnviroSmart Report	Provides a robust desk-based assessment of potential contaminated land issues, taking into account the regulatory perspective. Our EnviroSmart reports are designed to be the most cost effective solution for planning conditions. Each report is individually prepared by a highly experienced consultant conversant with Local Authority requirements. Ideal for pre-planning or for addressing planning conditions for small developments. Can also be used for land transactions. Please contact info@geosmartinfo.co.uk for further information.

Client checklist for limitations to infiltration SuDS

Conditions set by Draft National Standards (Defra, 2011)	Do these conditions arise at the site?
Is the surface runoff greater than the rate at which water can infiltrate into the ground?	
Is there an unacceptable risk of ground instability?	
Is there an unacceptable risk of mobilising contaminants?	
Is there an unacceptable risk of pollution to groundwater?	
Is there an unacceptable risk of groundwater flooding?	
Is the infiltration system going to create a high risk of groundwater leakage to the combined sewer?	

According to guidance available in the Draft National Standards for SuDS (Defra, 2011) surface water runoff must not be discharged to the ground where the conditions listed above occur. Should this be the case then attenuation SuDS features are recommended. Please contact GeoSmart for more information.

Client checklist for SuDS design considerations

Confirm that potential flooding on site in excess of the design storm event and exceedance flow routes have been considered.	
Review options for the control of discharge rates (e.g. hydrobrake).	
Confirm the owners/adopters of the drainage system. Consider management options for multiple owners	
Is there an unacceptable risk of pollution to groundwater?	
Review access and way leave requirements.	
Review maintenance requirements.	

10. Background information

What are SuDS?

SuDS are defined as:
A sustainable drainage system (SuDS) is designed to replicate, as closely as possible, the natural drainage from the Site (before development) to ensure that the flood risk downstream of the Site does not increase as a result of the land being developed. SuDS can also significantly improve the quality of water leaving the Site and can enhance the amenity and biodiversity that a site has to offer.

There are a range of SuDS options available to provide effective surface water management that intercept and store excess run-off. When considering these options the destination of the run off should be assessed using the order of preference outlined in the Building Regulations Part H document (HM Government, 2010) and DEFRA's Draft National Standards for SuDS (2011):

1. Discharge to the ground
2. Discharge to a surface water body
3. Discharge to a surface water sewer
4. Discharge to a local highway drain
5. Discharge to a combined sewer

For general information on SuDS see www.susdrain.org

Infiltration SuDS

Guidance

Government policy for England is to introduce sustainable drainage systems (SuDS) via conditions in planning approvals. Guidance indicates that capturing rainfall run-off on site and infiltrating it into the ground (infiltration SuDS) is the preferred method for managing surface water without increasing flood risk downstream.

The greatest benefit to general flood risk is if all run-off is infiltrated on site, however, this may not be feasible due to physical and economic constraints in which case infiltration may be considered as a part of an integrated drainage solution. The final design capacity for an infiltration SuDS system depends on the site constraints and the requirements of the individual Planning Authority and the Lead Local Flood Authority.

The capacity of the ground to receive infiltration depends on the nature, thickness and permeability of the underlying material and the depth to the high groundwater table. The final proportion of the site drained by infiltration will depend on topography, outfall levels and a suitable drainage gradient. It is important to note that, even if the whole site cannot be drained by infiltration, the use of partial infiltration is encouraged, with the remainder of run-off discharged via other SuDS systems.

Types of infiltration SuDS

Infiltration components include infiltration trenches, soakaways, swales and infiltration basins without outlets, rain gardens and permeable pavements. These are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, before returning it to the water table below.

An infiltration trench is usually filled with permeable granular material and is designed to promote infiltration of surface water to the ground. An infiltration basin is a dry basin or depression designed to promote infiltration of surface water runoff into the ground. Soakaways are the most common type of infiltration device in the UK where drainage is often connected to over-sized square or rectangular, rubble-filled voids sited beneath lawns.

According to the guidance in Building Research Establishment (BRE) Digest 365 (2007) a soakaway must be able to discharge 50% of the run-off generated during a 1 in 10 year storm event within 24 hours in readiness for subsequent storm flow. This is the basic threshold criteria for a soakaway design and the internal surface area of the proposed soakaway design options should be calculated on this basis by taking into account the soil infiltration rate for the Site.

Developers need to ensure their design takes account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any machinery access required.

How was surface water run-off estimated from the site?

In accordance with The SuDS Manual (C753) (CIRIA, 2015), the Greenfield run-off from the Site has been calculated using the IoH124 method and is assumed representative of the run-off generated on the undeveloped surfaces that are affected by the proposed development. The method used for calculating the runoff complies with the NPPF (DGLC, 2014). For the impermeable surfaces, it has been assumed that 100% runoff will occur (calculations provided in Appendix A). Rainfall data is derived from the Flood Estimation Handbook (FEH) CD-ROM, developed by NERC (2009). Only areas affected by the proposed development are considered in the flow and volume calculations. Permeable areas that remain unchanged are not included in the calculations as it is assumed these will not be actively drained and attenuated.

What is the peak discharge rate?

An estimation of peak run-off flow rate and volume is required to calculate infiltration, storage and discharge requirements. The peak discharge rate is the maximum flow rate at which surface water runoff leaves the site during a particular storm event, without considering the impact of any mitigation such as storage, infiltration or flow control. Proposed discharge rates (with mitigation) should be no greater than existing rates for all corresponding storm events. If all drainage is to infiltration there will be no discharge off site. Discharging all flow from site at the existing 1 in 100 event would increase flood risk during smaller events. Flow restriction is generally required to limit the final discharge from site during all events as a basic minimum to the green field QBAR rate. A more complex flow restriction which varies the final discharge rate from the site depending on the storm event will reduce the volume of storage required on site. Drainage to infiltration SuDS is subtracted from the total discharge off site to achieve a beneficial net affect.

What is the total discharge volume?

The total discharge volume is calculated on the basis of the surface water runoff that has the potential to leave the site as a result of the assumed 6 hour duration design storm event. The run-off is related to the underlying soil conditions, impermeable cover, rainfall intensity and duration of the storm event. The total volume generated by the current site is compared to the potential total volume from the developed site (not taking into consideration any mitigation). The difference provides the minimum total volume that will need to be stored and infiltrated on site or released at a controlled rate. Guidance indicates that the total discharge volume should never exceed the runoff volume from the development site prior to redevelopment for that event and should be as close as is reasonably practicable to the Greenfield runoff volume.

GeoSmart SuDS Infiltration Suitability Map (SD50)

In response to the need for national-scale information to support sustainable drainage and land-use planning, GeoSmart have produced the SuDS Infiltration Suitability Map (SD50) for preliminary assessment.

In producing the SuDS Infiltration Suitability Map (SD50), GeoSmart used data from the British Geological Survey on groundwater levels, geology and permeability to screen for areas where infiltration SuDS may be suitable. The map classifies areas into 3 categories of High, Medium and Low suitability for infiltration SuDS which is then informed by additional data on site constraints to give recommendations for SuDS and further investigation.

The primary constraint on infiltration potential is the minimum permeability of the underlying material and in some cases the range in permeability may be considerable, ranging down to low. The map classifies these areas as moderate infiltration suitability requiring further investigation. In cases where the thickness of the receiving permeable horizon is less than 1.5 meters then additional site investigation is recommended. If the site is at risk of groundwater flooding for up to the 1% annual occurrence the map classifies these areas as moderate infiltration suitability requiring further investigation.

The GeoSmart SuDS Infiltration Suitability Map (SD50) is a national screening tool for infiltration SuDS techniques but a site specific assessment should be used before final detailed design is undertaken.

Further details:

- The GeoSmart SuDS Infiltration Suitability Map (SD50) model takes advantage of all the available data and provides a preliminary indication of infiltration SuDS suitability on a 50m grid covering England and Wales. Our approach is consistent with latest best practice for such assessments and based on authoritative science and quality assured methods.
- The map is a general purpose indicative screening tool, and is intended to provide a useful initial view for a wide variety of applications. However, it does not provide an alternative to a proper site-specific assessment.
- Further information on the GeoSmart SuDS Infiltration Suitability Map (SD50) is available at geosmartinfo.co.uk

Guidance

Data limitations

The data and information which GeoSmart interprets in Reports is obtained by GeoSmart from third parties including the British Geological Survey. The data, information and related records supplied can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. Geological observations are made according to the prevailing understanding of the subject at the time. The quality of such observations may be affected by subsequent advances in knowledge or improved methods of interpretation.

11. References and glossary

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Glossary[3]

Attenuation	Reduction of peak flow and increased duration of a flow event.
Combined sewer	A sewer designed to carry foul sewage and surface water in the same pipe.
Detention basin	A vegetated depression, normally is dry except after storm events, constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground.
Evapotranspiration	The process by which the Earth's surface or soil loses moisture by evaporation of water and by uptake and then transpiration from plants.
FEH	Flood Estimation Handbook, produced by Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology).
Filter drain or trench	A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water, but may also be designed to permit infiltration.
First flush	The initial runoff from a site or catchment following the start of a rainfall event. As runoff travels over a catchment it will collect or dissolve pollutants, and the "first flush" portion of the flow may be the most contaminated as a result. This is especially the case for intense storms and in small or more uniform catchments. In larger or more complex catchments pollution.
Flood plain	Land adjacent to a watercourse that would be subject to repeated flooding under natural conditions (see Environment Agency's Policy and practice for the protection of flood plains for a fuller definition).
Greenfield runoff	This is the surface water runoff regime from a site before development, or the existing site conditions for brownfield redevelopment sites.
Impermeable surface	An artificial non-porous surface that generates a surface water runoff after rainfall.
Permeability	A measure of the ease with which a fluid can flow through a porous medium. It depends on the physical properties of the medium, for example grain size, porosity and pore shape.
Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or if rainfall is particularly intense.
Sewerage undertaker	This is a collective term relating to the statutory undertaking of water companies that are responsible for sewerage and sewage disposal including surface water from roofs and yards of premises.
Soakaway	A subsurface structure into which surface water is conveyed to allow infiltration into the ground.
Treatment	Improving the quality of water by physical, chemical and/or biological means.

[3] The terms included in this glossary have been taken from CIRIA guidance.

Appendices

Appendix A

Site plans (layout and topography)

