AKERA ENGINEERS
Consulting Structural Engineers

18A FROGNAL GARDENS
LONDON NW3 6XA

BASEMENT IMPACT ASSESSMENT

Client
Roger PlIlgrim and
Nadine Majaro

3rd October 2019

FOR

PROPOSED DEVELOPMENT AT
18 A FROGNAL GARDENS, LONDON NW3 6XA

REVISIONS

Rev	Date	Notes
1	17/10/2019	To accompany the Alison Brooks Architects Planning Application submission

David Akera
Meng MIStructE

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Date 3rd October 2019
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Introduction

Akera Engineers have been appointed by Roger Pllgrim and Nadine Majaro as the structural engineers for the proposed development at 18A Frognal Gardens, London NW3 6XA.

The proposed development consists of
- Demolishing the existing house on the property
- Constructing a new 4 storey house
- The new house will involve extending the existing lower ground floor level backwards cutting into the higher garden level at the rear. The extended lower ground floor will have a plunge pool at the rear of the space.

This report presents an outline structural scheme for the construction of the new lower ground and ground floor structures of the new house. The report is based on the Planning Application drawings submitted by Alison Brooks Architects.

The property is located at 18A Frognal Gardens, London NW3 6XA. in the London Borough of Camden. The building is a three storey (lower ground, ground and first floor) constructed in 1965. The house is cut into the hillside, with the lower ground floor level with the street and pavement and the upper ground floor level with the rear garden.
It is a semi-detached house. The house was originally constructed as a detached house in 1965 and the house at 18B was constructed against it a few years later in the late 1960s.
The house construction is
- Reinforced concrete lower ground floor
- Suspended timber joisted upper floors
- Flat timber joisted roof
- Load bearing external brickwork walls on mass concrete strip

Ground Conditions and Existing foundations

A geotechnical investigation was carried out by Soil Consultants. The full geotechnical investigation report (dated 25th September 2019) is included as part of the document.

In summary

- Groundwater

A standpipe was installed as part of the site investigation. Ground water was encountered at an average depth of 4.67 metres below the rear garden level. The extended lower ground floor level will be higher than the encountered water table, but the base of the plunge pool will be slightly lower that the water table.

- Made ground

The made ground was encountered below at various depths under the property
- Ranging between 0.45 to 0.75 metres below the lower ground floor
- 3.0 metres below the upper ground floor
- And 2.0 metres below the paved garden area.

- Bagshot formation

Below the various thicknesses initial of made ground, there is a layer of Bagshot formation (clayey fine grained silty sand) that extends to a depth of 7.0 metres below the garden level.

- Claygate beds

Below the Bagshot formation there is a Caygate beds layer (firm silty sandy clay) that extends to a depth of 8.5 metres below garden level

- London Clay formation

The underlying London Clay Formation was encountered below the Claygate bed formation.

- Safe bearing pressure

The geotechnical investigation carried out indicates that a safe bearing pressure of 100kN/m^2 is appropriate for moderate sized foundations at lower ground floor level within the Bagshot formation.

Hydrogeology & Hydrology

A groundwater and hydrology basement impact assessment by Stephen Bus Environmental Consulting Limited (dated 17th March 201) is included as part of the document.
In summary,
- The amount and quality of surface water run-off is not affected by the proposed development
- There will be a slight increase in the ground water level upstream of the new plunge pool depression
- The impact of the development on the ground water level will not be measurable at a distance further than 5 metres from the new extended lower ground floor at the rear of the of the house
- There is a negligible risk of impacting any of the identified receptors

Flood risk assessment

A flood risk assessment report by Evans Rivers and Coastal (dated September 2019) is included as part of the document.
In summary,
- The site is within Flood Zone 1
- There is a moderate risk of ground water flooding. This will be mitigated by tanking and a drained cavity system within the lower ground floor
- The drained cavity system will have a positive pumping device which will mitigate any sewer flooding
- There is a very low surface water flood risk

Below ground Drainage

A CCTV survey of the drainage has been carried out.
Refer to the Environmental Engineering Partnership drainage report that is included as part of the document.
In summary
- a green roof attenuation system will be utilised to control the flow of rainwater from the building

a hybrid underground attenuation system located to the front of the building twill be used to control the flow discharging into the main sewer. The hybrid system will have additional harvesting capacity for reuse through irrigation

Proposed New Lower ground and Ground floor construction
Design description

The proposed construction of the new ground and lower ground floor will be designed as a stiff reinforced concrete box, with reinforced concrete floors and walls. The reinforced concrete box will be capable of supporting the loads from the existing house and party walls and resist the horizontal pressures from the surrounding ground beneath the neighbour's property, the side access road and the rear garden and will distribute the loads safely to the ground. The bearing loads under the new reinforced concrete box and concrete underpins will be within the acceptable bearing capacities of the Bagshott formation.

A method of construction has been devised that will provide safe support to the surrounding ground and boundary wall at all times and stages of the construction of the lower ground and plunge pool structure and will limit any ground movements in order to avoid any damage to the neighbouring property.

A number of alternatives were considered before arriving at the proposed method. The main deciding factor that led to the current proposal was to minimise any vibrations while working adjacent to the party/boundary wall of the neighbouring properties.

The new lower ground and plunge pool structure will be formed using

- reinforced concrete walls in front of traditional hit miss mass concrete underpinning under the garden wall and party wall foundations
- a contiguous piled wall alongside the side access road and along the garden side of the lower ground floor (installed using a CFA piling rig) to retain the surrounding ground.

A construction methodology and sequence has been developed and included as part of the document.

Settlements and influence of the construction on the neighbouring properties

The design of the new basement will follow the guidelines set out by the London Borough of Camden Basement Planning Guidance and Policy.
This document addresses the following relevant considerations:

- maintain the structural stability of the neighbouring property
- avoid affecting drainage and run off
- avoid causing damage to the water environment
- avoid impacting upon the water environment in the local area
- avoid impacting upon the structural stability of local area
- evaluate the impacts of the proposed construction on the local basement hydrology, hydrogeology and land stability.
- historic Environment
- flooding
- Construction Method Statements

The underpin widths will be designed in order to limit the bearing pressures under the pins to below the levels indicated in the ground investigation report. The bearing pressures under the basement slab/raft level will be limited to below the levels indicated in the ground investigation report. By limiting the bearing pressures in the gravel, the settlements will be minimal.

Refer to the proposed lower ground and ground floor construction sequence that includes the proposed sequence for the temporary works. The proposed sequence and temporary works have been developed and designed to mitigate any effects on neighbouring properties and to avoid any slope instability that may threaten the neighbouring properties.

Movement monitoring

Movement monitoring of the adjoining properties will be undertaken during the construction of the lower ground and ground floor structure, with agreed trigger levels that are set in order to protect the adjoining property. A scheme for movement monitoring of the adjacent properties is to be agreed as part of the Party Wall awards negotiations with the neighbours and it will be incorporated into the main contractor's method statements.

The temporary and permanent works have been designed to limit eventual movement. It is anticipated that the category of the movement expected is between 1 and 2 based on the Burland

Burland Scale
Category of damage

Category of damage	**Description of typical damage**	**Approximate crack width (mm)**	**Limiting tensile strain ε_{lim} (per cent)**
0 - Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible	<0.1	0.0-0.05
1 - Very slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection	<1	0.05-0.075
2 - Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly.	<5	0.075-0.15
3 - Moderate	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable lining. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5-15 or a number of cracks > 3	0.15-0.3
4 - Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially overdoors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15-25 but also depends on number of cracks	>0.3
5 - Very severe	This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion, Danger of instability.	Usually > 25 but depends on number of cracks	
Damage Category Chart (CIRIA C580)			

Ground Movement Assessment Report

A Ground Movement Assessment Report A-squared Studio Engineers Limited (dated October 2019) is included as part of the document.
In summary

- provided that the permanent and temporary works designs are carried out in a coordinated manner between proposed design and sequence and substructure contractors to ensure that the overall design intent is achieved, the maximum damage classification for the neighbouring properties is anticipated to be Category 1 (Very Slight)

SITE INVESTIGATION REPORT

PROPOSED DEVELOPMENT AT:
18A FROGNAL GARDENS, HAMPSTEAD, LONDON NW3 6XA

Client:	**ROGER PILGRIM AND NADINE MAJARO**
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Report ref:	**10402/SC**
Date:	**25 September 2019**

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SITE INVESTIGATION REPORT

PROPOSED DEVELOPMENT AT:
18A FROGNAL GARDENS, HAMPSTEAD, LONDON NW3 6XA

DOCUMENT ISSUE STATUS:

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Rev 0	**18 Sep 2019**	**First issue**	**Stuart Childs BSc, MSc, FGS**	**Opher Tolkovsky BSc, MSc, DIC, FGS, CGeol Terry Rickeard BSc, MSc, CEng, CGeol, MICE, MIMM, FGS**
Rev 1	**25 Sep 2019**	**Architectural plan updated & Tree survey included**	**Stuart Childs BSc, MSc, FGS**	**Opher Tolkovsky BSc, MSc, DIC, FGS, CGeol Terry Rickeard BSc, MSc, CEng, CGeol, MICE, MIMM, FGS**

Soil Consultants Ltd (SCL) has prepared this Report for the Client in accordance with the Terms of Appointment under which our services were performed. No other warranty, expressed or implied, is made as to the professional advice included in this Report or any other services provided by us. This Report may not be relied upon by any other party without the prior and express written agreement of SCL.

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- Foreword
- Borehole records
- Standard Penetration Test results
- SPT hammer calibration certificates
- Window sample borehole records
- Trial pit records
- Soakage testing
- Groundwater/ground gas monitoring results

Laboratory testing

- Index property testing
- Plasticity chart
- Particle size distribution tests

Ground profiles

- Plot of SPT 'N' value & Cu versus level
- Cross section through the boreholes

Contamination and chemical testing

- Foreword
- General soil suite/water suite
- WAC test results
- PCBs
- Sulphate/pH suite

Plans, drawings & photographs

- Site photographs
- Topographical plan and proposed development plans
- Site Plan
- Location Plan

APPENDIX B

- GroundSure historical maps (Ref SCL-6195308)
- GroundSure EnviroInsight Report (Ref SCL-6195306)
- GroundSure GeoInsight Report (Ref SCL-6195307)

APPENDIX C

- Email correspondence with Camden Council Contaminated Lane

APPENDIX D

- Stephen Buss Environmental Consulting Ltd (SBEC) Hydrological Basement Impact Assessment Report (Ref: 2019-003-059-002)
- Evans River and Coastal Flood Risk Assessment (Ref: 2351-RE-08-19-01_RevA)

APPENDIX E

- J000215 - 18a Frognal Gardens - Asbestos Management Survey Report

APPENDIX F

- Arup Figures for BIA Land Stability Assessment

APPENDIX G

- CSG Usher's Ltd, 'Tree report in accordance with BS 5837:2012', ref: 031682, date: 28th August 2019

1.0 INTRODUCTION

Consideration is being given to the construction of a new 4-storey residential property, including an extended basement, to replace the existing 3-storey building.

In connection with the proposed works, Soil Consultants Ltd (SCL) were commissioned by Akera Engineers (the engineer) on behalf Roger Pilgrim and Nadine Majaro (the client) to carry out a site investigation to include the following elements:

- Phase 1 Preliminary Risk Assessment (PRA) including initial Conceptual Site Model (CSM)
- Phase 2 intrusive investigation
- Provision of advice on foundations, retaining walls and ground floor slabs
- Basement impact assessment
- Contamination risk assessment and refined Conceptual Site Model (CSM)

This investigation has been undertaken within the constraints of the client's instruction/contract, together with those set out in the 'General information, Limitations and exceptions' section at the end of this report. The SCL 'Standard Terms of Appointment' are also included at the end of this report and these identify the contractual arrangements for the investigation.

2.0 SITE DESCRIPTION

This property is located on the northern side of Frognal Gardens, in the London Borough of Hampstead with its centre at approximate NGR 52615E 185775N and with overall dimensions of approximately 11m x 37m at its widest/longest extremities. The wider area is occupied by residential buildings of varying construction/ages. The site is bounded by Frognal Gardens (Photo 6) to the south with a private access road to No.18 Frognal Gardens directly to the east (Photos 2,3) the garden to which also provides the northern boundary. No.18b Frognal Gardens bounds the site to the west. Residential properties are generally present in the wider area to all aspects.

Topographical information provided by AD Horner Ltd, Drawing No. 5594-14Jan19-01, indicates that the site has an elevation of about +107.9mOD at its most south western extent rising to +112.5mOD at the most north eastern extent attaining an overall gradient of approximately 5° to 6°.

This house is a vacant semi-detached three storey property of traditional brick construction (Photo 1). The entire area to the front of the house is block-paved (Photo 1) and has an elevation of about +108.6mOD. It is accessed directly off Frognal Gardens.

The existing house has been cut into the natural topography with the lowest level (lower ground floor level) being a garage which is accessed directly from the front driveway/block paved area. The garage only extends about halfway across the footprint of the house and it is assumed that the rear wall to the garage is a retaining structure. Living accommodation forms the ground floor and first floor levels with the ground floor being consistent with the rear garden level.

A patio leads out from the rear of the house (elevation of about +111.4mOD), and the garden beyond attains a gentle gradient rising to about +112.5mOD at the rear boundary. The rear garden is rectangular in shape comprising a mixture of grassed areas and flower beds, shrubs, several small trees up to about 6m in height (Photo 5), including magnolia, cherry and hawthorn. Of particular note is a large Lime tree about 18m high situated in the neighbouring garden immediately to the north.

A timber shed is present on the northern boundary. A side gate entrance to the rear garden is present half the way along the private access road to the east of the site (Photo 4).

As a consequence of the sloping nature of the site, various retaining walls are present along the boundaries.

The current site features are shown on the Site Plan and on the site photographs which are included in Appendix A.

3.0 PHASE 1 PRELIMINARY RISK ASSESSMENT (DESK STUDY)

This assessment is generally based upon current UK guidance, primarily the combined DEFRA/EA publication CLR 11 (Model Procedures for the Management of Land Contamination, 2004). The scope of the assessment is as follows:

- A review of historical and current land–use and potential contaminated land risks
- Development of an outline conceptual model, identifying potential sources, pathways and receptors
- Development of a strategy for Phase 2 intrusive investigation

3.1 Review of historical information

The following summary of the history of the site and surrounding area has been compiled from a series of historical maps obtained from a commercially available database; these are included in Appendix B.

Historical development of site and surrounding area

Map date	**The site**	**Significant development / features in surrounding area**
1870-73	The site is located on the access / estate road to a large house labelled 'The Mansion'. This road is tree lined and shown to comprise deciduous species	Wells present about 25m/30m SSE Mixture of residential properties and associated gardens in all directions together with chapels, schools, playgrounds Burial ground about 70m SE and church and graveyard about 130m SSE Nearest building about 20m W is The Mansion, which is shown to have glass structures attached
1894	The site was vacant and a track/road along E site boundary established which is shown to be tree lined	Wells 25/3m SSE are no longer present Land associated with R.C Chapel 20m NE was developed Building 20m SW was demolished
1896-1938	No significant changes apparent	Current road network established with some new housing constructed in the general area, nearest development to SE & N of the site Mount Vernon Hospital about 120m NNE and tube station (Hampstead Station) 230m E (1915) Ground works on a plot of land to the south of Mount Vernon Hospital is evident (80-100m N)
1953-69	No significant changes apparent	Medical Research Council Laboratories about 70m NNE General expansion of residential development in all directions; new buildings immediately W of site along Frognal Gardens
1972-2014	No18a (and 18b) constructed by this time in their current configuration	Some additional residential development in the general area Electricity substation 100m SE & 120m NE

3.2 Database information

The database report includes information of local activities encompassing a range of subjects related to land use, pollution, and geological/hydrological conditions. Our assessment of contaminative uses and other environmental issues relevant to the site and its surroundings is provided below. The full database report is included as Appendix B and this should be read and understood fully in conjunction with this summary.

Groundsure EnviroInsight Report (Ref SCL-6195306)

Historical Industrial Sites

- Records of Potentially Contaminative Uses: within 250m of site hospital (51m N, 106m N), unspecified ground workings (103m & 110m N), London Transport station (206m E)
- Records of Historical Tank Database: within 250m – 137m & 200m SW (unspecified tank, 1896)
- Records of Historical Energy Features: within 250m – electricity substations 101m SE, 110m NE, 128m NE, 140m NE, 230m E
- Records of Historical Garage and Motor Vehicle Repair: within 250m - garages recorded 219m E, 234m SE (1953)
- Records of Potentially Infilled Land: within 250m – unspecified ground workings 103m/110m N (1920 & 1949)

Environmental Permits, Incidents and Registers

- Records of Part A(2) and Part B Activities and Enforcements within 500m of the study site: 209m E, dry cleaners. No enforcements notified
- Records of Category 3 or 4 Radioactive Substances Authorisations: no data found
- Records of Licensed Discharge Consents: 307m N – unspecified trade discharges, revoked October 2000
- Records of National Incidents Recording System (List 2): 437 E, contaminated water, firefighting run-off; no impact

Landfill and other Waste Sites

- Records of Environment Agency historic landfill: 948m S; no details given

Current Land Use

- Current Industrial Data: engineering services 71m N; electricity substations 103m SE, 139m NE, 240m E; underground station 221m E; disability and mobility equipment 223m E
- Petrol and Fuel Sites: no data found within 500m

Hydrogeology and Hydrology

- Aquifer within Superficial Deposits: no superficial aquifer present
- Aquifer within Bedrock Deposits: 'secondary A' on-site
- Groundwater Abstraction Licences: nearest entry 1604m S (borehole)
- Surface/Potable Water Abstraction Licences: no data within 2000m
- Source Protection Zones: no data within 500m

- Groundwater vulnerability and soil leaching potential: on-site minor aquifer/high leaching potential (category HU)
- Surface water features within 250m of the study site: none identified

Flooding

- Environment Agency Zone 2/Zone 3 floodplain within 250m: none identified
- Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating: Very Low
- Flood Defences/Areas Benefitting from Flood Defences/Flood Storage within 250m: none identified
- British Geological Survey groundwater flooding susceptibility areas within 50m: Clearwater flooding, limited potential
- Groundwater Flooding Confidence Areas British Geological Survey confidence rating: Low

Designated Environmentally Sensitive Areas

- No data within 750m

Radon

- Radon: the property is not in a Radon Affected Area; no protective measures required

<u>Groundsure Geo Insight Report (Ref SCL-6195307)</u>

Geology

- Artificial /Made Ground: 401m N – worked ground
- Superficial Deposits/Drift Geology/Landslips/Linear features: no data found within 500m
- Permeability of superficial ground: on-site mixed flow type (high to very low permeability) and 17m NW intergranular flow type (very high to high permeability)
- Bedrock/Solid Geology: on-site Bagshot Formation (sand); Claygate Member 46m W
- Permeability of Bedrock Ground: intergranular high permeability
- Linear Features within 500m of site: 4m SE Fault (Normal Fault, inferred)
- No landslips within 500m

Ground Workings

- Historical Surface Ground Working Features: 103m & 110m N, unspecified
- Historical Underground Working Features: nearest entry 583m SE (tunnel)
- Current Ground Workings: no data found within 1000m

Mining, Extraction and Natural Cavities

- Historical Mining: ventilation shaft 619m (nearest entry)
- Other Mining, Cavities, Extraction: no data within 1000m

Natural Ground Subsidence

- Shrink-swell clays: on site; negligible, 46m W Moderate
- Hazard ratings for all categories on site either negligible or very low except for running san where a low hazard rating identified

Borehole Records

- No nearby boreholes available

Estimated Background Soil Chemistry

- No data

Railways and Tunnels

- Northern Line tunnel identified 144m NE, 7m bgl
- Site is within 5km of HS2 project

3.3 Other information

London Borough of Camden was contacted and requested to provide additional historical/environmental information for the site. The full response from the council is reported as Appendix C. A summary of relevant elements from the report is as follows:

- Historical land use activities - none
- Pollution Incidents - none
- Elevated levels of heavy metals in soils - none
- Landfill sites within 250m radius - none
- Part B Industrial Process - none

The results identified the following land uses of plausible concern within 25m of the site between 1894 - 1971:

- Wells, university medical research laboratory and grave yard

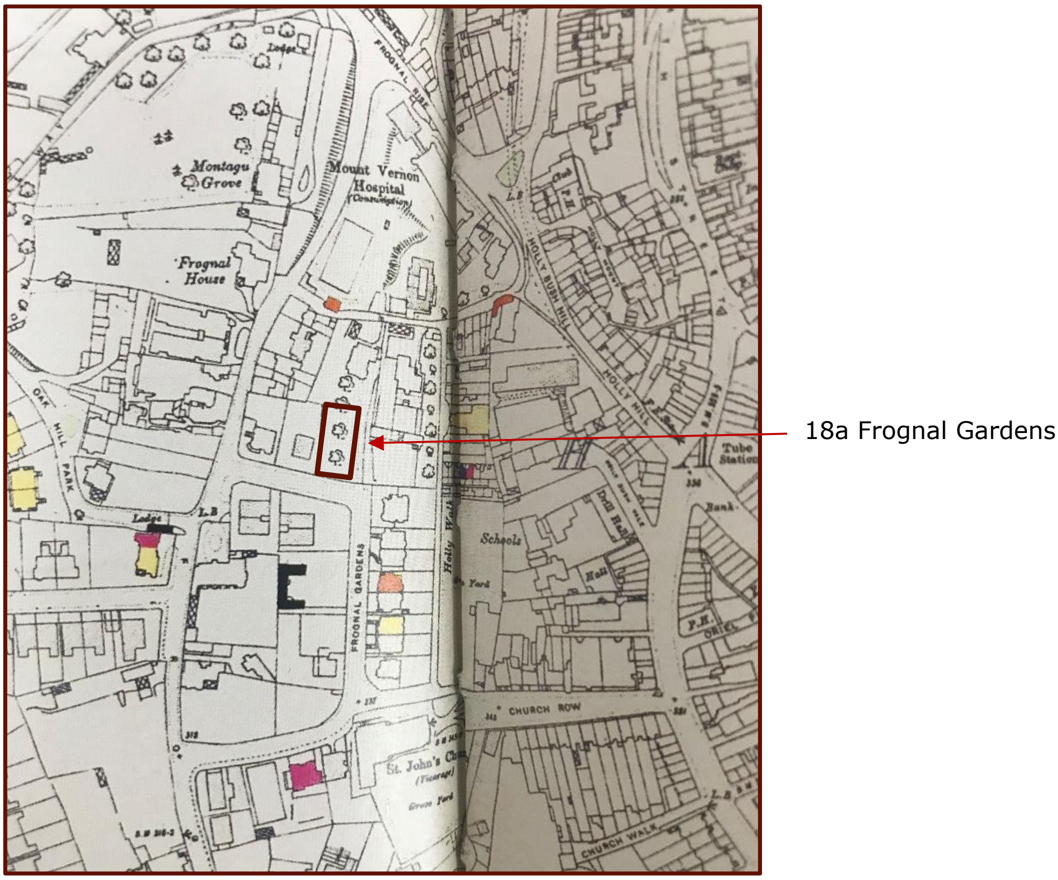
(note: the laboratory and grave yard are in fact located approx. 70m distance from the site).

According to our contaminated land risk characterisation, land on which the above processes/activities were carried out is considered to represent a low to high risk of contamination. It is considered likely that such land could exhibit significantly elevated contaminate levels with the potential to cause harm, although the Council has no present evidence that confirms that there are contamination issues affecting the site other than potentially contaminative land-use activities in proximity.

Camden Council has a Contaminated Land database to identify and prioritise sites within the Borough (with a former potentially contaminative land use) for inspection. Sites recorded on the database are not contaminated land (as defined by Part IIA of the Environmental Protection Act 1990); rather they are considered as having the potential to be contaminated due to their previous use. The subject site is **not** on the Council’s priority for inspection, nor is it proposed to investigate the site further under Part IIA of the Contaminated Land Regime. Furthermore, the subject site has **not** been determined as contaminated land under Part IIA of the Environmental Protection Act 1990.

3.4 Unexploded ordnance risk assessment

Maps published by Ward, L (2016), *The London county council; Bomb damage maps – 1939-1945'.* London: Thames & Hudson Ltd indicate that the wider area was subject to strikes and or blast damage but the site itself was not directly hit by any bombs. In the wider area there was damage ranging from Total Destruction to General Blast Damage and Minor Blast Damage.



3.5 Walk-over survey

A site walk-over survey was undertaken in conjunction with the fieldwork on 8th August 2019. A description of the general features of the site and the topography is provided in Section 2.0 above. From inspection of visible and accessible areas, a summary of specific features relevant to the land quality assessment is as follows:

Feature	Commentary
Electricity substations and transformers	- Electricity substation located off-site approx. 70m SE (photo No.8). Observed to be in good condition and no obvious signs of leakage
Fuel storage tanks	- None observed
Fuel interceptors	- None observed
General chemical storage/waste	- None observed
Invasive species	- None observed
Evidence of gas protection	- None observed

Feature	Commentary
Surface water contamination	None observed
Waste storage	None observed
ACMs	Refer to Appendix E - J000215 - 18a Frognal Gardens – Asbestos Management Survey Report

3.6 Potential pollution linkages and Initial Conceptual Site Model

The information in the preceding sections has been used to undertake the Preliminary Risk Assessment and to compile the Initial Site Conceptual Model below. The assessment follows as risk-based approach, with the potential risks determined qualitatively using the 'source-pathway-receptor' linkage concept; a risk of harm may only exist where a plausible linkage is present. The assessment has been formulated based on the following table:

		Consequences			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High likelihood**	Very high risk	High risk	Moderate risk	Moderate/low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

Definitions of the risks are summarised as follows:

- **Very high:** high probability that severe harm could occur, or there is evidence that it is currently occurring. If realised, the risk could result in substantial liability. Urgent investigation/remediation
- **High:** harm is likely to occur; realisation is likely to present substantial liability. Urgent investigation required. Remedial works may be required in short-term, will be in long-term
- **Moderate:** possible that harm could arise, but unlikely to be severe. Investigation normally required to clarify risk and liability. Remedial works may be necessary in long-term
- **Low:** possible that harm could occur, but this would at worst be mild
- **Very low:** low possibility of harm, unlikely to be severe

The assessment has been carried out by identifying and evaluating the potential sources of contamination, the potential receptors and the plausible pathways for contamination migration are summarised as follows:

Potential sources of contamination

Potential Source	**Element/Compound potential**
On site	
Building built pre-2000 Made Ground	Asbestos Hydrocarbons (TPH, PAH) Heavy metals/semi metals
Off site	
Made Ground (burial ground to SE) Hospital/medical research facility to NE Electricity substations	No off-site sources have been identified nearby which are considered likely to significantly affect the site; general potential contaminants already covered by the on-site element/compound potential above Ground gas and PCBs are considered to be additional potential contaminants from off-site sources which may impact this site and should be investigated further

Potential receptors

In the context of the proposed development, the following potential receptors have been identified:

- Human health: inhabitants/users of building, construction workers, adjacent site users
- Controlled waters: Secondary 'A' aquifer beneath the site. No nearby surface water features, abstractions or source potential zones; site assessed as **low to medium environmental sensitivity**
- Building fabric and services: buried foundations, basement wall, potable water pipes

Plausible pathways

- Ingestion of soil, dust or water
- Inhalation of dust, gas or vapours
- Direct physical contact with contaminated soil/water
- Vertical and lateral migration of contamination including leaching
- Chemical attack of building infrastructure, including water supply pipes
- Migration of ground gas/vapour through permeable soils or open pathways

The Initial Conceptual Site Model and an estimate of the risk associated with each potential linkage is shown in the following table:

Source	Pathway	Receptor	Assessed risk and commentary/justification
On-site: contaminated soil and groundwater	Ingestion, contact, inhalation	End user, construction workers and infrastructure	**Low risk:** main risk identified is presence of possible contamination within the made ground. Residential usage will continue so there will be potential for direct contact and ingestion in garden areas
	Leaching from contaminated soils and migration in groundwater	Aquifer and surface water	**Low risk:** granular deposits likely to underlie the site with a Secondary A aquifer classification. No nearby surface water, abstractions or SPZs. Main chalk aquifer will be protected by very low permeability Tertiary clay layers
Off-site: contaminated soil and groundwater	Lateral migration of contaminants to site in groundwater	End user	**Low risk:** main identified off-site sources are several electricity substations (nearest located uphill is >100m distance within hospital grounds). No other significant potential sources identified
On-site and off-site: ground gas and vapours	Lateral and vertical migration of gas/vapour	End-user and buildings	**Low risk:** made ground within grave yard to south-east of site may be a source of ground gas. The site is not in a radon affected area

The overall risk rating for the site is assessed as being **low**.

3.7 Recommendations for intrusive investigation

The Initial Conceptual Site Model identified potential pollution linkages resulting in the overall assessed risk rating of low to moderate. The following programme of intrusive investigation is recommended:

- Intrusive investigation within the proposed development to confirm the ground sequence, allow soil/water sampling and the installation of monitoring pipes
- Potential off-site sources to be targeted which have been identified by the PRA include electricity substation, graveyard and made ground
- Soil and groundwater samples should be recovered where relevant and be analysed for a range of general contaminants to include petroleum hydrocarbons, metals, speciated PAHs, PCBs and asbestos screening
- A programme of groundwater and gas monitoring should be undertaken following the fieldwork

The Initial Conceptual Site Model should then be revised to include complete pollution linkages and outline mitigation/remedial measures should be identified, together with any requirements for additional investigation.

4.0 EXPLORATORY WORK AND LABORATORY TESTING

The ground investigation was carried out in August 2019 under the supervision of an experienced geo-environmental engineer from SCL within the areas of proposed construction.

The investigation comprised the following elements:

4.1 Rotary auger borehole

One borehole of 125mm diameter (BH1) was drilled using a rotary auger rig to 15.00m depth below ground level (bgl). Representative samples were taken for geotechnical and environmental testing and PID headspace testing was carried out on all environmental samples. A 50mm ID combined water/gas monitoring standpipe was installed in the borehole to 5.00m depth.

In-situ Standard Penetration Testing (SPT) were carried out at appropriate intervals. The hammer Energy Ratio (E_r) for the equipment used was 80%; the relevant test certificate is appended.

4.2 Window sampler boreholes

Two window sample boreholes (WS1 and WS2) were completed using hand held/operated equipment to between 4.00m and 5.00m depth. WS1 was drilled from lower ground floor ground level and WS2 through the base of TP1. Representative samples were taken for geotechnical and environmental testing and PID headspace testing was carried out on all environmental samples. A 35mm ID combined water/gas monitoring standpipe was installed to 4.00m depth in WS1.

4.3 Trial pits

Three trial pits (TP1 to TP3) were hand-excavated to expose details of the party wall footings.

4.4 Soakage Testing

Soakage testing, generally following the BRE DG365 procedure, was undertaken within BH1 at 2.00m to provide preliminary information to establish the feasibility for the use of soakaways.

4.5 Groundwater and gas monitoring

Post-fieldwork water monitoring had been carried out on three occasions, on 12th and 22nd August and 18th September 2019, and gas monitoring on 22nd August and 18th September; the results are appended and discussed below.

4.6 Geotechnical laboratory testing

The following geotechnical laboratory testing was completed:

- Natural water content
- Index properties tests (Atterberg Limits)
- Particle size distribution tests

4.7 Chemical and contamination testing

Selected soil and water samples were delivered to a specialist laboratory (DETS Environmental Ltd) and the following testing was carried out:

- General soil suite - 2no samples
- General water suite - 1no samples
- Asbestos screening - 3no samples
- Waste Acceptance Criteria (WAC) - 1no samples
- Soluble sulphate/sulphur/pH analyses - 6no samples
- PCB (water) - 1no sample

The engineering borehole and trial pit logs and the laboratory testing results are included in Appendix A.

5.0 GROUND CONDITIONS

Published BGS information (1:50,000 and 1:10,000 scale maps) indicates that the site is underlain by Bagshot Beds and the Claygate Member which in turn overlies the London Clay Formation, which extends to a considerable depth (>100m) in this area. A geological cross section through the site is presented in Appendix A and our findings are summarised as follows:

5.1 Made ground

The made ground was met beneath paving slabs in the rear garden and brick paving/concrete in the front driveway, and extended to depths ranging between 0.45m and 0.75m below ground level (bgl) in the boreholes, and to 2.00m in TP1 in the rear garden. Beneath the property, the made ground extended to between 0.45m (TP3) and 3.00m depth (TP2), including a 1.2m sub-floor void. The made ground was variable but generally comprised orange brown/brown/dark brown silty sand to silty sandy clay with variable amounts of flint gravel, fragments of brick/concrete, charcoal, plastic and glass. In TP1/WS2 live roots were noted to 2.90m depth and to 0.75m depth in BH1.

It should be noted that, due to the sloping nature of the site and construction cutting into the natural topography, the thickness of made ground could be highly variable across the plot and clearly some re-levelling/upfilling would have occurred at the rear of the property.

5.2 Bagshot Formation

The Bagshot Formation was met in all boreholes and trial pits beneath the made ground at between 0.45mbgl (+108.25mOD) and 1.80mbgl (+109.65mOD) extending to the full depth investigated. Within BH1, these deposits extended to 7.00m depth (+104.45mOD).

This deposit comprised predominately orange brown/light brown slightly clayey fine-grained silt/sand with occasional clay lenses. Particle size distribution tests generally indicate a predominance of sand (between 63% and 74%) with subordinate silt (between 20% and 27%) and clay content (between 6% and 12%). SPT N-values through the granular material in BH1 ranged between 7 and 8, indicating a 'loose' relative density.

Cohesive layers were present within this formation comprising orange brown/grey brown silty sandy clay, up to 0.70m thick. SPT N-values ranged between 9 and 11 indicating a medium strength material, and our inspection assessed the clay as having a firm to stiff consistency. Plasticity Index testing classifies the clay as Intermediate to High Plasticity, according to BS5930 Classification with a Medium Volume Change Potential according to the NHBC Classification.

5.3 Claygate Beds

The Claygate Beds were met beneath the Bagshot Formation (only in BH1), at 7.00mbgl (+104.45mOD) and extended to 8.50mbgl (+102.96mOD). This deposit comprised a firm grey mottled brown sandy silty clay with sand horizons. An SPT N-value of 8 indicates a medium strength material. Plasticity Index testing classifies the clay as Intermediate Plasticity, according to BS5930 Classification with a Medium Volume Change Potential according to the NHBC Classification.

5.4 London Clay Formation

The London Clay has a gradational boundary with the Claygate Member, with the top of the formation taken at 8.50m depth (+102.95mOD). This unit was present to the full depth investigated (+95.95mOD). The material generally comprised stiff dark grey fine sandy silty clay with sand partings and laminations. SPT N-values ranged between 13 and 21, indicating a high strength soil.

Plasticity Index testing classifies the clay as Intermediate to High plasticity, according to BS5930 Classification with a Medium to High volume change potential according to the NHBC Classification.

5.5 Groundwater

Groundwater observations during drilling and the results of water level monitoring are as follows:

BH	Inflows	Monitoring results (depth and level)			
	(depth & level)	12 Aug 2019	22 Aug 2019	04 Sept 2019	18 Sept 2019
1	Inflow 1: 5.45m depth (+106mOD); rose to 4.65m depth in 20 mins (+106.80mOD)	4.58m (+106.87mOD)	4.67m (+106.78mOD)	4.69 (+106.76mOD)	4.71 (+106.74mOD)
WS 1	Inflow 1: 3.00m depth (+105.70mOD); rose to 2.78m depth in 20 mins (+105.92mOD)	2.78m (+105.92mOD)	2.37m (+106.33mOD)	2.70 (+106.00mOD)	2.69 (+106.01mOD)
WS 2	Seepage at 4.00m (+107.45mOD) Seepage at 4.80m (+106.65mOD)	No Installation	-	-	-

5.6 Trial Pitting

Three foundation trial pits were excavated to provide details of the party wall foundations at locations determined by Akera Engineers. The trial pits records are appended and briefly summarised below:

Trial pit	Foundation base depth	Projection from face of adjacent wall	Comments
TP1	2.00m	312mm	Garden wall foundations; footing sitting on natural Bagshot Formation
TP2			
A-A'	3.00m	400mm	Constructed internally (party wall with 18b); footing cast on natural Bagshot Formation
B-B'	3.00m	300mm	
TP3	1.60m	300mm	Constructed internally (party wall with 18b); footing cast on natural Bagshot Formation

5.7 Environmental observations

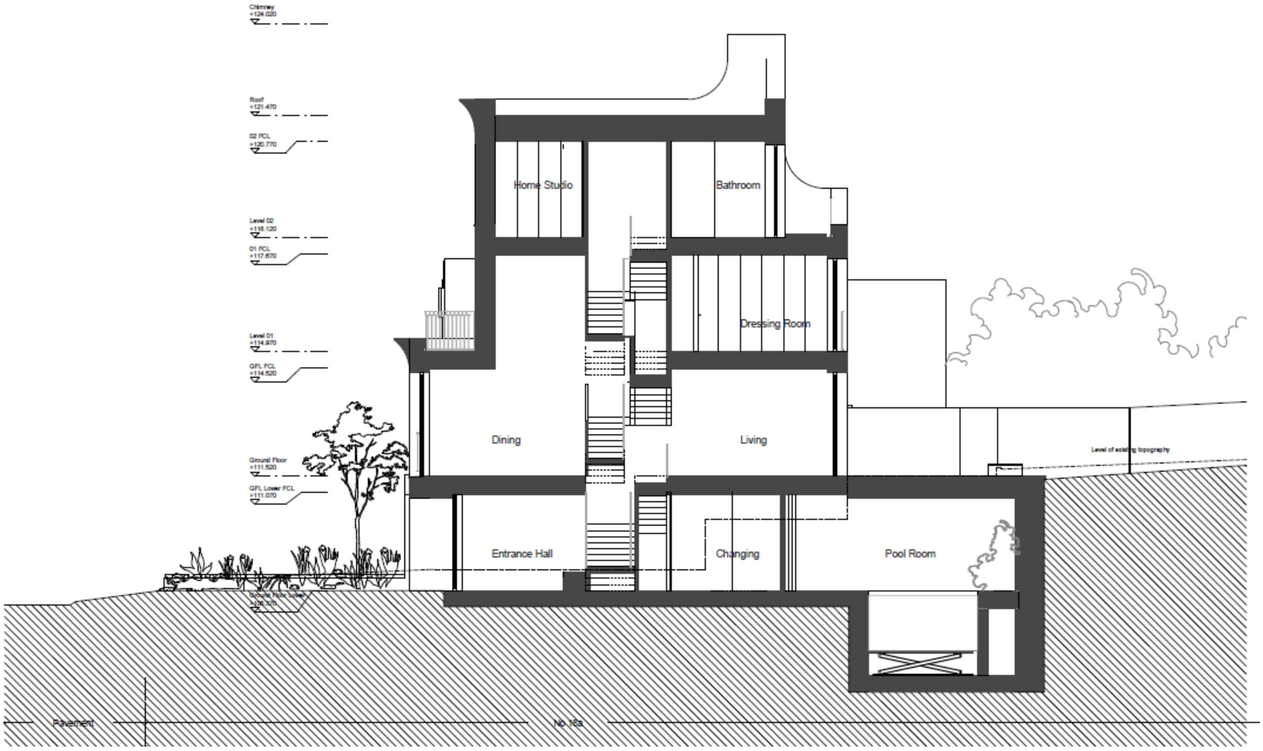
No obvious olfactory or visual signs of soil or groundwater contamination were encountered in the boreholes or trial pits. PID headspace testing (for VOC concentrations) was undertaken on all soil samples during the drilling and trial pitting exercise and no elevated levels were noted.

6.0 GEOTECHNICAL ASSESSMENT

The proposed works at this site include the following elements:

- Demolition of the existing 3-storey building
- Construction of a new 4-storey building with a basement to a similar level as that of the existing lower ground floor level, extending into the rear garden
- Localised deepening for a swimming pool

Architectural drawings of the proposed scheme are provided in Appendix A (with an extract of a section shown below). Details of the anticipated column/foundation loads were unavailable at the time of compiling this report but are expected to be moderate for this type of structure.



The investigation has revealed that beneath up to about 1.80m thickness of made ground at the rear garden boundary wall level and internally, in TP2, beneath the suspended floor, reaching 3.00m depth below floor level, the natural Bagshot Formation/Claygate Beds are present to a depth of 8.50mbgl. The London Clay Formation is then present and was proven to 15.00mbgl (+95.95mOD).

Groundwater was encountered during the drilling process and water level measurements immediately after borehole completion indicated water levels in WS1 of 2.78mbgl (+105.92mOD) and 4.58mbgl (+106.87mOD) in BH1. Subsequent monitoring in August and September 2019 indicate highest groundwater levels range between 4.69mbgl and 2.69mbgl in the boreholes.

6.1 Basement excavation and retaining wall

The following table summarises the current proposals as expressed in the cross sections in Appendix A:

Section	Approx existing site levels (mOD)	Approx Proposed finished floor level (mOD)	Excavation depth to reach FFL, below existing site level (m)
Southern	+108.70	+108.37	0.30
Entrance hall	+111.45	+108.37	Up to 3.10
Plunge Pool	+111.52	+106.02	5.50m

The excavation for the proposed basement is expected to encounter a variable thickness of made ground followed by the Bagshot Beds.

At lower ground floor level, where the driveway and garage currently sit, excavation is expected to be minimal and likely to remain dry, therefore traditional basement excavation methods would be applicable.

At ground floor level, beyond the retaining wall separating the lower ground floor from the ground floor, party wall foundations associated with No.18b were encountered at 3.00m depth (TP2) and the garden retaining wall at 2.00m depth (TP1). Excavations here are expected to be >3.00m deep to reach the desired lower ground floor level. In this instance traditional underpinning to any party wall foundations should be viable. Trial pits may be required along the private road side of the property to assess the depth of existing retaining wall.

Due to the lack of space along eastern side of the property and deep excavations to form the new basement and plunge pool, open excavations cannot be used for these elements, and some form of water-tight construction, most likely embedded piled retaining wall, would be required to provide stability during excavation for the majority of the excavation footprint. In order to prevent water ingress, the retaining wall will need to be sealed into the low permeability London Clay. A secant piled wall is likely to be the optimum solution for the plunge pool construction. The use of a sheet piled wall can also be considered, subject to any issues with vibrations and noise being resolved. It is recommended that specialist contractors are consulted to ascertain the most suitable and cost-effective form of retaining wall construction.

On the basis of the groundwater monitoring to-date, the proposed basement construction (excluding the plunge pool) is expected to remain dry. The deepening for the plunge pool is likely, however, to encounter groundwater and this will need to be addressed in the design and construction. Continued monitoring of the borehole installations should be undertaken to establish long-term fluctuations in groundwater levels. It should be noted that minor water seepages could occur trapped within the made ground, granular layers of the Bagshot Beds and/or during wet periods.

Water levels measured in BH1 indicate that water pressures at the base of the plunge pool will be problematic during construction. Without a water-tight retaining wall being installed there is a danger that digging below the water table at the base of the excavation could cause piping/liquefaction of the Bagshot sands which would lead to base failure. A suitably constructed water-tight retaining wall embedded into the London Clay would overcome such issues.

When constructed diligently by an experienced contractor, we anticipate that it should be possible to limit foundation settlements and any ground movements/groundwater issues associated with the basement excavation to acceptable levels. Careful installation must be implemented to ensure adjacent structures are not adversely affected. Whilst vibration caused by the installation of sheet piles should be relatively small, any vibrations could induce settlement of the surrounding ground if not carefully controlled. It will be imperative to use an experienced and competent piling contractor who should take all necessary measures to monitor and control installation-related movements.

Potential desiccation will need to be addressed due to the vegetation identified within the rear garden of 18b (6m high magnolia tree & 18m English Lime tree) and the neighbouring garden of No 18b. Based on laboratory test results, the cohesive soils beneath the site all have a medium volume change potential classification (NHBC Standards Chapter 4.2, 'Building near trees'). Signs of obvious desiccation were not apparent in the made ground or Bagshot Beds samples, however roots were identified to 2.90m depth in WS2. Whilst desiccation was not apparent and the Bagshot Beds are not shrinkable, the soils will be excavated to up to 5.50m at the rear of the property and the potential for swelling clays behind the basement walls imposing some additional active pressures on the retaining walls will need to be addressed by the designer.

The following table of coefficients may be used for the preliminary design of the basement retaining wall:

Stratum	**Bulk density (Mg/m^3)**	**Effective cohesion, c' (kN/m^2)**	**Effective friction angle, ϕ' (degrees)**
Made ground	1.80	0	24
Bagshot Formation			
Granular	2.00	0	28
Cohesive	2.00	0	22

Eurocode 7 stipulates that partial material factors must be applied to the best estimates of geotechnical soil properties during the design stage. The design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors. The determination of appropriate earth pressure coefficients and the pattern of earth pressure distribution should be carried out by the geotechnical designer; these will depend upon the type/geometry of the wall and the overall design approach. The perimeter walls may of course also be used to provide vertical load capacity subject to the necessary allowance being made for interaction effects. We recommend that a specialist contractor is consulted to confirm the most appropriate type of wall and to provide the final wall design.

6.2 Spread Foundation at basement level

At the proposed basement which will be between 3.10m and 5.50m deep, strip or individual pad foundations should be adequate for supporting structural loads at basement level and for any proposed underpinning works. Both sands and clays are expected at formation level and allowance for some differential foundation performance/settlement should be considered in the design.

As required by EC7, the design engineer must ensure that the correct comparisons are made between Design Actions and Design Resistances after the application of appropriate partial factors and using the final base geometry. For ULS design, both drained and undrained bearing resistances should be determined to calculate the degree of utilisation of the foundation (limit state GEO). SLS checks should be carried out using appropriate methods in accordance with current practice. For preliminary assessment of the feasibility and sizing of foundations, we envisage that an allowable bearing resistance of 100kN/m^2 is considered appropriate for moderate sized pad foundations (say up to 2m width) at basement level. This is applicable to both the cohesive and granular element of the Bagshot Beds.

The formation is expected to be too deep for any significant influence by tree roots and desiccation. However, it should be carefully inspected by a suitably-qualified person, and any made ground or other unsuitable soils, such as low strength clays, root infested or desiccated clays should be excavated and replaced with well-compacted granular fill.

6.3 Piled foundations

For the ground conditions encountered, we consider that CFA piles will present the optimum type. The following table of coefficients may be used for the preliminary determination of the pile resistance.

Shaft adhesion

Stratum	Depth/level	Undrained cohesion (from strength profile)	Ultimate unit shaft adhesion ‘q_s’
All soils above basement level	Above say 3.50m depth (about +108.00mOD)	N/A	Ignore
Bagshot Beds (Sand)	3.50m to 7.00m depth (about +108.00mOD to +104.50mOD)	N/A	26kN/m^2 (nominal)
Claygate Beds and London Clay	7.00m to 12.00m depth (about +104.50mOD to +99.45mOD)	Increases linearly from 30kN/m^2 at a rate of 10kN/m^2/m	Increases linearly from 15kN/m^2 at a rate of 5.0kN/m^2/m (incorporates α = 0.50)

Notes:

a) Unit shaft adhesion ‘q_s’ = α x c_u (where α = 0.50 and c_u is the undrained cohesion from the strength profile)

b) The α value of 0.5 is based upon 102mm diameter triaxial tests and this should not be varied

c) The average shaft adhesion over the pile length should be limited to 110kN/m^2

d) The maximum value for unit shaft adhesion should be limited to 140kN/m^2

e) Levels are based on a ground level of +111.5mOD - this is approximate and should be confirmed

End bearing

Stratum	Depth/level	Undrained cohesion (from strength profile)	Ultimate unit base resistance 'q_b'
London Clay	Below 11.00m depth (Below about +100.50mOD)	Increases linearly from 70kN/m^2 at a rate of 10kN/m^2/m	Increases linearly from 630kN/m^2 at a rate of 90kN/m^2/m (incorporates Nc = 9)

Notes:

a) Unit base resistance 'q_b' = Nc x c_u (where Nc = 9 and c_u is the undrained cohesion from the strength profile)

b) Levels are based on a ground level of +111.5mOD - this is approximate and should be confirmed

Under EC7 (BS EN 1997-1:2004 and UK National Annex) the limit states GEO and STR must be verified using Design Approach 1, which checks reliability with two different combinations of partial factors. The following partial factors are applicable to bored and CFA piles, to be used in conjunction with a Model Factor of 1.4:

Parameter			Combination 1			Combination 2			
			A1	M1	R1	A2	M1	R4	R4+
Permanent actions (G)	Unfavourable	γ_G	1.35			1.0			
	Favourable	$\gamma_{G, fav}$	1.0			1.0			
Variable actions (Q)	Unfavourable	γ_Q	1.5			1.3			
	Favourable	$\gamma_{Q, fav}$	0			0			
Material properties (X)		γ_M		1.0			1.0		
Base resistance (R_b)		γ_b			1.0			2.0	1.7
Shaft resistance (R_s)		γ_s			1.0			1.6	1.4
Total resistance (R_t)		γ_t			1.0			2.0	1.7
Tensile resistance ($R_{s,t}$)		$\gamma_{s,t}$			1.0			2.0	1.7

For guidance purposes, indicative pile resistances for single rotary piles are as follows, calculated using the above preliminary parameters and partial factors where relevant:

Pile diameter (mm)	Pile toe level (mOD)	Pile toe depth (m)	Compressive Resistance (kN)	
			Combination 1	Combination 2
300	+100.5	11	160	95
	+98.5	13	230	140
375	+100.5	11	210	125
	+98.5	13	305	180
450	+100.5	11	265	155
	+98.5	13	380	225

Notes:

a) Concrete stress should be considered in the final design

b) Pile toe depth is relative to existing ground level (approximately +111.5mOD)

c) Pile resistances are given as a guide and are not constituted as design recommendations; due to interaction effects, a reduction in pile resistances will apply if the pile is part of a retaining wall

The design engineer must ensure that the correct comparisons are made between the properly factored Design Actions and Design Resistances. The above pile resistances have incorporated the required partial factors for ULS design but do not incorporate explicit checks on serviceability.

A piling specialist must be consulted at an early stage to advise on the most appropriate pile type and to ultimately provide the final pile design. This should address issues such as the potential clay softening and interaction effects between piles. If pile load testing is undertaken it may be possible to apply lower partial factors, resulting in increased pile resistances, however pile load testing on such a site may be impractical.

6.4 Basement slab performance

The basement excavation will involve several excavations across the site. At the lower ground floor, there will be minimal soil removal and will not lead to any significant unloading of the soils beneath. However, the removal of up to about 3.50m (main basement) to 5.50m (plunge pool) of soil, will result in unloading of about 70kN/m^2 to 115kN/m^2. This stress reduction could theoretically result in an element of immediate and long-term heave in the underlying Claygate Formation and London Clay, although the heave will be mitigated by the applied structural loads and by the presence of approximately 3.5m and 1.5m of the remaining Bagshot Beds below the base of the main basement and pool excavation, respectively (and above the clay) which will tend to reduce the magnitude of movement. Other factors such as the length of the construction programme, the restraining effects of any axially loaded piles and the basement slab stiffness will also determine the amount of heave which will occur.

The potential long-term effect of this heave in the Claygate Formation/London Clay as it recovers should be considered during slab design. The slab could be designed as a fully suspended structure, supported on the main foundations, and incorporating an effective void beneath to accommodate future heave movement. We have carried out a preliminary analysis and this indicates that a total unrestrained heave of up to approximately 35mm could occur as a result of the unloading for the main basement excavation. Approximately 50% of this heave movement is likely to occur during a typical construction programme, leaving a maximum possible post-construction heave of <15mm to be accommodated.

Alternatively, the slab could be ground bearing and designed to withstand potential heave forces/ movements. If it is (reasonably) assumed that the relationship between heave movement and pressure is linear, the maximum heave pressure for an infinitely stiff slab could therefore be about 35kN/m^2 for the fully constrained condition. However, this will not occur in reality and the heave pressure beneath a more flexible slab will clearly be less (due stress dissipation as the slab deflects); we anticipate that an 'average' stiffness slab would experience heave pressures of the order of <15kN/m^2, with <10mm upward heave movement. The plunge pool excavation is expected to result in about 5mm additional post-construction heave movement. It should be noted that this estimate does not take account of the restraining effect of any remaining Bagshot Beds, bearing piles supporting the main structure or the embedded retaining wall piles – these could be significant and will reduce the overall heave movements and pressures. However, it is useful in that it allows general conclusions to be drawn regarding likely maximum under-slab pressures.

It will be necessary to consider uplift of the slab due to potential hydrostatic pressures and in this respect the guidelines incorporated in BS8102:2009 should be followed. The slab design will need to take account of potential seasonal fluctuations and/or accidental and flood conditions and any base blowing which is common within the Bagshot Beds. From advice provided by SBEC groundwater levels at road level/ground level is considered to be suitable for preliminary purposes and this would result in a hydrostatic uplift pressure of up to about 60kN/m^2 on the underside of the plunge pool, decreasing to 40kN/m^2 or below elsewhere; this design water level would need to be agreed with the local building control.

The above estimates assume hydrostatic conditions with total stress used throughout and thus they include the water pressure in any soil uplift pressures/stresses. In the long-term condition, if the soil is permitted to heave (the slab deflects or there is a void former beneath the slab) then the water pressure will still remain. It is therefore important to note that the water pressure is not additional to the heave pressure and should be taken as the minimum uplift pressure for design. In this instance it is apparent that the water pressures may be more critical than potential soil heave pressures and would then be the minimum uplift pressure on the slab.

Piles within the heave zone may be subject to an element of uplift as the clay responds to the excavation unloading, with tensile forces being generated within the shaft. The maximum tensile forces will occur if the piles are installed prior to the excavation (for example single piles with plunge columns), but even if installed following the basement excavation they could still be subjected to some tension until the axial loads are applied by the new structure. The final pile design should address the potential tensile forces and appropriate reinforcement should be incorporated.

A detailed ground movement analysis is to be commissioned separately, to assess the construction and long-term ground movements affecting the adjacent party walls and infrastructure.

6.5 Soakaways

Soakage testing was undertaken in BH1 in general accordance with BRE DG365:2016. An infiltration rate of 2.06E-06m/s was calculated over the testing period. Only one fill/partial drain cycle was achieved within the time frame. It is considered that soakaways would not be feasible at the site and that the overall soil mass would not provide an efficient soakage medium. The nature of the geology would suggest that spring lines cold develop downslope of the site if water was introduced at higher level and this could have an adverse effect on structures/basement or gardens lower down the slope.

6.6 Foundation concrete

Concentrations of water-soluble sulphate (2:1 water/soil extract) were measured in selected soil samples and a sample of groundwater, with slightly acidic to alkaline pH values. The results fall into Site Design Class DS-2 of Table C2 given in BRE Special Digest 1 (2005). We assess the site as having 'mobile' groundwater and this would result in an ACEC Site Class of AC-3z.

Consideration should also be given to the potential oxidation of pyritic soils. Following the procedure recommended in the BRE digest, the amount of oxidisable sulphides is seen to be >0.3% in three samples of the London Clay suggesting that pyrite is probably present in the London Clay; this substantiates observations made during sample description. The characteristic value of Total Potential Sulphate is 1.92%, which equates to Class DS-4 with a resultant classification of ACEC AC-5 (but limited to AC-4). If it is deemed unlikely that the piles and basement slab will be exposed to disturbed ground which might be vulnerable to oxidation, this more onerous classification may not be required; this must be determined by the pile/raft designer who should provide the final classification.

7.0 BASEMENT IMPACT ASSESSMENT

This section of the report assesses the potential impact relating to the proposed subterranean development in terms of 'Land Stability' as required by the London Borough of Camden CPG 'Basements', March 2018. This guidance requires the impacts of the proposed development have been adequately considered using appropriate professional expertise, and that the structural stability of neighbouring buildings will not be put at risk by the proposals.

The hydrological/hydrogeological aspects of the basement impact assessment have been assessed separately by a specialist hydrogeologist (Stephen Buss – Environmental Consulting Ltd).

Five stages are used to allow a full assessment of the effects of the redevelopment on adjacent properties and groundwater and these are summarised as follows:

- Stage 1 - Screening
- Stage 2 - Scoping
- Stage 3 - Site investigation/study
- Stage 4 - Impact assessment
- Stage 5 - Review and decision making

SCL have carried out Stages 1 to 4 of the 'Land stability' element of the BIA to establish the potential impact of the proposed construction and these are described below.

The groundwater flow/hydrogeology and surface flow have been addressed in a report by Stephen Buss Environmental Consulting Ltd (Ref:2019-003-059-002) reported in Appendix D, with a summary of the conclusions presented in Section 7.5 below.

7.1 Stage 1 Land stability – Screening

The purpose of a screening stage is to determine whether a full Basement Impact Assessment is required. We have used a flowchart for this purpose, identifying a series of questions. An answer of 'Yes' or 'Unknown' will require progression to Stage 2 scoping. Answers of 'No' require no further action. The screening stage for land stability is shown in the table below.

Impact question	Answer	Justification	Reference
1) Does the existing site include slopes, natural or man-made greater than 7° (approximately 1 in 8)?	No	Site survey data indicate a maximum slope within the site of about 2° (and about 5° to 6° from Frognal Gardens to the rear wall of the rear garden) along the side access road	• Site Topo plan (AD Horner Ltd, Drawing No. 5594-14, Jan19-01)
2) Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7°?	No	Landscaping/re-profiling proposed however this will not lead to slopes changes to more than 7°	• Proposed development plans

Impact question	Answer	Justification	Reference
3) Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No	The neighbouring land is generally at a similar elevation/slope to the site	• Site Topo plan (AD Horner Ltd, Drawing No. 5594-14Jan19-01) • OS mapping • Arup slope angle map (Fig.16)
4) Is the site within a wider hillside setting in which the general slope is greater than 7°?	No	The general topography slopes down towards the south however with reference to the Arup slope angle map the wider area sits with a slope angle varying between 0°-7°	• Arup slope angle map (Fig.16)
5) Is the London Clay the shallowest stratum at the site?	No	Claygate Formation and Bagshot Beds are present above the London Clay	• SCL Site Investigation Report (this report) • BGS mapping and Arup North Camden geology map, Fig.4
6) Will any trees be felled as part of the proposed development and/or any works proposed within any tree protection zones where trees are to be retained?	Yes	Trees are present within the site and some of these (3m to 7m high) will be cleared. The 18m Lime tree on the northern boundary does not have a TPO however has a root protection area (RPA). We are not aware of any trees in adjacent gardens with RPAs and TPOs. We are not aware of any trees in adjacent gardens with TPOs or that are likely to be affected by the construction. This should be confirmed by a specialist arboriculturalist	• SCL site observations • Proposed development plans • Site survey plan
7) Is there a history of seasonal shrinkage/swelling subsidence to the local area, and or evidence of such effects at the site?	No	We are not aware of any desiccation-related property subsidence on site or in the general area. The shrink/swell risk as reported within the Desk Study, Groundsure Ref SCL-6195307 reported the on sites soils as negligible risk	• Visual observation • SCL Site Investigation Report (this report) • Groundsure Ref SCL-6195307

Impact question	Answer	Justification	Reference
8) Is the site within 100m of a watercourse or a potential spring line?	No	None identified during walk-over survey or by desk study No Surface water features identified	• BGS maps and Arup watercourses/surface water features (Figs.11 & 12) • SCL Site Investigation Report & SCL-619530 (this report)
9) Is the site within an area of previously worked ground?	No	No ground workings identified on site or immediate surroundings in the desk study	• SCL desk study (this report) • Arup slope angle map (Fig.16)
10) Is the site within an aquifer? If so; will the proposed basement extend beneath the water table such that dewatering may be required during construction?	Yes	No superficial aquifer present, however there is a Secondary A Bedrock aquifer Based on our observations the deepest element of the proposed scheme (plunge pool) will intercept the water table	• SCL desk study and investigation (this report) • Arup aquifer designation map (Fig.8)
11) Is the site within 5m of a highway or pedestrian right of way?	Yes	The road 'Frognal Gardens' forms the southern boundary; access track forms the eastern boundary	• Survey plan and mapping
12) Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes	No18b neighbouring wall. Basement sheet piled/bored piled retaining walls are likely to extend below founding levels to the adjacent property. Underpinning may be required locally.	• Proposed development plans • Site survey
13) Is the site over (or within) the exclusion zone of any tunnels, eg railway lines?	No	The site is >50m of any present day or historical railway lines	• Desk study (this report)

7.2 Stage 2 Land stability – Scoping

The purpose of Stage 2 is to assess the potential impacts of the proposed scheme that Stage 1 has indicated require further consideration. Potential issues identified are as follows:

- Question 6 (trees) is answered 'Yes'. Some small trees (3m to 7m height) are to be removed. One 18m Lime tree is present within the site (on the northern boundary) with an RPA. A report provided by CSG Usher's Ltd, 'Tree report in accordance with BS 5837:2012', ref: 031682, date: 28th August 2019 (Appendix G) concludes that:

  - With regards to the trees on site and adjacent to the site: *'The most significant tree with respect to the proposal is a lime located towards the rear boundary of 18a Frognal Gardens' rear garden. No works are planned to occur within the RPA of this tree.'*
  - With regards to the RPA on the Lime tree*: 'there is no incompatibility between T10 and the new structure. New decking will be laid to the rear of the proposed dwelling that will exist very slightly in the southern portion of T10's RPA. This will not involve extensive ground excavation and will be done by hand-only. Measures laid out within the AMS will be followed should roots from this tree be encountered.'*
  - *'There is a Tree Preservation Order (TPO) on a tree within the front garden (not marked on survey), mixed in amongst mature shrubbery. This is a false acacia (Robinia pseudoacacia) that was felled by CSG (Usher's) due to poor health in late 2006. Landscaping works will have no impact within the front garden as roots from T1 are not likely to be encountered. There is little in the way of amenity remaining in its current state and its complete removal is recommended to facilitate the proposal.'*
  - *'Construction activity will technically enter the RPA of T1 when drawn as a nominal circle. Given the established hard standing (pavement, tree surround and tarmac driveway to eastern side of property) in between T1 and the front garden of 18a, it is not anticipated that any significant roots from T1 exist within the section of the RPA that clips the front corner of the rear garden. There is very little in the way of root-induced disturbance of these surfaces that might suggest root encroachment into the RPA.'*

- Question 10 (aquifer) is answered 'Yes'. Secondary A bedrock aquifer is present
- Question 11 & 12 (within 5m of highway and differential basement depth) is answered 'Yes'. The proposed redevelopment will incorporate properly designed and constructed retaining walls to ensure that any property/infrastructure is not adversely affected.

7.3 Stage 3 Land stability - Site investigation and study

This report describes the ground investigation undertaken to establish the ground sequence and groundwater levels, a summary of which is included in Section 5.0.

7.4 Stage 4 Land stability - Impact assessment

The purpose of Stage 4 is to assess the potential impacts of the proposed scheme that the preceding stages have indicated require further consideration.

The impacts described (as assessed through the three previous stages) in relation to Land Stability are summarised in the following table and further details are provided below:

Potentially impacting attribute	Assessed Impact	Mitigation measures required and further notes
Ground Stability Question 6	Possible impact	The trees in the neighbouring property and 18m Lime which has root protection order will need to be considered to ensure that any of the proposed construction works do not adversely affect the health and stability of these trees. Some small trees (3m to 7m height) will be removed in the rear garden The potential for clay desiccation within the zone of root influence will also need to be assessed with regard to any additional active pressures on the retaining walls
Ground Stability Question 10 (Aquifer)	Possible impact	The SBEC report should also be referred to in relation to the basement extending below the water table Continued monitoring of groundwater levels is recommended up to start of and throughout construction
Ground Stability Questions 11 & 12	Likely impact	Initial and final condition surveys would be required for all neighbouring buildings; monitoring to be undertaken during construction and a plan of action to be instigated in response to any departures from appropriately set limits A combination of traditional underpinning techniques/hand excavation in small sections, and piled retaining walls are likely to be required to form the new basement. This work must be undertaken following careful design and construction methods that provide both short and long-term support to neighbouring land/foundations and minimise any ground movements

7.5 Summary of Basement Impact Assessment (groundwater/hydrogeology)

A full assessment has been carried out by Stephen Buss Environmental Consulting Ltd (SBEC) and the associated report is included as Appendix D. A summary of the findings and conclusions of the report is as follows:

- There will be a minor increase in man-made impermeable area, but it is proposed that this is compensated for by the use of permeable paving. Therefore, the amount, timing and quality of surface water runoff will not be affected by the development. No additional water will go to ground as a result of the basement development.
- Available geological and hydrogeological information indicates there is an aquifer layer, the Bagshot Formation, beneath the site that is water-bearing.
- Basement excavation is likely to intercept the water table, and construction of the plunge pool (though not the main basement structure) will intercept the water table permanently. A slight rise in groundwater level up-gradient of the new basement is therefore to be expected.

- Potential receptors for changing groundwater levels have been identified but a) the impact on groundwater level at a distance more than 5 m is likely to be un-measurable, and b) all potential receptors are either above the water table or several tens of metres from the new basement. Therefore, there is negligible risk of impacting any of the identified receptors.

7.6 Ground stability

The matters arising from the previous Stages are addressed below.

Trees (Q6) and Shrink/Swell (Q7)

There is a lime tree with an RPA to the north of the site and according to CSG Usher's Ltd, 'Tree report in accordance with BS 5837:2012', ref: 031682, date: 28th August 2019 indicated that 'excavation works to accommodate the basement level will occur outside the RPA of T10 (English Lime Tree)' and 'there is no incompatibility between this tree and the new structure'. Furthermore, 'the landscaping works will have no impact on the tree stump with a TPO in the front garden'. With regards to the health and stability of these trees reference should be made to CSG Usher's Ltd, 'Tree report in accordance with BS 5837:2012', ref: 031682, date: 28th August 2019.

Some small trees (3m to 7m height) will be removed in the rear garden. The proposed basement will extend well below any zone of root influence; thus, the shrink/swell potential of the clay is not considered a significant design factor in basement design at this site. Nevertheless, this aspect should be considered by the engineer in the scheme design, for example in relation to increased active pressures on the back of the retaining walls.

Impact on adjacent highways (Q12) and neighbouring properties (Q13)

A robust arrangement of temporary internal bracings/props & support elements must be provided to the basement wall, to maintain wall stability and assist in controlling ground movements. Any piling must be carefully designed and carried out to ensure no adverse effects occur.

The GMA (Ground Movement Assessment) Report will address the potential effects on neighbouring properties and should be commissioned once construction sequencing and loadings have been calculated.

Initial and final condition surveys will typically be required for all neighbouring buildings; monitoring during construction and a plan of action to be instigated in response to any departures from appropriately set limits.

7.7 Summary Flood Risk Assessment

A flood risk assessment has been carried out by Evans Rivers and Coastal (ref: 2351/RE/08-09/01_RevA) and the associated report is included as Appendix D. A summary of the findings and conclusions of the report is as follows:

- The site is located within Flood Zone 1.

- This assessment has investigated the possibility of groundwater flooding and flooding from other sources at the site. It is considered that there will be a moderate risk of groundwater flooding which will be mitigated by tanking of the lower ground floor.
- There is a very low surface water flood risk across the site and along Frognal Gardens.
- There is a low sewer flooding risk, however, it is considered that the site should be fitted with a positive pumped device so that it will be protected further from sewer flooding. In addition to the pumped device there should be a non-return valve (e.g. http://www.forgevalves.co.uk/) installed so that if the sewers become completely full during a heavy storm, foul water does not backflow into the property.
- There will not be an increase in surface water runoff from the site and there will be no overall net increase in impermeable area. Existing impermeable hard surfaces at the front of the property will be retrofitted using SUDS permeable paving which will lead to a net reduction in impermeable area and runoff.

7.8 Conclusions

From the available information, we consider that the risk to ground stability from this development should be LOW. However, most ground movement problems occur due to construction issues thus the works must be undertaken by reputable experienced specialists and the temporary and permanent works are adequately designed, with due consideration to the geology and hydrogeology of the site and surrounding areas.

The conclusions of the groundwater/hydrogeology can be reviewed in section 7.5 and Appendix D; however in summary there is an aquifer layer, the Bagshot Formation, beneath the site that is water-bearing. Basement excavation is likely to intercept the water table, and construction of the plunge pool (though not the main basement structure) will intercept the water table permanently. A slight rise in groundwater level up-gradient of the new basement is therefore to be expected. There is a negligible risk of impacting any of the potential receptors in the surrounding area.

The flood risk assessment in section 7.7 and Appendix D concludes that the site is in flood zone 1 and it is considered a moderate risk of groundwater flooding, very low risk for surface flooding and a low sewer flooding risk.

We conclude that for the proposed basement construction, it should be possible to design the construction methods to ensure that ground movements do not adversely affect either adjacent properties or infrastructure. A ground movement analysis report is being carried out separately to provide a detailed assessment on the degree of movement anticipated.

8.0 ENVIRONMENTAL ASSESSMENT

This appraisal is generally based on the DEFRA/EA publication CLR 11 (Model Procedures for the Management of Contaminated Land, 2004), adopting current UK practice which uses the Source-Pathway-Receptor methodology to assess contamination risks. For a site to be designated as contaminated a plausible linkage between any identified sources and receptors must be identified, ie whether significant pollution linkages (SPLs) are present. In considering the potential for contamination to cause a significant effect, the extent and nature of the potential source are assessed and pathways/receptors identified; without an SPL there is theoretically no risk to the receptors from contamination. The assessed risks to the various potential receptors are summarised in the tabulated Conceptual Site Model which forms Section 8.6 of this report.

8.1 Environmental setting and context

The Site is underlain by the Bagshot Formation which has a Bedrock Aquifer Designation of **'Secondary A'**. The site is not within a source protection zone and the nearest groundwater abstraction point recorded is 1600m south. No surface water or potable water abstraction licenses lie within 2000m of the study site.

The site is assessed as being of **Low Environmental Sensitivity.**

8.2 Contamination sources and testing

The Preliminary Risk Assessment presented in Section 3.6 identified the following potential contaminative sources:

Potential Source	Element/Compound potential
On site	
✚ Building built pre-2000 ✚ Made Ground	✚ Asbestos ✚ Hydrocarbons (TPH, PAH) ✚ Heavy metals/semi metals
Off site	
✚ Made Ground (burial ground to SE) ✚ Hospital/medical research facility to NE ✚ Electricity substations	✚ No off-site sources have been identified nearby which are likely to significantly affect the site; general potential contaminants already covered by the on-site element/compound potential above ✚ Ground gas and PCBs are considered to be additional potential contaminants from off-site sources which may impact this site and should be investigated further

The site is assessed as having a low risk rating and low environmental sensitivity and the intrusive investigation has provided coverage of the proposed development and targeted the potential sources. Laboratory testing has been carried out to identify whether these have caused contamination of the soil.

The testing comprised analysis of two soil samples and one groundwater sample for a range of contaminants which were considered to reflect the potential historical/current site usages and the potential sources. Specifically, analysis for PCBs, speciated petroleum hydrocarbons, metals and asbestos was included.

The results have been assessed where relevant against the DEFRA Soil Guideline Values (SGV) and Category 4 Screening Levels (C4SLs), together with the LQM/CIEH Suitable 4 Use Level (S4UL) for Human Health Risk Assessment in which Generic Assessment Criteria (GACs) have been derived from the current CLEA Model (2nd Edition, 2009). For Extractable/Total Petroleum Hydrocarbons, the results have been compared with the frequently used EA remedial target of 1,000mg/kg. Groundwater testing results were assessed against the Water Supply (Water Quality) Regulations 2016, Environmental Quality Standards (EQS), WHO Guidelines for Drinking Water Quality WHO/SDE/WSH/0.5.08/123. The contamination testing was carried out specifically for the purpose of providing a general guidance evaluation for the proposed development. Reference should be made to the foreword to the appended contamination test results in order to fully understand the context in which this discussion should be viewed.

The redevelopment will be for residential usage with a garden remaining to the rear of the property. We have therefore used, where relevant, the trigger levels for **residential development (with home-grown produce)** to assess the results of the contamination testing.

Using these criteria, the following results are of note:

Soil Samples

- **Lead:** below relevant trigger levels
- **Arsenic:** below relevant trigger levels
- **Asbestos:** none detected
- **Speciated PAHs:** below relevant trigger levels

Water Sample (WS1)

- **Nickel:** below all water screen criteria except UK DWS. WS1 result 27μg which is slightly above the UK DWS trigger level of 20μg
- **Speciated PAHs:** all results below laboratory detection level
- **PCBs:** below laboratory detection levels

The results of the contamination testing suggest that there is no contamination present at the sampling points with regards to the proposed residential end use. Of course, the ground investigation undertaken only provided limited site coverage and, although considered unlikely, hotspot contamination may be present elsewhere at the site.

The implications of these results are addressed in the revised Conceptual Site Model below.

Although Asbestos-Containing Materials (ACM) were neither observed on site nor identified in the samples examined, we note that buildings (especially those constructed before 2000) are a potential source of ACM.

Furthermore, any made ground, construction or demolition materials on site may also contain ACM. These matters should be addressed in the Pre-construction H&S plan prior to any demolition or earthworks and the Asbestos report by Artisan Surveyors (Appendix E) should be consulted prior to any construction works.

8.3 Ground gas/vapour monitoring

No specific gas generating uses/risks were identified by the PRA, but with 'made ground' being identified as a possible source. At the time of writing this report, gas monitoring had been undertaken on three occasions following completion of the boreholes. No elevated levels of methane, carbon dioxide, carbon monoxide or hydrogen sulphide were measured. PID readings in the borehole installations were <1ppm. On the basis of these results, we consider that Characteristic Situation 1 (very low risk) is appropriate (as described in CIRIA C665 "Assessing risks posed by hazardous ground gases to buildings", 2007) and this suggests that no gas protection measures will be required; this should be re-assessed following any further monitoring.

8.4 Disposal of excavated soils

A rigorous hazard assessment of the results was not within the scope of our investigation, but our preliminary conclusion from the contamination and WAC testing (where all results were within inert waste threshold values), is that the made ground soils will probably classify as either 'inert' or 'non-hazardous' for off-site disposal purposes, and the natural soils as 'inert' waste. Early consultations should be made with appropriate waste facilities or regulators to confirm the classification for off-site disposal.