940.000E
950.000E
960.000E
970.000E
980.000E
990.000E
1000.000E
1030.000N
1020.000N
1010.000N
1000.000N
990.000N
50.26
ADJACENT PROPERTY
RIDGE 59.66
EAVES 57.65
EAVES 57.63
WALL
TOW 52.42
50.23
50.46
50.56
PLANTER
LOW WALL
50.54
STN A2
50.22
50.29
50.07
50.02
TARMAC
LOW WALL
TREE
50.15
50.29
KERB
50.30
STN A4
49.86
TOW 52.24
DIA 100
50.06
50.38
IC
IL 49.45
SWP
RWP
IC
IL 49.80
STN A3
50.53
50.30
50.13
50.61
ADJACENT GARDEN
WALL
TOW 52.19
50.12
50.07
CPS PATH
49.86
CPS
IC
IL 48.86
50.71
59.65
UP
PLANTER
LOW WALL
50.66
TARMAC
CPS
TARMAC
50.01
RG
49.97
AVENUE ROAD
TREE
50.98
WALL
SHED
CONCRETE
RET. WALL
CPS
50.60
50.60
50.40
SHRUBS
TOW 50.99
50.17
50.06
KERB
50.01
49.85
No 77
RIDGE 60.58
50.68
CPS
TOW 51.03
EAVES 56.59
DIA 100
TARMAC
SP
TARMAC
50.01
49.73
GRASS
50.69
IC
IL 47.73
50.42
LOW WALL
50.28
CPS
49.99
50.00
TREE
SHED
RET. WALL
TREE
50.87
ADJACENT GARDEN
WALL
POND OUTLINE
49.76
GRASS
49.77
49.70
50.63
CPS
50.84
TOW 52.27
TOW 51.81
50.14
50.54
SVP
50.17
STN A1
50.00
1000.000N
IC
IL 47.53
DIA 100
50.13
50.02
DIA 100
IC
IL 47.72
50.11
49.92
TOW 54.19
49.57
EAVES 56.59
RWP
DIA 100
FLAT ROOF
TOP 52.31
IC
IL 48.44
CPS
TOP 52.27
49.48
DIA 100
TOP 52.85
TARMAC
50.05
50.16
WALL
TOW 51.50
50.04
50.03
WALL
TOW 51.23
50.06
FENCE CB
50.55
FENCE CB
TREE
ADJACENT GARDEN
WINDOW 56.57
WINDOW 55.11
TOP 57.95
TOP OF WINDOW 59.70
RIDGE 60.70
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RIDGE 60.63
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50.03
49.93
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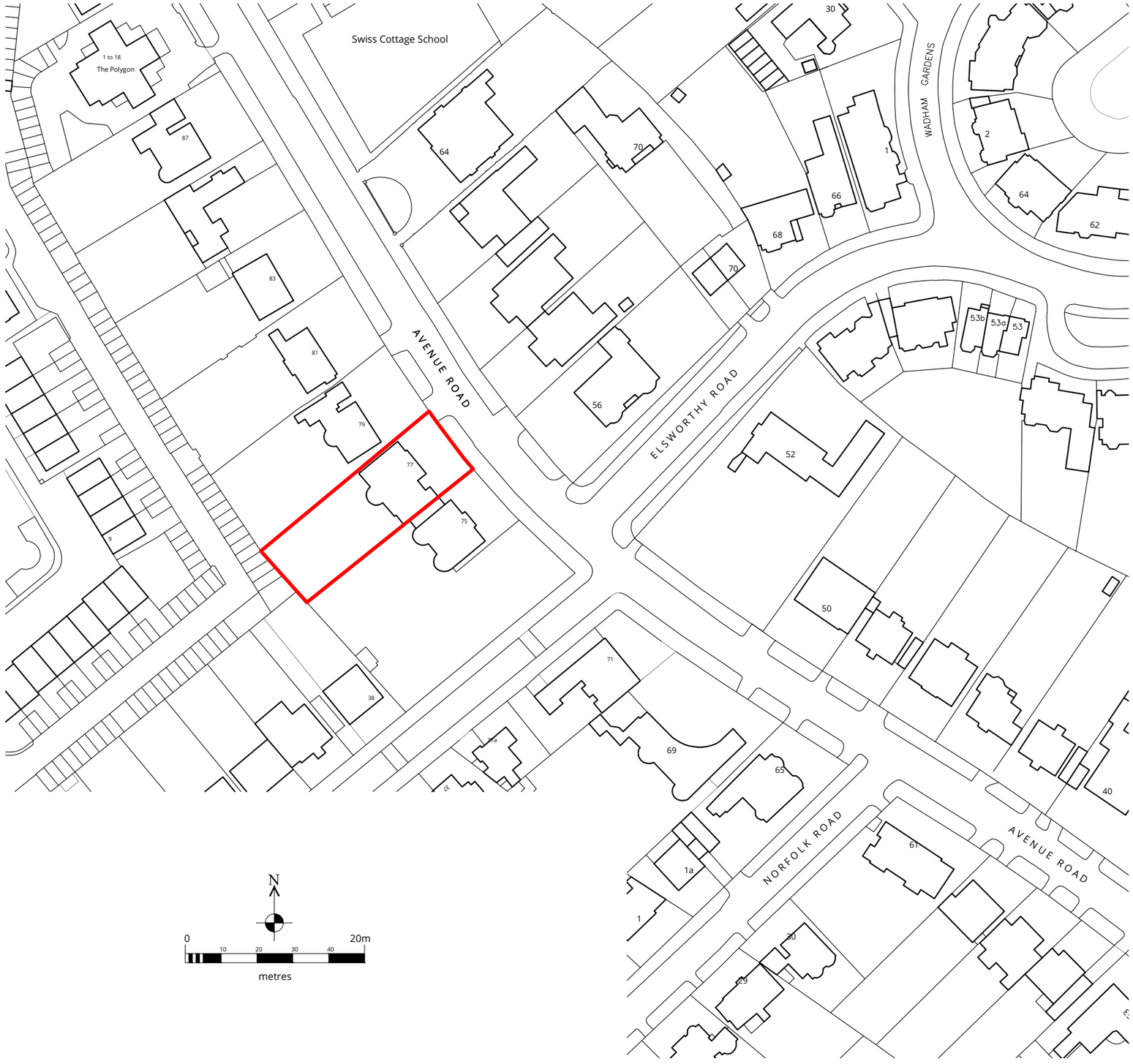
KERB
49.87
49.85



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0	First issue.	09.2.2018

Project Title
77 Avenue Road
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Drawing Title
Site Location Plan

Status
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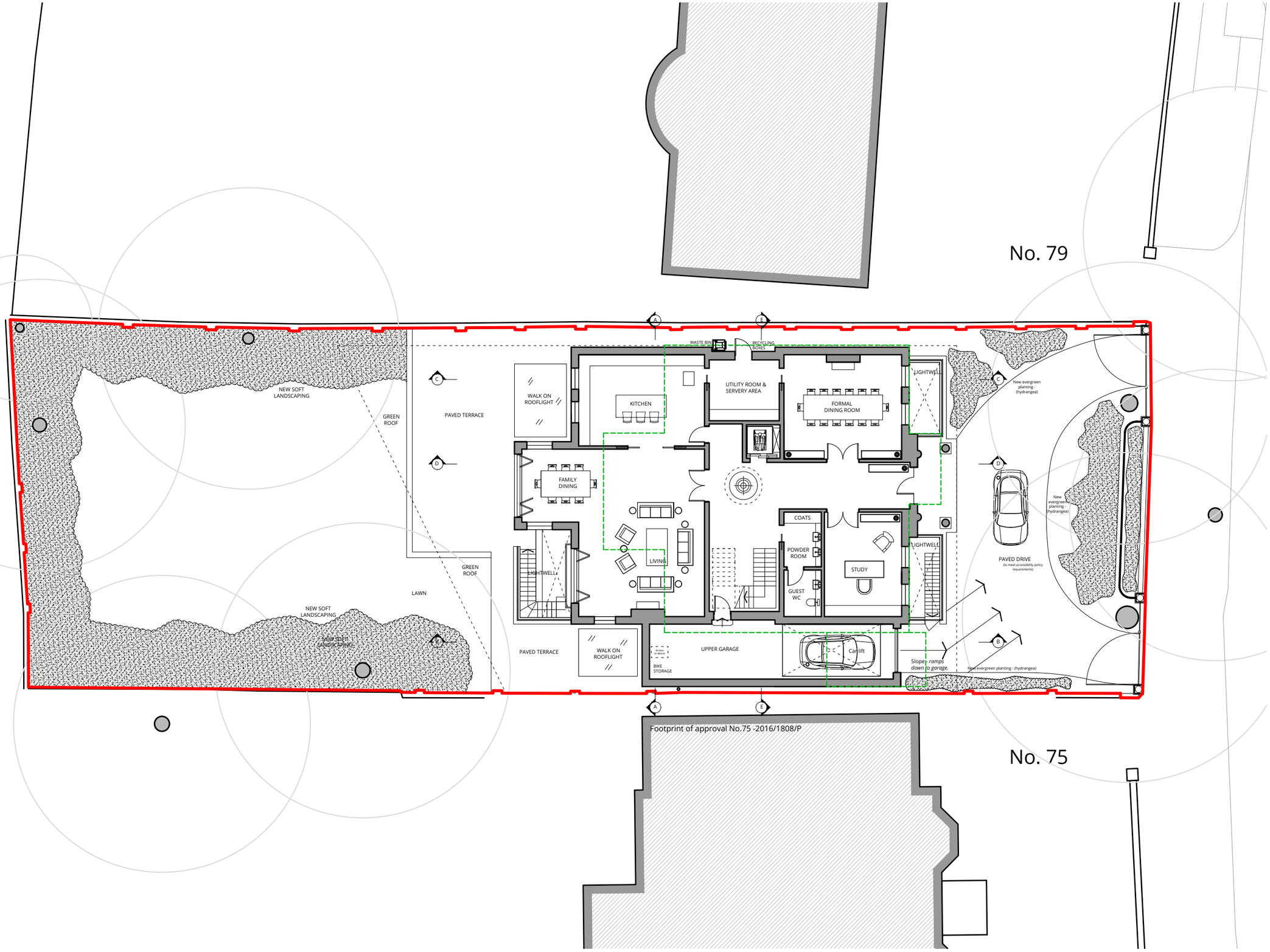
EW	DW	1:1250 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	001	0



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Drawing Title
Proposed Site Plan

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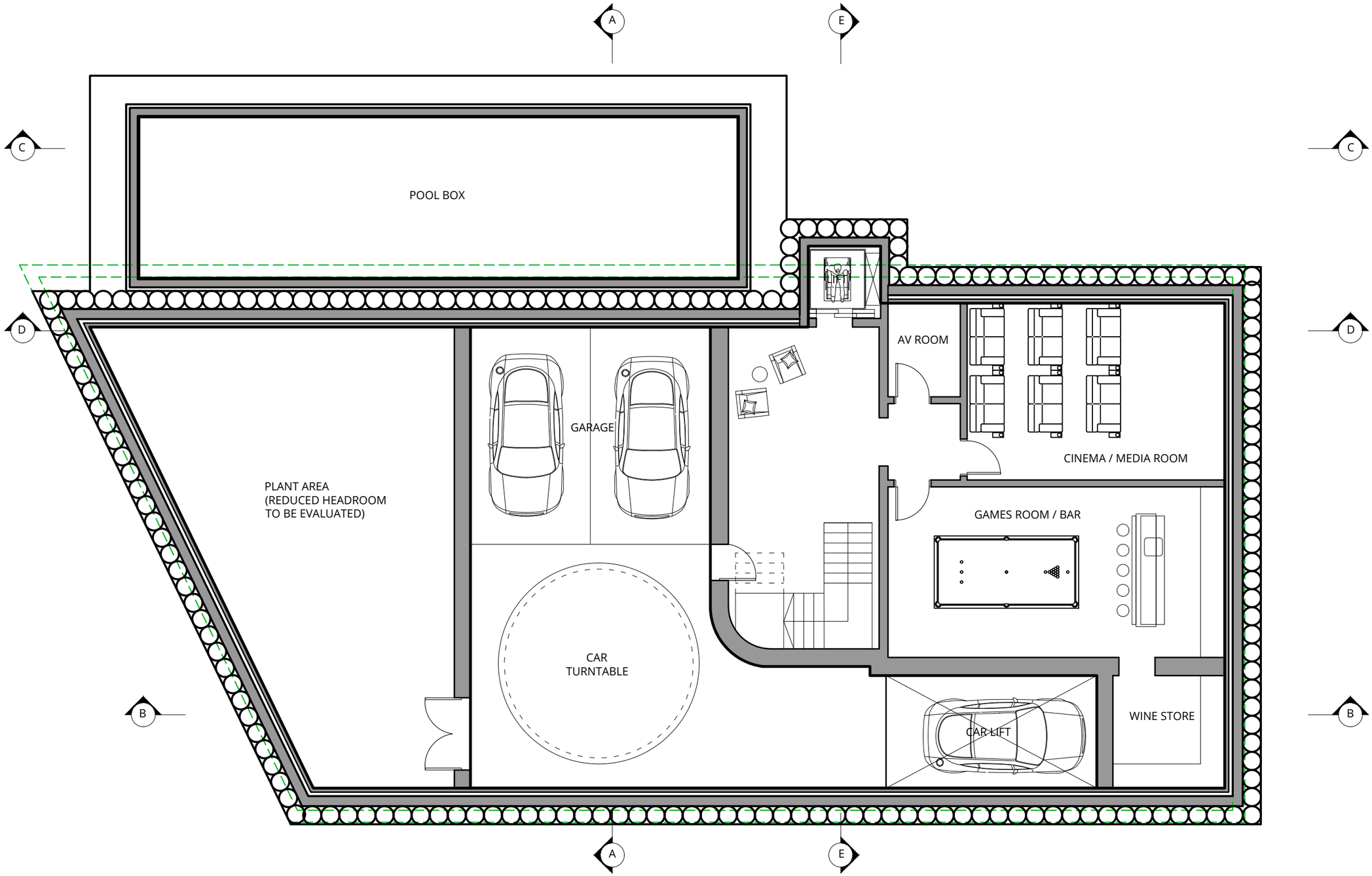

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metres

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Proposed Sub-Basement Floor Plan

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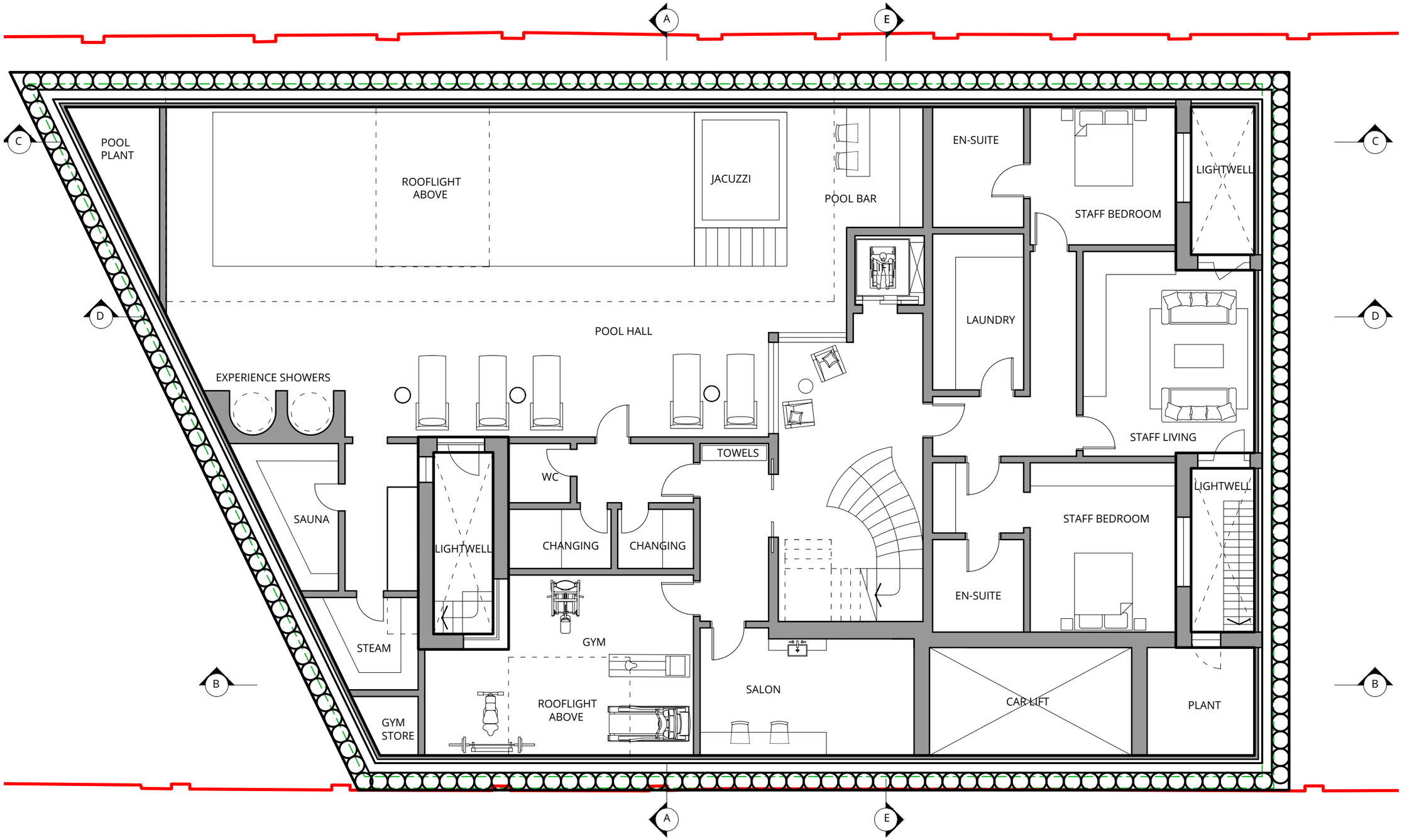

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Project Title
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Proposed Basement Floor Plan

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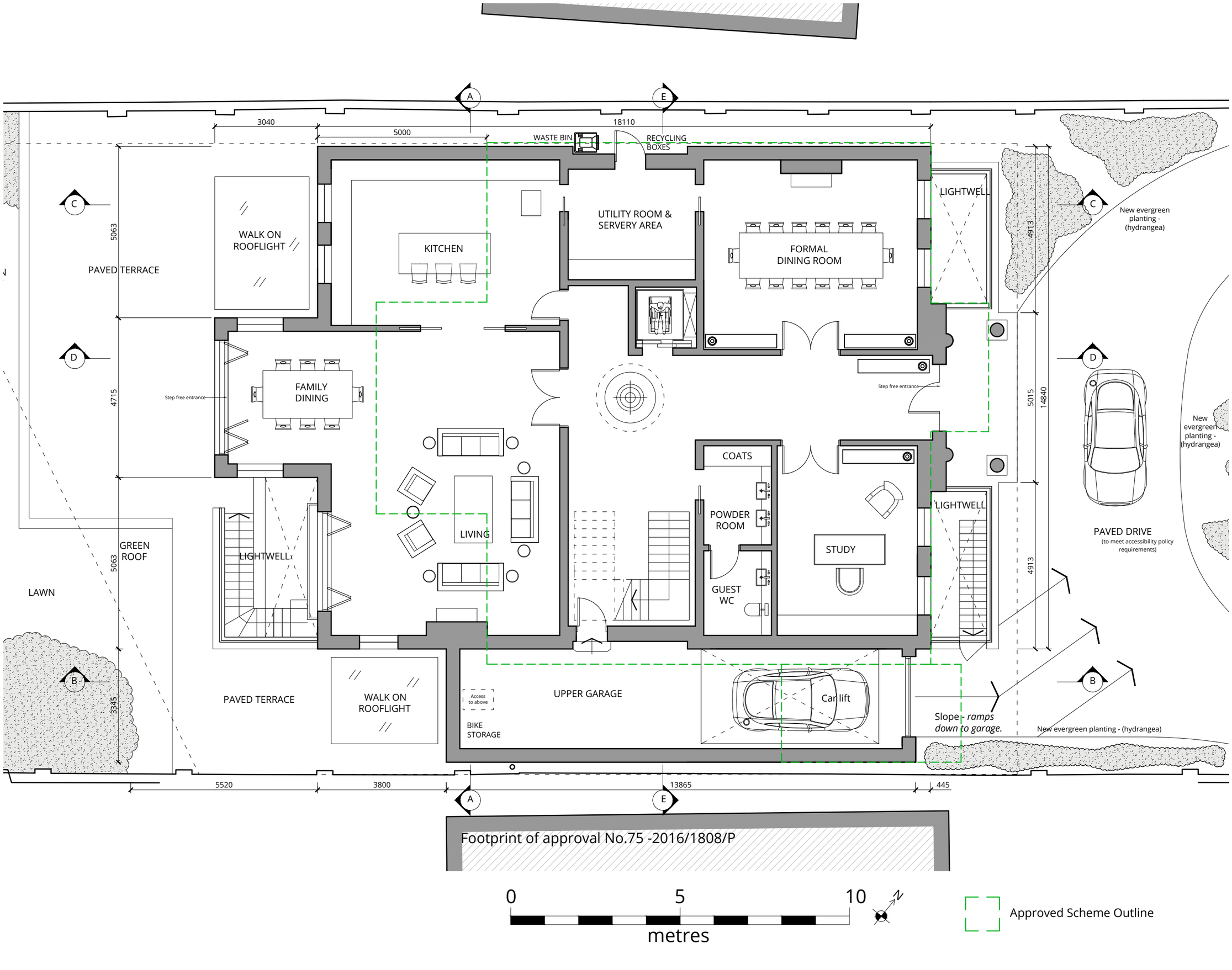

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For landscaping and tree canopies see site plan drawing 200

For front boundary treatment see drawing 316.

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Drawing Title
Proposed Ground Floor Plan

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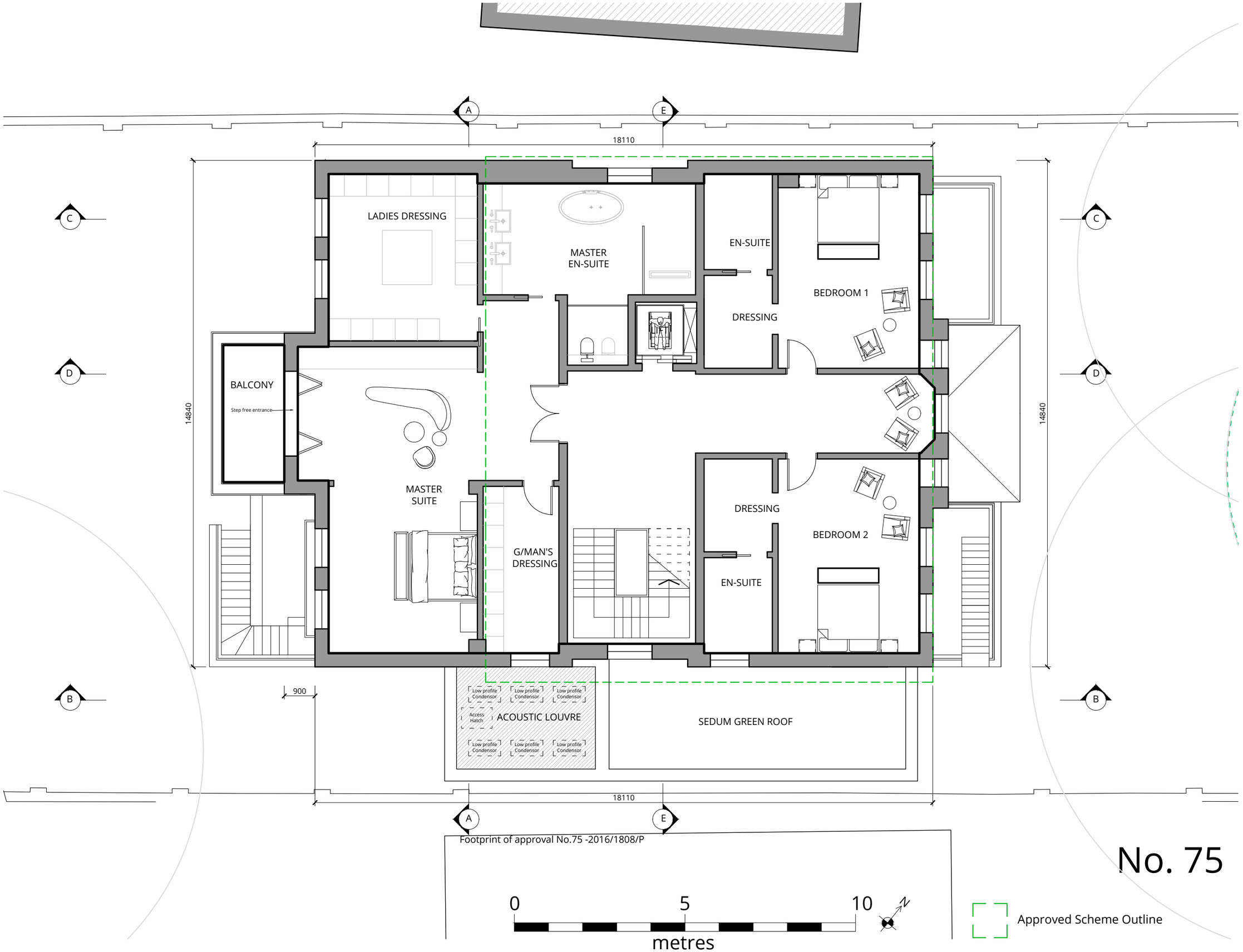

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Project Title
77 Avenue Road
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Drawing Title
Proposed First Floor Plan