8.5 Refined Conceptual Site Model

Taking into account the above discussion, the assessed risks to potential receptors identified in the PRA are summarised in the refined Conceptual Site Model (CSM) below. This includes recommendations for appropriate mitigation measures to render any SPLs inactive and reduce the risks to receptors to acceptable levels:

Source	Pathway	Receptor	Assessed risk, justification and measures to mitigate the risk to acceptable levels
On site: contaminated soil/water	Ingestion & direct contact	End user	**Low** - No contamination was measured nor was there any visual/olfactory evidence of contamination in the soil/groundwater samples so there will be no SPL to human health - Some made ground will be removed during basement excavation reducing the likelihood of contaminants remaining on site A careful watching brief should be kept during construction and if obvious or suspected contamination is encountered this should be dealt with prescriptively
	Ingestion, contact & inhalation	Construction workers and third parties	**Low:** - No significant soil/water contamination was identified during the fieldwork or in subsequent laboratory testing - A careful watching brief should be kept during construction and if obvious or suspected contamination is encountered this should be dealt with prescriptively

Source	Pathway	Receptor	Assessed risk, justification and measures to mitigate the risk to acceptable levels
			• The risks to these receptors will be managed through health & safety procedures and CDM/Control of Asbestos regulations
	Leaching from contaminated soils and migration in groundwater	Aquifer and surface water	**Low:** • Site is assessed to be in a low environmental sensitivity setting • The proposed basement will reduce the infiltration potential of the site • Soil and groundwater testing did not detect any significant leachable contamination beneath the site • The main chalk aquifer is protected by a thick layer of very low permeability London Clay
	Direct contact with soil/water	Building fabric and infrastructure	**Low:** • Any new water supply pipe classification will need to be agreed with the local water company • The effects of soluble sulphates and alkali/acidic ground are discussed in Section 6.6 of this report
Off site: contaminated soil/water (see 7.2 above)	Lateral migration of contaminants in groundwater	End-user and buildings	**Low:** • No contamination measured in soils which may be associated with contaminant migration from off-site sources • No evidence of PCB migration from electricity substation
On-site and off-site: ground gas & vapour	Lateral migration through strata, service runs and cracks in buildings	End-user and buildings	**Very low:** • The development is expected to remove the made ground soils from beneath the building footprint and include installation of a concrete slab and concrete retaining walls across the entire site • Monitoring results to date revealed no elevated landfill gas concentrations, and indicates that CIRIA C665 CS1 applies and no gas protection measures are necessary • No elevated VOCs were identified in our testing; no visual/olfactory evidence of contamination • Radon protective measures are not required based on the desk study information from Groundsure

In conclusion, based upon the information reviewed and the results of the investigation, our assessment is that the site is uncontaminated and no further assessment is required in this regard.

The investigation has provided a coverage of the proposed construction area and it is self-evident that there may be zones of contamination within the site which were not encountered. A careful watching brief should be kept during construction to ensure that any potentially contaminated soil/water encountered is disposed of in a safe and controlled manner. Site workers should observe appropriate hygiene precautions when handling soils, and if material suspected of being contaminated is identified during construction, this should be set aside under protective cover and further tests undertaken to verify the nature and levels of contamination present. If contamination is present, a full site re-assessment may be required and a contingency should be in place in this regard.

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Proposed Lower ground and Ground construction sequence

The following suggested construction sequence sets out the main steps to be carried out to create the extended lower ground and plunge pool area but is not necessarily exhaustive.
It covers all the major structural work and the temporary and shoring works required.
The sequence is set out in a particular order so as to form the lower ground extension without causing any movement and damage to the existing surrounding properties.
The main contractor carrying out the work is to appoint a temporary works engineer. The temporary works engineer is to develop and augment this he proposed sequence as necessary for construction purposes and provide supporting calculations.

To be read in conjunction with the following
- Alison Brooks Planning Application submission drawings and documents.
- The attached following drawings TW01 to TW19.
- The geotechnical soils investigation report.

Prior to carrying out any of the proposed basement excavation works
- Surveys will be carried out to determine the locations of all the incoming services and drain runs.
- All the necessary service diversions will be carried out prior to the basement works.
- A condition survey of the existing and surrounding buildings will be carried out.

Lower ground construction sequence

1. Demolish the existing house down to the lower ground floor.
   1A - Demolish and reduce the level of the access steps up to the house down to the driveway level.

2. Retain the existing lower ground concrete floor slab.
   2A - Retain the existing lower ground floor walls (walls from lower ground to ground floor.
   2B - Retain the rear garden terrace build up.

3. Retain the brickwork salvaged from the demolition of the building.
   Use the brick rubble from the building demolition as hardcore for the pile platform construction.
   Infill the void under the rear raised ground floor with the brick rubble up to garden level (upper piling mat level).
   3A – remove the staircase in the entrance lobby and infill the stairwell with brick rubble.
     - install raking props to shore the garage / bedroom wall.
     - create a ramp from the driveway to the garden level using the brick rubble.

4. Track the piling rig up to the garden level.
   Install piles A to B.

5. When the installation of piles A to B is complete, track the piling rig back down to the driveway level.
   5A – excavate the terrace / garden down to the level of the top of the garden wall foundation.
   5B – Excavate and remove the brick rubble down from the rear section of the house down to the level of the existing concrete slab.

6. Install the first lift of mass concrete underpins under the garden wall (follow the underpinning specification).

7. Rearrange the brick rubble to create a lower piling platform level at the level of the house entrance lobby
   7A – create a ramp up from the driveway to the lower piling mat level.

8. Track the piling rig to the lower platform level.

9. Install piles C to D.

10. Install temporary trench sheeting behind the piles A to B alongside the boundary.
Reduce the level of the piles A to B.
Cast the RC capping beam on top of piles A to B.

11. Install a steel strut between the pile capping beam.
11A – install a strut between the end of the RC capping beam and the party wall.

12. Install temporary trench sheeting behind the piles C to D alongside the boundary.
Reduce the level of the piles C to D.
Cast the RC capping beam on top of piles C to D.

13. Excavate the rear section of the house down to the level of the top of the party wall foundation level.

14. Cast the mass concrete underpins under the rear party wall footing (follow the underpinning specification).

15. Install a steel strut between the end of the lower capping beam and the party wall.

16. Excavate the front section of the house down to the formation level of the new lower ground floor slab
16A – remove the rest of the brick rubble (ramp and piling mat).

17. Install sacrificial trench sheeting along the construction joint / edge of the of the first slab pour.

18. Cast the front section of the lower ground floor slab.

19. Excavate the ground down to half the depth of the first lift of underpins. Demolish the existing foundation below the rear wall.

20. Install waling beams and struts against the underpins and the piles.

21. Excavate down to 400mm above the base of the first lift of underpins.

22. Install the lower mass concrete underpins (follow the underpinning specification).

23. Excavate down to half the depth of the second lift of underpins.

24. Install a second set of walling beams and struts against the underpinning and the piles at this level

25. Excavate down to the formation level of the piling mat.

26. Install the Cordek and cast the RC pool slab.

27. Remove the lowest level of waling beams struts.

28. Shutter and cast the RC lining walls and the RC retaining walls up to the underside of the upper level of walling beams. Install the Cordek and cast the remainder of the ground floor slab.

29. Remove the upper level of waling beams struts.

30. Shutter and cast the RC lining walls and the RC retaining walls up to the pile capping beam level and up to the ground floor RC slab soffit.

31. Shutter and cast the circular column, the columns by the party wall and the column at Grid 2/H to the underside of the ground floor slab.
Shutter and cast the RC lift shaft walls to the underside of the ground floor slab.

32. Shutter and cast the RC upstand wall between the pile capping beam and the underside of the ground floor slab.

33. Shutter and cast the RC ground floor slab.

34. After the appropriate period of time, remove the ground floor props and shutters and steel props.

35. Install the temporary trench sheeting.

36. Excavate and cast the RC retaining wall.

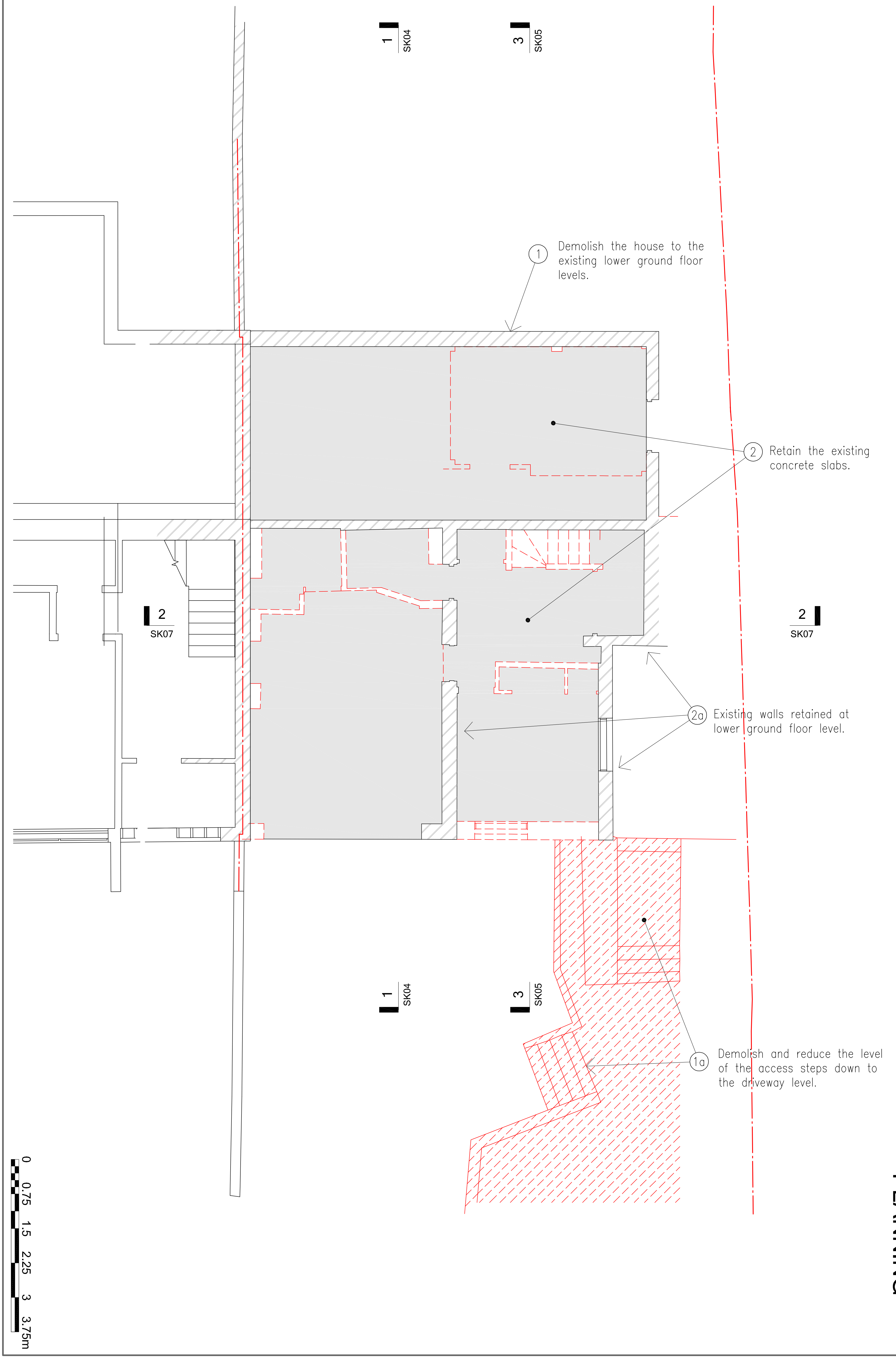
37. Excavate to formation level and cast the lower ground floor slab.

38. Cast the RC columns.

39. Cast the upper ground floor slab.

Underpinning details and specification

- The underpinning is to be carried out in short sections of about 1 metre in length.
- The bottoms of the foundation shall be inspected and approved by the Engineer and the Building
  Inspector before concrete is poured.
- The underside of the footings are to be cleaned and hacked free of dirt, soil or loose materials before underpinning.
- The body of the underpinning is to be constructed in C40 concrete and is to be cast to the widths shown
- Excavation and concreting of any section of underpinning shall be carried out on the same day.
- The mass concrete is to be stopped off 75mm below the underside of the existing footing
- The final pinning up over the whole of the footing is to be carried out with dry pack mortar (1:3 mix cement to sharp sand)
  Ram the dry pack into the 75mm gap 24 hours after the mass concrete underpin has been poured.
- Excavation to any section of underpinning shall not be started until at least 48 hours after completion of any adjacent sections of the work.
- The sides of the previous underpinning bays are to be roughened or keyed.
- Sequence of underpinning to be as shown on the plans
- All sections marked 1 to be excavated, cast and dry packed before starting excavation of section marked 2 and all sections marked 2 to be complete before excavation for sections marked 3 etc.
- A record of the sequence and dimensions of the underpinning carried out is to be kept.



① Demolish the house to the existing lower ground floor levels.

② Retain the existing concrete slabs.

②a Existing walls retained at lower ground floor level.

①a Demolish and reduce the level of the access steps down to the driveway level.

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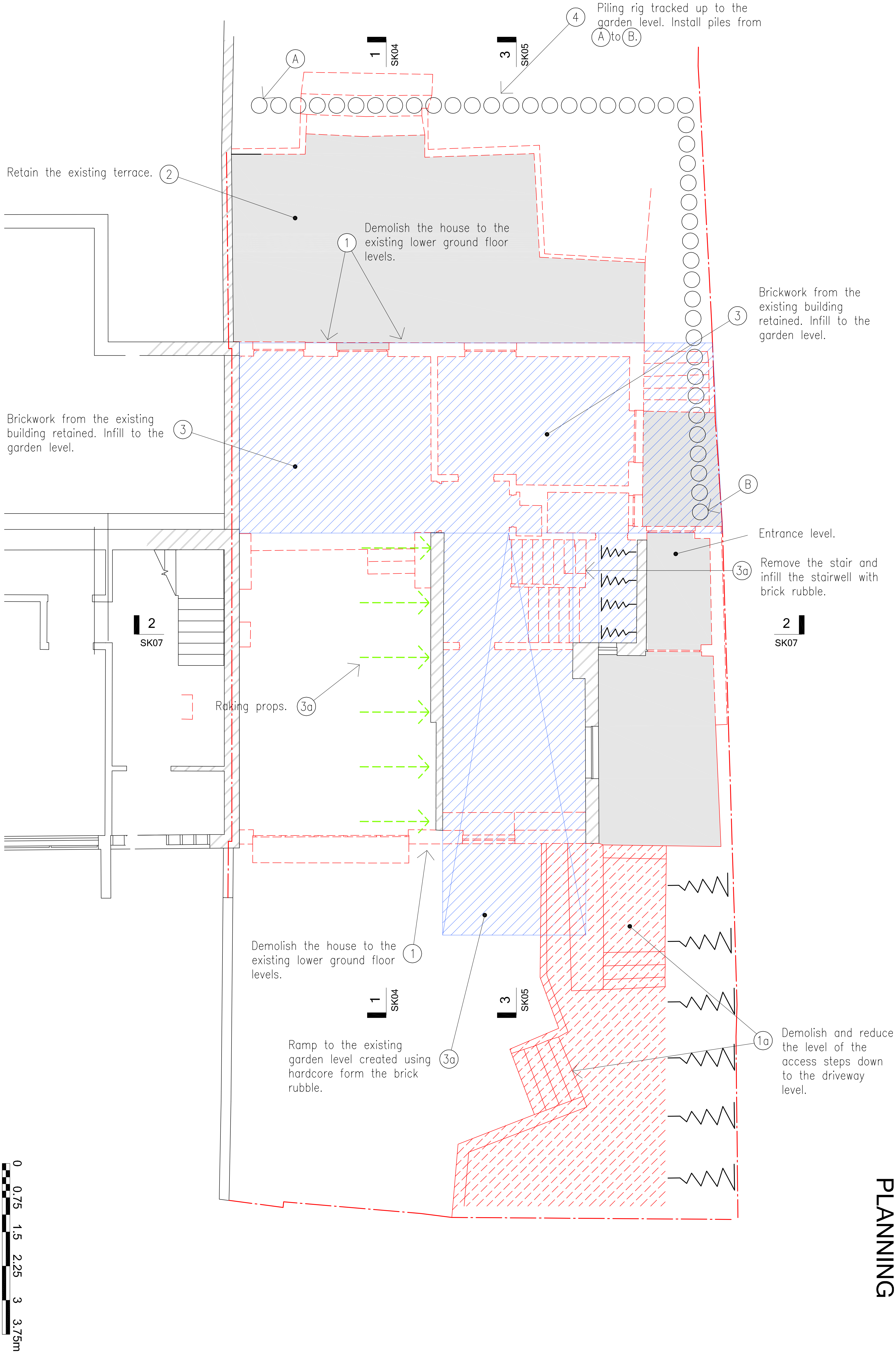
Project
18a FROGNAL GARDENS
-

LOWER GROUND FLOOR PLAN
-

Rev	Date	Description
P1	02.10.19	PLANNING ISSUE

PLANNING

Project no. 2739
Date SEPT '19
Engineer DA Checked
Drawing SK01
Revision P1
Scale at A3 1:75



Piling rig tracked up to the garden level. Install piles from A to B.

Retain the existing terrace. ②

Demolish the house to the existing lower ground floor levels. ①

Brickwork from the existing building retained. Infill to the garden level. ③

Brickwork from the existing building retained. Infill to the garden level. ③

Entrance level.

Remove the stair and infill the stairwell with brick rubble. ③a

Raking props. ③a

Demolish the house to the existing lower ground floor levels. ①

Ramp to the existing garden level created using hardcore form the brick rubble. ③a

Demolish and reduce the level of the access steps down to the driveway level. ①a

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UPPER GROUND FLOOR PLAN
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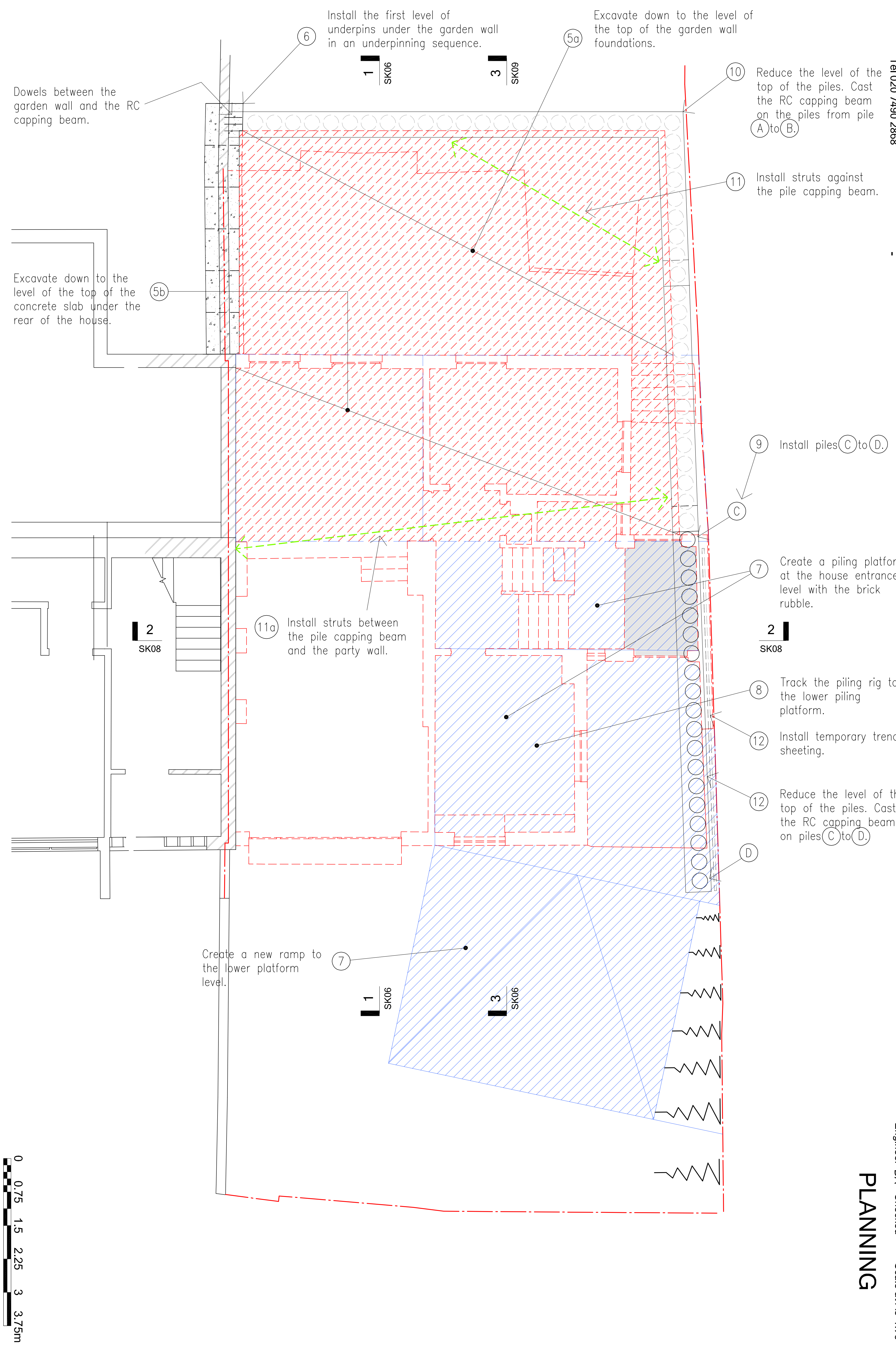
Engineer DA Checked

Drawing SK02
Revision P1
Scale at A3 1:75

PLANNING



⑥ Install the first level of underpins under the garden wall in an underpinning sequence.

(5a) Excavate down to the level of the top of the garden wall foundations.

Dowels between the garden wall and the RC capping beam.

⑩ Reduce the level of the top of the piles. Cast the RC capping beam on the piles from pile Ⓐ to Ⓑ.

⑪ Install struts against the pile capping beam.

(5b) Excavate down to the level of the top of the concrete slab under the rear of the house.

⑨ Install piles Ⓒ to Ⓓ.

⑦ Create a piling platform at the house entrance level with the brick rubble.

(11a) Install struts between the pile capping beam and the party wall.

⑧ Track the piling rig to the lower piling platform.

⑫ Install temporary trench sheeting.

⑫ Reduce the level of the top of the piles. Cast the RC capping beam on piles Ⓒ to Ⓓ.

⑦ Create a new ramp to the lower platform level.

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Drawing SK03
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Scale at A3 1:75

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SECTION 1-1
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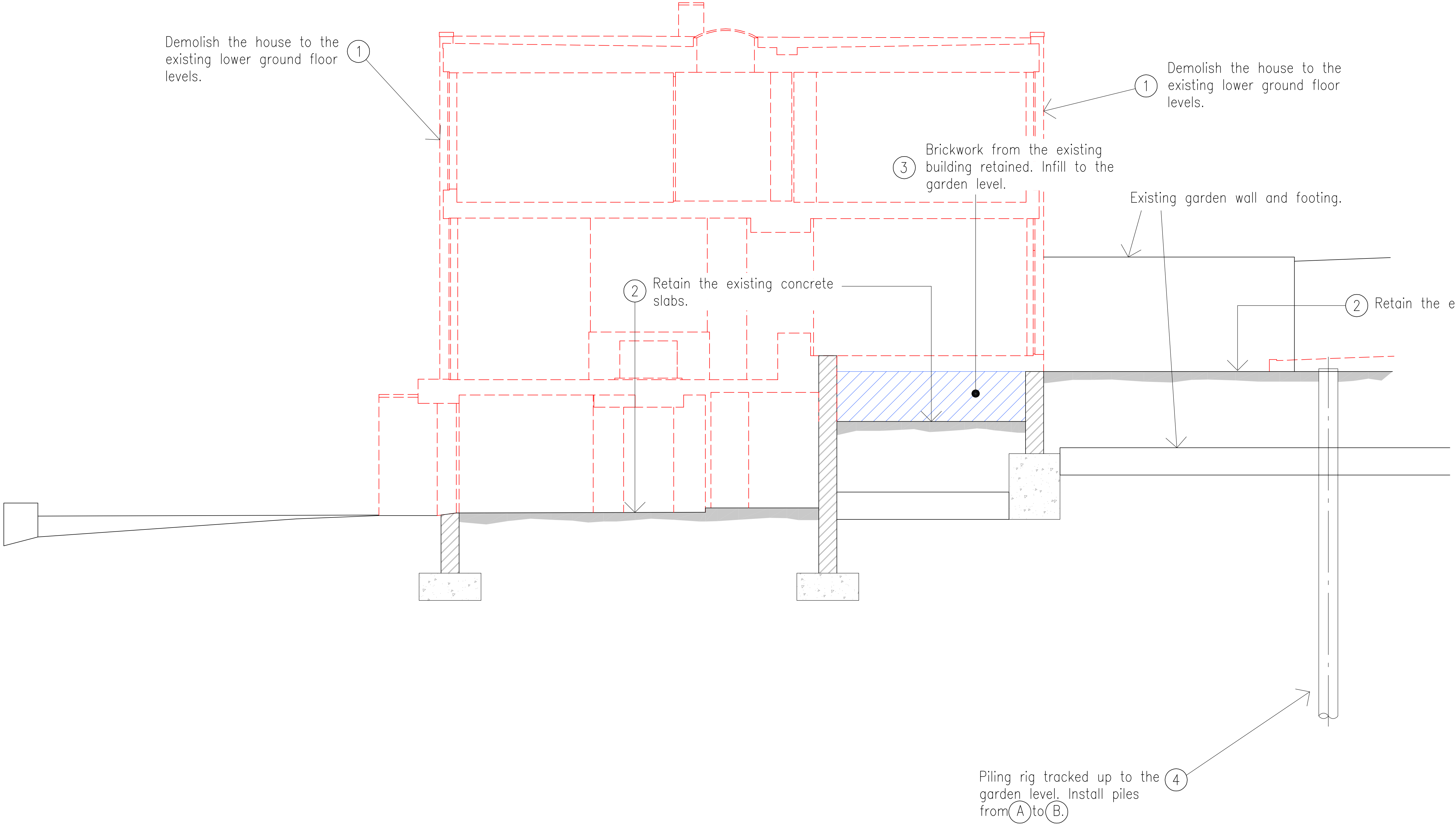
Drawing SK04
Revision P1
Scale at A3 1:75

PLANNING



Demolish the house to the existing lower ground floor levels. ①

① Demolish the house to the existing lower ground floor levels.

③ Brickwork from the existing building retained. Infill to the garden level.

Existing garden wall and footing.

② Retain the existing concrete slabs.

② Retain the existing terrace.

Piling rig tracked up to the garden level. Install piles from Ⓐ to Ⓑ. ④

0 0.75 1.5 2.25 3 3.75m

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SECTION 3-3
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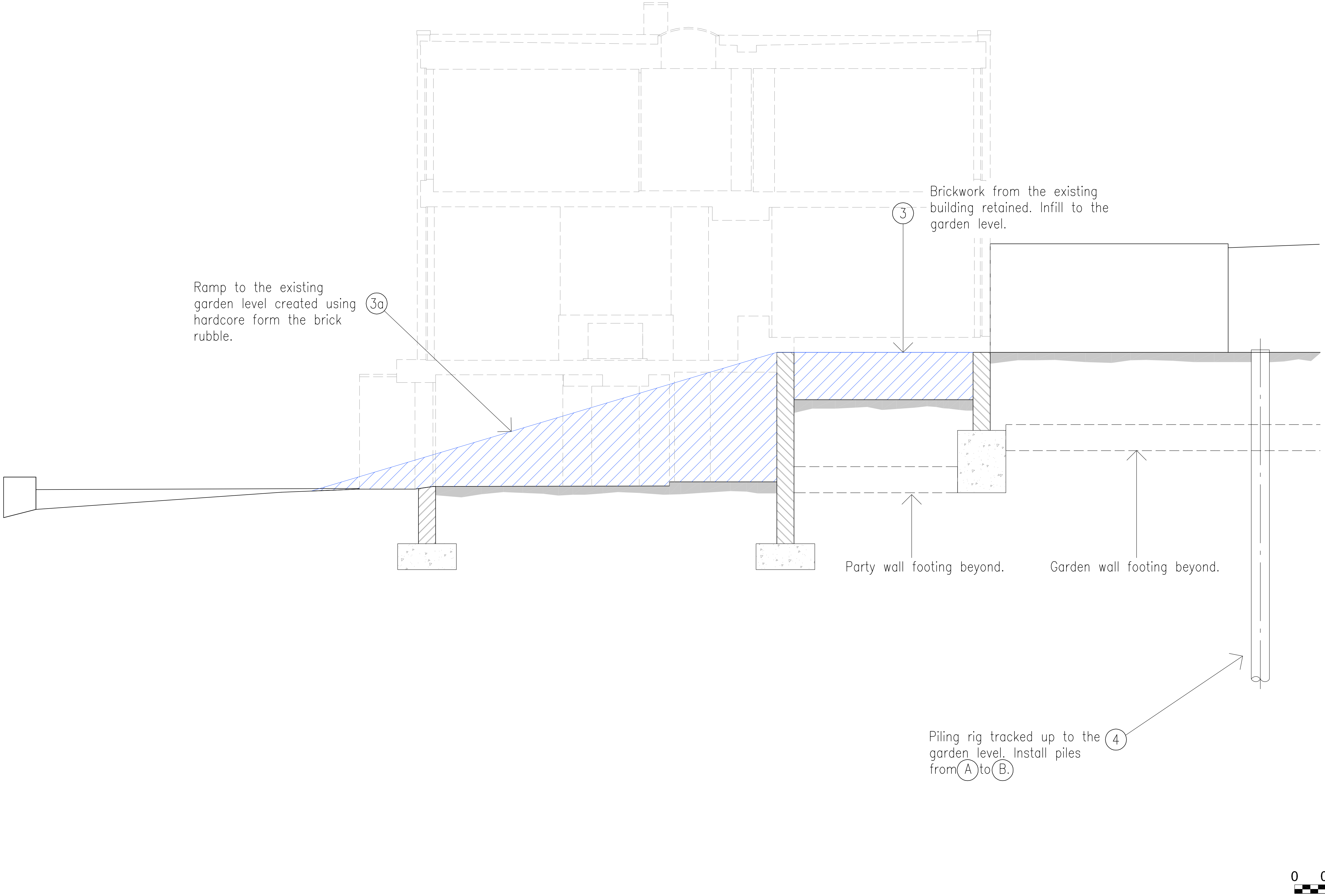
Drawing SK05
Revision P1
Scale at A3 1:75

PLANNING



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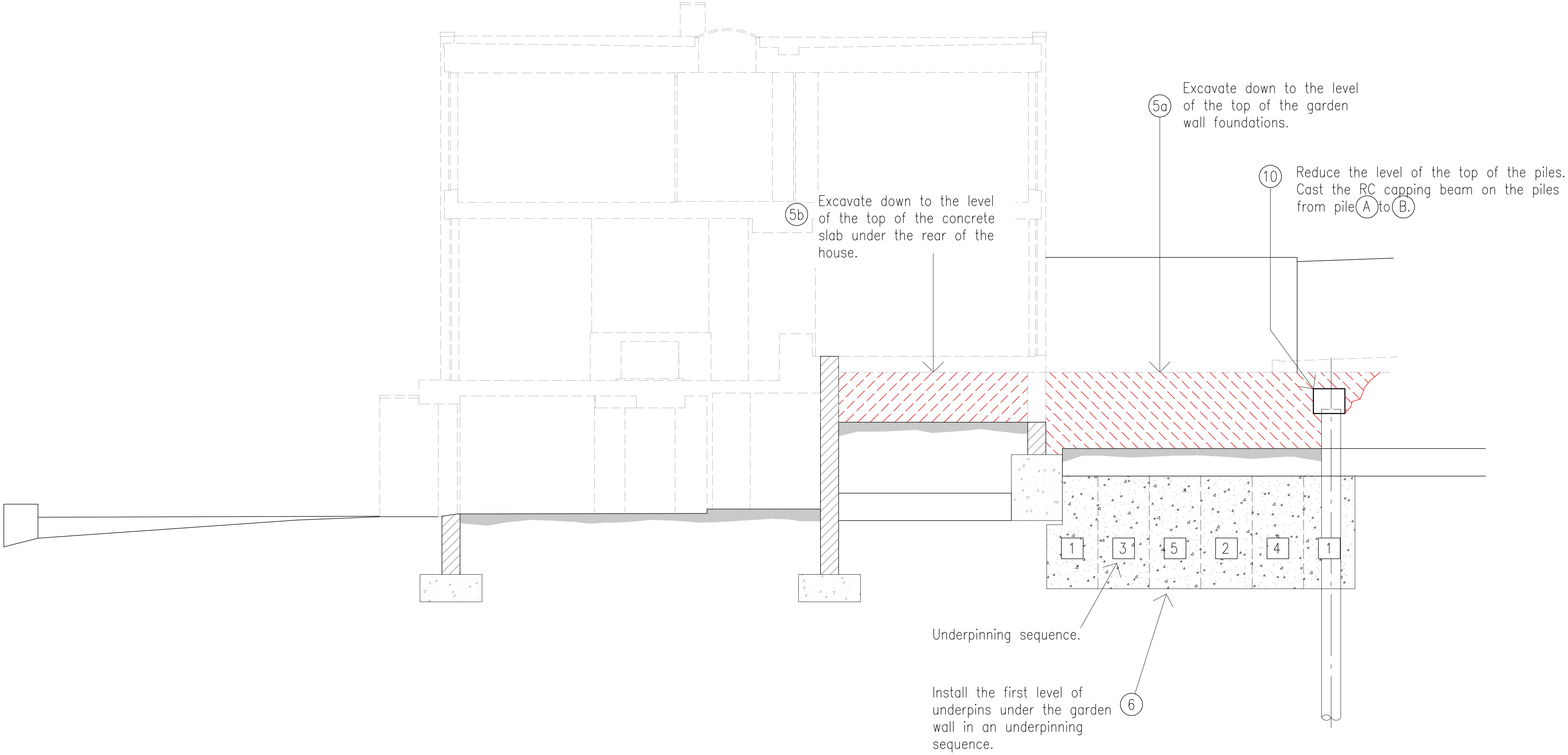
Drawing SK06
Revision P1
Scale at A3 1:75

PLANNING



⑤a Excavate down to the level of the top of the garden wall foundations.

⑩ Reduce the level of the top of the piles. Cast the RC capping beam on the piles from pile Ⓐ to Ⓑ.

⑤b Excavate down to the level of the top of the concrete slab under the rear of the house.

Underpinning sequence.

⑥ Install the first level of underpins under the garden wall in an underpinning sequence.

0 0.75 1.5 2.25 3 3.75m

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SECTION 2-2
-

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Drawing SK07
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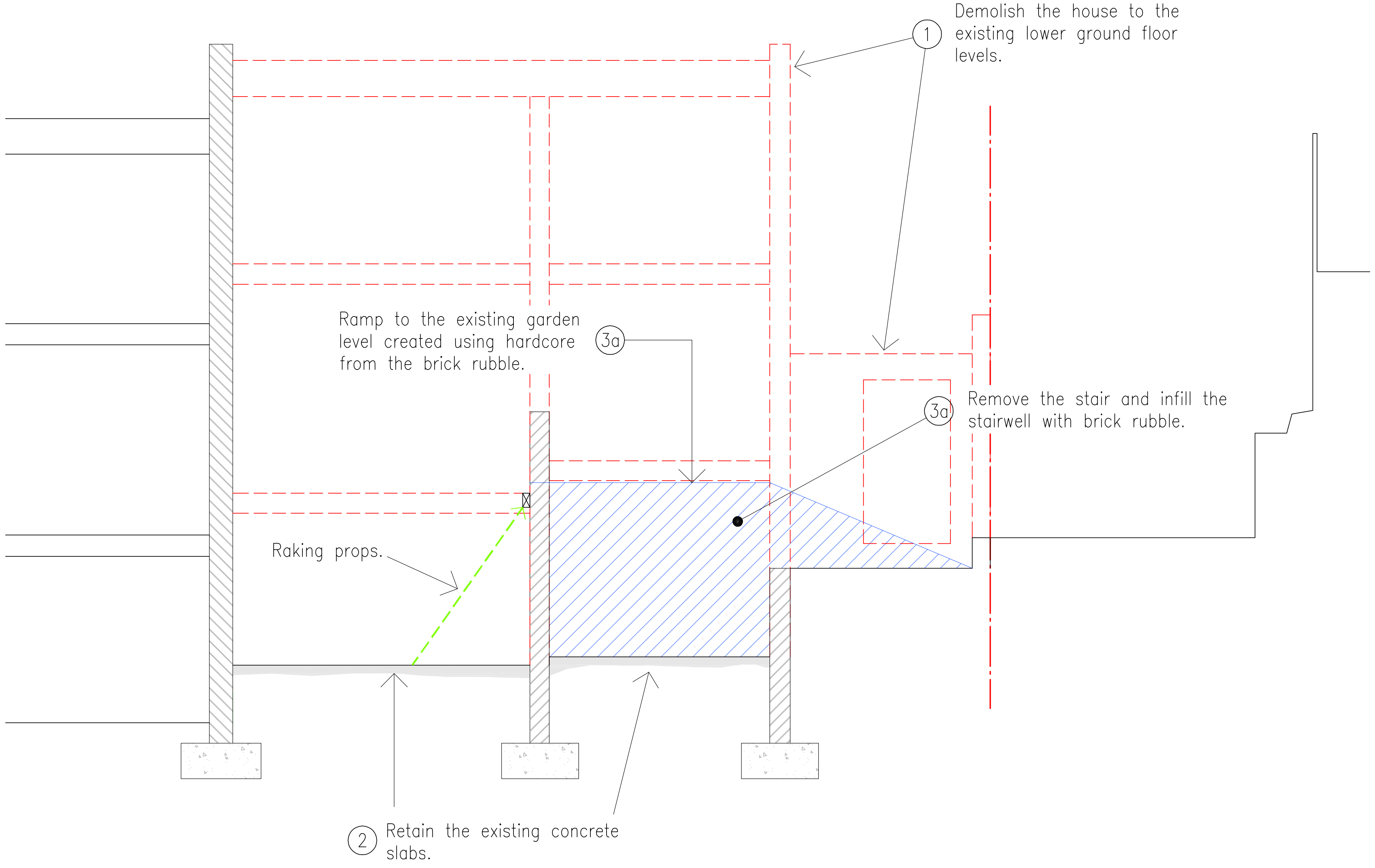
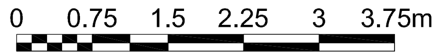
Scale at A3 1:75

PLANNING





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Drawing SK08
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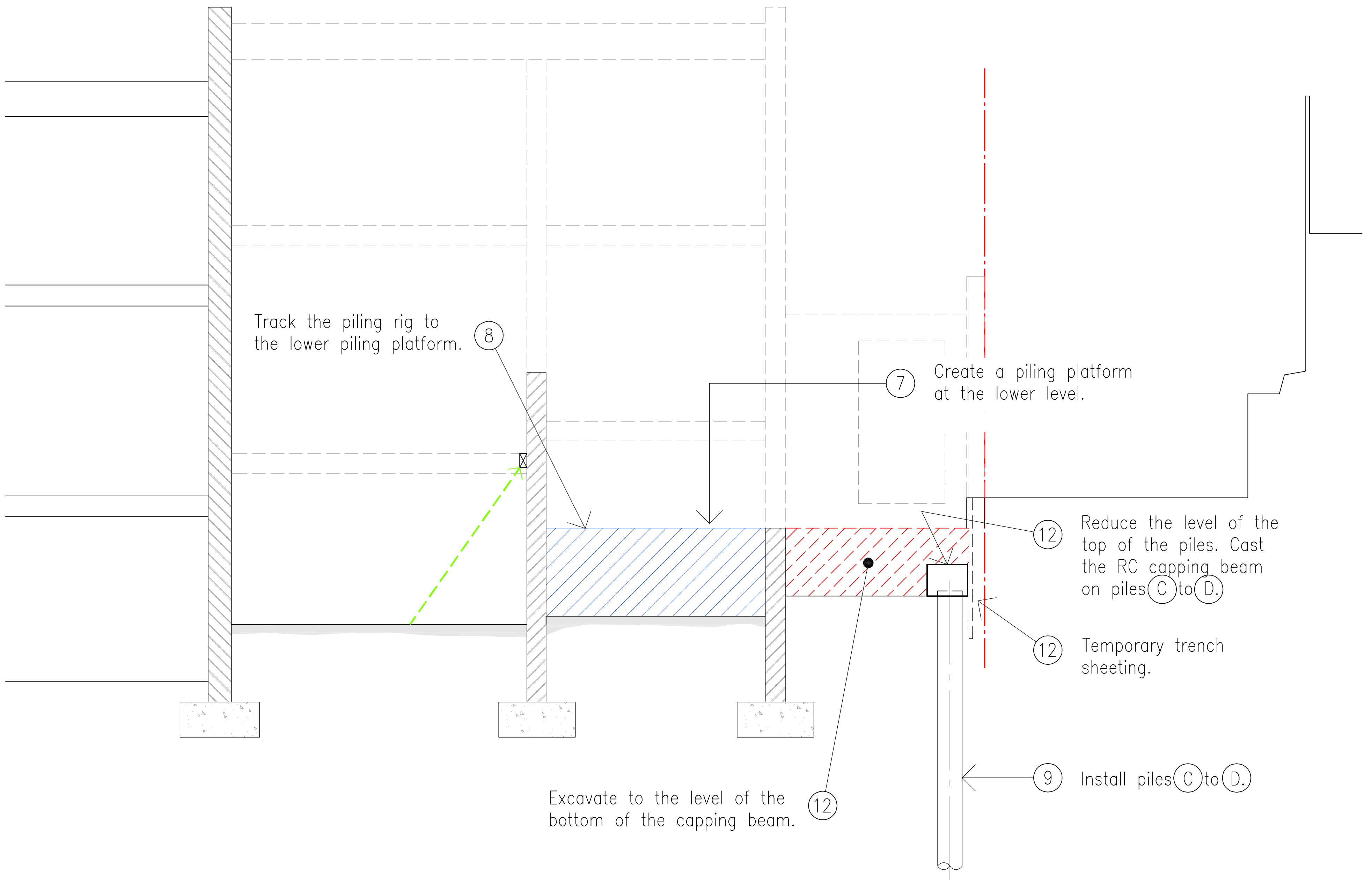
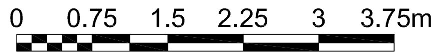
Scale at A3 1:75

PLANNING





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SECTION 3-3
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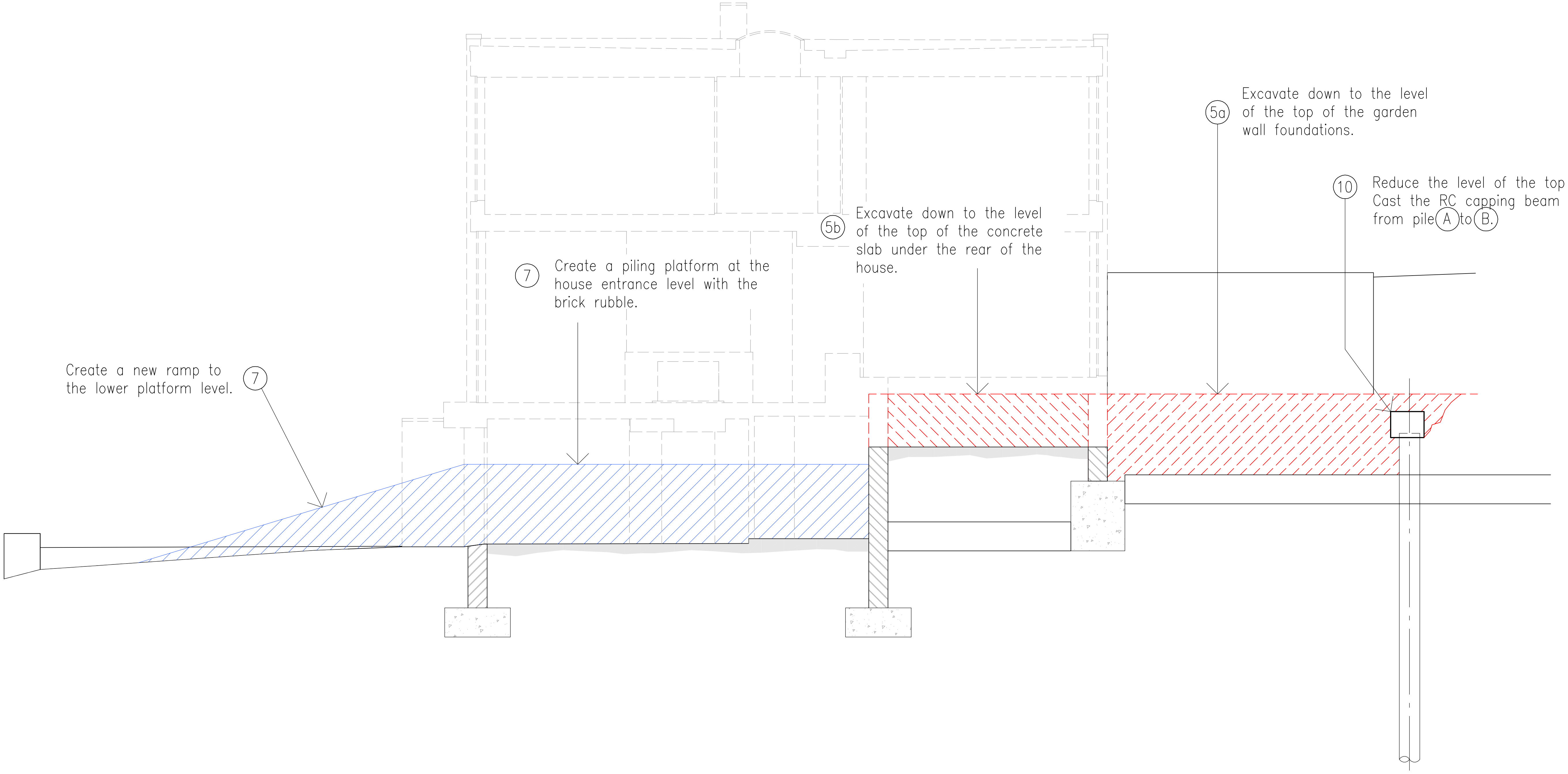
Drawing SK09
Revision P1
Scale at A3 1:75

PLANNING


(5a) Excavate down to the level of the top of the garden wall foundations.

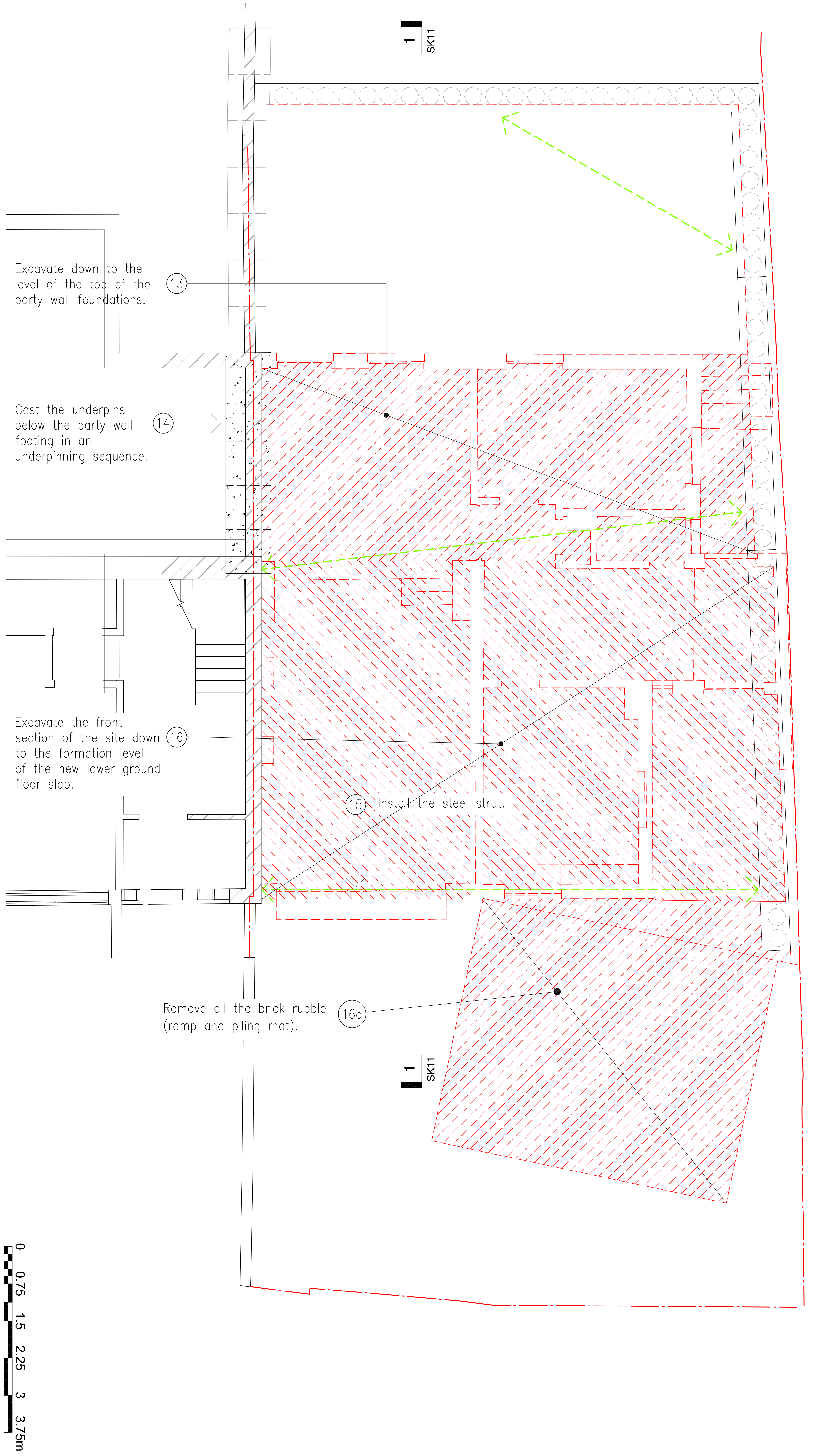
⑩ Reduce the level of the top of the piles. Cast the RC capping beam on the piles from pile Ⓐ to Ⓑ.

(5b) Excavate down to the level of the top of the concrete slab under the rear of the house.

⑦ Create a piling platform at the house entrance level with the brick rubble.

Create a new ramp to the lower platform level. ⑦

0 0.75 1.5 2.25 3 3.75m



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UPPER GROUND FLOOR PLAN
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Drawing SK10
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SECTION 1-1
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Drawing SK11
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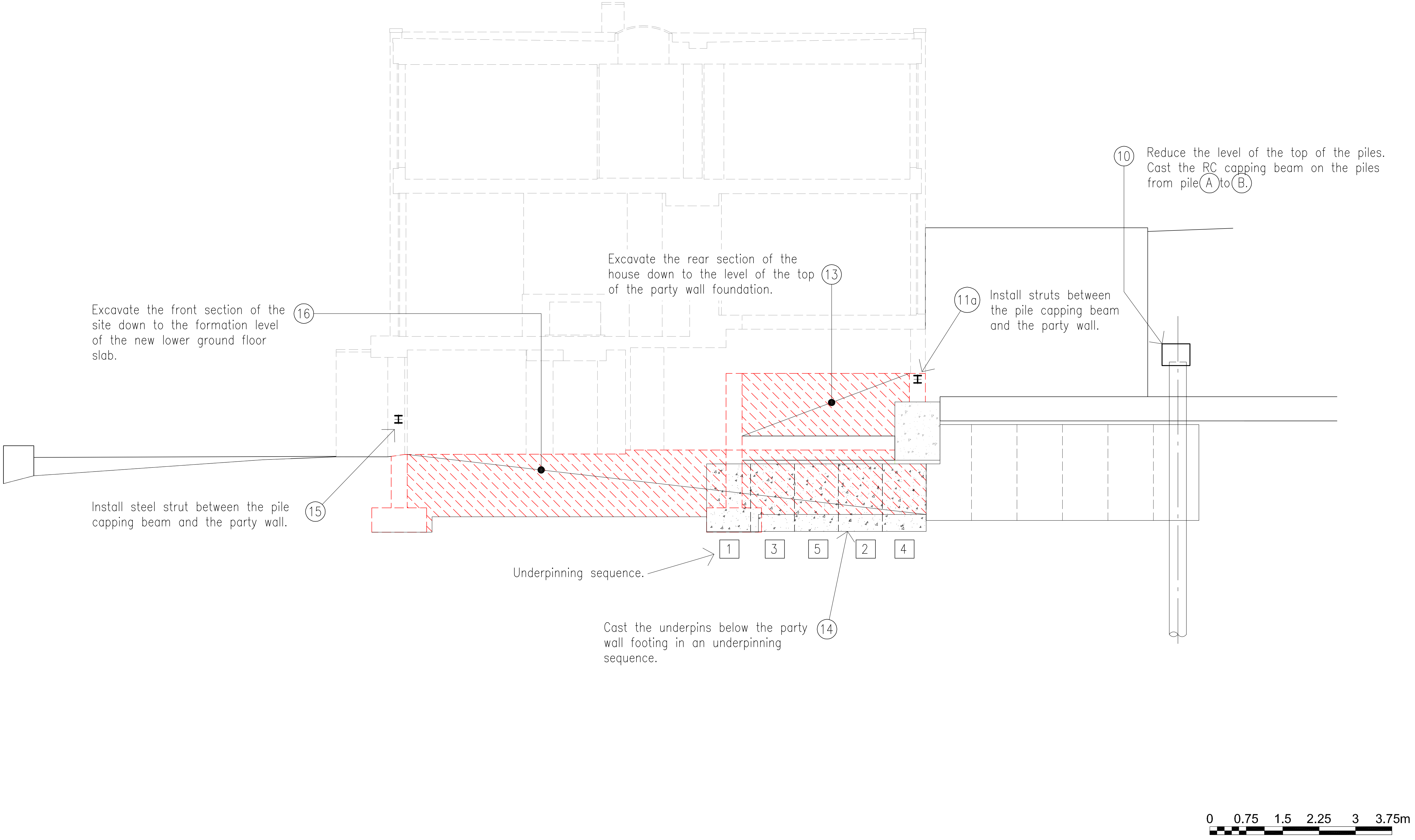
PLANNING



⑩ Reduce the level of the top of the piles. Cast the RC capping beam on the piles from pile Ⓐ to Ⓑ.

⑬ Excavate the rear section of the house down to the level of the top of the party wall foundation.

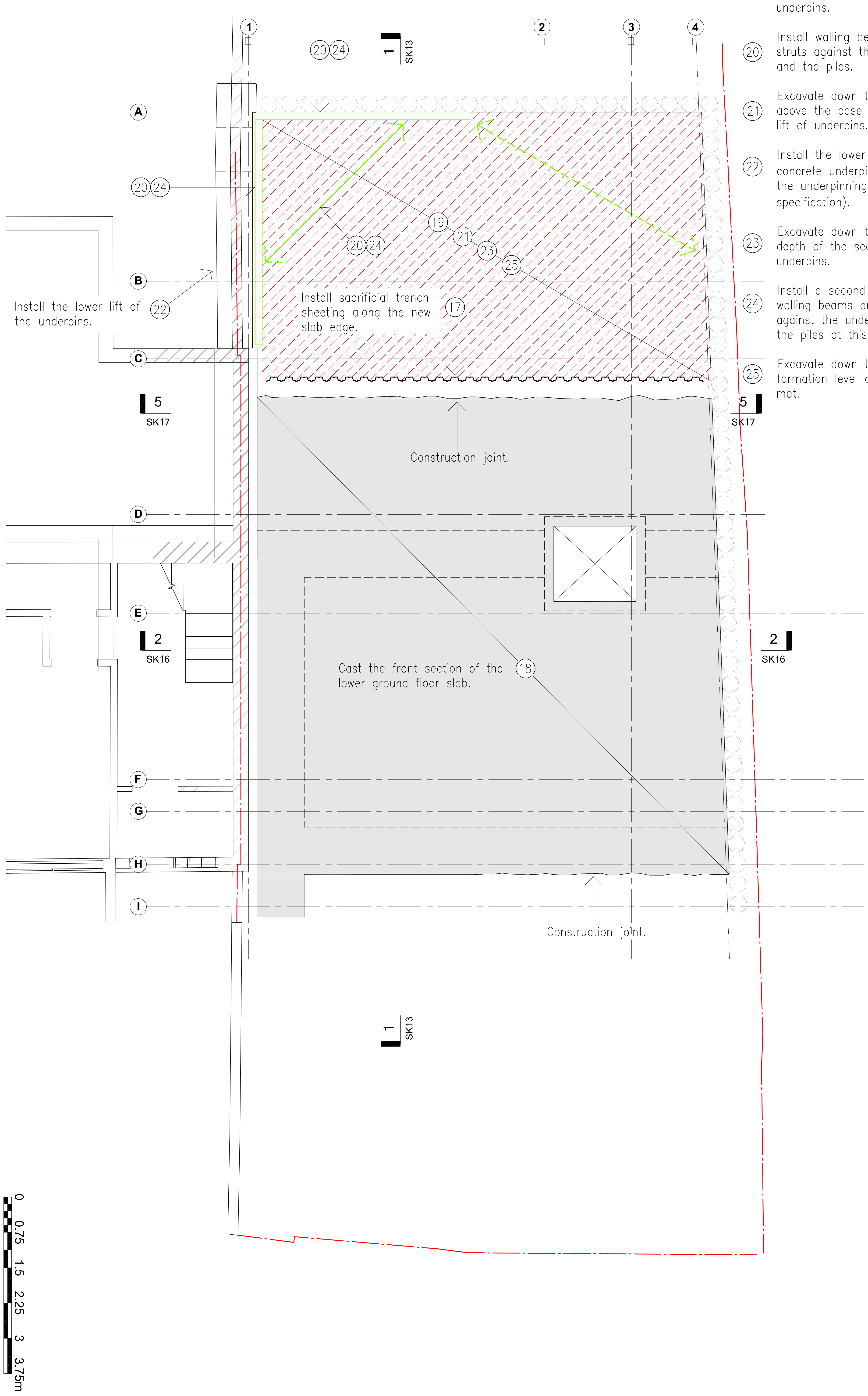
(11a) Install struts between the pile capping beam and the party wall.

⑯ Excavate the front section of the site down to the formation level of the new lower ground floor slab.

⑮ Install steel strut between the pile capping beam and the party wall.

Underpinning sequence.

⑭ Cast the underpins below the party wall footing in an underpinning sequence.



⑲ Excavate down to half the depth of the first lift of underpins.

⑳ Install walling beams and struts against the underpins and the piles.

㉑ Excavate down to 400mm above the base of the first lift of underpins.

㉒ Install the lower mass concrete underpins (follow the underpinning specification).

㉓ Excavate down to half the depth of the second lift of underpins.

㉔ Install a second set of walling beams and struts against the underpinning and the piles at this level.

㉕ Excavate down to the formation level of the piling mat.

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LOWER GROUND FLOOR PLAN
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Drawing SK12
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SECTION 1-1
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Drawing SK13
Revision P1
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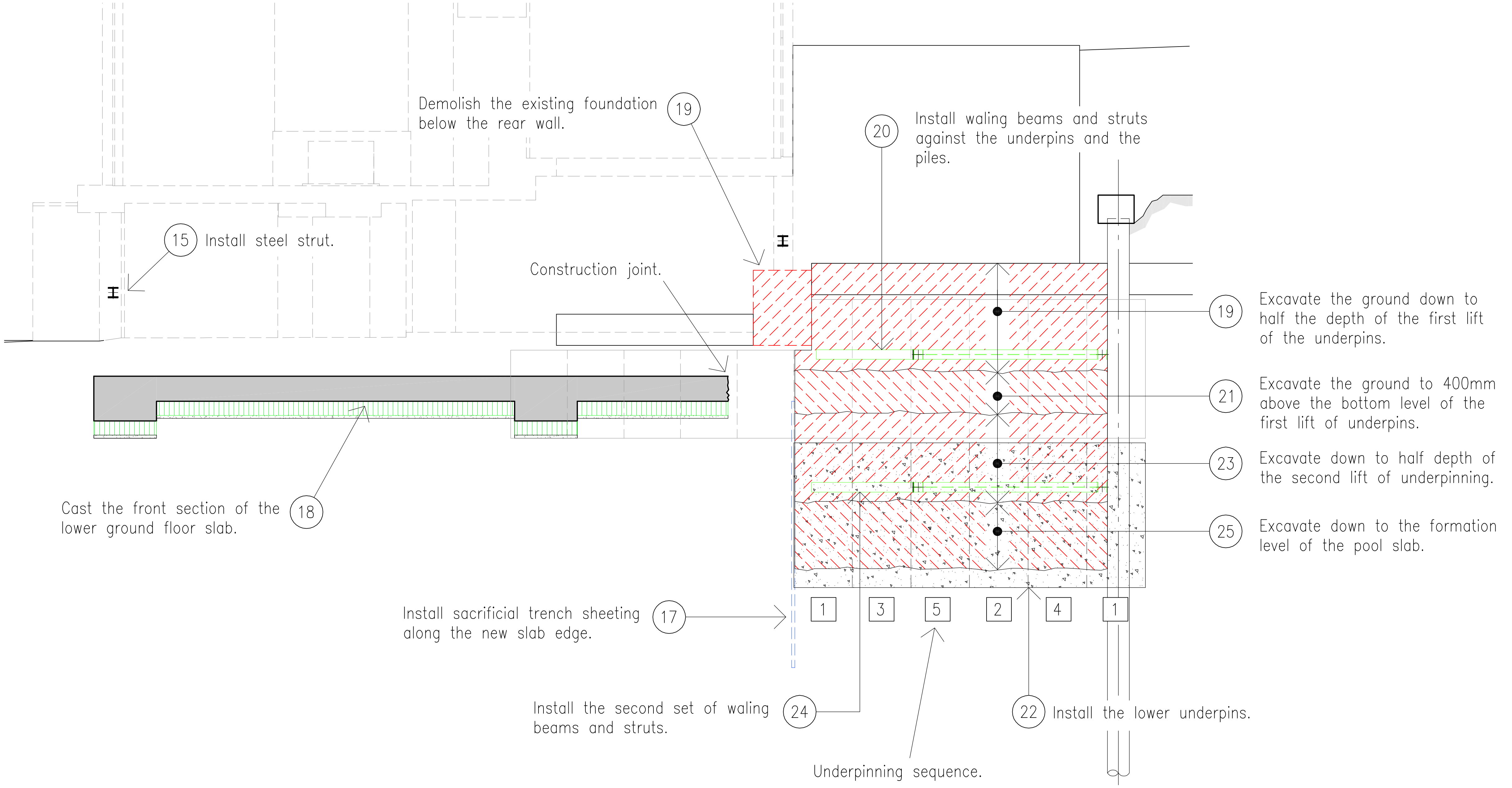
PLANNING



Demolish the existing foundation below the rear wall. ⑲

⑳ Install waling beams and struts against the underpins and the piles.

⑮ Install steel strut.

Construction joint.

⑲ Excavate the ground down to half the depth of the first lift of the underpins.

㉑ Excavate the ground to 400mm above the bottom level of the first lift of underpins.

㉓ Excavate down to half depth of the second lift of underpinning.

㉕ Excavate down to the formation level of the pool slab.

Cast the front section of the lower ground floor slab. ⑱

Install sacrificial trench sheeting along the new slab edge. ⑰

Install the second set of waling beams and struts. ㉔

㉒ Install the lower underpins.

Underpinning sequence.

0 0.75 1.5 2.25 3 3.75m

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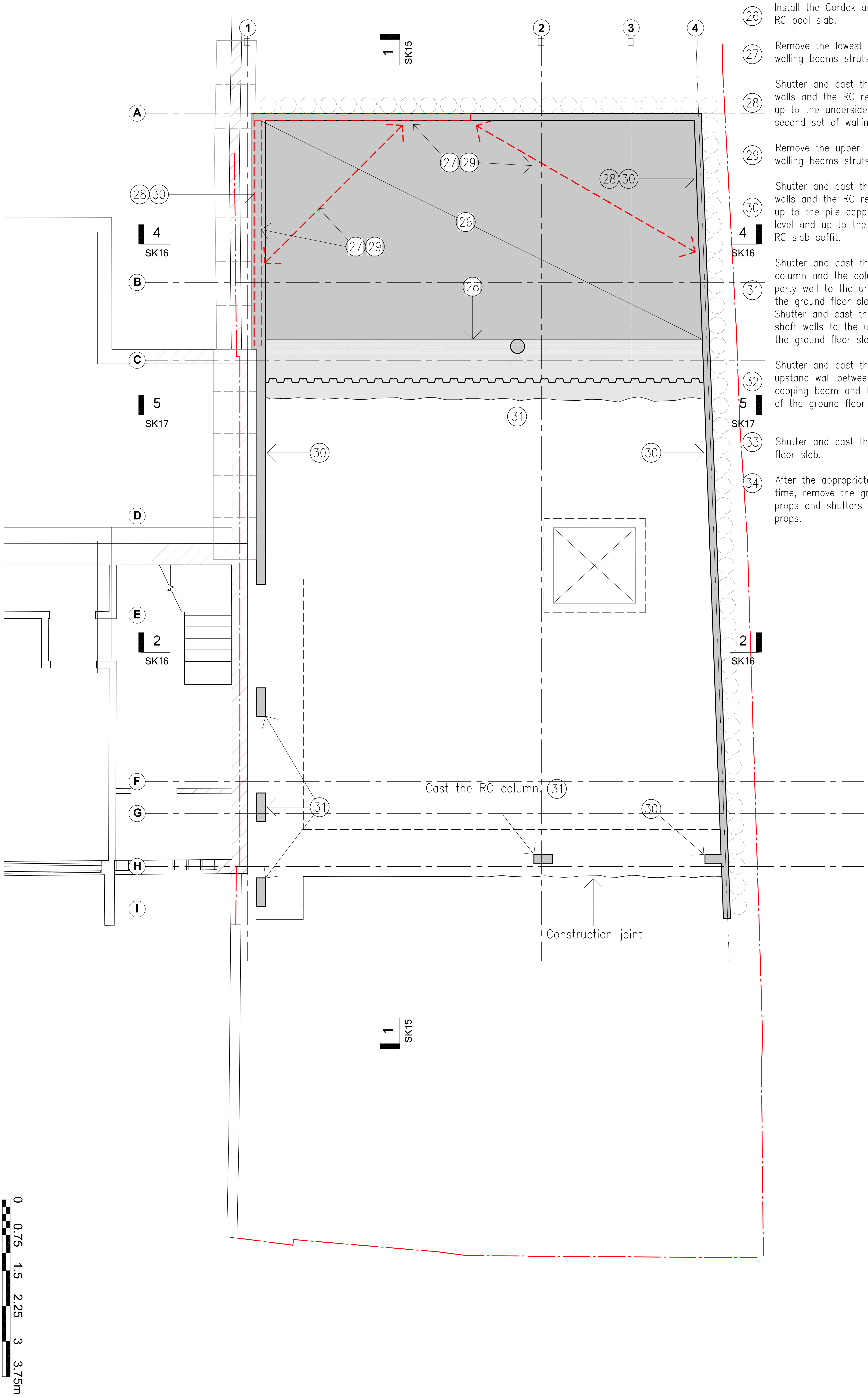
LOWER GROUND FLOOR PLAN



- ㉖ Install the Cordek and cast the RC pool slab.
- ㉗ Remove the lowest level of walling beams struts.
- ㉘ Shutter and cast the RC lining walls and the RC retaining walls up to the underside of the second set of walling beams.
- ㉙ Remove the upper level of walling beams struts.
- ㉚ Shutter and cast the RC lining walls and the RC retaining walls up to the pile capping beam level and up to the ground floor RC slab soffit.
- ㉛ Shutter and cast the circular column and the columns by the party wall to the underside of the ground floor slab
  Shutter and cast the RC lift shaft walls to the underside of the ground floor slab.
- ㉜ Shutter and cast the RC upstand wall between the pile capping beam and the underside of the ground floor slab.
- ㉝ Shutter and cast the RC ground floor slab.
- ㉞ After the appropriate period of time, remove the ground floor props and shutters and steel props.

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Drawing SK14
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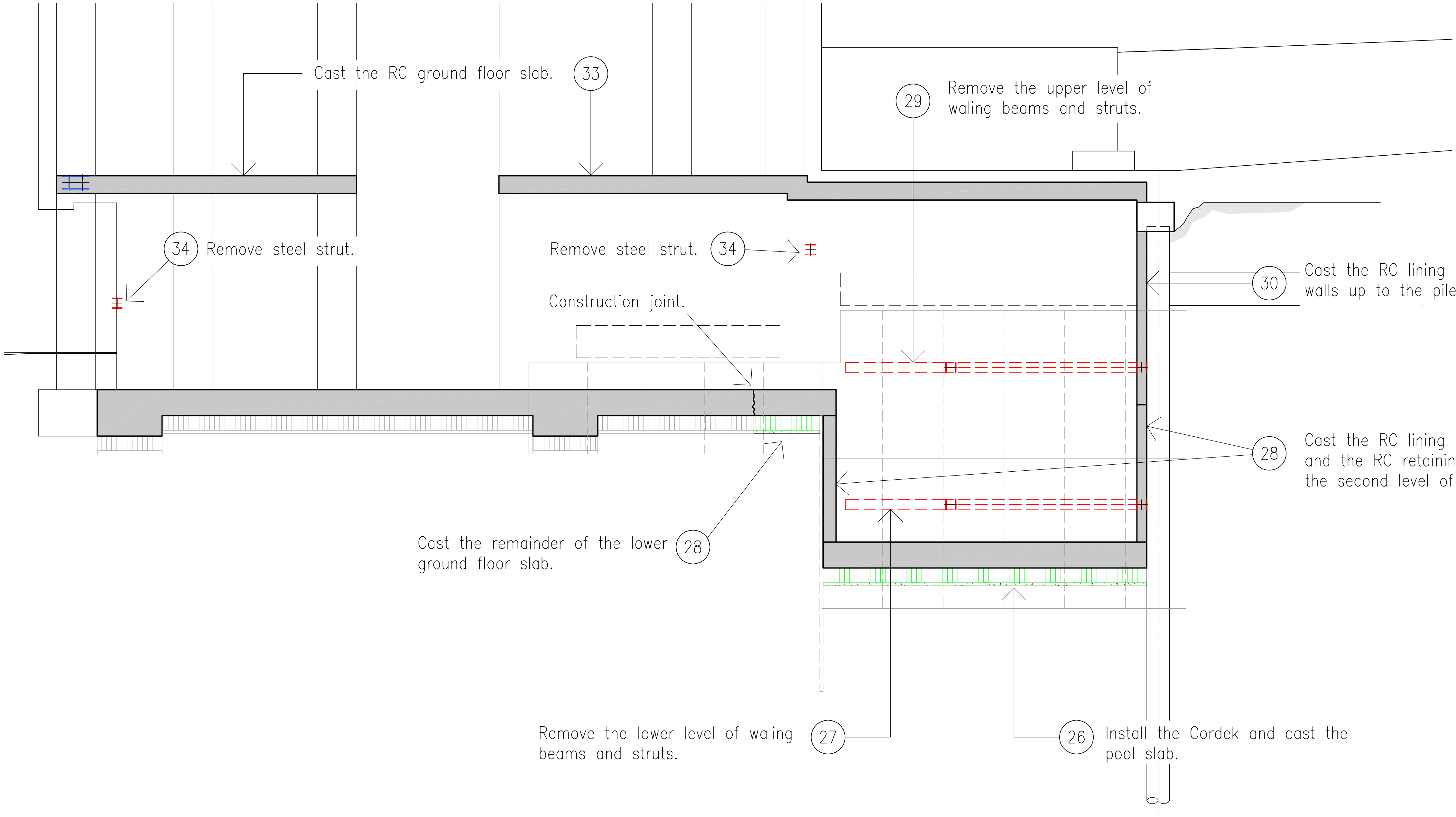
Drawing SK15
Revision P1
Scale at A3 1:75

PLANNING



Cast the RC ground floor slab. (33)

(29) Remove the upper level of waling beams and struts.

(34) Remove steel strut.

Remove steel strut. (34)

Construction joint.

(30) Cast the RC lining walls and RC retaining walls up to the pile capping beam level.

(28) Cast the RC lining walls in front of the piles and the RC retaining walls up to the level of the second level of waling beams.

Cast the remainder of the lower ground floor slab. (28)

Remove the lower level of waling beams and struts. (27)

(26) Install the Cordek and cast the pool slab.