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Planning

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Project No.	Work Stage	Dwg. No.	Rev.
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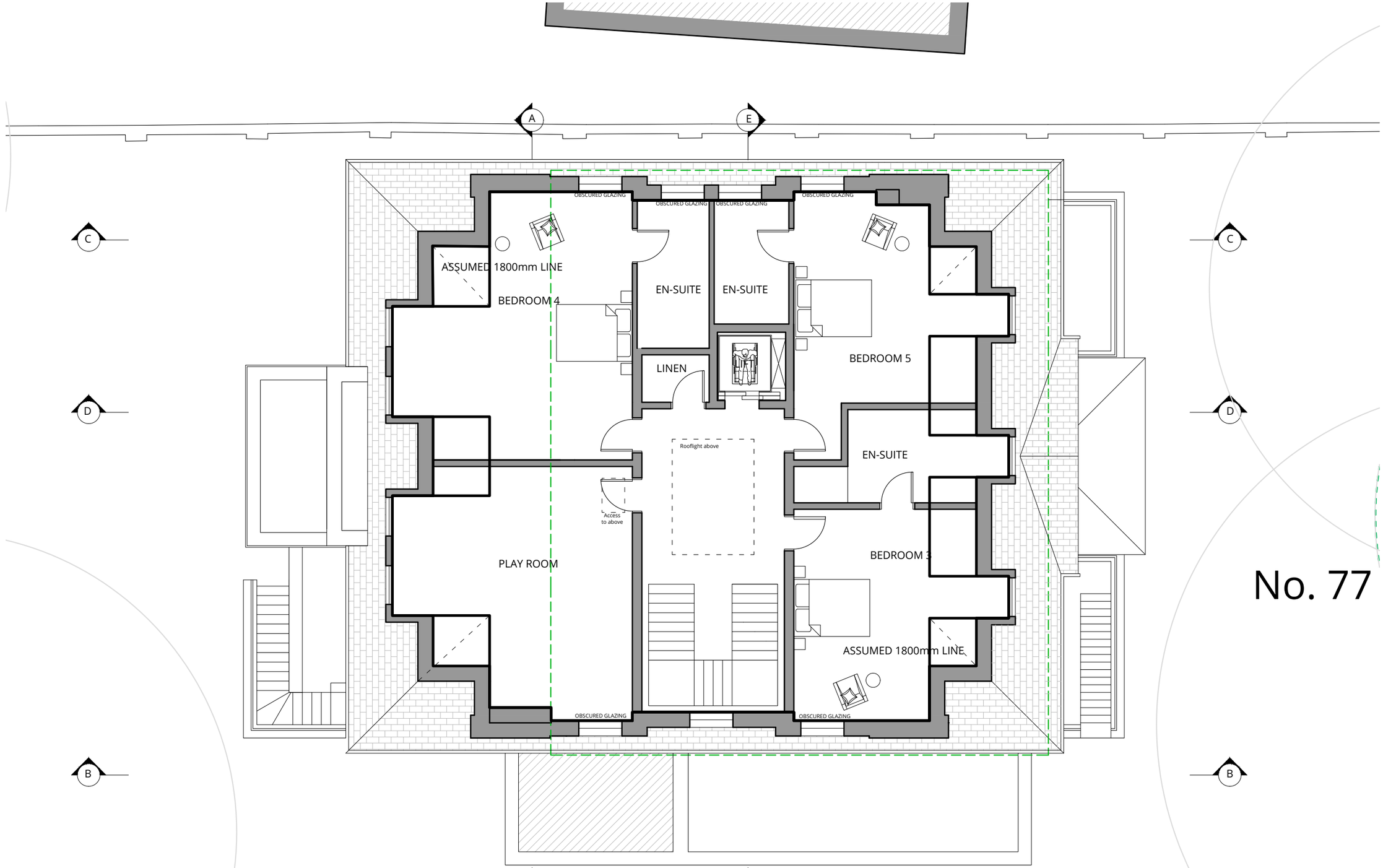

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Project Title
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Drawing Title
Proposed Second Floor Plan

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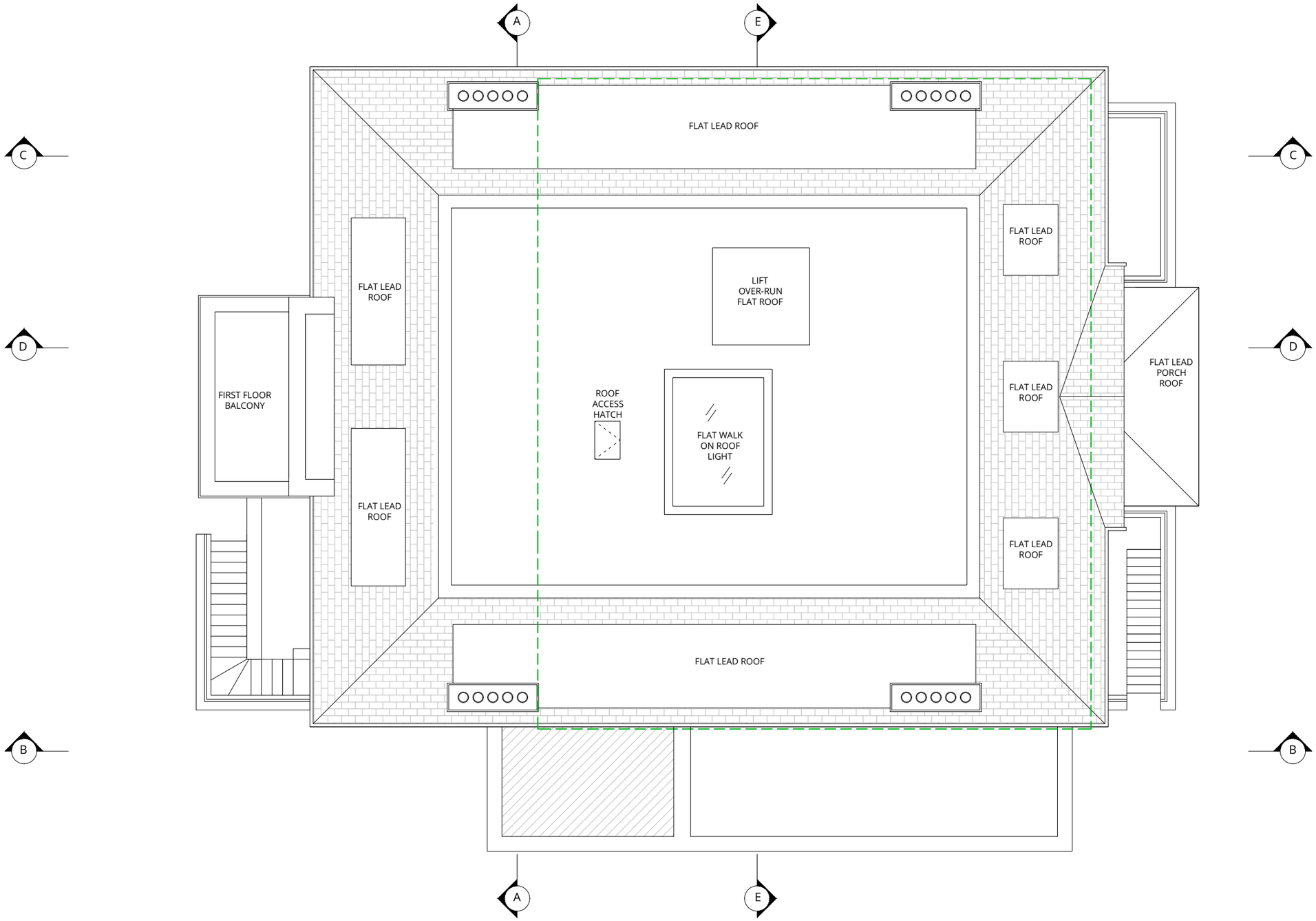
Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	304	A



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Rev.	Description	Date
A	Various revisions	09.2.2018
0	First issue.	15.9.2017

Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Roof Plan
Floor Plan

Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	305	A

Proposed Front (northeast) Elevation

Cut through front garden.

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Rev.	Description	Date
A	Various revisions	09.2.2018
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Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed Front Elevation

Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	310	A

Proposed Rear (southwest) Elevation

Cut through rear gardens.

0 5 10

metres

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Rev.	Description	Date
B	Garage roof updated	09.2.2018
A	Various revisions	09.2.2018
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Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed Rear Elevation

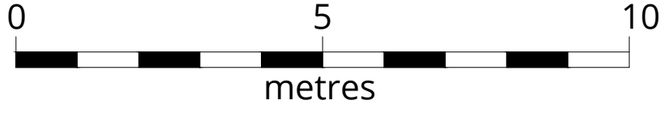
Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	311	B

Proposed Side (southeast) Elevation

Facing No 75 Avenue Road.



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Rev.	Description	Date
A	Various revisions	09.2.2018
0	First issue.	15.9.2017

Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed SE Side Elevation

Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	312	A

Proposed Side (northwest) Elevation

Facing No 79 Avenue Road

0 5 10

metres

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Rev.	Description	Date
A	Various revisions	09.2.2018
0	First issue.	15.9.2017

Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed NW side elevation

Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	313	A

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Front Elevation in Context

Cut through gardens facing No 79 Avenue Road.

Rev.	Description	Date
A	Various revisions	09.2.2018
0	First issue.	15.9.2017

Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed Street Elevations

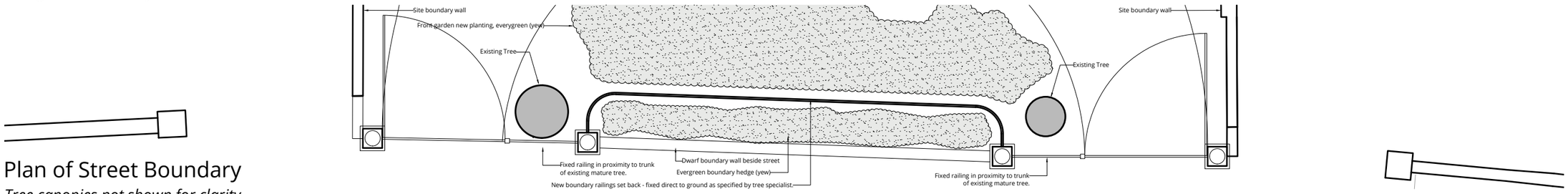
Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:333 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	315	A

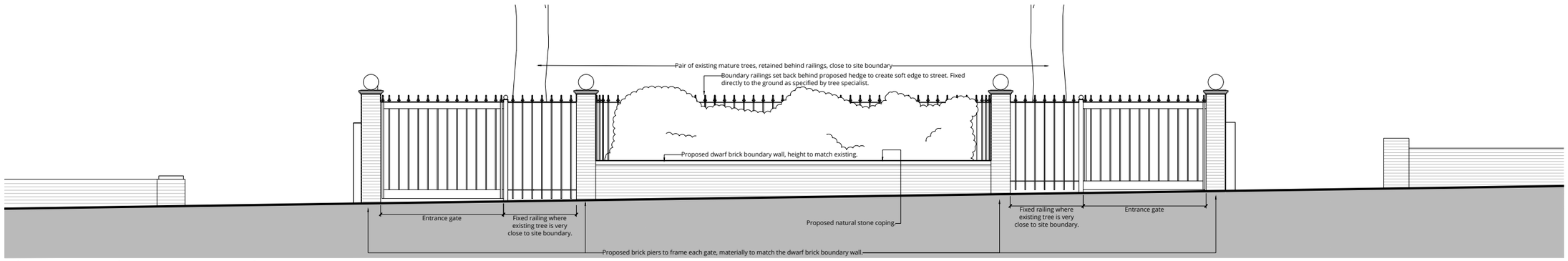
Elevations of Buildings in Context

Foliage indicative only.