0 0.75 1.5 2.25 3 3.75m

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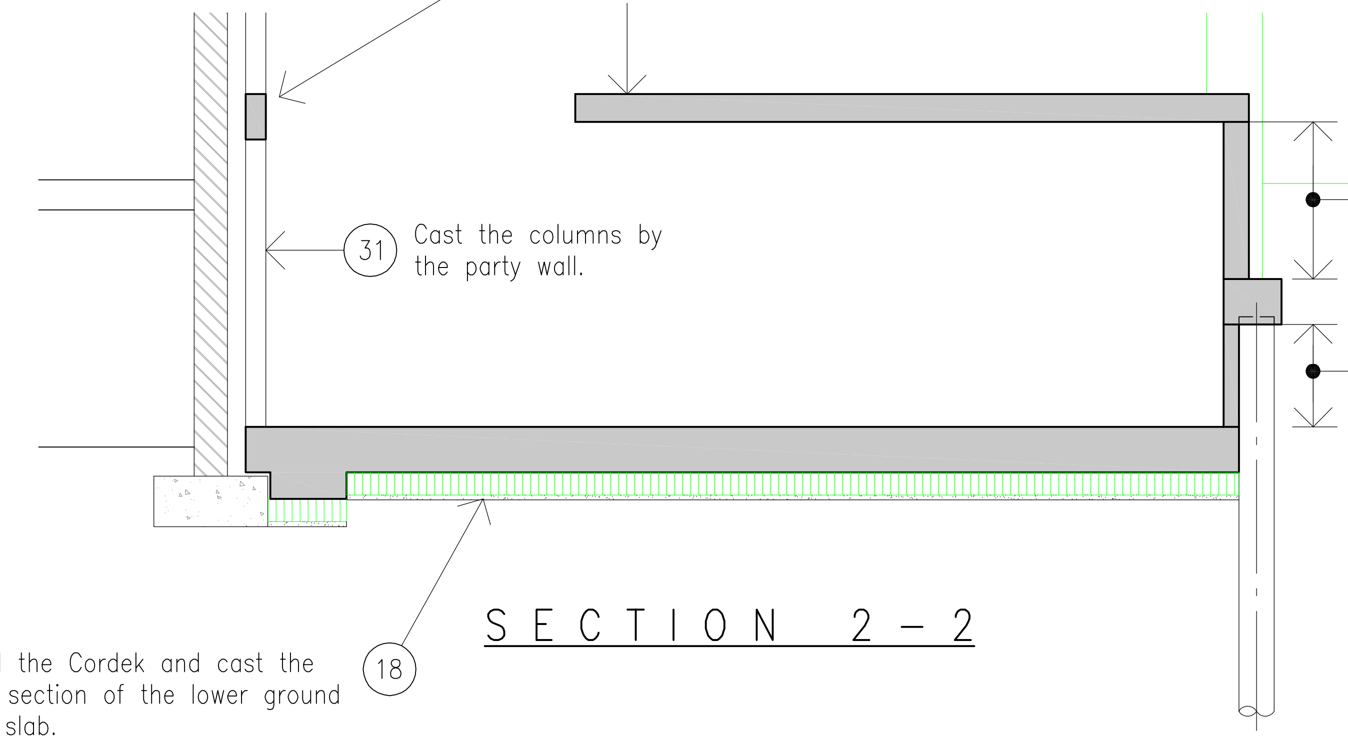
Drawing SK16
Revision P1
Scale at A3 1:75

PLANNING



㉝ Cast the ground floor RC slab and beams.

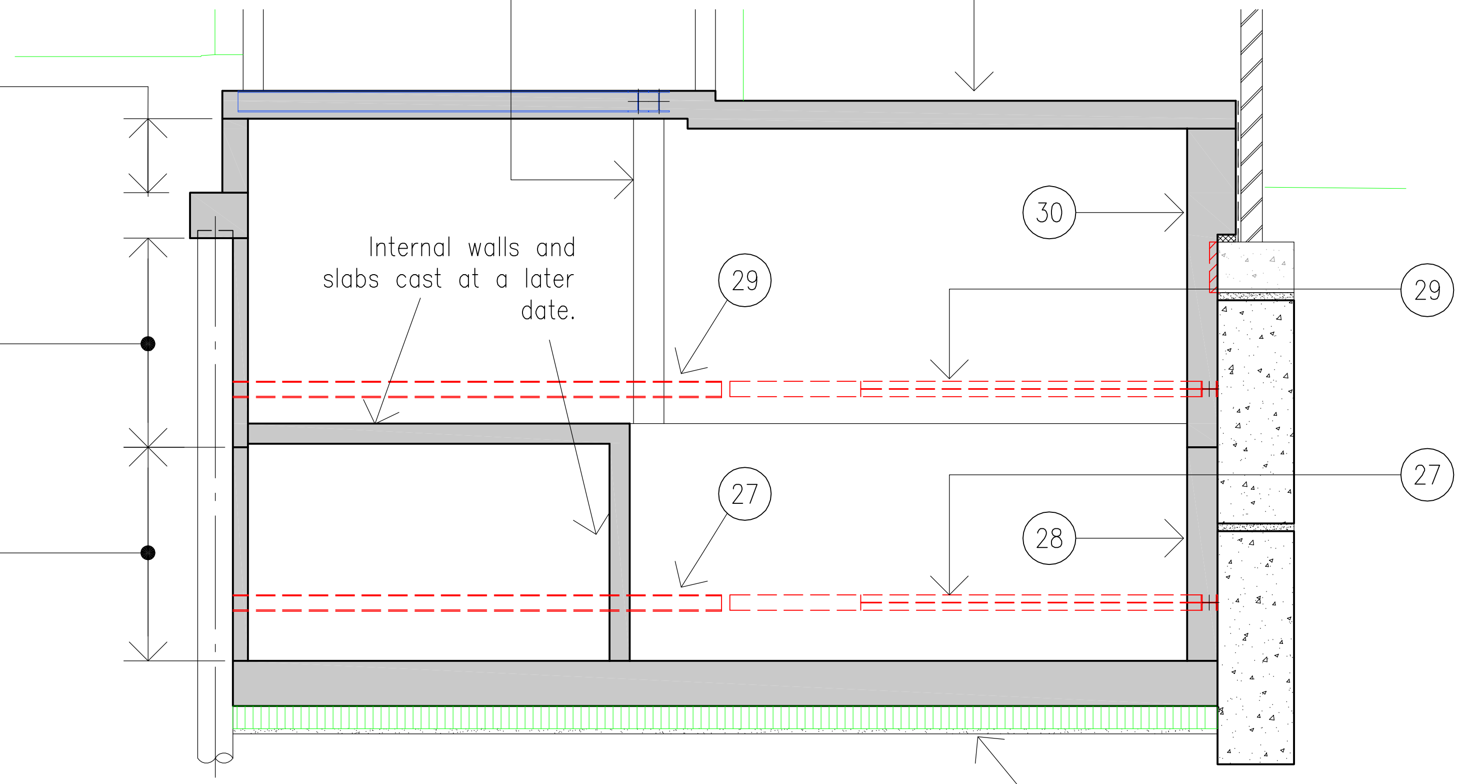
㉛ Cast the columns by the party wall.

㉜ Cast the upstand walls between the pile capping beam and the underside of the upper ground floor slab.

㉚ Cast the RC lining walls and the RC retaining walls up to the pile capping beam level.

⑱ Install the Cordek and cast the front section of the lower ground floor slab.

SECTION 2 – 2



Cast the RC circular column. ㉛

Cast the ground floor RC slab. ㉝

㉜ Cast the RC upstand walls between the pile capping beam and the underside of the upper ground floor slab.

㉚ Cast the RC lining walls and the RC retaining walls up to the pile capping beam level.

㉘ Cast the RC lining walls and the RC retaining walls up to the underside of the upper level waling beams.

Internal walls and slabs cast at a later date.

㉙ Remove the upper level of waling beams and struts.

㉗ Remove the lower level of waling beams and struts.

㉖ Install the Cordek and cast the RC pool slab.

SECTION 4 – 4

0 0.75 1.5 2.25 3 3.75m

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SECTION 5-5
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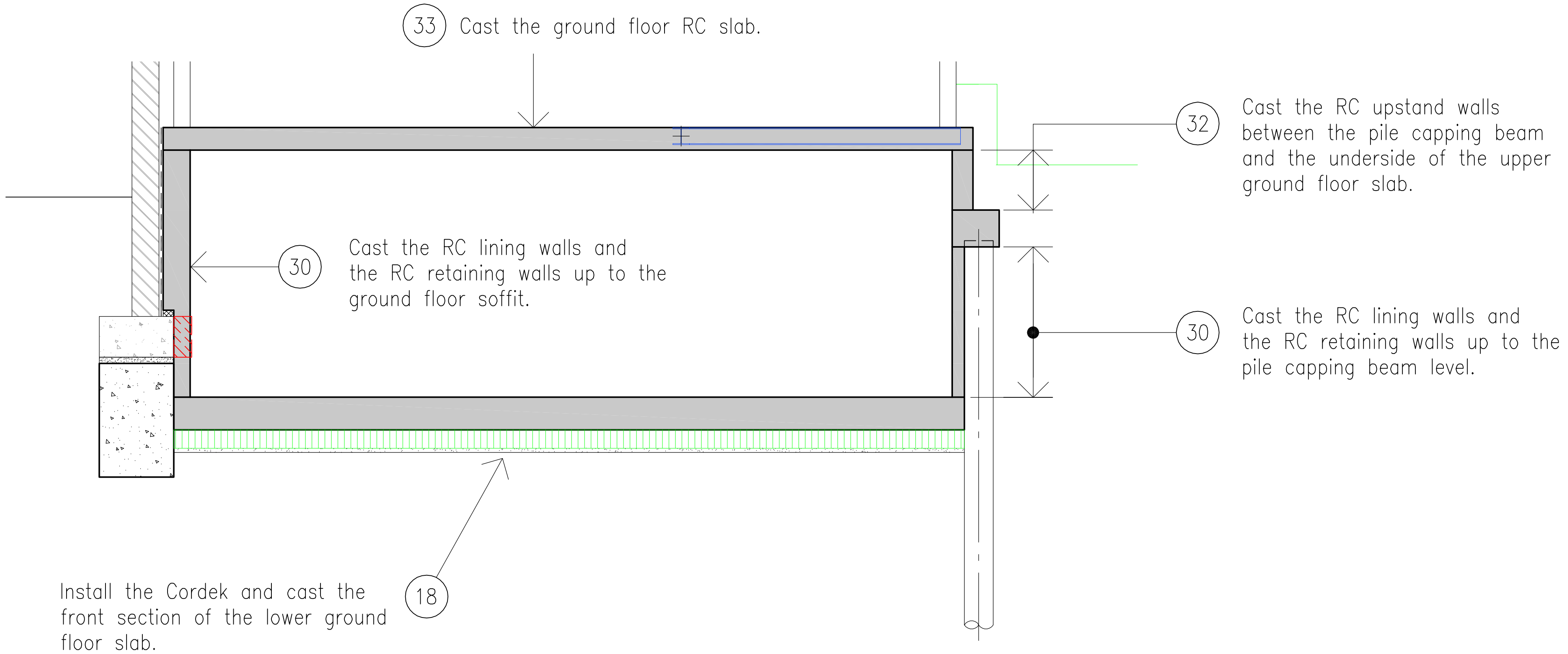
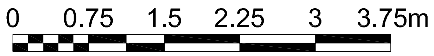
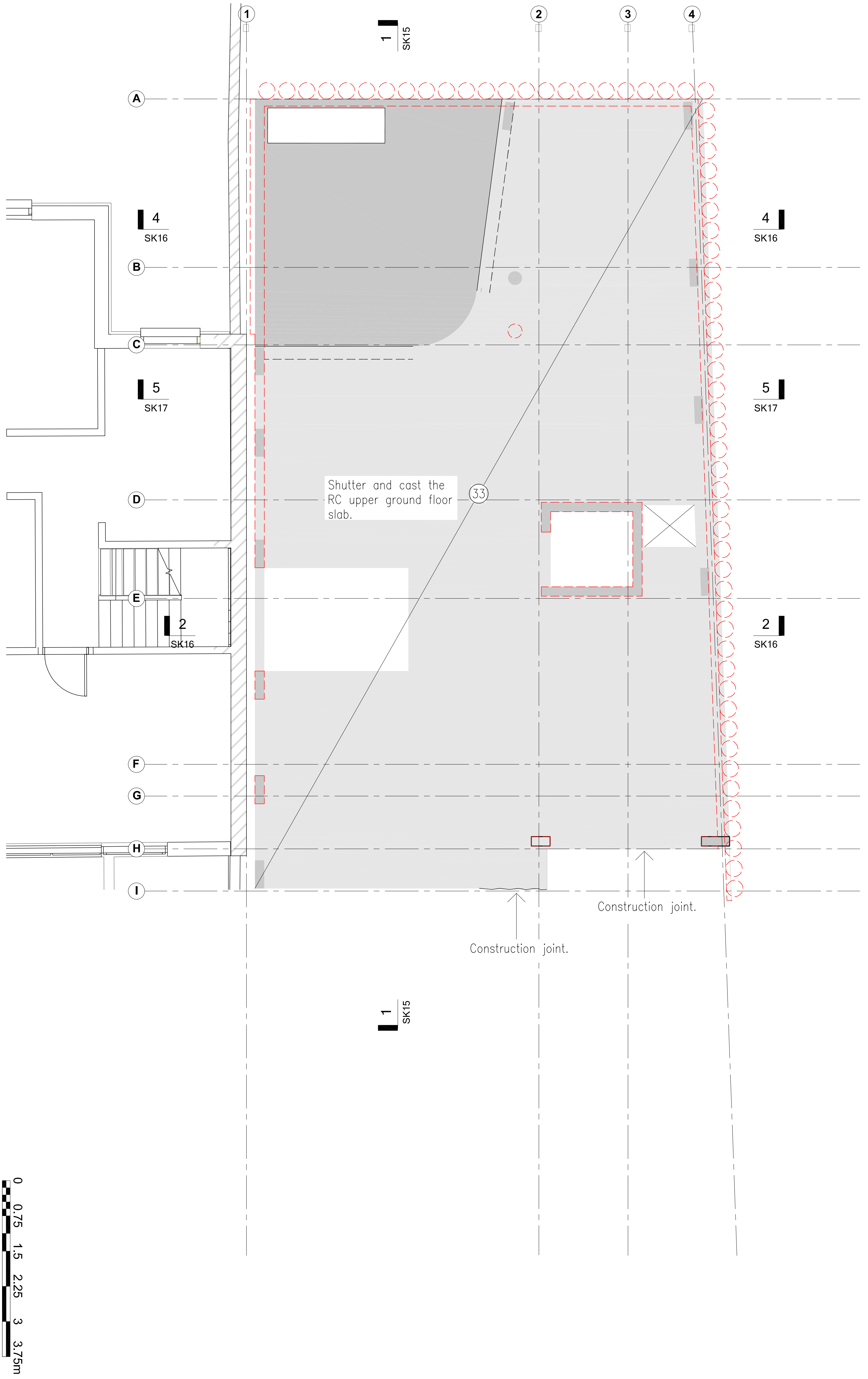
PLANNING



SECTION 5 – 5





Shutter and cast the RC upper ground floor slab.

Construction joint.

Construction joint.

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UPPER GROUND FLOOR PLAN
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Drawing SK18
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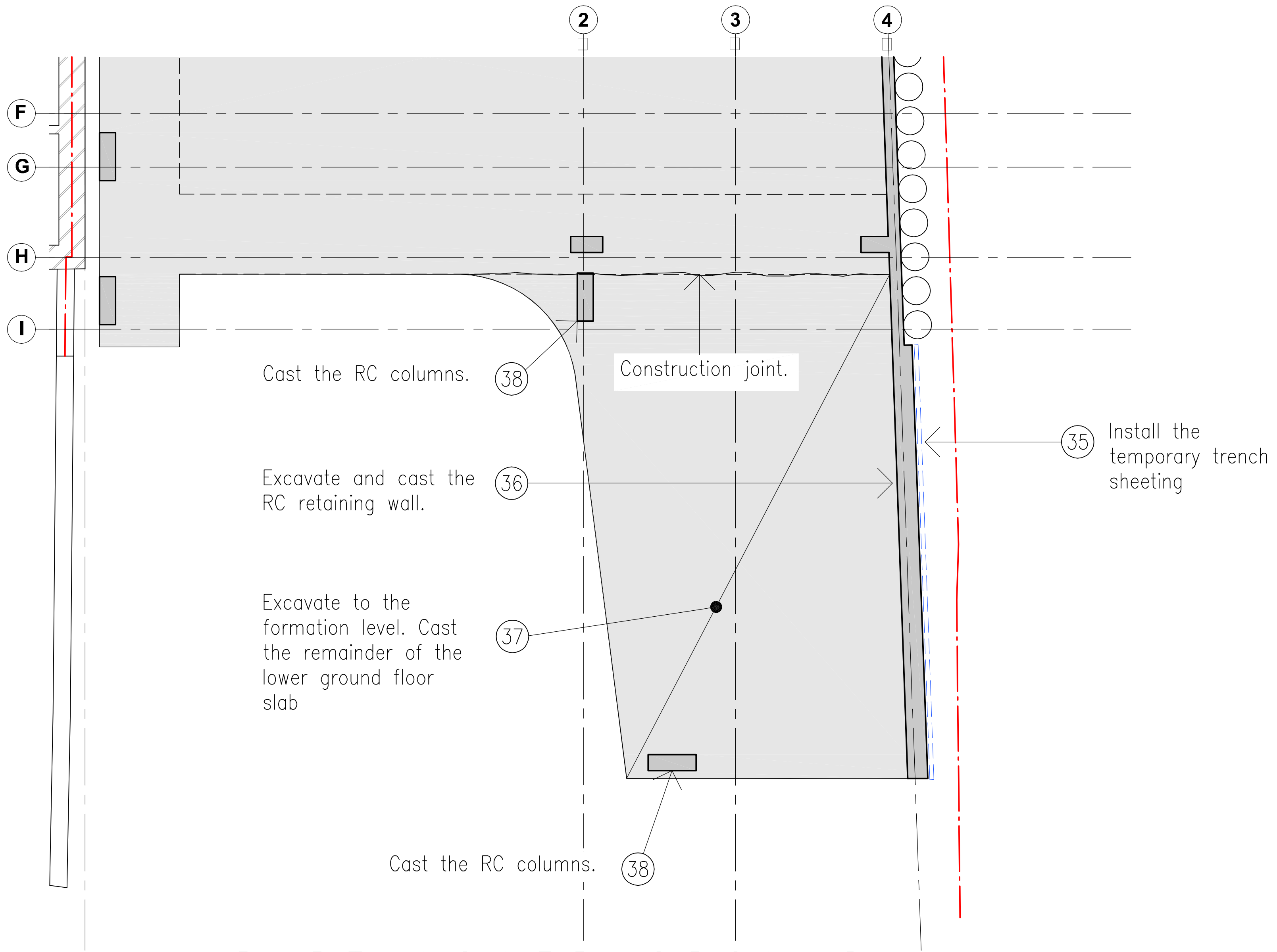


Cast the RC columns. (38)

Construction joint.

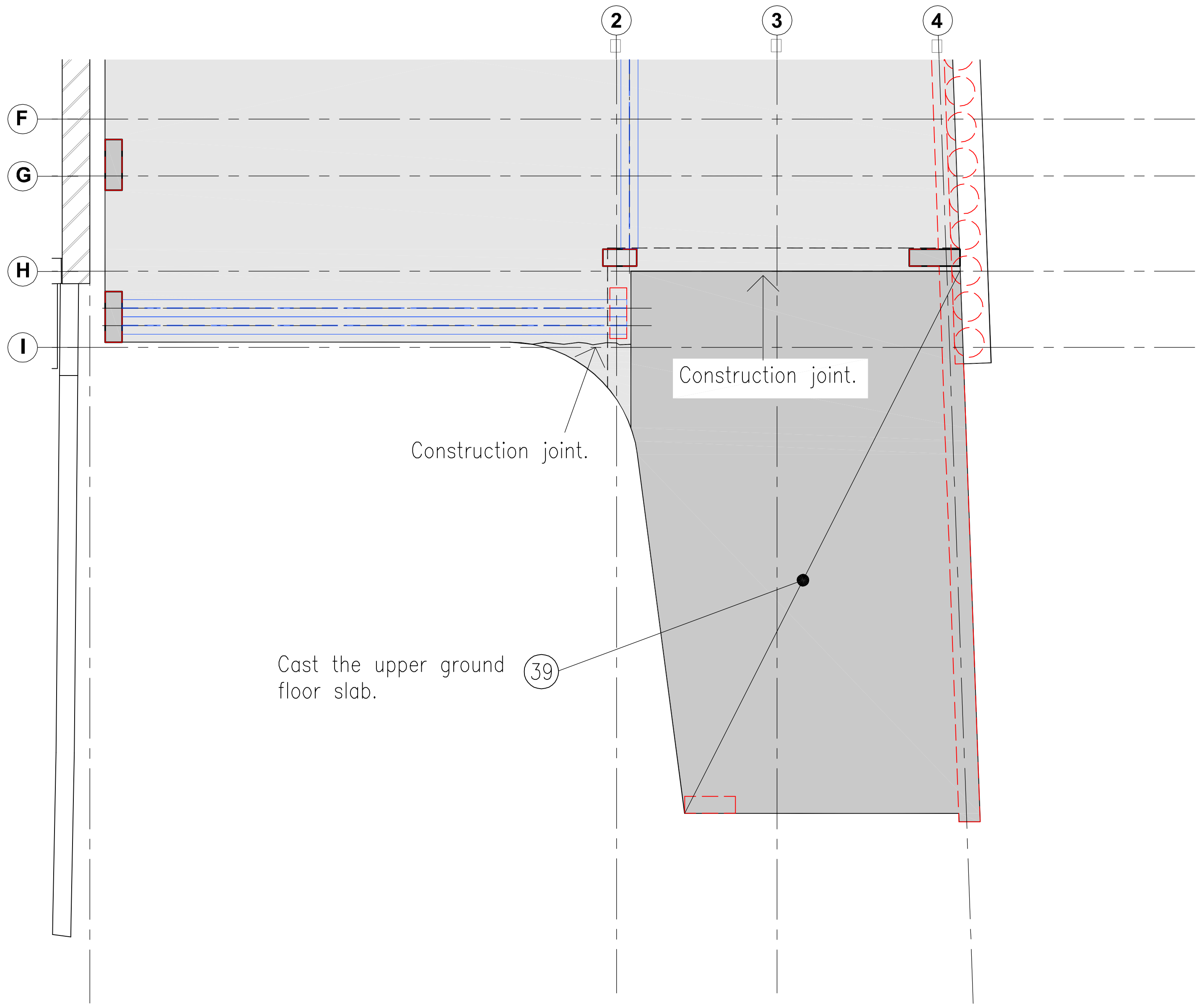
(35) Install the temporary trench sheeting

Excavate and cast the RC retaining wall. (36)

Excavate to the formation level. Cast the remainder of the lower ground floor slab (37)

Cast the RC columns. (38)

PART LOWER GROUND FLOOR PLAN

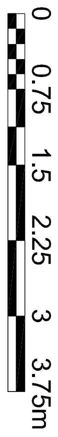


Construction joint.

Construction joint.

Cast the upper ground floor slab. (39)

PART UPPER GROUND FLOOR PLAN



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PLANS
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Drawing SK19
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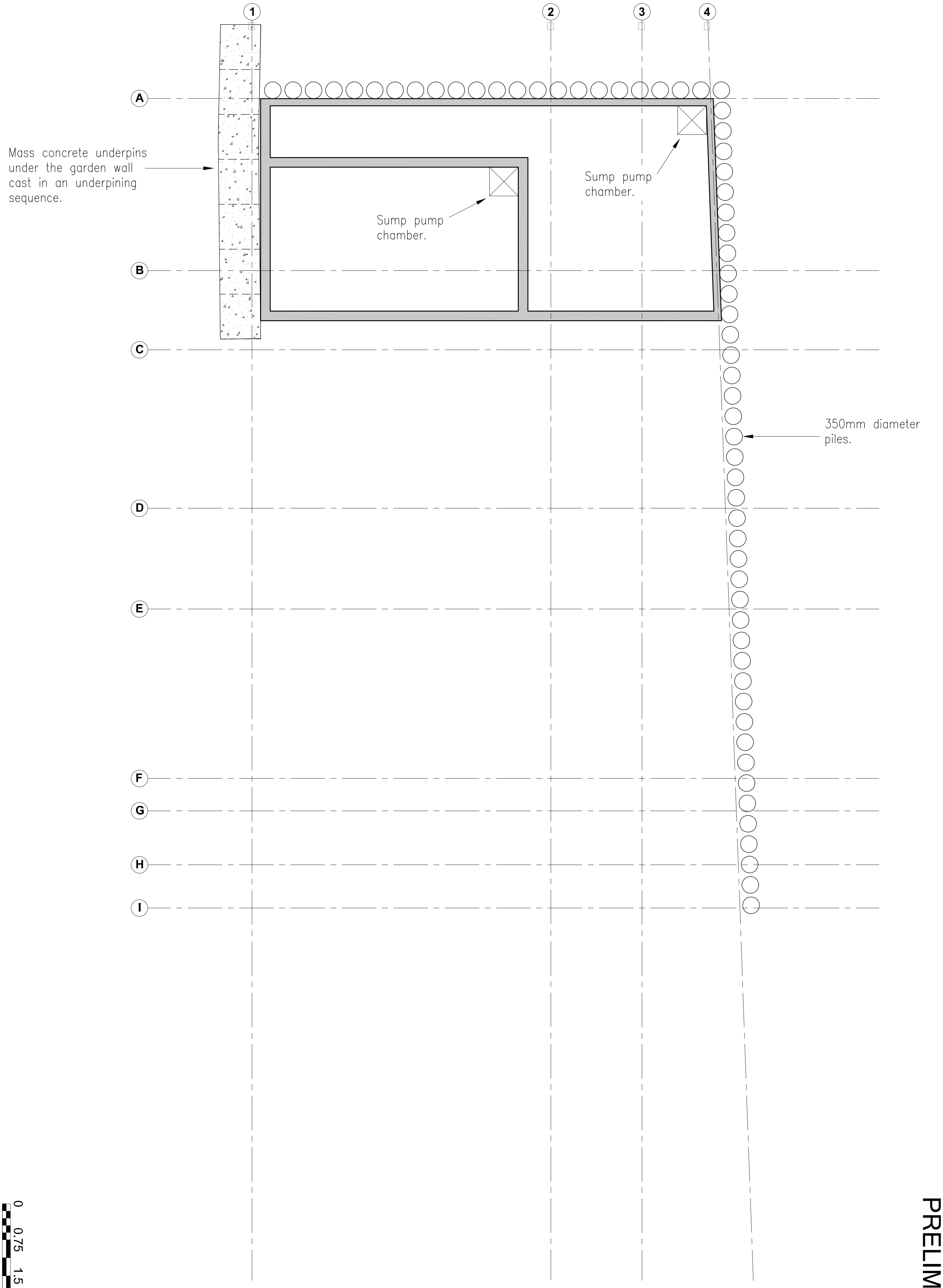
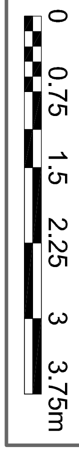
18 A FROGNAL GARDENS

STRUCTURAL GENERAL ARRANEMENT PLANS AND SECTIONS



POOL LEVEL PLAN

1:50



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POOL LEVEL PLAN
-

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PRELIMINARY

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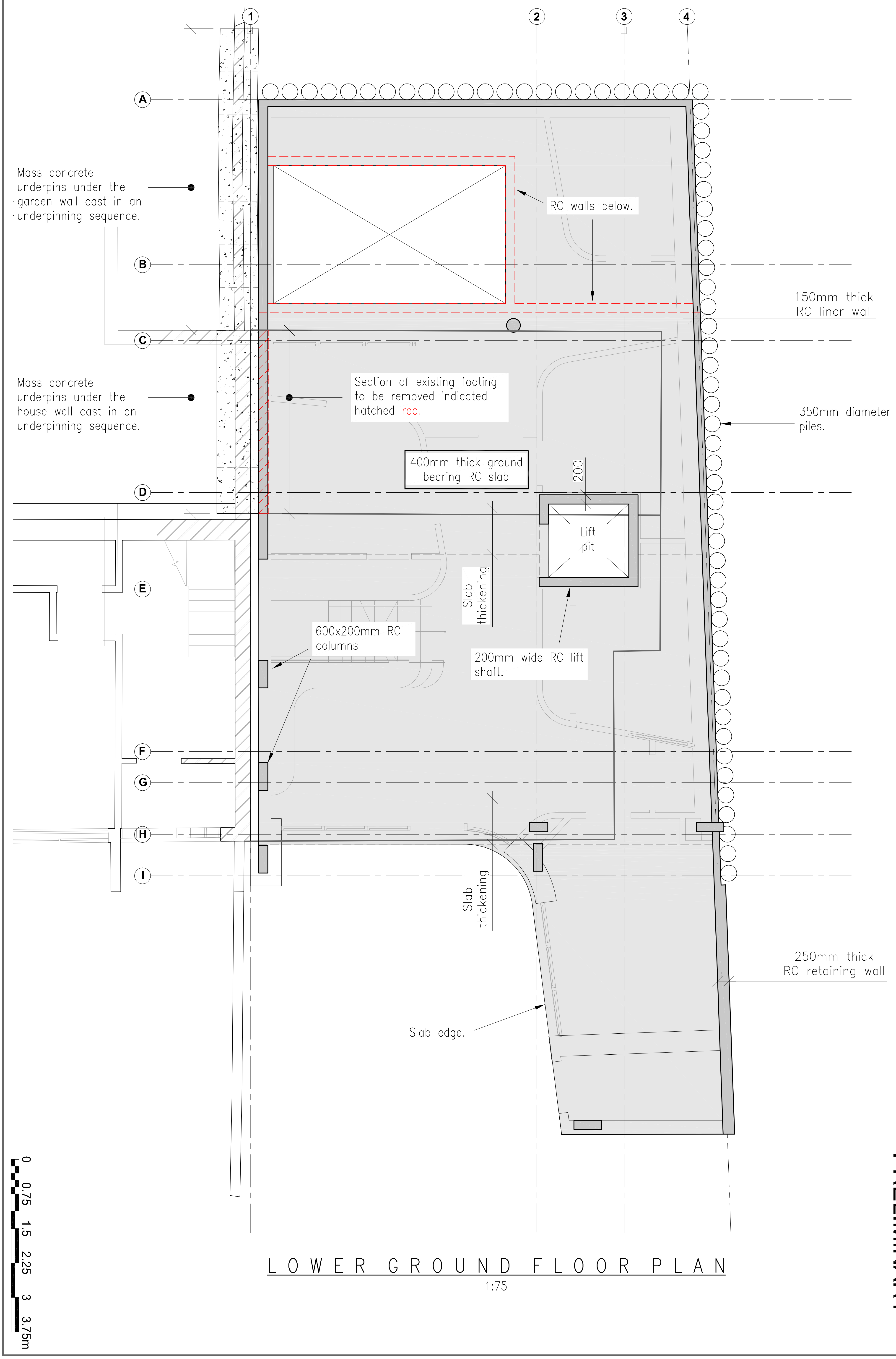

LOWER GROUND FLOOR PLAN

1:75

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LOWER GROUND FLOOR PLAN
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Drawing 02
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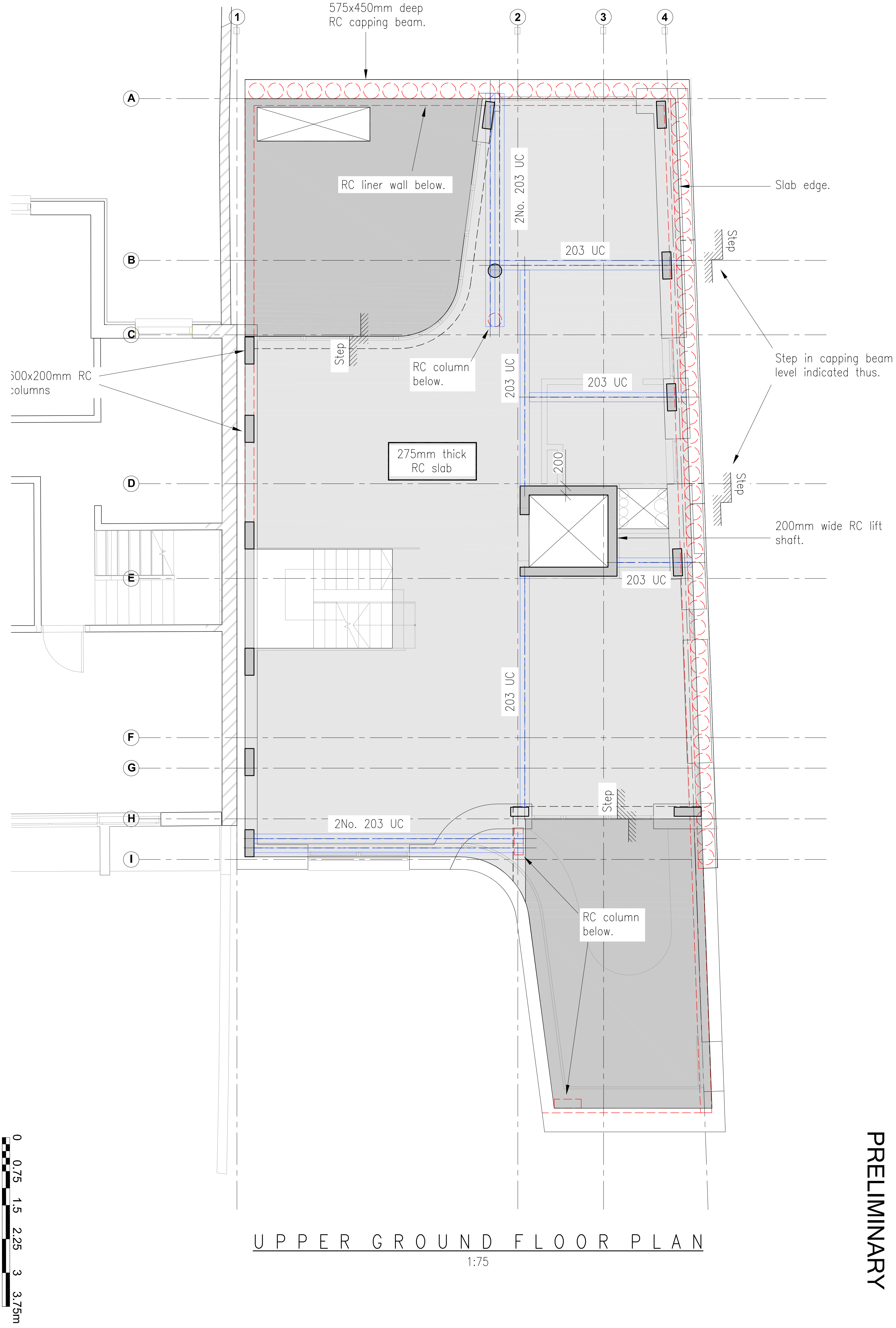

UPPER GROUND FLOOR PLAN

1:75

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UPPER GROUND FLOOR PLAN
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Drawing 03
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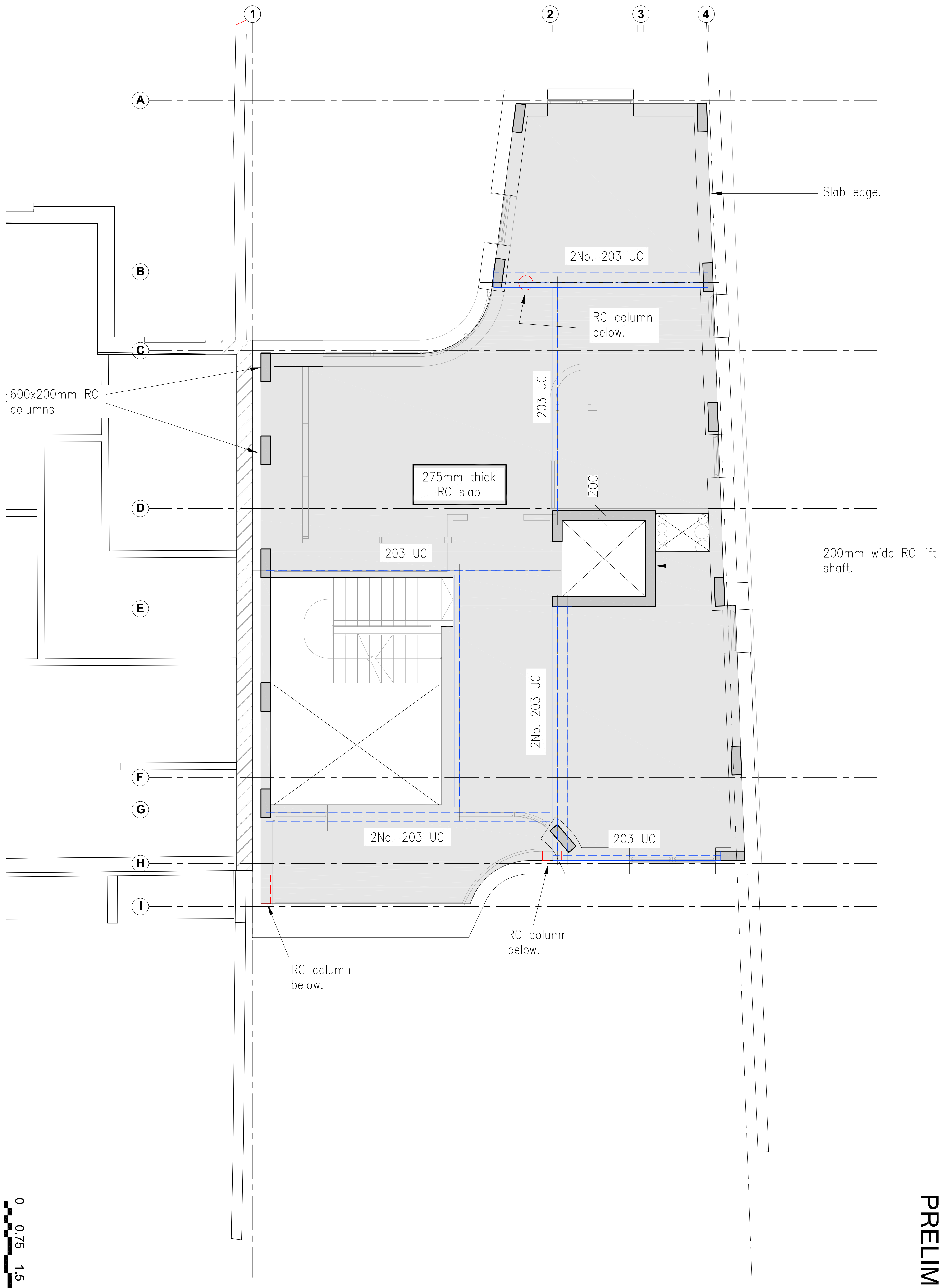
PRELIMINARY



FIRST FLOOR PLAN

1:75

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FIRST FLOOR PLAN
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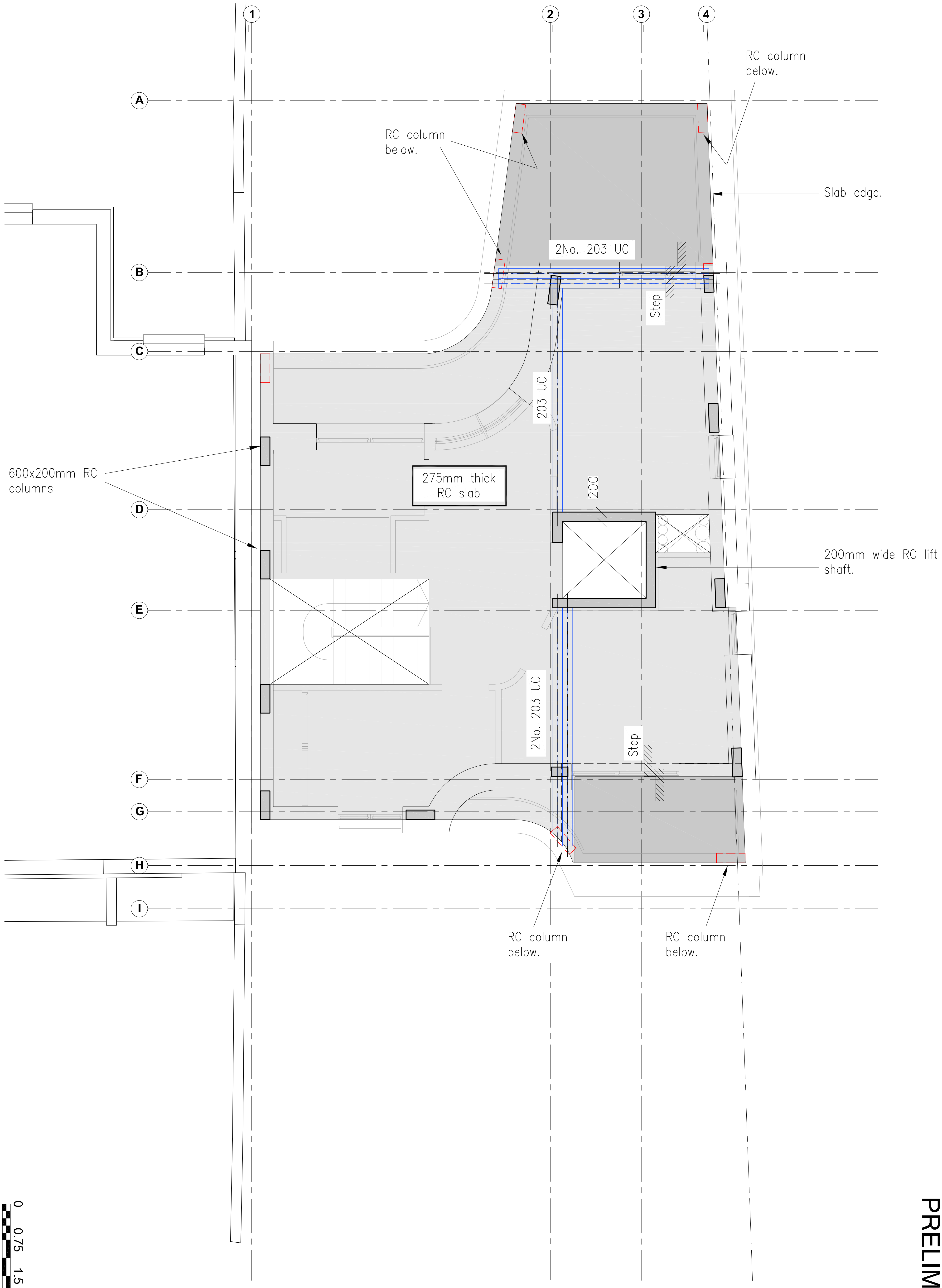

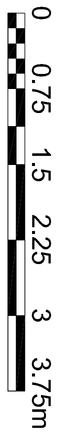

SECOND FLOOR PLAN

1:75

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SECOND FLOOR PLAN
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Drawing 05
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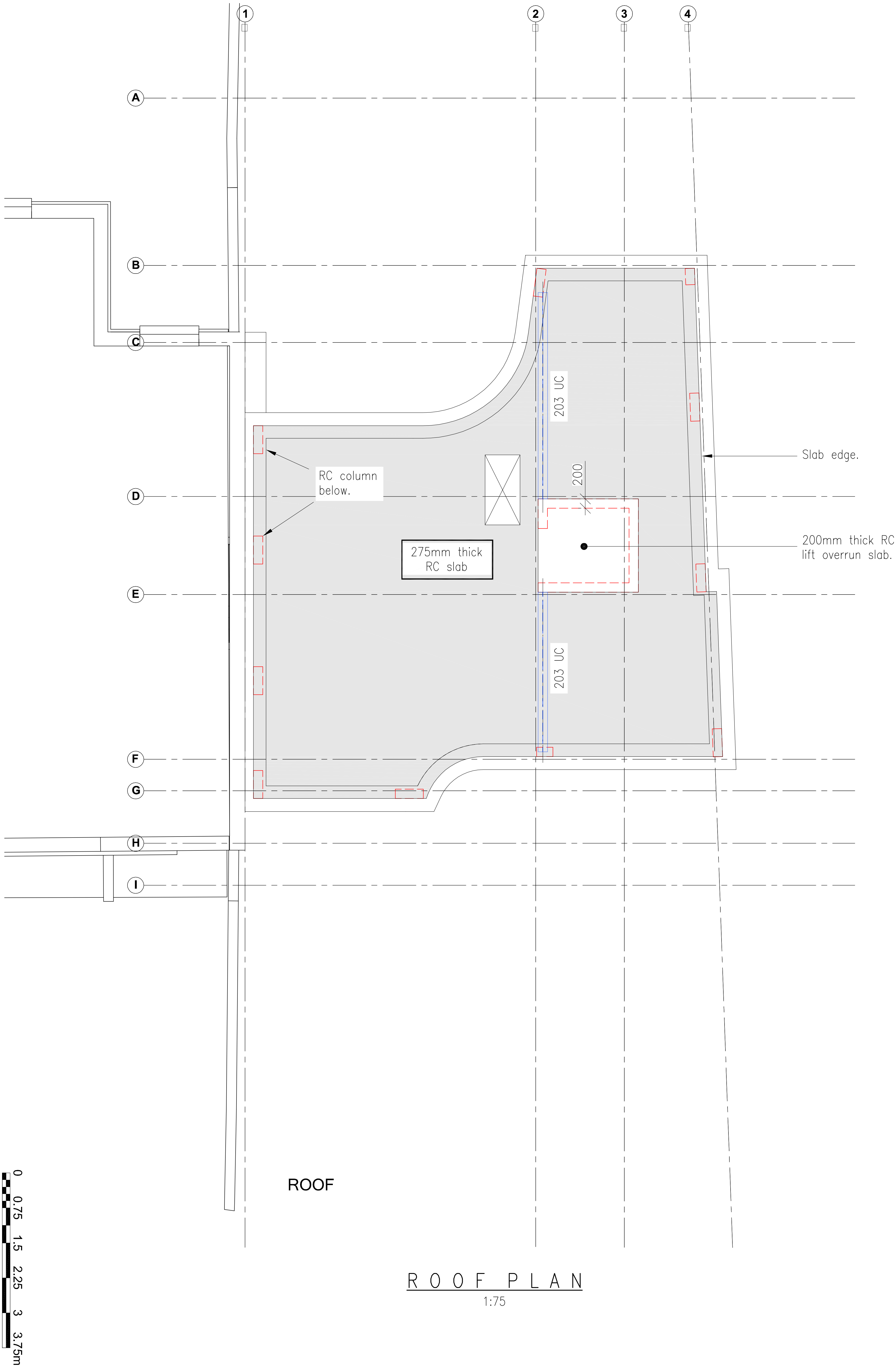
Scale at A3 1:75

PRELIMINARY



ROOF PLAN

1:75

AKERA ENGINEERS
Consulting Structural Engineers
Tel 020 7490 2868

Project
18a FROGNAL GARDENS
-

ROOF PLAN
-

Rev	Date	Description
P1	-	-

PRELIMINARY

Project no. 2739
Date SEPT '19
Engineer DA Checked

Drawing 06
Revision P1
Scale at A3 1:75

AKERA ENGINEERS
Consulting Structural Engineers
Tel 020 7490 2868

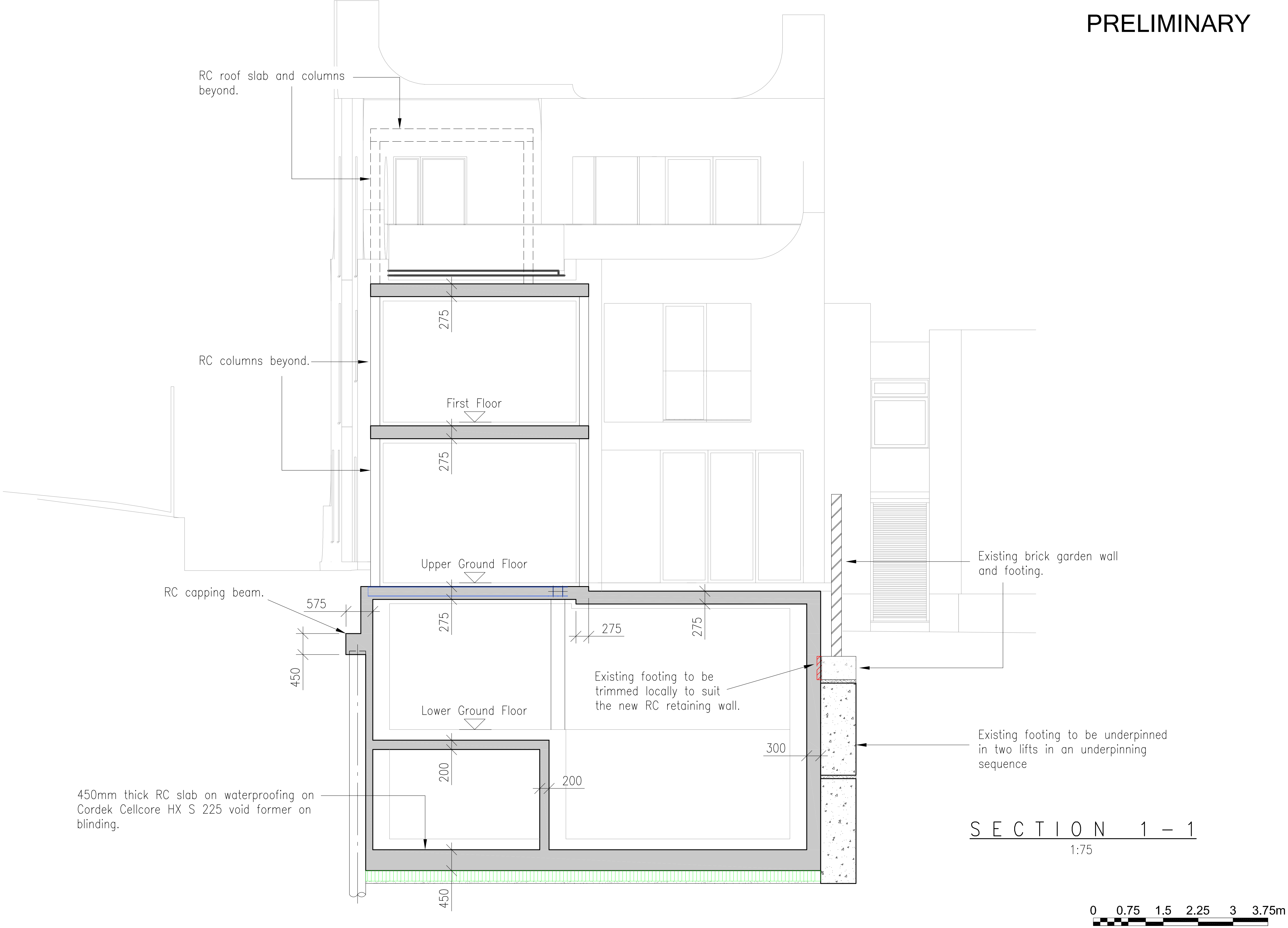
Project
18a FROGNAL GARDENS
-

SECTION 1-1
-

Rev	Date	Description
P1	-	-

Project no. 2739
Date SEPT '19
Engineer DA Checked
Drawing 10
Revision P1
Scale at A3 1:75

PRELIMINARY



SECTION 1 – 1
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AKERA ENGINEERS
Consulting Structural Engineers
Tel 020 7490 2868

Project
18a FROGNAL GARDENS
-

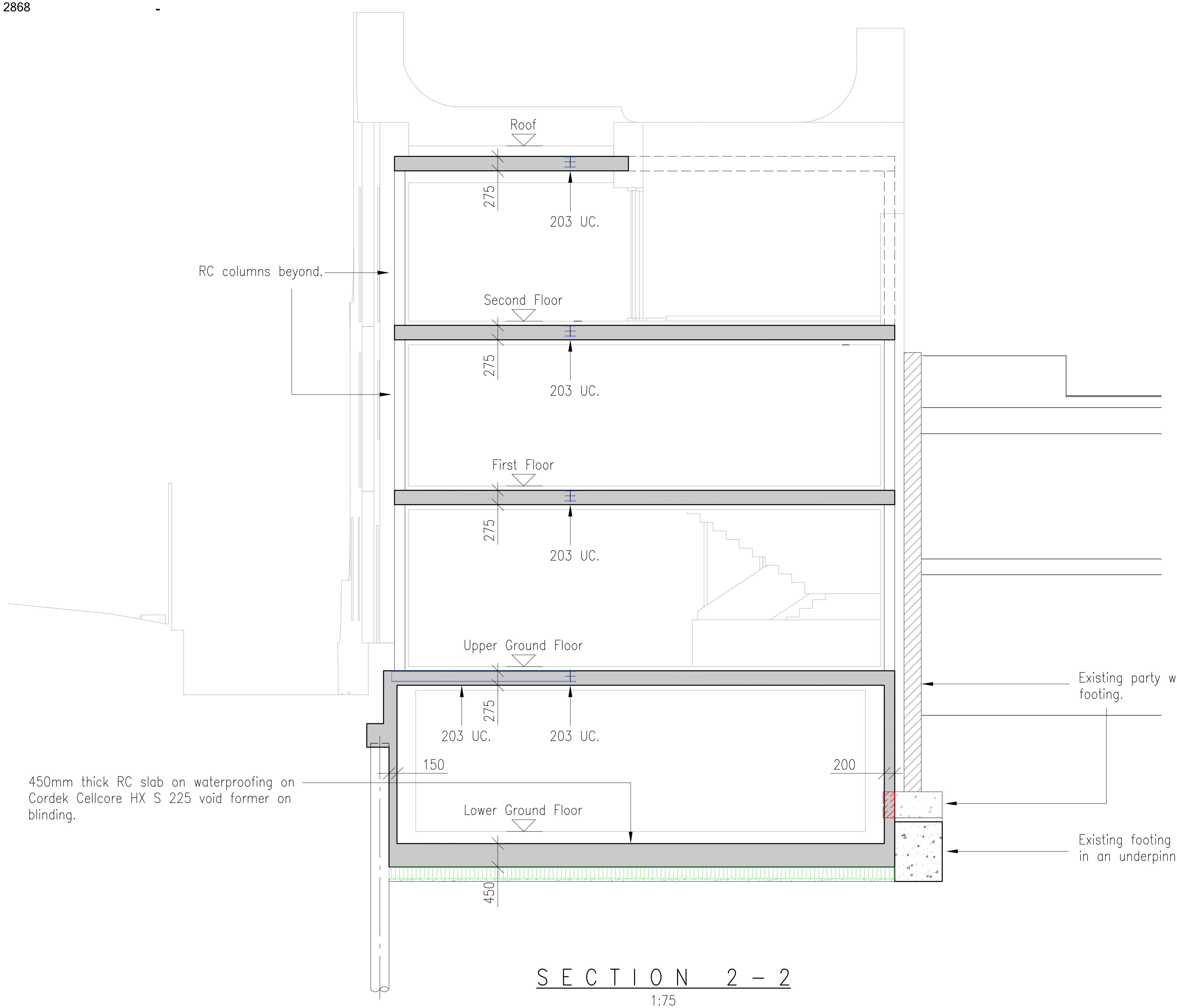
SECTION 2-2
-

Rev	Date	Description
P1	-	-

Project no. 2739
Date SEPT '19
Engineer DA Checked

Drawing 11
Revision P1
Scale at A3 1:75

PRELIMINARY



SECTION 2-2
1:75

0 0.75 1.5 2.25 3 3.75m

AKERA ENGINEERS
Consulting Structural Engineers
Tel 020 7490 2868

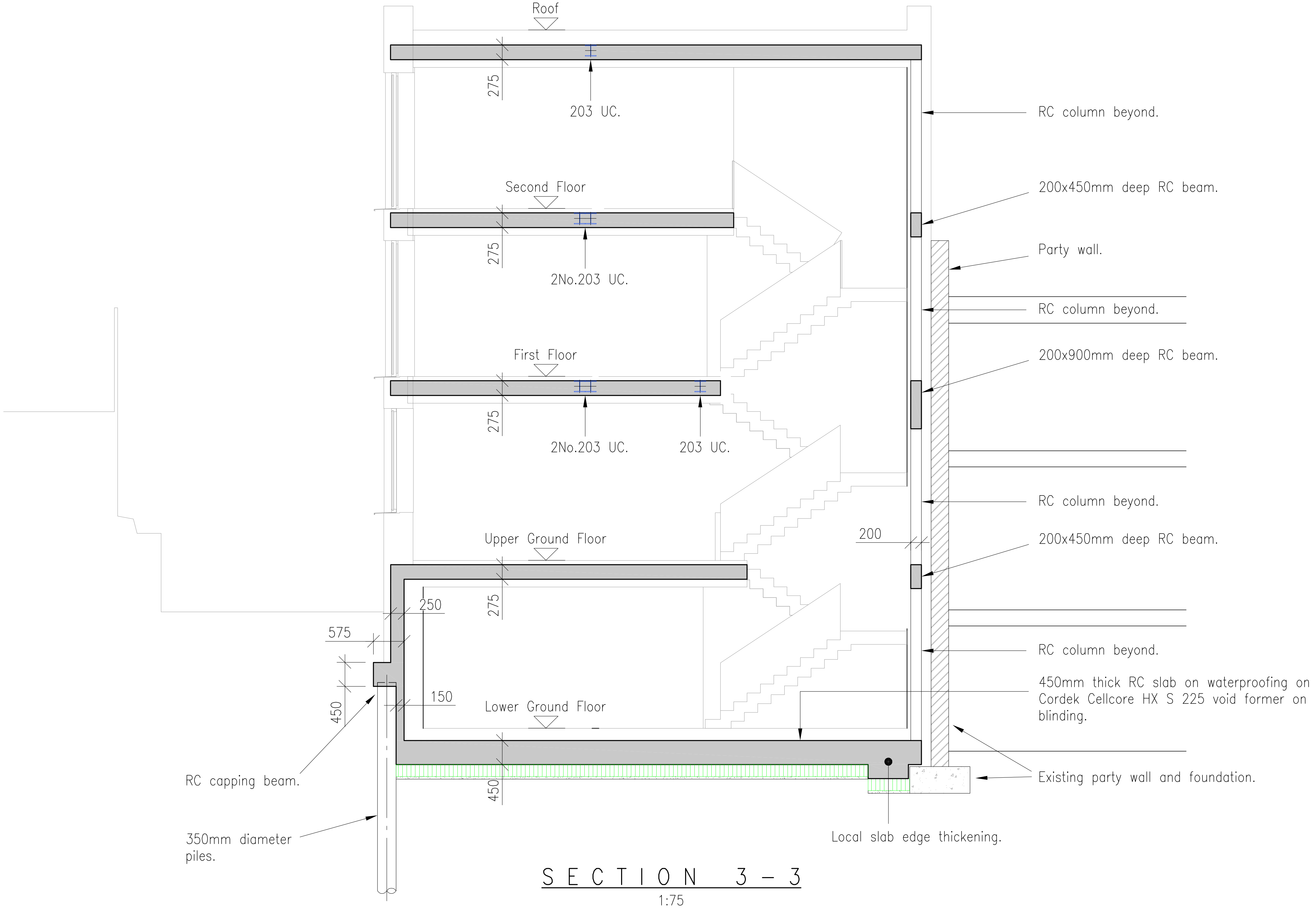
Project
18a FROGNAL GARDENS
-

SECTION 3-3
-

Rev	Date	Description
P1	-	-

Project no. 2739
Date SEPT '19
Engineer DA Checked
Drawing 12
Revision P1
Scale at A3 1:75

PRELIMINARY



SECTION 3-3
1:75

AKERA ENGINEERS
Consulting Structural Engineers
Tel 020 7490 2868

Project
18a FROGNAL GARDENS
-

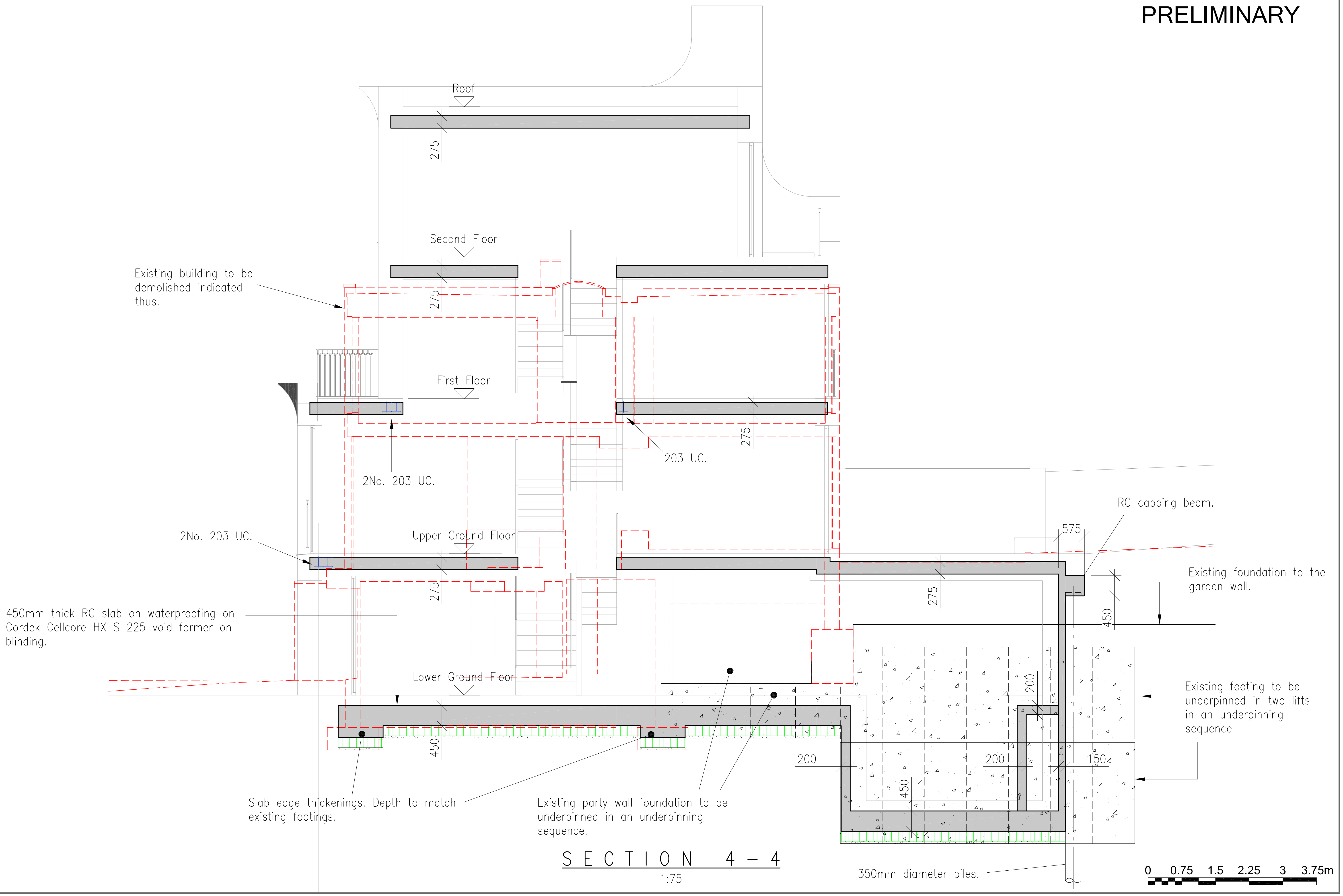
SECTION 4-4
-

Rev	Date	Description
P1	-	-

Project no. 2739
Date SEPT '19
Engineer DA Checked

Drawing 13
Revision P1
Scale at A3 1:75

PRELIMINARY



SECTION 4-4
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AKERA ENGINEERS
Consulting Structural Engineers
Tel 020 7490 2868

Project
18a FROGNAL GARDENS
-

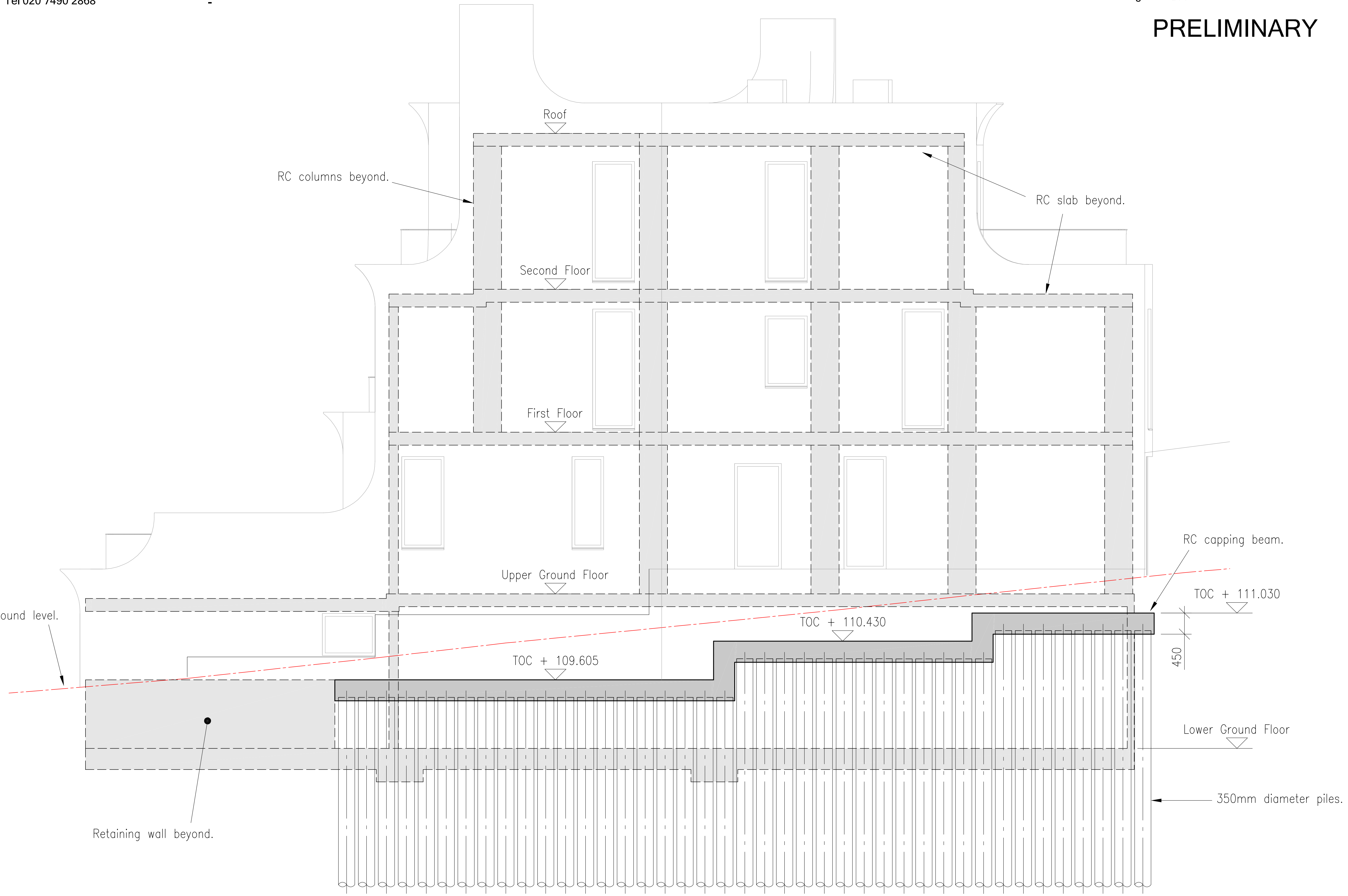
SECTION 4-4
-

Rev	Date	Description
P1	-	-

Project no. 2739
Date SEPT '19
Engineer DA Checked

Drawing 14
Revision P1
Scale at A3 1:75

PRELIMINARY



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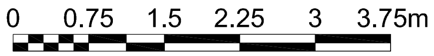


APPENDIX A

Fieldwork, in-situ testing and monitoring

- Foreword
- Borehole records
- Standard Penetration Test results
- SPT hammer calibration certificates
- Window sample borehole records
- Trial pit records
- Soakage testing
- Groundwater/ground gas monitoring results

Laboratory testing

- Index property testing
- Plasticity chart
- Particle size distribution tests

Ground profiles

- Plot of SPT 'N' value & Cu versus level
- Cross section through the boreholes

Contamination and chemical testing

- Foreword
- General soil suite/water suite
- WAC test results
- PCBs
- Sulphate/pH suite

Plans, drawings & photographs

- Site photographs
- Topographical plan and proposed development plans
- Site Plan
- Location Plan

APPENDIX B

- GroundSure historical maps (Ref SCL-6195308)
- GroundSure EnviroInsight Report (Ref SCL-6195306)
- GroundSure GeoInsight Report (Ref SCL-6195307)

APPENDIX C

- Email correspondence with Camden Council Contaminated Lane

APPENDIX D

- Stephen Buss Environmental Consulting Ltd (SBEC) Hydrological Basement Impact Assessment Report (Ref: 2019-003-059-002)
- Evans River and Coastal Flood Risk Assessment (Ref: 2351-RE-08-19-01_RevA)

APPENDIX E

- J000215 - 18a Frognal Gardens - Asbestos Management Survey Report

APPENDIX F

- Arup Figures for BIA Land Stability Assessment

APPENDIX G

- CSG Usher's Ltd, 'Tree report in accordance with BS 5837:2012', ref: 031682, date: 28th August 2019

GENERAL INFORMATION, LIMITATIONS AND EXCEPTIONS

Unless otherwise stated, our Report should be construed as being a Ground Investigation Report [GIR] as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report [GDR] as defined in EN1997-2. Any 'design' recommendations which are provided are for guidance only and are intended to allow the designer to assess the results and implications of our investigation/testing and to permit preliminary design of relevant elements of the proposed scheme.

The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access and space limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique we have adopted a practical technique to obtain indicative soil parameters and any interpretation is based upon our engineering experience and relevant published information.

The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during our investigation. In addition, Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata both between the exploratory points and/or below the maximum depth of the investigation; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

Comments made relating to ground-water or ground-gas are based upon observations made during our investigation unless otherwise stated. Ground-water and ground-gas conditions may vary with time from those reported due to factors such as seasonal effects, atmospheric effects and and/or tidal conditions. We recommend that if monitoring installations have been included as part of our investigation, continued monitoring should be carried out to maximise the information gained.

Specific geotechnical features/hazards such as [but not limited to] areas of root-related desiccation and dissolution features in chalk/soluble rock can exist in discrete localised areas - there can be no certainty that any or all of such features/hazards have been located, sampled or identified. Where a risk is identified the designer should provide appropriate contingencies to mitigate the risk through additional exploratory work and/or an engineered solution.

Where a specific risk of ground dissolution features has been identified in our Report [anything above a 'low' risk rating], reference should be made to the local building control to establish whether there are any specific local requirements for foundation design and appropriate allowances should be incorporated into the design. If such a risk assessment was not within the scope of our investigation and where it is deemed that the ground sequence may give rise to such a risk [for example near-surface chalk strata] it is recommended that an appropriate assessment should be undertaken prior to design of foundations.

Where spread foundations are used, we recommend that all excavations are inspected and approved by suitably experienced personnel; appropriate inspection records should be kept. This should also apply to any structures which are in direct contact with the soil where the soil could have a detrimental effect on performance or integrity of the structure.

Ground contamination often exists in small discrete areas - there can be no certainty that any or all such areas have been located, sampled or identified.

The findings and opinions conveyed in this Report may be based on information from a variety of sources such as previous desk studies, investigations or chemical analyses. Soil Consultants Limited cannot and does not provide any guarantee as to the authenticity, accuracy or reliability of such information from third parties; such information has not been independently verified unless stated in our Report.

Our Report is written in the context of an agreed scope of work between Soil Consultants Ltd and the Client and should not be used in any different context. In light of additional information becoming available, improved practices and changes in legislation, amendment or re-interpretation of the assessment or the Report in part or in whole may be necessary after its original publication.

Unless otherwise stated our investigation does not include an arboricultural survey, asbestos survey, ecological survey or flood risk assessment and these should be deemed to be outside the scope of our investigation.

We will identify tree and plant species if possible, but a suitably qualified arboriculturalist/botanist should be consulted to provide definitive identification

STANDARD TERMS OF APPOINTMENT OF SOIL CONSULTANTS LTD FOR GEOTECHNICAL SERVICES

1 Unless previously withdrawn, our offer remains valid for a period of sixty days from date of offer. If an instruction is given after the sixty days we reserve the right to reasonably adjust any cost associated with the project to reflect any variance on the original offer. In placing an instruction to proceed with exploratory work, whether directly from the Client or Client's representative, the Client is deemed to have accepted our Terms of Appointment.

2 Our offer is on the basis that free, unhindered access and working conditions are available and that the investigation can be completed in one visit, if applicable. Delays beyond our control will incur additional charges. If additional works outside our offer are required to facilitate the investigation these will be advised and any costs will be passed on to the Client.

3 In our quotation we will provide an estimate of any mobilisation period following an instruction to proceed. This estimate will be accurate at the time of quotation, but it should be noted that the mobilisation period may vary at a later date due to factors such as sub-contractor availability and workload.

4 In commissioning this work, the Client has a responsibility for the health, safety and welfare of operatives invited to undertake work on their site. The Client shall indemnify us in respect of any failure to fulfil their obligations in connection with all relevant and current Health and Safety Regulations.

5 The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access, space and budgetary limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique, or where a non-compliant technique has been specified, we will adopt practical and appropriate techniques to obtain indicative soil parameters.

6 Unless otherwise stated, our Report should be construed as being a Ground Investigation Report (GIR) as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report (GDR) as defined in BS EN1997-2. Any interpretation which is provided is for guidance only and must not be regarded as design or design recommendation.

7 Where excavation is required as part of the exploratory work, the Client shall provide drawings or plans showing accurate and complete locations of all underground services and structures. In performing our service, we shall take reasonable precautions to avoid damage to underground services or structures. We will not be responsible for any damage caused to underground services or structures and will not be liable for any claims for damage, expenses arising or losses unless the location of all underground services or structures are accurately shown on drawings and those plans have been provided to us in good time prior to commencement of the exploratory work. Risk to the Client can be further reduced by undertaking a scan of the site using a specialist underground scanning service which would be intended to identify traceable services at shallow depth.

8 With some sites, especially those in certain areas of London and other large towns and cities, there may be a risk of unexploded ordnance (UXO) being present. Unless otherwise stated our offer is on the basis that the Client or their representative provides a preliminary UXO risk assessment for the site. It should be noted that if the site is deemed to be in an area of risk then further measures will be required. These would normally comprise either a more detailed risk assessment and/or specialist site attendance by an EOD engineer. These measures can be commissioned either by the Client or Soil Consultants Ltd. If the Client requires, we would be pleased to obtain a preliminary risk assessment at cost+10%.

9 The Client will supply a site plan (to a rational scale), an indication of the scope and type of the proposed development and an indication of any relevant structural loading information.

10 Should the Client terminate the contract after instruction, we reserve the right to recover costs associated to work carried out between the time of instruction and the point of termination. Cancellation fees, and material costs shall be charged at cost plus 20% (+VAT). Engineer/technician time shall be charged at £95+VAT per hour and principal consultant/director time shall be charged at £125+VAT per hour.