Plan of Street Boundary

Tree canopies not shown for clarity



Elevation of Street Boundary

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Rev.	Description	Date
B	Updated.	13.2.2018
A	Updated.	07.2.2018
0	First issue.	15.9.2017

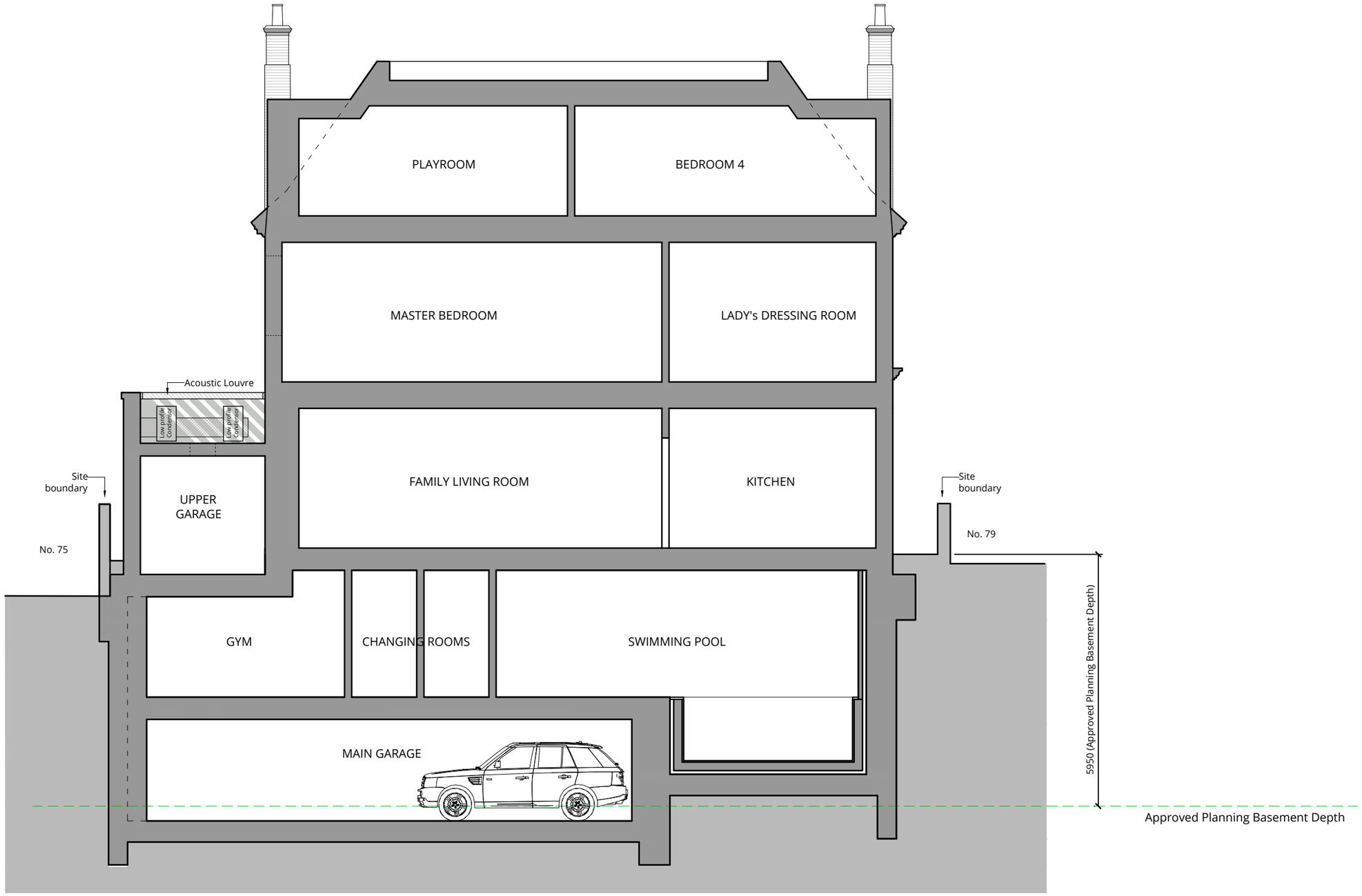
Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed Street Boundary Treatment

Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	316	B



0 5 10
metres

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Rev.	Description	Date
B	Garage roof updated	09.2.2018
A	Various revisions	09.2.2018
0	First issue.	15.9.2017

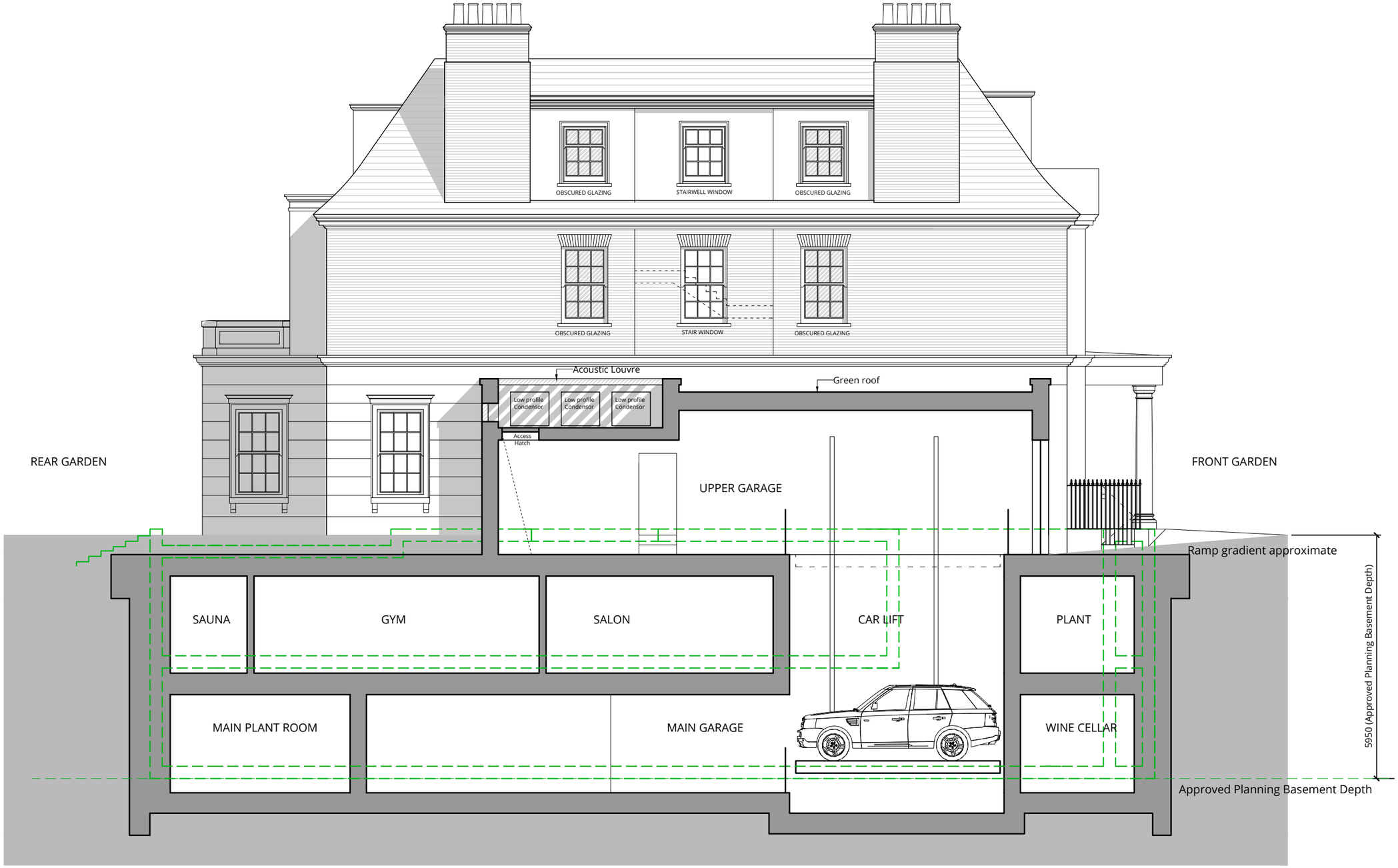
Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed Section
A-A

Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	330	B



0 5 10

metres

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Rev.	Description	Date
B	Garage roof updated	09.2.2018
A	Various revisions	09.2.2018
0	First issue.	15.9.2017

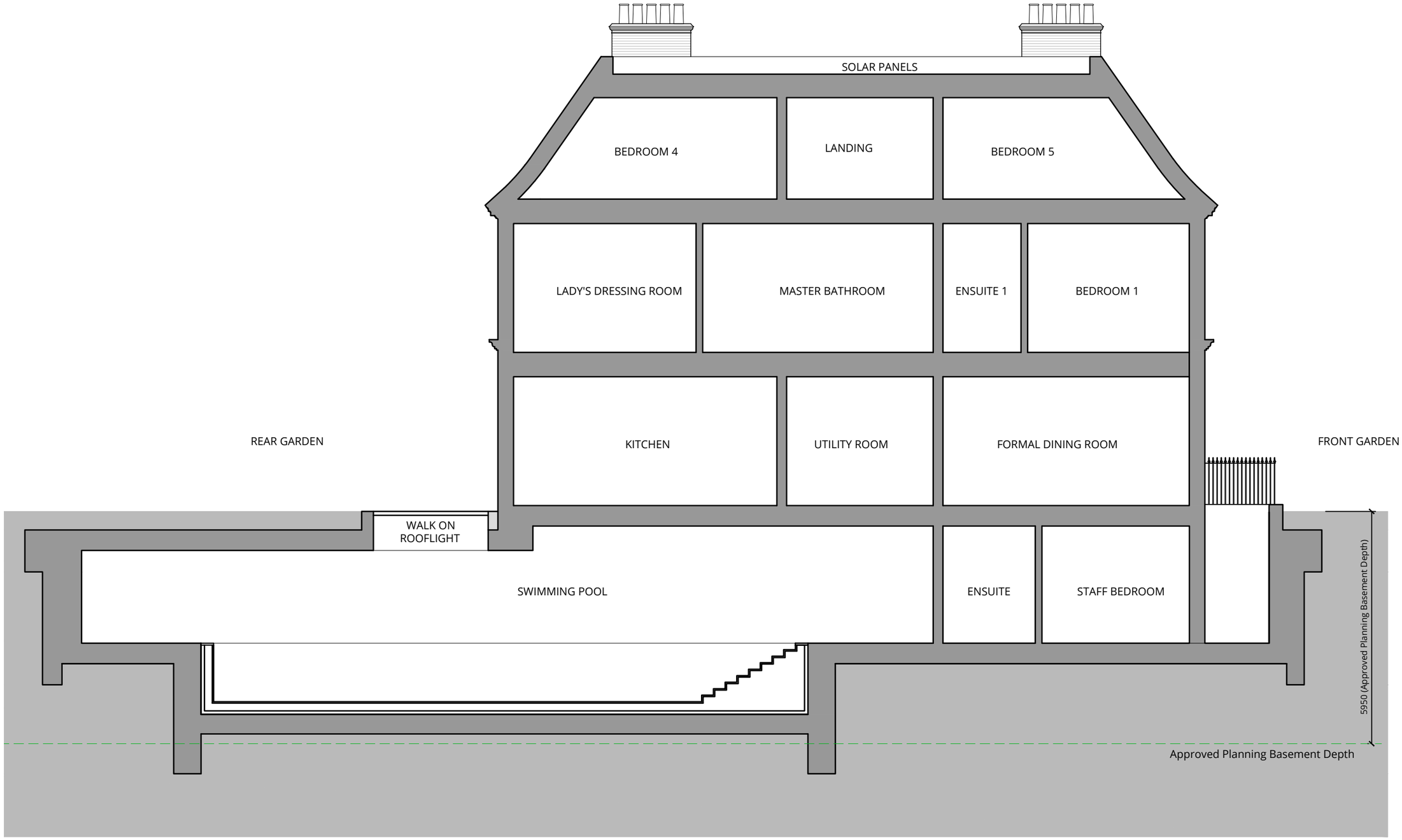
Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed Section
B-B

Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	331	B



0 5 10
metres

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Rev.	Description	Date
A	Various revisions	09.2.2018
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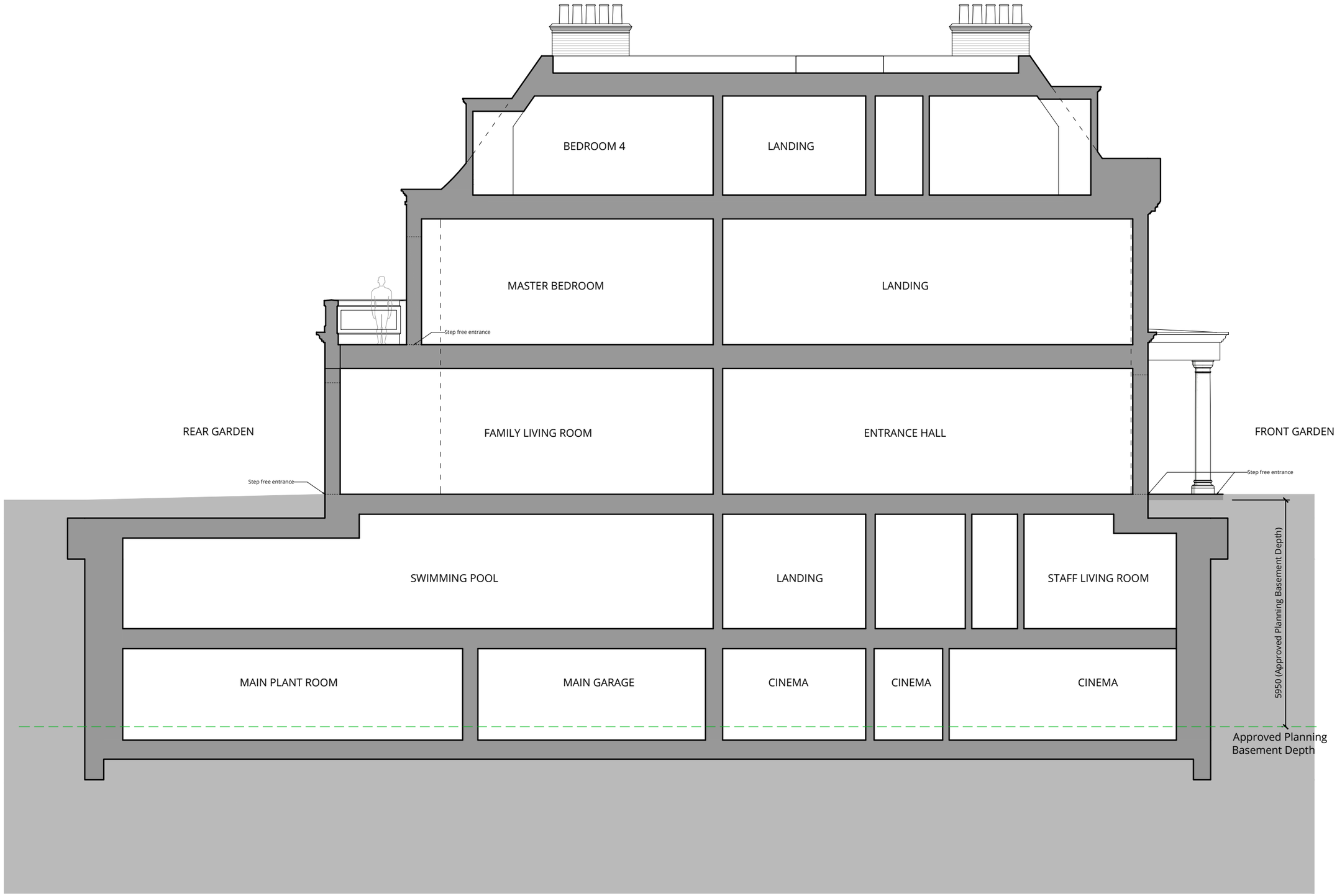
Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed Section
C-C

Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	332	A



0 5 10
metres

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Rev.	Description	Date
A	Various revisions	09.2.2018
0	First issue.	15.9.2017

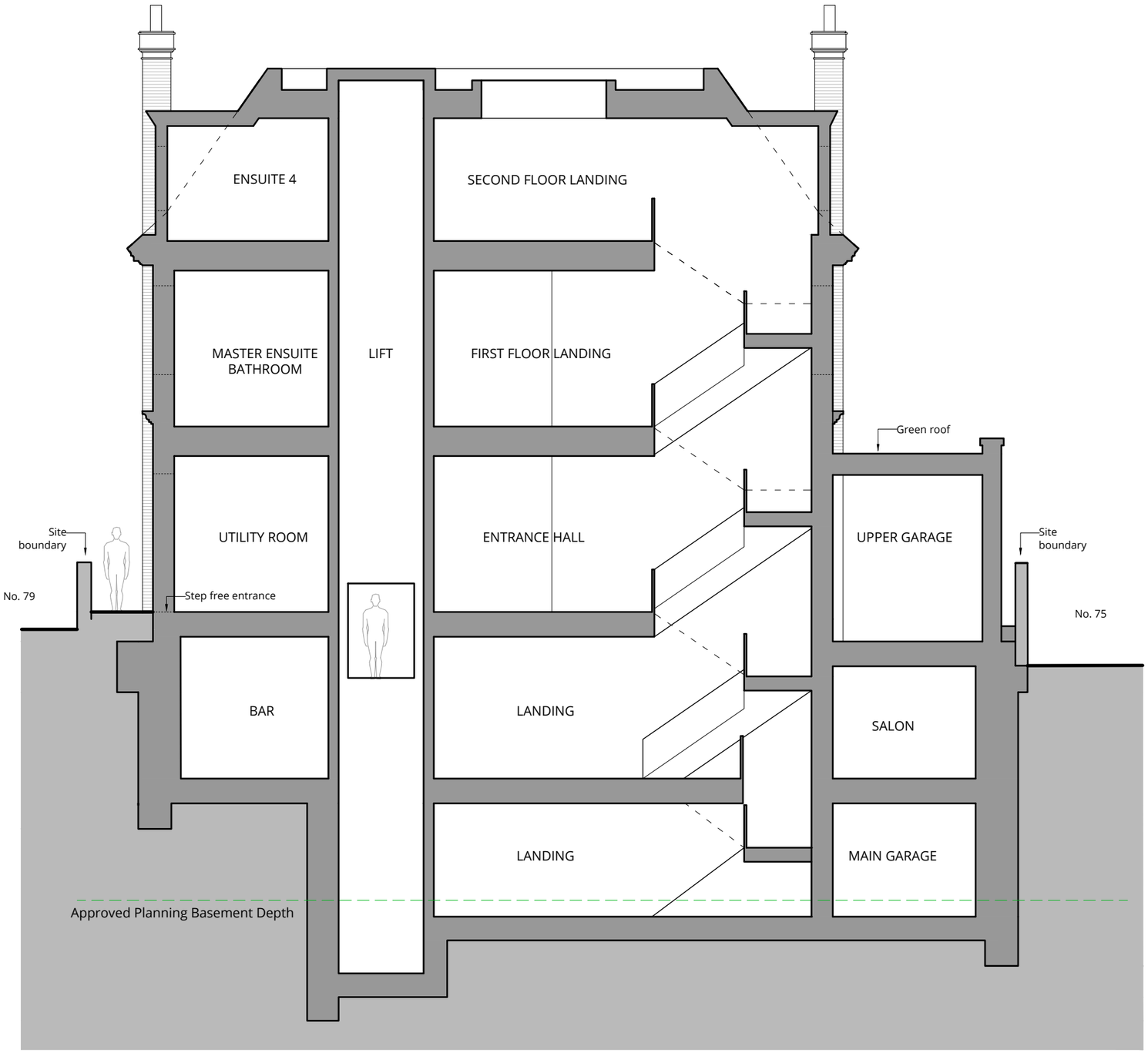
Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed Section
D-D

Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	333	A



0 5 10
metres

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Rev.	Description	Date
A	Various revisions	09.2.2018
0	First issue.	15.9.2017

Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed Section
E-E

Status
Planning

Drawn by	Checked by	Scale
EW	DW	1:100 @ A3

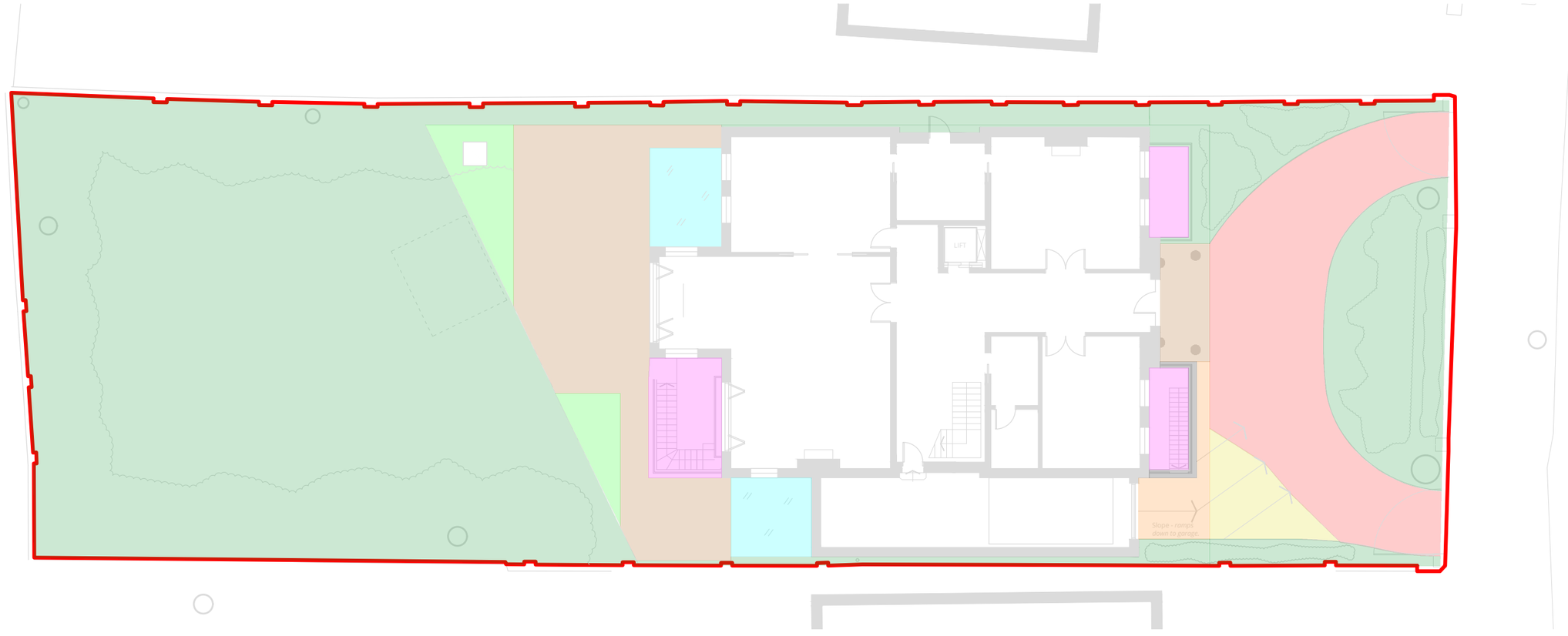
Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	334	A

Legend

- Lawn or planting border
- Basement roof -green roof
- Basement roof -paved terrace
- Glass Rooflight
- Driveway
- Driveway ramped
- Driveway over basement
- Sunken lightwell

This Surfaces Keyplan must be read in conjunction with Architect's GA plans.

For Tree root protection area and rainwater requirements refer to Arboriculturalist's information.



0 5 10
metres

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Rev.	Description	Date
B	Issued for planning	06.6.2017
A	Note amended.	21.3.2017
0	First issue.	07.3.2017

Project Title
77 Avenue Road
Camden NW8 6JD

Drawing Title
Proposed Ground Surfaces Keyplan

Status
Planning

Drawn by	Checked by	Scale
AP	DW	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
1716	PL	335	B

Appendix B

Rainfall run-off calculations

Greenfield Site Run-Off Calculations usng the IoH124 method

Greenfield peak run-off rate (QBAR):

Parameters	Input	Units	Comments
Area	50	ha	mimimum 50ha
SAAR	649	mm	FEH CD ROM (NERC, 2009)
SPR	0.47	N/A	Soil run-off coefficient
Region	6	N/A	Region on Hydrological area map

QBAR

$$Q_{BAR(rural)} = 1.08AREA^{0.89}SAAR^{1.17}SPR^{2.17}$$

Where:

$Q_{BAR(rural)}$	is the mean annual flood (a return period of 2.3 years) in l/s
AREA	is the area of the catchment in km² (minimum of 0.5km²)
SAAR	is the standard average rainfall for the period 1941 to 1970 in mm
SPR	is the soil run-off coefficient

$Q_{BAR(rural)}$ can be factored by the UK Flood Studies Report regional growth curves to produce peak flood flows for any return period.