11 The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified

during the investigation. In addition Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata both between the exploratory points and/or below the maximum depth of the investigation; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

12 If and when instructed, an agreed number of contamination tests will be carried out to give an <u>outline assessment</u> of potential contaminants. In some circumstances it may be necessary to recommend further monitoring, contamination testing and assessment and the scope of this work would be agreed with the Client. Notwithstanding this additional scope, local regulatory authorities may have specific requirements which need to be addressed. Unless otherwise agreed or stated our reporting will constitute neither a Quantitative Risk Assessment nor a Remediation Statement or Strategy.

13 Our reports are counter-checked by one of our suitably qualified and experienced engineers/geologists.

14 Notwithstanding anything to the contrary contained in these terms, our liability under or in connection with these terms whether in contract or in tort, in negligence, for breach of statutory duty or otherwise (other than in respect of personal injury or death) shall not exceed the sum equivalent to ten times our contract fee or £100,000 whichever is less in the aggregate for geotechnical and environmental matters unless otherwise agreed.

15 Without prejudice to any other exclusion or limitation of liability, damages, loss, expense or costs our liability for any claim or claims under this agreement be further limited to such sum as it would be just and equitable for us to pay having regard to the extent of our responsibility for the loss or damage giving rise to such claim or claims ("the loss and damage") and on the assumptions that:

(a) All other consultants, contractors, sub-contractors, project managers or advisers engaged in connection with the Project have provided contractual undertakings to the Client on terms no less onerous than those set out in the original contracts in respect of the carrying out of their obligations in connection with the Project; and

(b) There are no exclusions of or limitations of liability nor joint insurance or co-insurance provisions between the Client and any other party referred to in this clause and any such other party who is responsible to any extent for the loss and damage is contractually liable to the Client for the loss and damage; and

(c) All such other consultants, contractors, sub-contractors, project managers or advisers have paid to the Client such proportion of the loss or damage which it would be just and equitable for them to pay having regard to the extent of their responsibility for the loss and damage.

16 Further and notwithstanding anything to the contrary contained in this agreement and without prejudice to any provision in this agreement whereby liability is excluded or limited to a lesser amount, our liability under or in connection with this agreement whether in contract or in tort, in negligence, for breach of statutory duty or otherwise for any claim shall not exceed the amount, if any, recoverable by us by way of indemnity against the claim in question under professional indemnity insurance taken out by us and in force at the time that the claims or (if earlier) circumstances that may give rise to the claim is or are reported to the insurers in question. The limitation shall not apply if no such amount is recoverable due to us having been in breach of our obligations or the terms of any insurance maintained in accordance therewith or having failed to report any such claim or circumstances to the Insurers in question timeously.

17 Whilst our investigation may include asbestos screening/quantification on selected samples, this must not be deemed to constitute a full asbestos survey or be taken as sufficient to definitively identify the presence or quantity of asbestos within or on the ground. We will not accept responsibility if asbestos is encountered during any subsequent construction or development works and in placing a contract with us the Client accepts this condition. Where the fabric of a building is to be disturbed, the Client shall provide an appropriate asbestos survey to us prior to exploratory work and make adequate provision to allow us to provide relevant protective/remedial measures to progress the work safely.

18 The Client agrees that they shall not bring any claim personally against any director/employee of Soil Consultants Ltd or consultant to us in respect of loss or damage suffered by the Client arising out of this contract.

19 Our appointment shall be under simple agreement and our liability under this contract shall be for a period of six years from date of appointment.

20 Our reports are non-assignable and are prepared for the benefit of the Client. No reliance can be assumed by others without written agreement from Soil Consultants Ltd. We will provide a letter of reliance at our discretion and this will be subject to payment of our fee, which will be 10% of contract value, subject to a minimum fee of £750 plus VAT. The terms of our letter of reliance are non-negotiable and the beneficiary should be aware that the information shall only apply to the scheme for which the report was originally produced and the original rights and benefits will apply.

21 A VAT invoice (at current rate) will be presented in respect of the work undertaken. Payment of our account is to be made within twenty-eight days of issue of our invoice unless otherwise agreed. On no account shall payment be on a 'pay-when-paid' basis. The information contained within our report remains the property of Soil Consultants Ltd and no reliance may be assumed by any party with an interest in the project until payment has been received in full. After one calendar month interest shall be chargeable at 10% above the Bank of England Rate and compensation claimed in accordance with 'Late Payments of Commercial Debts (Interest) Act 1998 and subsequent revisions. If the debt is referred to a debt collection agency then we have the right to recover associated fees under the terms of our contract.

Site & Location:	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Borehole No:	**BH1**
Client:	**Roger Pilgrim and Nadine Majaro**	Coordinates: 526165E, 185780N	Sheet 1 of 2
Engineer:	**Akera Engineers**	Ground Level: +111.45mOD	Report No: 10402/SC

Progress & Observations	Samples & Tests		Field Test Results	Strata		Strata Descriptions
	Type	Depth (m)		Depth (m)	Level (m)	
BH commenced: 08/08/19				0.08	111.37	PAVING SLAB
				0.10	111.35	CONCRETE
BH drilled by rotary auger technique BH dia: 125mm	D	0.25				MADE GROUND: orange brown/dark brown slightly gravelly sandy clay. Gravel is fine to coarse, sub angular to angular flint, concrete and brick. Live roots and rootlets
	PID	0.25	0.1			
	D	0.50				
	PID	0.50	0.1			
	D	0.75		0.75	110.70	Orange brown/yellow slightly clayey very silty SAND with occasional grey clay partings
	PID	0.75	0.2			
	D	1.00				
	PID	1.00	0.0			
Inspection pit to 1.20m	D	1.20		1.20	110.25	Firm grey brown sandy very silty CLAY with occasional sand partings
	SPT/S	1.20	N=11			
	PID	1.20	0.0			
	D	1.65		1.65	109.80	Loose grey brown/orange brown clayey silty fine to medium SAND
	PID	1.65	0.0			
	D	1.85				
	PID	1.85	0.0			
	D	2.00				
	SPT/S	2.00	N=7			
	PID	2.00	0.0			
	D	2.75				
	PID	2.75	0.0			
	D	3.00		3.00	108.45	Firm grey brown sandy very silty CLAY with occasional orange sand laminations and pockets
	SPT/S	3.00	N=10			
	PID	3.00	0.0			
				3.60	107.85	Loose light brown/ orange brown clayey very silty fine SAND with rare grey clay partings
	D	3.75				
	D	4.00				
	SPT/S	4.00	N=9			
	D	4.75				
50mm ID monitoring pipe installed to 5.00m	D	5.00				
	SPT/S	5.00	N=8			
Water struck at 5.45m; rose to 4.65m. Not sealed						
	D	5.75				
	D	6.00				
	D	6.50				
	SPT/S	6.50	N=8			
				7.00	104.45	Firm grey mottled brown sandy silty CLAY with occasional light grey sand partings and pockets and rare iron oxide staining
	D	7.50				
	D	8.00		8.00	103.45	Firm grey/dark grey sandy silty CLAY with occasional light grey sand partings
	SPT/S	8.00	N=7			
				8.50	102.95	Stiff fissured grey slightly sandy silty CLAY
	D	9.00				
	D	9.50				
	SPT/S	9.50	N=17			
				10.00	101.45	

Continued on next sheet

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Rotary auger

Remarks: Coordinates and ground levels obtained from A D Horner Limited, 'Topographical Survey', 5594-14 Jan19-01, January 2019

Borehole No: **BH1**

Soil Consultants

Site & Location:	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Borehole No:	**BH1**
Client:	**Roger Pilgrim and Nadine Majaro**	Coordinates: 526165E, 185780N	Sheet 2 of 2
Engineer:	**Akera Engineers**	Ground Level: +111.45mOD	Report No: 10402/SC

Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
							Stiff fissured grey slightly sandy silty CLAY	
	D	10.50						
	D SPT/S	11.00 11.00	N=13				*Decayed wood at 11.00m and rare black pyritic sand partings from 11.00m to 12.50m*	
	D	12.00						
	D SPT/S	12.50 12.50	N=20					
	D	13.75		13.75	97.70		Stiff fissured grey sandy silty CLAY with occasional light grey/brown sand pockets	
	D SPT/S	14.50 14.50	N=21				*at 14.55m occasional light grey sand laminations*	
BH complete: 08/08/19 BH depth: 15.00m Water depth: dry								
				15.50	95.95		End of hole at 15.50m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Rotary auger

Remarks: Coordinates and ground levels obtained from A D Horner Limited, 'Topographical Survey', 5594-14 Jan19-01, January 2019

Borehole No: **BH1**

Site & Location		Report No:	
	18A Frognal Gardens **Hampstead, London, NW3 6XA**		**10402/SC**

STANDARD PENETRATION TEST SUMMARY

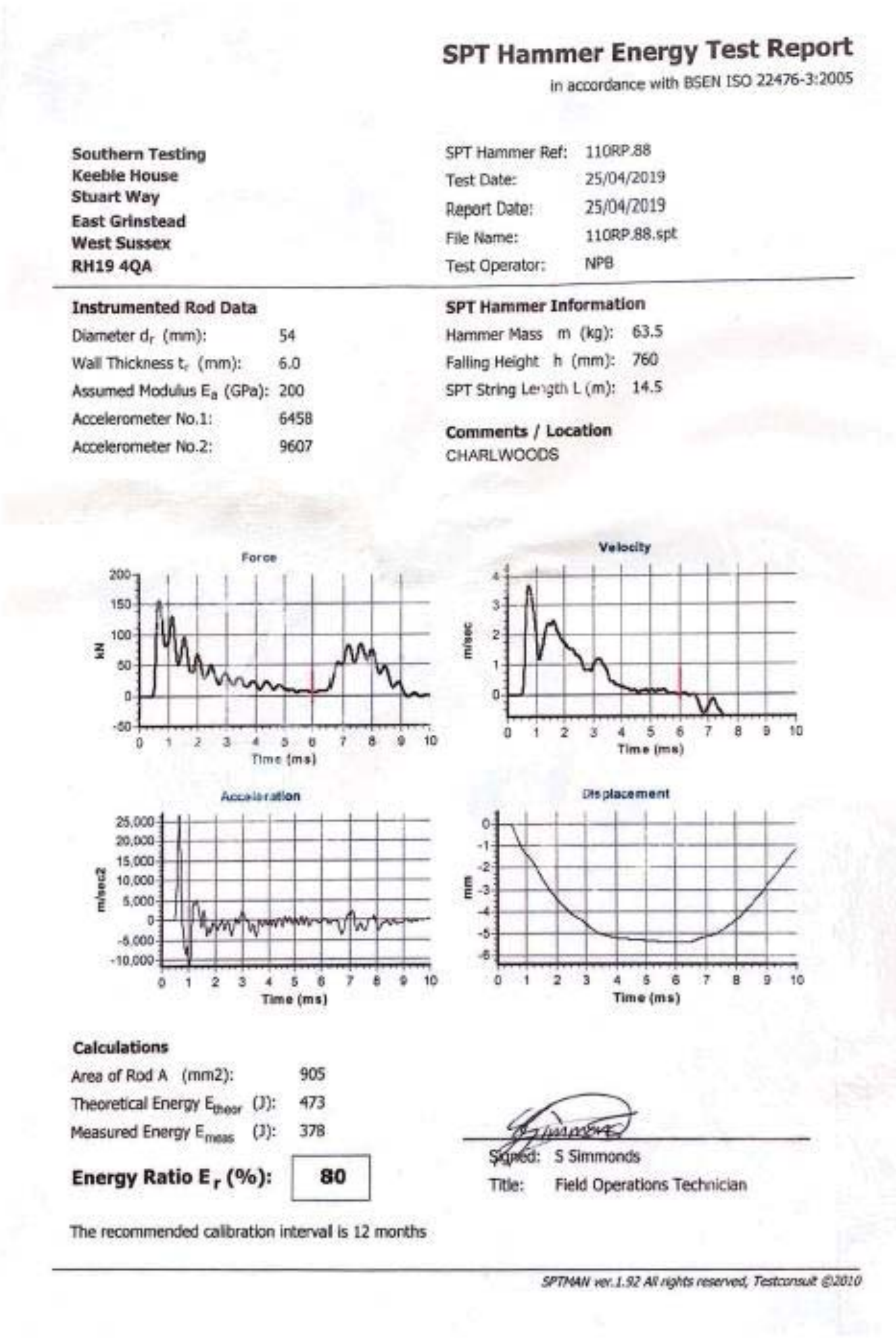
BH ID	Depth (m)	Test type	N value (Note b)	Blow-counts and penetration						Casing depth (m)	Water depth (m)	Remarks
				Seating blows		Test blows						
BH1	1.20	S	N=11	1	2	2	3	3	3		DRY	
BH1	2.00	S	N=7	1	2	1	2	2	2		DRY	
BH1	3.00	S	N=10	1	2	2	3	2	3		DRY	
BH1	4.00	S	N=9	1	2	2	3	2	2		DRY	
BH1	5.00	S	N=8	2	2	2	2	2	2		4.65	
BH1	6.50	S	N=8	1	2	2	2	2	2		DRY	
BH1	8.00	S	N=7	1	1	1	2	2	2		DRY	
BH1	9.50	S	N=17	3	3	4	4	4	5		DRY	
BH1	11.00	S	N=13	3	3	3	3	3	4		DRY	
BH1	12.50	S	N=20	3	3	4	4	6	6		DRY	
BH1	14.50	S	N=21	3	4	4	5	6	6		DRY	

a) Standard Penetration Test : BS EN ISO 22476:2005 Part 3

b) Where full penetration was not achieved, the total test blow-counts are reported

c) Hammer Energy Ratio, Er =80%

SPT hammer energy test report



SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing
Keeble House
Stuart Way
East Grinstead
West Sussex
RH19 4QA

SPT Hammer Ref: 110RP.88
Test Date: 25/04/2019
Report Date: 25/04/2019
File Name: 110RP.88.spt
Test Operator: NPB

Instrumented Rod Data

Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	6458
Accelerometer No.2:	9607

SPT Hammer Information

Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	14.5

Comments / Location
CHARLWOODS

Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	378

Energy Ratio E_r (%): 80

Signed: S Simmonds
Title: Field Operations Technician

The recommended calibration interval is 12 months

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Site & Location:	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Borehole No:	**WS1**
Client:	**Roger Pilgrim and Nadine Majaro**	Coordinates: 526161E, 185765N	Sheet 1 of 1
Engineer:	**Akera Engineers**	Ground Level: +108.70mOD	Report No: 10402/SC

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Strata Descriptions
BH commenced: 12/08/19				0.08	108.62	PAVING SLAB
				0.15	108.55	CONCRETE
BH diameter 90mm; reducing with depth				0.20	108.50	MADE GROUND: dark brown sandy gravel. Gravel is fine to coarse, angular flint
	E PID	0.30 0.30	 0.1	0.30	108.40	CONCRETE
				0.45	108.25	MADE GROUND: orange brown/dark brown slightly clayey sand and gravel. Gravel is fine to coarse, sub angular to angular flint, concrete and brick
	E PID	0.50 0.50	 0.2			Orange brown/ yellow slightly clayey very silty SAND with occasional grey clay partings
	D PID	0.90 0.90	 0.0			
Inspection pit to 1.20m						
				1.30	107.40	Stiff orange brown mottled grey very sandy silty CLAY with rare orange sand laminations
	D PP PID PP	1.50 1.50 1.50 1.60	 3.6 0.0 3.0	1.65	107.05	Orange brown/yellow clayey very silty fine SAND with rare grey clay partings
	D	1.80				
Seepage at 1.90m						
	D	2.00				
	D	2.50				
	D	2.60				
	D	2.80				
Water struck at 3.00m; rose to 2.78m	D	3.00		3.00	105.70	Stiff orange brown mottled grey very sandy silty CLAY with rare orange sand laminations
	D	3.50				
	PP	3.60	2.5			
	PP	3.70	3.0			
	PP	3.80	3.5			
35mm ID monitoring pipe installed to 4.00m BH complete: 12/08/19 BH depth: 4.00m Water depth: 2.78m				4.00	104.70	End of hole at 4.00m

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

Remarks: Coordinates and ground levels obtained from A D Horner Limited, 'Topographical Survey', 5594-14 Jan19-01, January 2019

Borehole No: **WS1**

Soil Consultants

Site & Location: **18A Frognal Gardens**
Hampstead, London, NW3 6XA

Borehole No: **WS2**

Client: **Roger Pilgrim and Nadine Majaro**
Coordinates: 526161E, 185780N
Sheet 1 of 1

Engineer: **Akera Engineers**
Ground Level: +111.45mOD
Report No: 10402/SC

Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
BH commenced: 12/08/19							Paving Slab	
				0.08	111.37		CONCRETE	
BH diameter 90mm; reducing with depth				0.15	111.30		MADE GROUND: brick rubble	
				0.30	111.15		MADE GROUND: brown/dark brown clayey gravelly silty sand. Gravel is fine to coarse sub angular to angular flint, brick concrete with plastic and glass fragments. Rare brick cobbles. Live root to 1.90m	
BH drilled through the base of TP1 at 1.80m	D	1.80						
	PID	1.80	0.0					
	D	2.00		2.00	109.45		Firm to stiff orange brown/dark brown slightly sandy silty CLAY. Live roots and rootlets	
	PID	2.00	0.0	2.10	109.35		Orange brown/yellow slightly clayey very silty SAND with occasional grey clay partings. Live roots and rootlets	
				2.30	109.15		Stiff orange brown mottled grey very sandy silty CLAY with rare orange sand laminations. Live rootlets to 2.90m	
	D	2.40						
	PID	2.40	0.0					
	D	2.60						
	PP	2.60	3.0					
	PP	2.70	3.0					
	PP	2.80	3.0					
	D	2.90						
	PP	2.90	4.0					
	D	3.00		3.00	108.45		Light brown/ orange brown silty slightly clayey SAND with grey clay partings	
	D	3.40						
	D	3.50						
Seepage at 4.00m	D	4.00						
				4.10	107.35		Stiff light brown/orange brown slightly sandy silty CLAY with occasional sand lenses	
	D	4.20						
	PP	4.30	3.5					
	PP	4.40	3.5	4.40	107.05		Light brown/orange brown silty slightly clayey SAND with grey clay partings	
Seepage at 4.80m	D	4.50						
BH complete: 12/08/19 BH depth: 5.00m Water depth: dry	PP	4.50	3.5					
	D	5.00		5.00	106.45		End of hole at 5.00m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Window Sampler

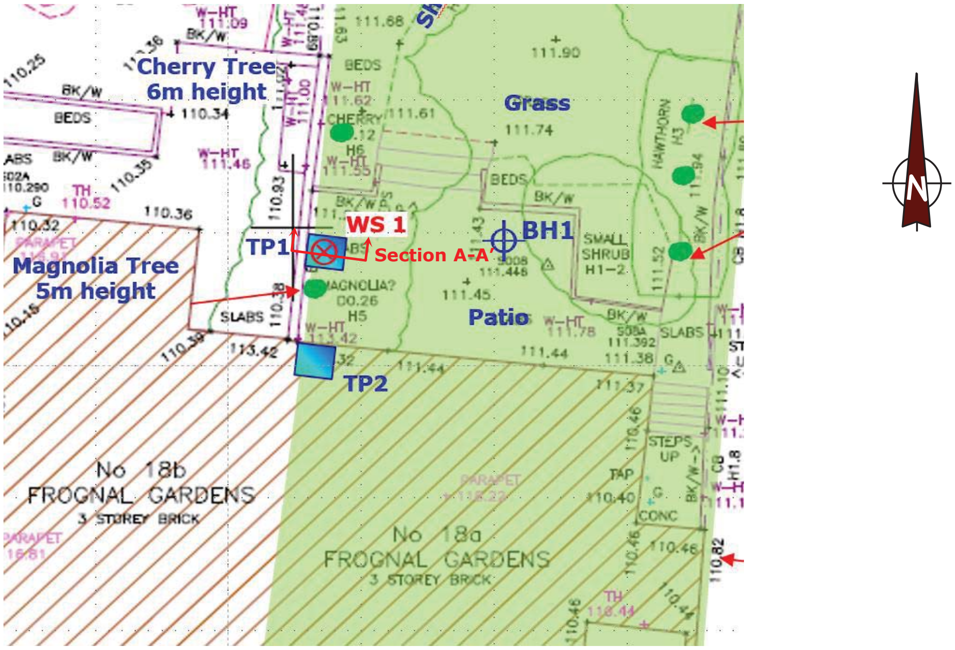
Remarks: Coordinates and ground levels obtained from A D Horner Limited, 'Topographical Survey', 5594-14 Jan19-01, January 2019

Borehole No: **WS2**

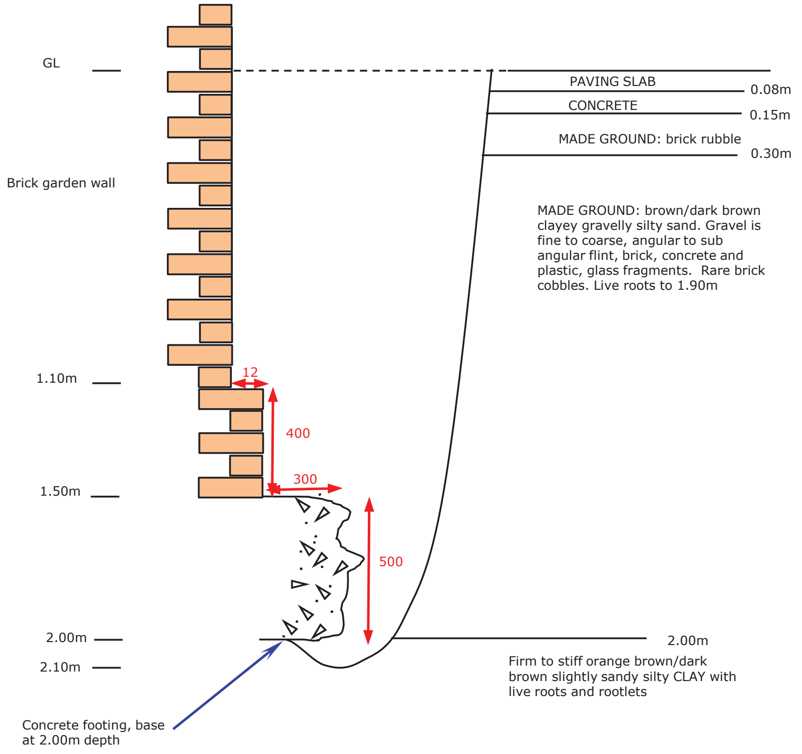
Soil Consultants

Site & Location	**18A Frognal Gardens Hampstead, London, NW3 6XA**	Trial Pit No: **TP 1 (1 of 2)**
Client: Engineer:	**Roger Pilgrim and Nadine Majaro** **David Akera Engineering**	Report No: **10402/SC**

PLAN



SECTION A-A' (looking N)



MADE GROUND: brown/dark brown clayey gravelly silty sand. Gravel is fine to coarse, angular to sub angular flint, brick, concrete and plastic, glass fragments. Rare brick cobbles. Live roots to 1.90m

Firm to stiff orange brown/dark brown slightly sandy silty CLAY with live roots and rootlets

Concrete footing, base at 2.00m depth

Note: foundation dimensions in millimetres

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	08/08/19	**Groundwater details**	**Samples**
Equipment:	Hand excavation	- Dry	1.00m to 2.00m E
Stability:	Stable		
Remarks:			**Logged by**: SC

Site & Location	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Trial Pit No: **TP 1 (2 of 2)**
Client:	**Roger Pilgrim and Nadine Majaro**	Report No: **10402/SC**
Engineer:	**David Akera Engineering**	

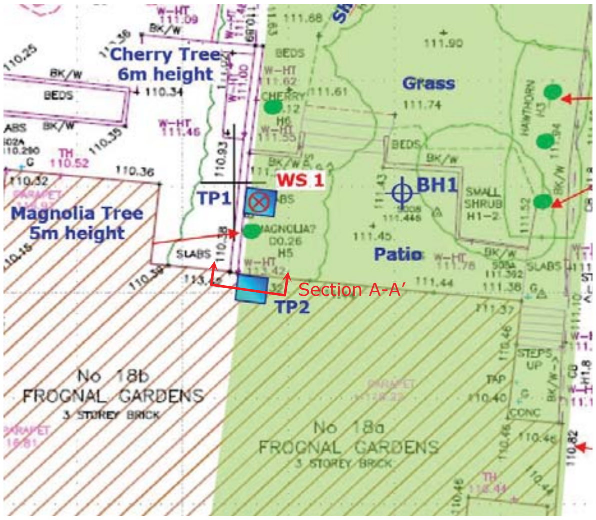
PHOTOGRAPHS

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

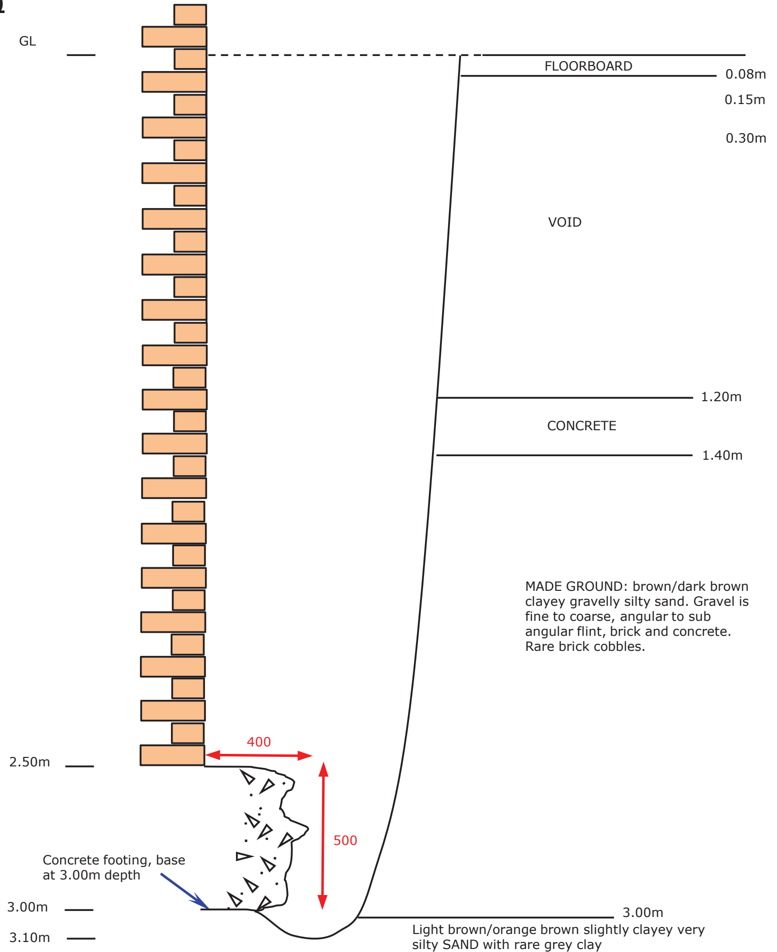
Date:	08/08/19	**Groundwater details**	**Samples**
Equipment:	Hand excavation	- Dry	1.00m to 2.00m E
Stability:	Stable		
Remarks:			**Logged by**: SC

Site & Location	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Trial Pit No: **TP 2** **(1 of 4)**
Client:	**Roger Pilgrim and Nadine Majaro**	Report No:
Engineer:	**David Akera Engineering**	**10402/SC**

PLAN



SECTION A-A' (looking N)



MADE GROUND: brown/dark brown clayey gravelly silty sand. Gravel is fine to coarse, angular to sub angular flint, brick and concrete. Rare brick cobbles.

Concrete footing, base at 3.00m depth

Light brown/orange brown slightly clayey very silty SAND with rare grey clay partings/laminations

Note: foundation dimensions in millimetres

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	08/08/19	**Groundwater details**	**Samples**
Equipment:	Hand excavation	- Dry	1.00m to 2.00m E
Stability:	Stable		
Remarks:			**Logged by**: SC

Site & Location	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Trial Pit No: **TP 2 (2 of 4)**
Client: Engineer:	**Roger Pilgrim and Nadine Majaro** **David Akera Engineering**	Report No: **10402/SC**

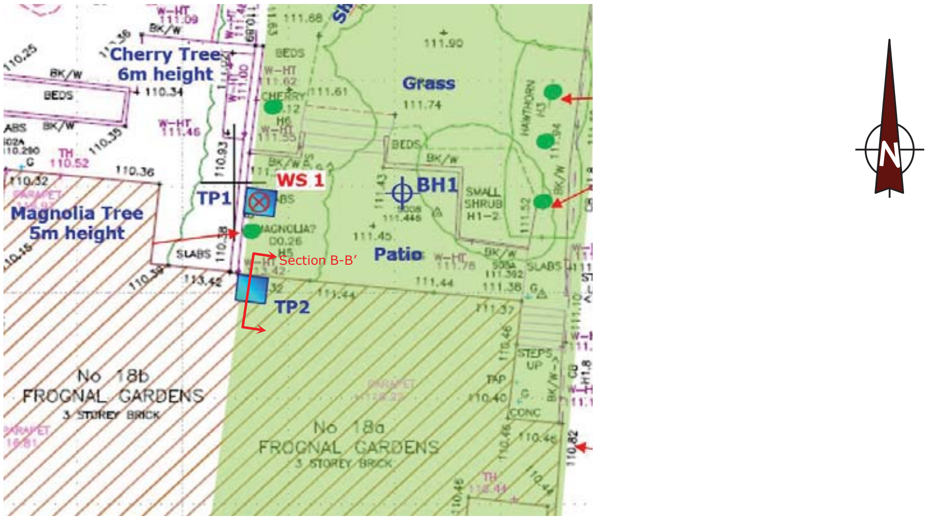
PHOTOGRAPHS

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

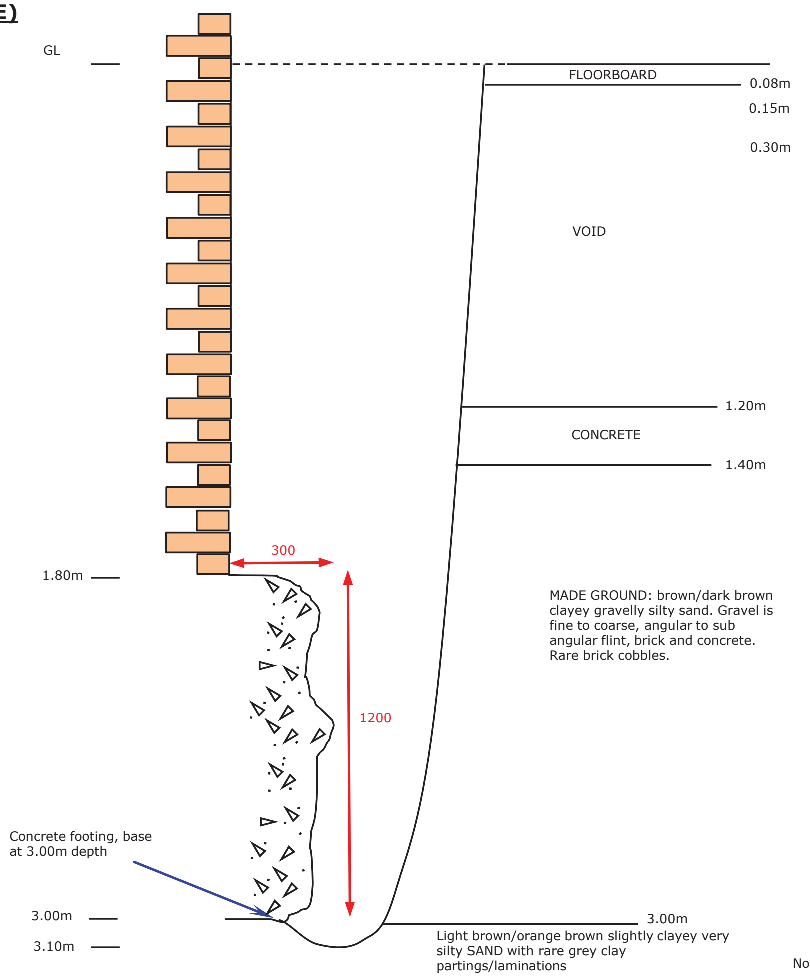
Date:	08/08/19	**Groundwater details**	**Samples**
Equipment:	Hand excavation	- Dry	1.00m to 2.00m E
Stability:	Stable		
Remarks:			**Logged by**: SC

Site & Location	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Trial Pit No: **TP 2 (3 of 4)**
Client:	**Roger Pilgrim and Nadine Majaro**	Report No:
Engineer:	**David Akera Engineering**	**10402/SC**

PLAN



SECTION B-B' (looking E)



Note: foundation dimensions in millimetres

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm^2)

Date:	08/08/19	**Groundwater details**	**Samples**
Equipment:	Hand excavation	- Dry	1.00m to 2.00m E
Stability:	Stable		
Remarks:			**Logged by**: SC

Site & Location	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Trial Pit No: **TP 2 (4 of 4)**
Client: Engineer:	**Roger Pilgrim and Nadine Majaro** **David Akera Engineering**	Report No: **10402/SC**

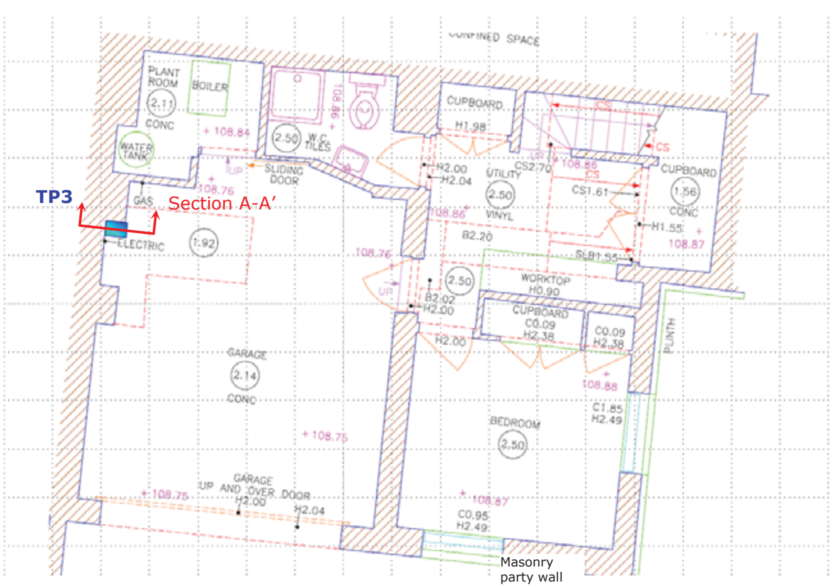
PHOTOGRAPHS

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

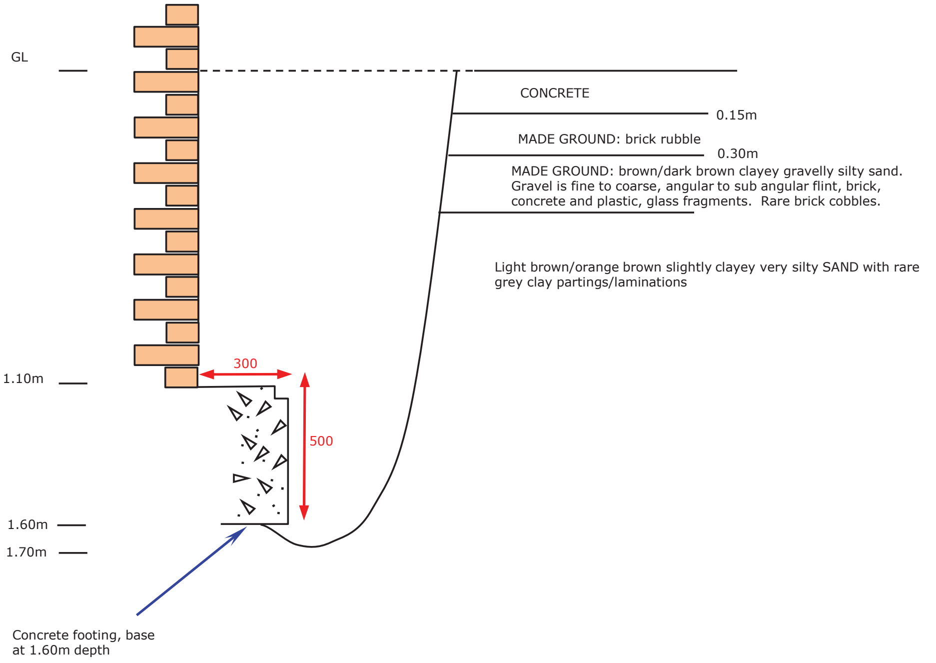
Date:	08/08/19	**Groundwater details**	**Samples**
Equipment:	Hand excavation	- Dry	1.00m to 2.00m E
Stability:	Stable		
Remarks:			**Logged by**: SC

Site & Location	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Trial Pit No: **TP 3** **(1 of 2)**
Client:	**Roger Pilgrim and Nadine Majaro**	Report No: **10402/SC**
Engineer:	**David Akera Engineering**	

PLAN



SECTION A-A' (looking N)



Note: foundation dimensions in millimetres

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	09/08/19	**Groundwater details**	**Samples**
Equipment:	Hand excavation	• Dry	1.50m E
Stability:	Stable		
Remarks:			**Logged by**: SC

Site & Location	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Trial Pit No: **TP 3 (2 of 2)**
Client:	**Roger Pilgrim and Nadine Majaro**	Report No: **10402/SC**
Engineer:	**David Akera Engineering**	

PHOTOGRAPHS

D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	09/08/19	**Groundwater details**	**Samples**
Equipment:	Hand excavation	- Dry	1.50m E
Stability:	Stable		
Remarks:	Unable to progress further due to concrete and pipe obstructions		**Logged by**: SC

Site & Location	18A Frognal Gardens, Hampstead, London, NW3 6XA	Report No:	10402/SC

Borehole soakage test results

BH No: 1 **Depth: 2.00 m** Test No: **1**

Dimensions:

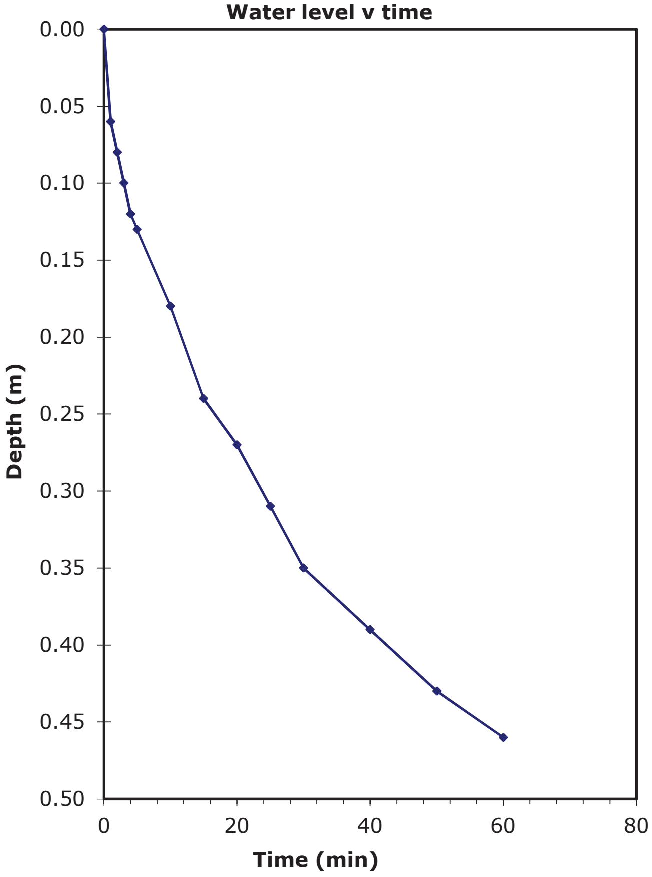
Ground sequence: (see borehole log)

Borehole diameter = **0.1** m
Casing depth = **0.00** m

Perimeter = 0.31 m
Base area = 0.01 m^2

Readings measured from **0.00** m above ground level

No	Mins	Depth m	Depth mbgl	
1	**0**	**0.00**	0.00	
2	**1**	**0.06**	0.06	
3	**2**	**0.08**	0.08	
4	**3**	**0.10**	0.10	
5	**4**	**0.12**	0.12	< WL1
6	**5**	**0.13**	0.13	
7	**10**	**0.18**	0.18	
8	**15**	**0.24**	0.24	
9	**20**	**0.27**	0.27	
10	**25**	**0.31**	0.31	
11	**30**	**0.35**	0.35	<WL2
12	**40**	**0.39**	0.39	
13	**50**	**0.43**	0.43	
14	**60**	**0.46**	0.46	



		Water Level (m)	Time (sec)
WL 1 [top]	**5**	0.12	240
WL 2 [bottom]	**11**	0.35	1800

Vol change	=	0.00	m^3	V
Soakage area	=	0.5624	m^2	A
Time	=	1560	sec	T

Soil infiltration rate 2.06E-06 m/sec

The 'soil infiltration rate' is calculated using two selected water levels (BRE DG 365: 2016 "Soakaway design")

Site & Location	Report No:
18A Frognal Gardens **Hampstead, London, NW3 6XA**	**10402/SC**

Results of groundwater/gas monitoring

Date:	22 Aug 19	04 Sep 19	18 Sep 19
Barometric pressure:			
a) Trend (24hrs):	Rising	Falling	Rising
b) At start (mB):	1016	1006	1023
c) At end (mB):	1016	1006	1023
Recorded by:	TBH	TBH	TBH
Surface ground conditions:	Dry	Wet	Dry
Weather conditions:	Sunny	Sunny with cloud interv	Sunny
Ambient air temp (oC):	20	17	15

Monitoring equipment

Instrument:	GA5000. Serial No. G505055
Calibration check details:	See note 2 below
Next calibration date:	02 Feb 20

Notes:

1) Barometric pressure trend and ambient air temperature is recorded from metoffice.gov.uk website on the day of the monitoring visit

2) Calibration check is performed at start of monitoring against ambient air and also periodically with a 5% CH_4, 5% CO_2 and 6% O_2 gas mixture

3) CH_4 = methane; CO_2 = carbon dioxide; CO = carbon monoxide; O_2 = oxygen; H_2S = hydrogen sulphide

Results

Date	Time (24hr)	Borehole ID	GW depth	Depth to base	CH_4 (%)		CO_2 (%)		O_2 (%)		Highest (ppm)		Emission rate	Relative pressure	PID
			(m)	(m)	Max	Steady	Max	Steady	Min	Steady	CO	H_2S	(l/hr)	(mb)	
22/08/2019	11:32	BH1	4.67	4.90	0.1	0.1	5.5	5.5	16.0	16.0	0.0	0.0	0.00	0.19	0.0
	11:49	WS1	2.37	3.32	0.0	0.0	0.6	0.2	18.8	19.9	0.0	0.0	0.00	-0.03	0.0
04/09/2019	10:59	BH1	4.69	4.89	0.0	0.0	0.2	0.1	20.4	20.5	0.0	0.0	0.00	-0.09	0.3
	11:05	WS1	2.70	3.30	0.0	0.0	1.7	1.7	19.6	19.6	0.0	0.0	0.00	0.03	0.6
18/09/2019	09:43	BH1	4.71	4.89	0.0	0.0	5.0	5.0	17.0	17.0	0.0	0.0	0.00	0.12	0.2
	09:56	WS1	2.69	3.29	0.0	0.0	0.8	0.8	20.2	20.2	0.0	0.0	0.00	0.17	0.1

SoilConsultants

Site & Location	18A Frognal Gardens Hampstead, London, NW3 6XA	Report No:	10402/SC

SUMMARY OF CLASSIFICATION TEST RESULTS

BH ID	Depth (m)	Type	w (%)	w_L (%)	w_P (%)	Pass 425 (%)	I_P (%)	Mod I_P (%)	I_L (%)	LOI (%)	Description
BH1	1.20	D	26	54	24	>95	30		0.05		Grey brown sandy very silty CLAY
BH1	3.00	D	20	44	23	>95	21		-0.13		Grey brown sandy very silty CLAY
BH1	7.50	D	32	48	24	>95	24		0.33		Grey mottled brown sandy silty CLAY
BH1	9.50	D	26	67	24	>95	43		0.04		Grey slightly sandy silty CLAY
BH1	12.00	D	28	63	27	>95	36		0.04		Grey slightly sandy silty CLAY
BH1	13.75	D	27	44	20	>95	24		0.29		Grey sandy silty CLAY
WS1	3.00	D	30	44	23	>95	21		0.33		Orange brown mottled grey very sandy silty CLAY
WS2	2.40	D	25	43	22	>95	21		0.13		Orange brown mottled grey very sandy silty CLAY
WS2	2.90	D	29	49	24	>95	25		0.22		Orange brown mottled grey very sandy silty CLAY
WS2	4.20	D	30	50	24	>95	26		0.23		Light brown/orange brown slightly sandy silty CLAY

Testing in accordance with BS EN ISO 17892 unless specified otherwise

Date: 20 Aug 19

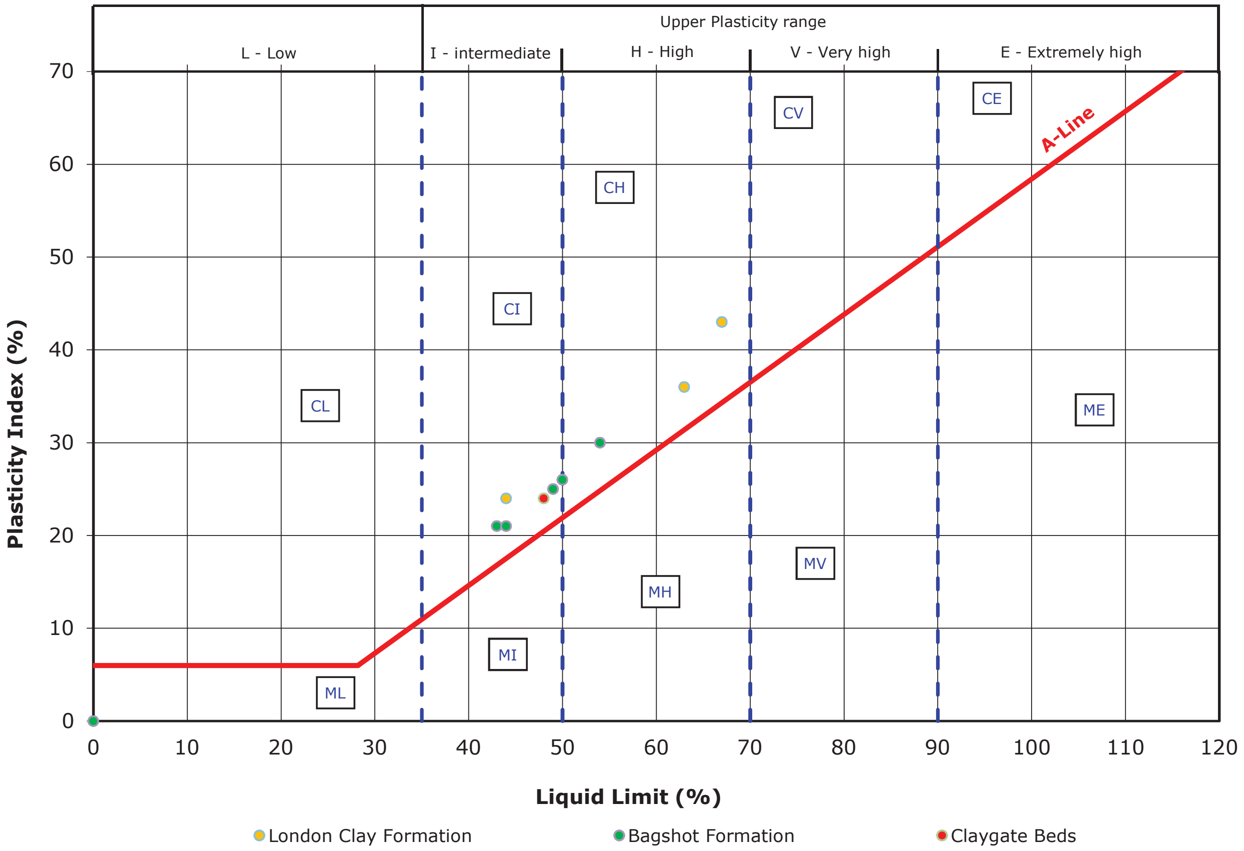
Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)

Percent passing 425μm: by estimation, by hand* or by sieving**

(Classification Sheet 1 of 1)

Site & Location	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Report No:	**10402/SC**

Plasticity Chart



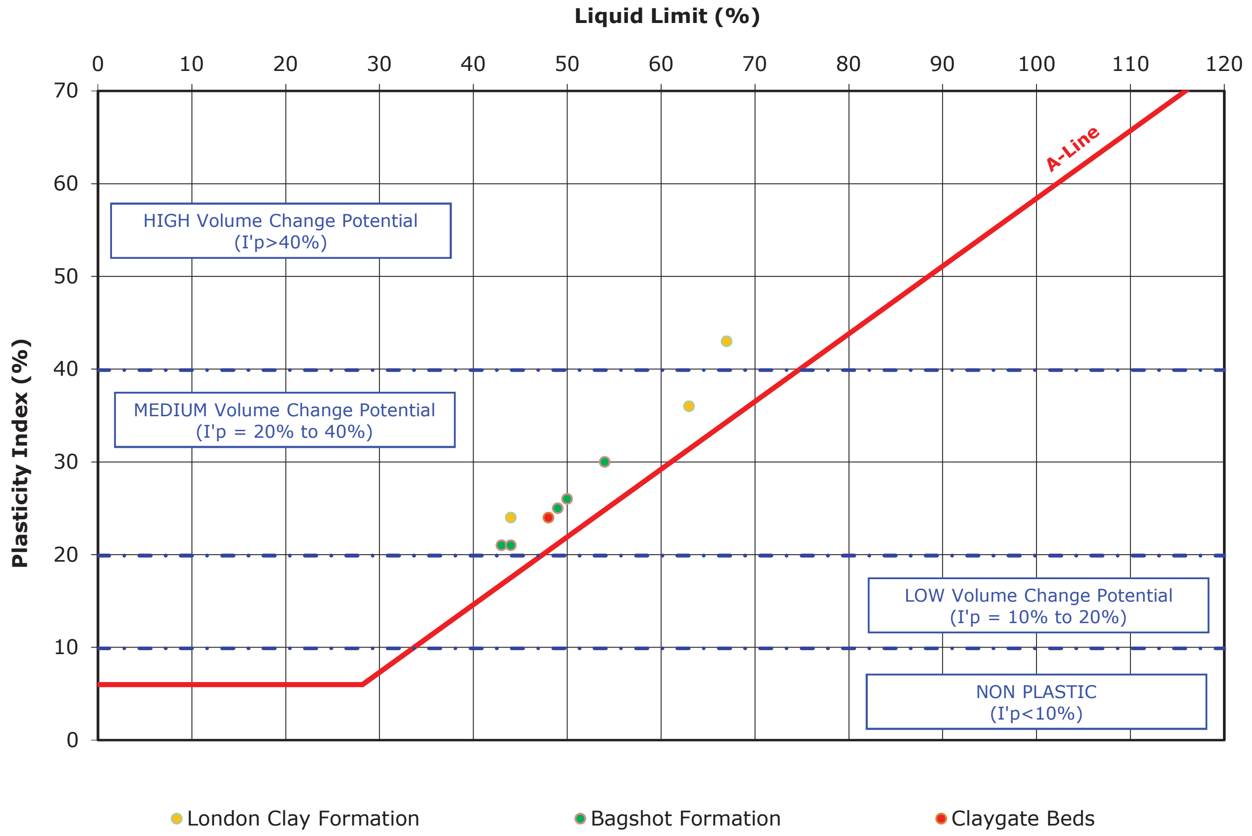
M - SILT [plots below the A-Line}

C - CLAY [plots above the A-Line]

Classification in accordance with BS5930:2015 "Code of practice for site investigations"

Site & Location	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Report No:	**10402/SC**

Plasticity Chart



Modified Plasticity Index, I'p:

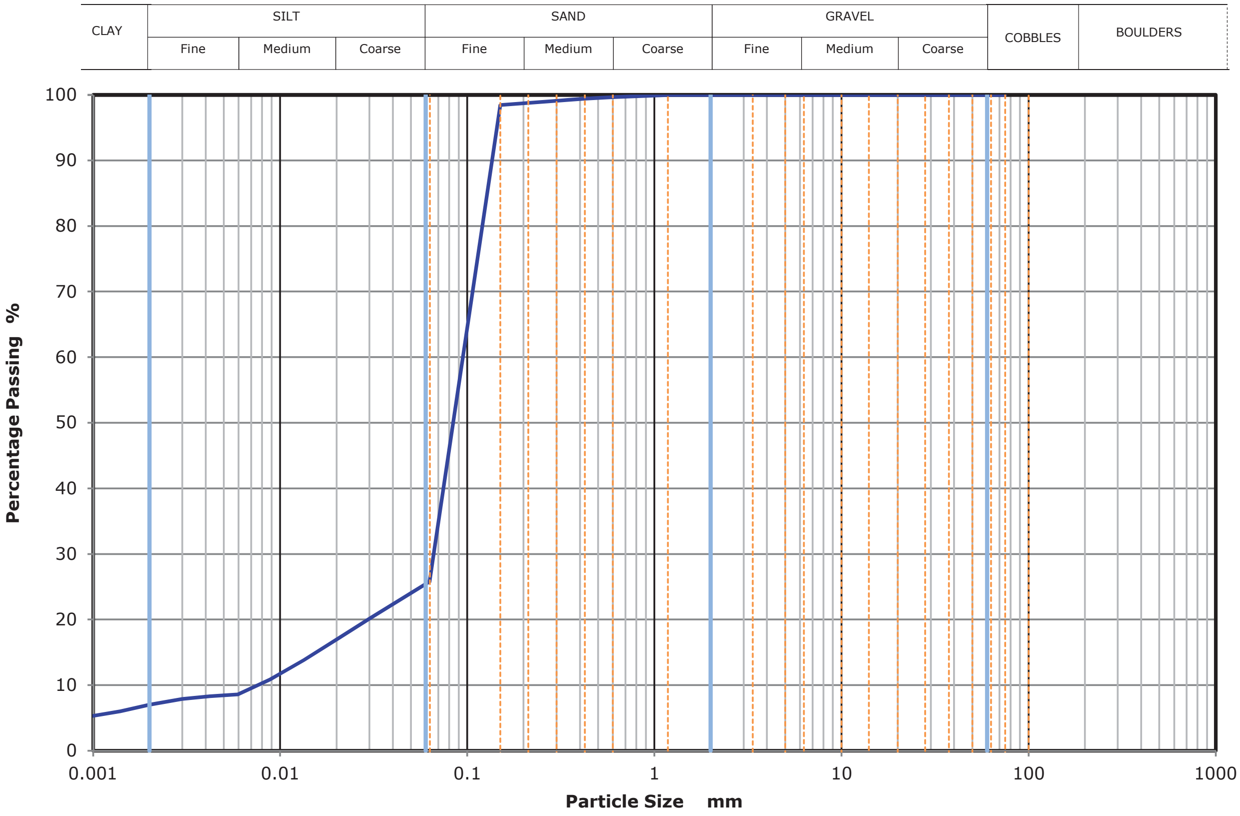
$$I'p = \frac{Ip \times (\% \text{ passing } 425mm)}{100\%}$$ (where Ip = Plasticity Index)

Classification in accordance with NHBC Standards, Part 4 'Foundations', Chapter 4.2 'Building near trees'

Site	**18A Frognal Gardens**	Report No:	**10402/SC**
Location	**Hampstead, London, NW3 6XA**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **BH1** Depth (m): **1.85**	Description: **Grey brown/orange brown clayey silty fine to medium SAND**



Sieving	
Size (mm)	% passing
75	100.0
63	100.0
50	100.0
37.5	100.0
28	100.0
20	100.0
14	100.0
10	100.0
6.3	100.0
5	100.0
3.35	100.0
2	100.0
1.18	99.9
0.6	99.7
0.425	99.4
0.3	99.1
0.212	98.8
0.15	98.4
0.063	25.8

Sedimentation	
Size (μm)	% passing
30.6	20.3
20.4	17.1
13.4	13.8
8.8	10.9
5.9	8.6
4.2	8.3
3.0	7.9
2.0	7
1.4	6
1.0	5.3
0.4	3.7

Sample proportions	%
Cobbles	0
Gravel	0
Sand	74
Silt	20
Clay	6

Grading analysis		
D60	mm	0.09
D30	mm	0.066
D10	mm	0.008
Uniformity Coefficient		12.6
Curvature Coefficient		6.2

Test method and date

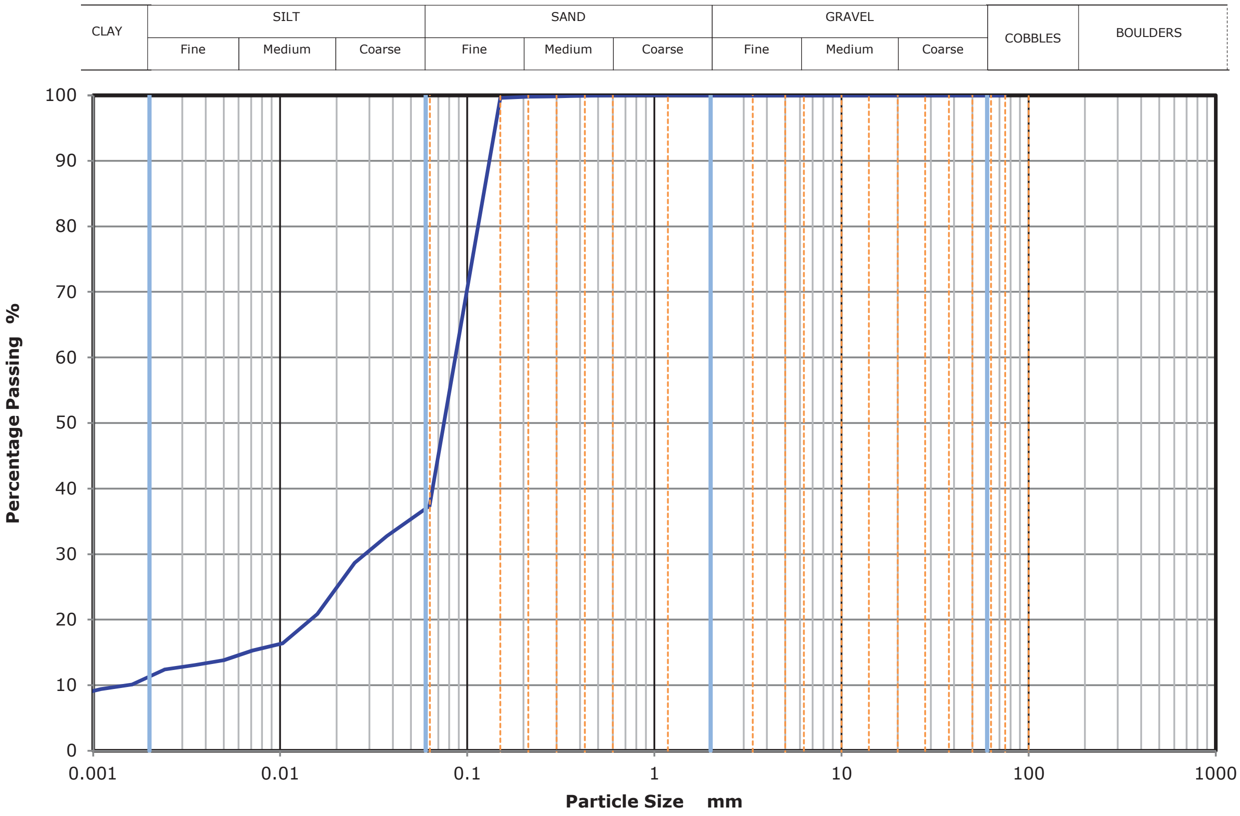
Testing in accordance with BS EN ISO 17892:
- Wet sieving method
- Hydrometer method

Reporting date: 20 Aug 19

Site	**18A Frognal Gardens**	Report No:	**10402/SC**
Location	**Hampstead, London, NW3 6XA**		

PARTICLE SIZE DISTRIBUTION

Hole ID:	**BH1**	Description:	**Light brown/ orange brown clayey very silty fine SAND**
Depth (m):	**3.75**		



Sieving	
Size (mm)	% passing
75	100.0
63	100.0
50	100.0
37.5	100.0
28	100.0
20	100.0
14	100.0
10	100.0
6.3	100.0
5	100.0
3.35	100.0
2	100.0
1.18	100.0
0.6	100.0
0.425	100.0
0.3	99.8
0.212	99.8
0.15	99.6
0.063	37.4

Sedimentation	
Size (μm)	% passing
37.2	32.8
25.0	28.7
15.8	20.9
10.3	16.4
7.1	15.3
5.0	13.8
3.5	13.1
2.4	12.4
1.6	10.1
1.1	9.4
0.4	6.4

Sample proportions	%
Cobbles	0
Gravel	0
Sand	63
Silt	27
Clay	10

Grading analysis		
D60	mm	0.09
D30	mm	0.028
D10	mm	0.002
Uniformity Coefficient		56.9
Curvature Coefficient		6.1

Test method and date

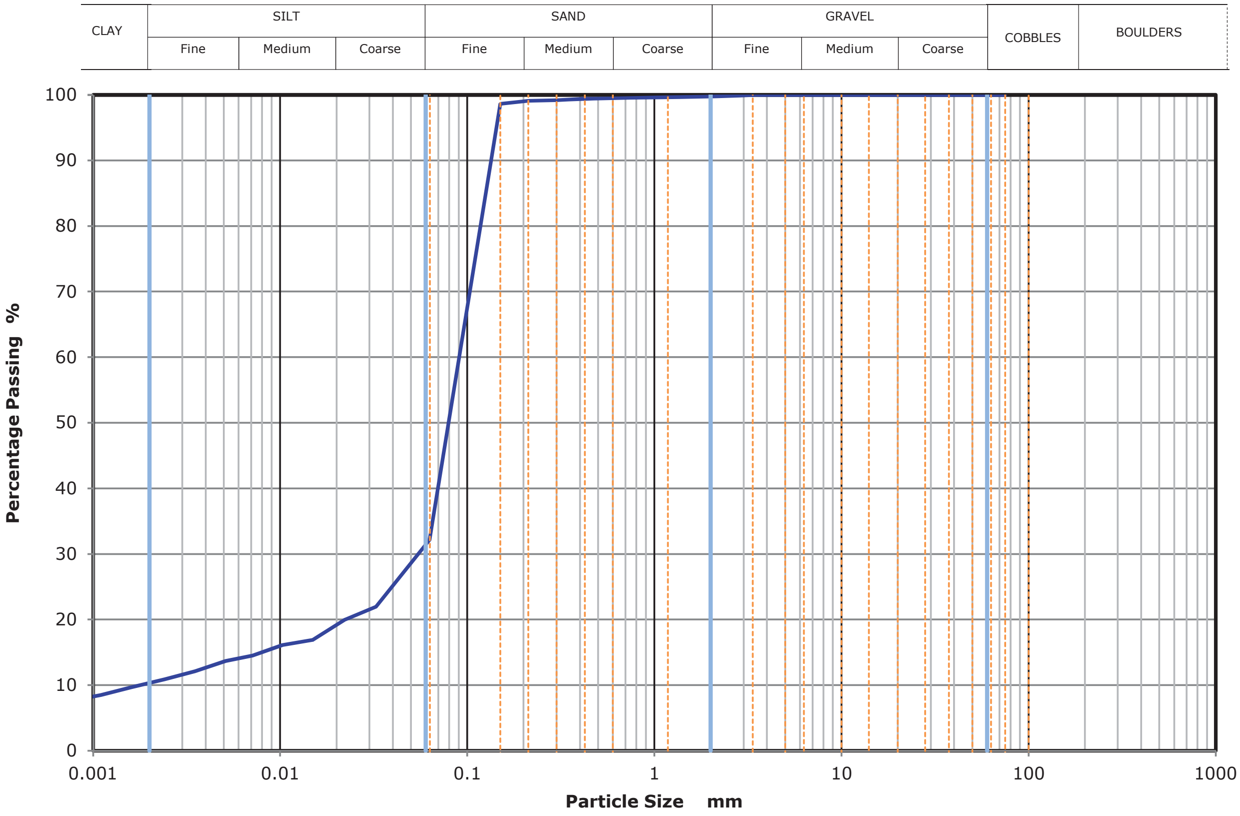
Testing in accordance with BS EN ISO 17892:
- Wet sieving method
- Hydrometer method

Reporting date: 20 Aug 19

Site	**18A Frognal Gardens**	Report No:	**10402/SC**
Location	**Hampstead, London, NW3 6XA**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **BH1**	Description:
Depth (m): **6.00**	**Light brown/ orange brown clayey very silty fine SAND**



Sieving	
Size (mm)	% passing
75	100.0
63	100.0
50	100.0
37.5	100.0
28	100.0
20	100.0
14	100.0
10	100.0
6.3	100.0
5	100.0
3.35	100.0
2	99.8
1.18	99.6
0.6	99.5
0.425	99.4
0.3	99.2
0.212	99.1
0.15	98.6
0.063	32.2

Sedimentation	
Size (μm)	% passing
32.5	22
22.2	20
14.9	16.9
10.3	16.1
7.1	14.5
5.1	13.7
3.5	12.1
2.4	10.9
1.6	9.7
1.1	8.5
0.4	6.1

Sample proportions	%
Cobbles	0
Gravel	0
Sand	68
Silt	22
Clay	10

Grading analysis		
D60	mm	0.09
D30	mm	0.055
D10	mm	0.002
Uniformity Coefficient		51.2
Curvature Coefficient		18.7

Test method and date

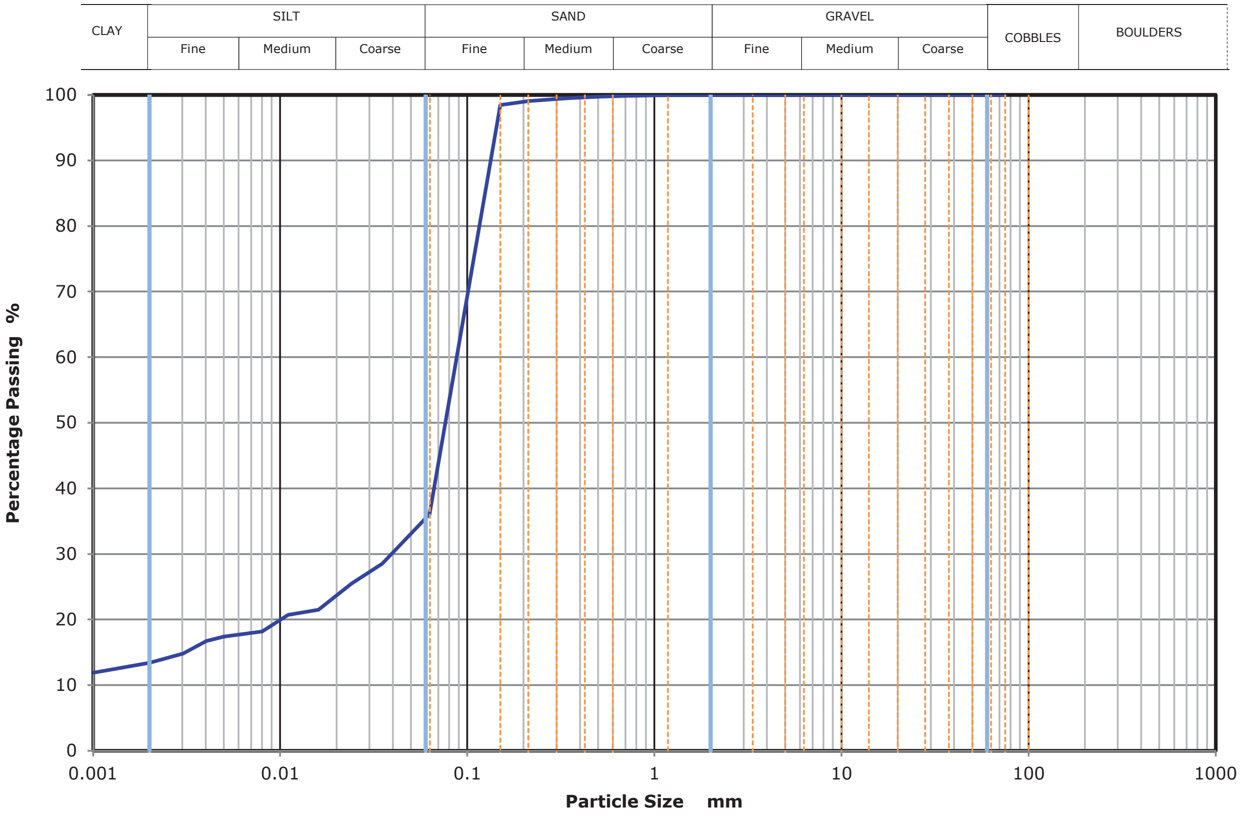
Testing in accordance with BS EN ISO 17892:
- Wet sieving method
- Hydrometer method

Reporting date: 20 Aug 19

Site	**18A Frognal Gardens**	Report No:	**10402/SC**
Location	**Hampstead, London, NW3 6XA**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **WS1** Depth (m): **1.80**	Description: **Orange brown/ yellow clayey very silty fine SAND**



Sieving	
Size (mm)	% passing
75	100.0
63	100.0
50	100.0
37.5	100.0
28	100.0
20	100.0
14	100.0
10	100.0
6.3	100.0
5	100.0
3.35	100.0
2	100.0
1.18	99.9
0.6	99.8
0.425	99.6
0.3	99.4
0.212	99.1
0.15	98.4
0.063	36.1

Sedimentation	
Size (μm)	% passing
35.0	28.5
24.0	25.5
16.0	21.5
11.0	20.7
8.0	18.2
5.0	17.4
4.0	16.7
3.0	14.8
2.0	13.4
1.0	11.9
0.0	8.6

Sample proportions	%
Cobbles	0
Gravel	0
Sand	64
Silt	24
Clay	12

Grading analysis		
D60	mm	0.09
D30	mm	0.039
D10	mm	#NUM!
Uniformity Coefficient		
Curvature Coefficient		

Test method and date

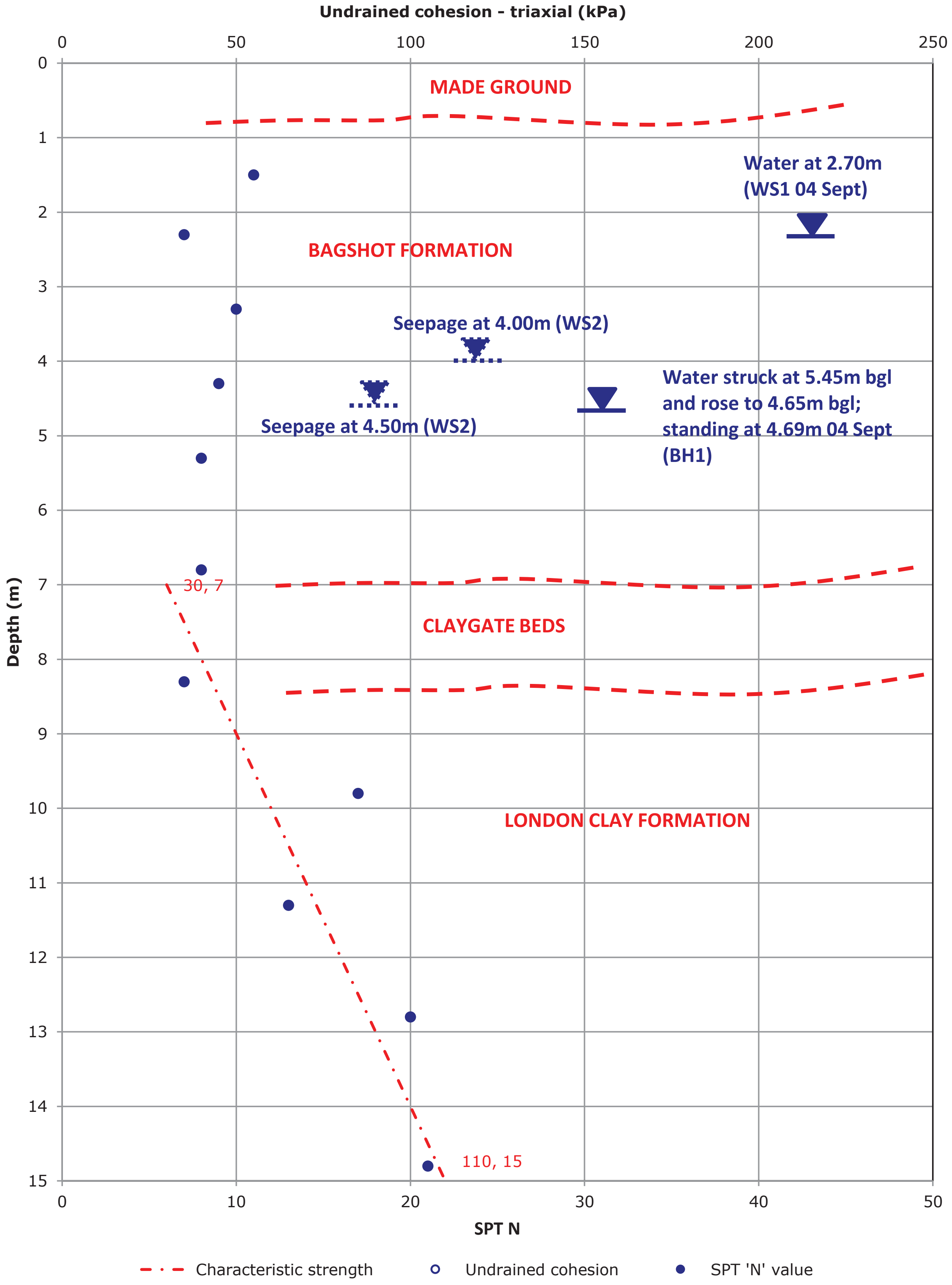
Testing in accordance with BS EN ISO 17892:
- Wet sieving method
- Hydrometer method

Reporting date: 20 Aug 19

Soil Consultants

Site & Location	**18A Frognal Gardens** **Hampstead, London, NW3 6XA**	Report No:	**10402/SC**

Undrained cohesion and SPT-N vs depth



Δcu = 10kPa/m

Site &
Location

18A Frognal Gardens,
Hampstead, London, NW3 6XA

Report No: 10402/SC