$Q_{BAR(rural)}$	=	220.95	l/s for 50ha site
Divided by 50 to scale down	=	4.42	l/s/ha
Actual Area of the entire Site	=	0.12	ha

Return Periods (Growth curves obtained from DEFRA report)

Return Period		Growth Factor	l/s/ha	Peak site run-off rate (l/s)
1	**$Q_{BAR(rural)}$ x**	**0.85**	**3.76**	**0.443**
2	$Q_{BAR(rural)}$ x	0.88	3.89	0.46
5	$Q_{BAR(rural)}$ x	1.28	5.66	0.67
10	$Q_{BAR(rural)}$ x	1.62	7.16	0.84
25	$Q_{BAR(rural)}$ x	2.14	9.46	1.12
30	**$Q_{BAR(rural)}$ x**	**2.24**	**9.90**	**1.168**
50	$Q_{BAR(rural)}$ x	2.62	11.58	1.37
100	**$Q_{BAR(rural)}$ x**	**3.19**	**14.10**	**1.66**
200	$Q_{BAR(rural)}$ x	3.86	17.06	2.01

Greenfield total run-off volume:

= actual area of the entire site x SPR x 6 hour rainfall depth

Return Period	6 hour rainfall (mm) from FEH CD-ROM	Area (ha)	SPR	Total run-off (m^3)
2.3 (QBAR)	26.49	0.12	0.47	14.7
1	12.49	0.12	0.47	6.9
10	43.04	0.12	0.47	23.9
30	59.6	0.12	0.47	33.1
100	84.52	0.12	0.47	46.9

Summary

Entire site area:	0.118	ha
Climate Change Factor	40%	

	Current	*Proposed*
Permeable Surface (ha)	0.063	0.064
Impermeable Surface (ha)	0.055	0.053

1 in 1 year

Greenfield run-off volume total: 6.93 m^3

RUN-OFF During a 1 in 1 year 6 hour event:	**Greenfield Site**	**Current Development**	**Proposed Development**	**Proposed Development +CC**
From permeable surfaces (using GF total run-off) (m^3)	6.93	3.72	3.75	5.25
From impermeable surfaces (m^3)		6.83	6.63	9.29
TOTAL run-off produced from Site (m^3)	6.93	10.55	10.38	14.54

Difference between greenfield site and proposed +cc development (m^3):	**7.61**
	110%
Difference between current and proposed +cc development (m^3):	**3.99**
	38%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):	**0.44**

1 in 10 year

Greenfield run-off volume total: 23.87 m^3

RUN-OFF During a 1 in 1 year 6 hour event:	**Greenfield Site**	**Current Development**	**Proposed Development**	**Proposed Development +CC**
From permeable surfaces (using GF total run-off) (m^3)	23.87	12.80	12.93	18.10
From impermeable surfaces (m^3)		23.54	22.85	32.00
TOTAL run-off produced from Site (m^3)	23.87	36.35	35.78	50.09

Difference between greenfield site and proposed +cc development (m^3):	**26.22**
	110%
Difference between current and proposed +cc development (m^3):	**13.74**
	38%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):	**0.84**

1 in 30 year

Greenfield run-off volume total: 33.05 m^3

RUN-OFF During a 1 in 30 year 6 hour event:	**Greenfield Site**	**Current Development**	**Proposed Development**	**Proposed Development +CC**
From permeable surfaces (using GF total run-off) (m^3)	33.05	17.73	17.90	25.06
From impermeable surfaces (m^3)		32.60	31.65	44.31
TOTAL run-off produced from Site (m^3)	33.05	50.33	49.55	69.37

Difference between greenfield site and proposed +cc development (m^3):	**36.31**
	110%
Difference between current and proposed +cc development (m^3):	**19.03**
	38%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):	**1.17**

1 in 100 year

Greenfield run-off volume total: 46.87 m^3

RUN-OFF During a 1 in 100 year 6 hour event:	**Greenfield Site**	**Current Development**	**Proposed Development**	**Proposed Development +CC**
From permeable surfaces (using GF total run-off) (m^3)	46.87	25.15	25.38	35.54
From impermeable surfaces (m^3)		46.23	44.88	62.83
TOTAL run-off produced from Site (m^3)	46.87	71.38	70.26	98.37

Difference between greenfield site and proposed +cc development (m^3):	**51.49**
	110%
Difference between current and proposed +cc development (m^3):	**26.99**
	38%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):	**1.66**

Developed site run-off calculation sheet

1 in 1 year

Proposed impermeable area	0.053	ha
CC Factor	40%	
Total volume for surfaces during 6 hour event	6.63	m³
Total volume for 6 hour event inc CC	9.29	m³
Total volume for 6 hour event exc CC	6.63	m³

Duration	Rainfall 1 yr event	Run-off rate 1 yr event	Run-off rate 1 yr +cc event
hours	mm	m³	m³
0.25	3.52	1.87	2.62
0.5	4.64	2.46	3.45
0.75	5.45	2.89	4.05
1	6.12	3.25	4.55
2	8.06	4.28	5.99
3	9.48	5.03	7.05
4	10.63	5.64	7.90
5	11.61	6.16	8.63
6	12.49	6.63	9.29
8	14.01	7.44	10.42

1 in 30 year

Proposed impermeable area	0.053	ha
CC Factor	40%	
Total volume for surfaces during 6 hour event	31.65	m³
Total volume for 6 hour event inc CC	44.31	m³
Total volume for 6 hour event exc CC	31.65	m³

Duration	Rainfall 30 yr event	Run-off volume 30 yr event	Run-off volume 30 yr +cc event
hours	mm	m³	m³
0.25	25.89	13.75	19.25
0.5	31.05	16.49	23.08
0.75	34.54	18.34	25.68
1	37.25	19.78	27.69
2	44.68	23.73	33.22
3	49.69	26.39	36.94
4	53.59	28.46	39.84
5	56.82	30.17	42.24
6	59.60	31.65	44.31
8	64.28	34.13	47.79

1 in 100 year

Proposed impermeable area	0.053	ha
CC Factor	40%	
Total volume for surfaces during 6 hour event	44.88	m³
Total volume for 6 hour event inc CC	62.83	m³
Total volume for 6 hour event exc CC	44.88	m³

Duration	Rainfall 100 yr event	Run-off volume 100 yr event	Run-off volume 00 yr +cc event	Outflow at 2 l/s	inflow from rain	Diff (storage required)
hours	mm	m³	m³			
0.25	40.43	21.47	30.06	1.80	30.06	28.26
0.5	47.49	25.22	35.30	3.60	35.30	31.70
0.75	52.17	27.70	38.78	5.40	38.78	33.38
1	55.77	29.61	41.46	7.20	41.46	34.26
2	65.50	34.78	48.69	14.40	48.69	34.29
3	71.96	38.21	53.50	21.60	53.50	31.90
4	76.93	40.85	57.19	28.80	57.19	28.39
5	81.01	43.02	60.22	36.00	60.22	24.22
6	84.52	44.88	62.83	43.20	62.83	19.63
8	90.35	47.98	67.17	57.60	67.17	9.57

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- By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
- conduct business in an honest, fair and professional manner
- handle complaints speedily and fairly
- ensure that products and services comply with industry registration rules and standards and relevant laws
- monitor their compliance with the Code

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs contact details:

The Property Ombudsman scheme
Milford House
43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk.

Please ask your search provider if you would like a copy of the search code

Complaints procedure

GeoSmart Information Limited is registered with the Property Codes Compliance Board as a subscriber to the Search Code. A key commitment under the Code is that firms will handle any complaints both speedily and fairly.

If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with his final decision.

Complaints should be sent to:

Jemma Prydderch
Operations Manager

GeoSmart Information Limited
Suite 9-11, 1st Floor,
Old Bank Buildings,
Bellstone, Shrewsbury
SY1 1HU
Tel: 01743 298 100
jemmaprydderch@geosmartinfo.co.uk

Terms and Conditions

GEOSMART INFORMATION LIMITED
Conditions of contract for environmental reports

March 2016, Version 1.1

Definitions:

The following words shall have the following meaning:

a) "Client" means the person for whom the Report has been procured either directly or through an Intermediary;

b) "Conditions" means these terms and conditions of sale, the User Guide and the Order;

c) "GEOSMART" means GeoSmart Information Ltd of New Zealand House, 160, Abbey Foregate, Shrewsbury, Shropshire, SY2 6FD, registered in England and Wales with company registration number 05475394.

d) "Information" means environmental data, including other third party sources of information;

e) "Intermediary" means the party that places the Order acting on behalf of the Beneficiary, who might be a lawyer, consultant or other party;

f) "Order" means the order for Services sent by a Client or an Intermediary to GEOSMART;

g) "Report" or "Reports" means a report which relates to environmental information (as distinct from opinion) and which is prepared by GEOSMART in respect of a Site;

h) "Services" means the preparation and provision of Report(s) by GEOSMART from the Information;

i) "Site" shall mean the site specified in the Order;

j) "User Guide" means the document (if any) which may be produced from time to time by GEOSMART entitled 'GeoSmart User Guide', which may be requested with the Report by writing to GEOSMART at the above address and will be provided if applicable.

1. Conditions

1.1 Subject to receipt of a valid Order, GEOSMART agrees to supply to the Client or the Intermediary (if the Client has appointed one) the Services subject to these Conditions and the Client or the Intermediary agrees that by placing an Order for the Services it accepts these Conditions. The User Guide applicable to each Report should be read in conjunction with the Report and is incorporated into these Conditions as if it were repeated herein. A Report is sold subject to all information contained in such User Guide

1.2 GEOSMART acknowledges that in the provision of the Report and Services it owes a duty of care to the Intermediary and to the Client.

1.3 In providing search reports and services GEOSMART will comply with Search Code and will take into account the requirements of the Alternative Dispute Resolution for Consumer Disputes (Amendment) Regulations 2015. Further details are provided in the PCCB Bulletin which accompanies GEOSMART Reports.

2. Report

GEOSMART shall use reasonable care, skill and diligence in carrying out the Services and providing the Report to the Intermediary (and the Client). However the Report is provided to the Intermediary (and the Client) on the express basis that the Intermediary (and the Client) acknowledge and agree to the following:

2.1 information and data supplied in Report(s) is derived from the Information and GEOSMART does not warrant the accuracy or completeness of such Information;

2.2 the sources of information and data supplied in Report(s) are specifically cited in the Report and the User Guide; however GEOSMART does not claim that these sources represent an exhaustive or comprehensive list of all sources that could or might be consulted; and

2.3 GEOSMART does not guarantee that all environmental risks that are or might be associated with the Site will be identified in the Report; and

2.4 Reports and other services provided by GEOSMART are generally professional business to business services and intended as such for use or interpretation by professional persons skilled in the use of environmental information; and

2.5 GEOSMART shall not be responsible for any error or corruption in a Report resulting from inaccuracy or omission of third party information and data provided by the Intermediary or the Client (as applicable), inaccurate processing of information and data by third parties, computer malfunction or corruption of data whilst in the course of conversion, coding, processing by computer or electronic means, or in the course of transmission by telephone or other communication link.

3. Liability

3.1 As some of the data and information which GEOSMART interprets in Reports is obtained by GEOSMART from third parties, GEOSMART cannot control the accuracy or completeness of such data and information, nor is it within the scope of the Services to verify the data or information by a physical inspection of the Site. Save as provided in Conditions 3.5 and 3.11 GEOSMART will only be liable to the Client or to the Intermediary in respect of the Services:

3.1.1 for loss or damage caused by breach by GEOSMART of these Conditions accordingly save as provided in Condition 3.5 GEOSMART shall not be liable in any other circumstances for any errors, inaccuracies, faults or omissions in the Services;

3.1.2 for any obvious errors or obvious inaccuracies in any information obtained by it where GEOSMART should reasonably have been alerted to such error or inaccuracy;

3.2 GEOSMART has no liability whatsoever for, under or in respect of any insurance policy purchased by the Client or the Intermediary where insurance is made available to the Client or Intermediary following the provision of a Report by GEOSMART issued in accordance with these Conditions. Where such a policy has been purchased, all liability arising from or relating to the Site shall remain exclusively with the insurers. Moreover, GEOSMART is not endorsing any policy recommended by insurers and the Client or the Intermediary is entirely responsible for ensuring the insurance policy offered is suitable for its needs and should seek independent advice.

3.3 GEOSMART does not guarantee that an insurance policy will be available for the environmental risks that may be associated with the Site specified in the Report and the provision of a Report does not constitute any indication by GEOSMART that insurance will be available for the Site.

3.4 GEOSMART has undertaken the Services for use by the Client or the Intermediary and those persons referred to at condition 5.1 and 5.2 and for no other purpose whatsoever and the Services should not be relied upon by any other third party. GEOSMART cannot accept responsibility and will not be liable to any other party for any loss caused as a result of reliance upon the Services. Any other party relying on the Services does so entirely at its own risk, including without limitation, any insurers. Recipients of the Services are to rely on their own skill and judgment in determining the suitability of the Services for their own purpose and use.

3.5 Nothing in these Conditions shall exclude or restrict GEOSMART's liability for death or personal injury resulting from the negligence of GEOSMART or their employees while acting in the course of their employment or arising from a breach of its statutory duty or fraud.

3.6 GEOSMART shall not be liable to any recipient of the Service for loss of profits, loss of contracts, (or other indirect or consequential loss or damage) resulting from any event or default by GEOSMART in the provision of the Services to the fullest extent permitted by law.

3.7 GEOSMART shall make reasonable endeavors to supply the Report on the date agreed with the Intermediary or the Client (as applicable). This date will be taken as a guideline for time planning purposes only. Time shall not be of the essence with respect to the provision of the Services except where it has agreed in writing to a deadline with the Client or Intermediary in which it is stated that time is of the essence.

3.8 GEOSMART shall not be liable for any delay, interruption or failure in performance of its obligations hereunder which is caused by war, flood, riot, Act of God, strike or other labour dispute (including those affecting Government officials), suspension or delay of service at public registries, lack of power, telecommunications failure or overload, or computer malfunction caused by any event beyond the reasonable control of GEOSMART.

3.9 The Client or the Intermediary (as appropriate) shall on receipt of the Services make a reasonable inspection of the Site to satisfy itself that there are no apparent defects or failures with respect to the description of the Site.

3.10 GEOSMART's liability under the Conditions shall cease upon the expiry of six (6) years from the date when the Client, Intermediary or any person making use of the Report in accordance with Condition 5.2 became aware that it may have a claim in respect of a particular Report provided always that there shall be no liability at the expiration of six (6) years from the date of the Report. For the avoidance of doubt, any claims in respect of which proceedings are notified to GEOSMART prior to the expiry of the time periods referred to in this Condition shall survive the expiry of those time periods.

3.11 Subject as otherwise provided in these Conditions, GEOSMART's aggregate liability arising out of the provision or use of the Services, in contract, negligence or in any other way, for damages or loss sustained or incurred by the Intermediary shall be limited to an aggregate amount not exceeding £2,000,000 pounds. For the avoidance of doubt, if multiple parties make use of the Report, the limit referred to above applies to all users of that Report in aggregate.

3.12 GEOSMART undertakes for the duration of the six (6) year period of liability provided for by Condition 3.11 to maintain and renew annually Professional Indemnity Insurance in respect of the Services with a liability limit of not less than £2,000,000 provided that such insurance is available at commercially reasonable rates (and in such case then at the next highest limit which is available in the market at commercially reasonable rates). Details of Professional Indemnity Insurance shall be made available to the Client or Intermediary (as applicable) on request.

3.13 Where GEOSMART procures for the Intermediary, otherwise than as part of a Report, any third party service, including but not limited to, environmental reports, risk models, risk assessments, professional opinions, or any other service, GEOSMART accepts no liability whatsoever for the information contained therein.

3.14 The Client and the Intermediary warrant that they shall: (i) comply with all applicable laws, statutes and regulations relating to anti-bribery and anti-corruption including but not limited to the Bribery Act 2010; (ii) comply with such of GEOSMART 'S anti-bribery and anti-corruption policies as are notified to them from time to time; and (iii) promptly report to GEOSMART any request or demand for any undue financial or other advantage of any kind received by the or on their behalf in connection with these Conditions. Breach of this clause shall be deemed a material breach of these Conditions.

4. Copyright

4.1 The Intermediary, the Client and any recipient of the Report pursuant to the provisions of condition 5.2 acknowledge that the proprietary rights subsisting in copyright, design rights and any other intellectual property rights in respect of the data and information in the Report are and shall remain the property of GEOSMART and these Conditions do not purport to grant, assign, or transfer any such rights in respect thereof.

4.2 Reports may be stored on the Intermediary's server and used on up to ten (10) units (where a "Unit" means a single client personal computer or workstation) on the Intermediary's network and any network of a recipient of the Report pursuant to the provisions of Condition 5.2. Data in Reports is deemed to be in use when it is loaded into the temporary memory (i.e. RAM) or installed onto the permanent memory (i.e. memory chip, hard disc, CDROM) of that computer.

4.3 The Intermediary, the Client and all recipients of the Report pursuant to the provisions of Condition 5.2 are all entitled to make up to five printed copies only of any Report. Copies of the Report may be provided for information purposes for proper and lawful use only to a person who is considering whether to acquire or hold an interest in the Site or to provide funding in relation to the Site. Further copies may not be made in whole or in part without the written permission of GEOSMART who shall be entitled to make a charge for each additional copy.

4.4 The Intermediary and the Client (as applicable) shall (and shall procure that all recipients of the

Report pursuant to the provisions of Condition 5.2 shall):

4.4.1 not remove, suppress or modify any trademark, copyright or other proprietary marking belonging to GEOSMART from the Services;

4.4.2 not create any product which is derived directly or indirectly from the data contained in the Services; save for products documents and advice provided by those acting in a professional or commercial capacity in accordance with 5.2.3;

4.4.3 not combine the Services with or incorporate such Services into any other information data or service;

4.4.4 not re-format or otherwise change (whether by modification, addition or enhancement) data contained in the Services save for those modifications made by those acting in a professional or commercial capacity in accordance with 5.2.3;

4.5 The mapping (if any) contained in any Services is protected by Crown Copyright and must not be used for any purpose outside the context of the Services.

5. Confidentiality and reliance

5.1 Subject to (i) full payment of all relevant Fees and (ii) compliance with this Contract, the Client or the Intermediary is entitled to rely on the report and information provided.

5.2 Subject to Condition 5.3, the Client or the Intermediary (as applicable) may without further charge make the Report available to:

5.2.1 Up to a maximum of three (3) persons who acquire or hold an interest in the Site or an interest in the Client or the entity which holds or acquires an interest in the Site save that nothing shall hereby entitle any such person to recover twice (whether directly or indirectly) in respect of the same loss nor seek recovery in respect of any loss relating to any period after such entity ceases to hold its interest or to have potential liability for the Site(whichever is the later) (unless otherwise agreed by the parties);

5.2.2 Up to a maximum of three (3) persons who provide funding to the Client or to a person at condition 5.2.3;

5.2.3 Up to a maximum of three (3) persons acting in a professional or commercial capacity for the Client in relation to the Site.

5.3 GEOSMART shall have the same duties and obligations to those persons referred to in Conditions 5.2.1, 5.2.2, 5.2.3 in respect of the Services as it has to the Client and the Intermediary , and such persons shall be entitled to rely on the relevant Report as if it was addressed to them and any such person shall be entitled to enforce each of these Conditions as if they were named as joint Client in the Order, provided always that the person to whom the Report is made available accepts these Conditions by writing accordingly to GEOSMART citing the Report and the Site.

5.3 The Report is to be used solely for the benefit of such persons as are set out in Condition 5.1 and 5.2, and GEOSMART exclude all liability to all other persons unless GEOSMART has expressly agreed in writing to a third party taking the benefit of the Report and has been paid reasonable fees for so doing.

5.4 Any information provided by the Intermediary or the Client to GEOSMART in contemplation of the Services to be provided together with the Report will be treated as confidential information.

5.5 GEOSMART agrees not to disclose or publish any statement relating to such confidential information (in whole or in part) to any third party without the prior written consent of the Intermediary save for its provision to GEOSMART 's employees who require access to the confidential information in order to perform their duties to GEOSMART.

5.6 GEOSMART will procure that its employees will maintain the confidential information in strict confidence.

6. GEOSMART's charges

6.1 The Client or the Intermediary (as applicable) shall pay GEOSMART's charges for the Services at the rate set out in the Order.

6.2. Unless otherwise stated all prices are exclusive of Value Added Tax which shall, where applicable, be payable in addition to any sum payable for the Services at the relevant rate in force from time to time, against delivery of an appropriate tax invoice.

6.3 The Client or the Intermediary (as applicable) shall pay the price referred to in Condition 6.1 above for the Services:

6.3.1 without any set off, deduction or counterclaim;

6.3.2 GEOSMART requests upfront payment by debit or credit card (No surcharges for credit cards) or by bank transfer. A credit agreement can be set up for repeat clients with terms based on 14 days from the date of GEOSMART's invoice.

6.4 GEOSMART shall not be obliged to invoice any party other than the Client or the Intermediary (as applicable) for the provision of Services, but where GEOSMART does so invoice any third party at the written request of the Client Intermediary, and such invoice is not accepted or remains unpaid, GEOSMART shall have the right at any time to cancel such invoice and invoice the Client or the Intermediary (as applicable) direct for such Services. Where the Intermediary 's order comprises a number of Services or separate elements within any one or more Services, any failure by GEOSMART to provide an element or elements of the Services shall not prejudice GEOSMART's ability to require payment in respect of the other Services delivered to the Intermediary or the Client (as applicable).

6.5 If the Intermediary or the Client (as applicable) fails to make any payment on the due date GEOSMART shall be entitled to cancel or suspend any further orders or delivery. In addition, GEOSMART may charge the Intermediary or the Client (as applicable) interest on overdue amounts at 4% over the NatWest plc base rate (as varied from time to time) from the due date until payment in full is made (whether before or after judgment).

7. General

7.1 These Conditions constitute the entire agreement between the parties and no statement given orally or in writing should be deemed incorporated herein unless executed in writing by a director of GEOSMART and countersigned by the Intermediary or the Client (as applicable). Each of the Conditions and Sub-conditions of these Conditions is distinct and severable. If any provision of these Conditions shall be determined to be invalid, illegal or unenforceable, the remainder of these Conditions shall continue to be valid, legal and enforceable to the fullest extent of the law.

7.2 Any time or indulgence granted by GEOSMART or the Client or the Intermediary or delay in exercising any of its rights under these Conditions shall not prejudice or affect GEOSMART's or the Client's or the Intermediary 's rights or operate as a waiver of the same.

7.3 GEOSMART, the Client and the Intermediary shall not be entitled to assign their respective rights or obligations pursuant to these Conditions without the prior written approval of the other parties.

7.4 GEOSMART may suspend or terminate the provision of the Services if the Client or the Intermediary (as applicable) is bankrupt or insolvent or makes any voluntary arrangements with its creditors or become subject to an administration order or has an administrative receiver appointed over any of its assets or GEOSMART has reason to believe that any of foregoing circumstances may come into existence or any amount owing to GEOSMART that is overdue or where the Client or Intermediary (as applicable) has exceeded any credit limit.

7.5 These Conditions shall at all times be governed construed and enforced in accordance with English Law which shall be the proper law of these Conditions, and both parties thereby submit to the exclusive jurisdiction of the English courts.

7.6 Except as otherwise provided in these Conditions a person who is not a party to any contract made pursuant to these Conditions shall have no right under the Contracts (Rights of Third Parties) Act 1999 to enforce any terms of such contract and GEOSMART shall not be liable to any such third party in respect of the Products.