

Gas Holder Site, Reading

Geotechnical and Structural Engineering
Planning Design Report

April 2019



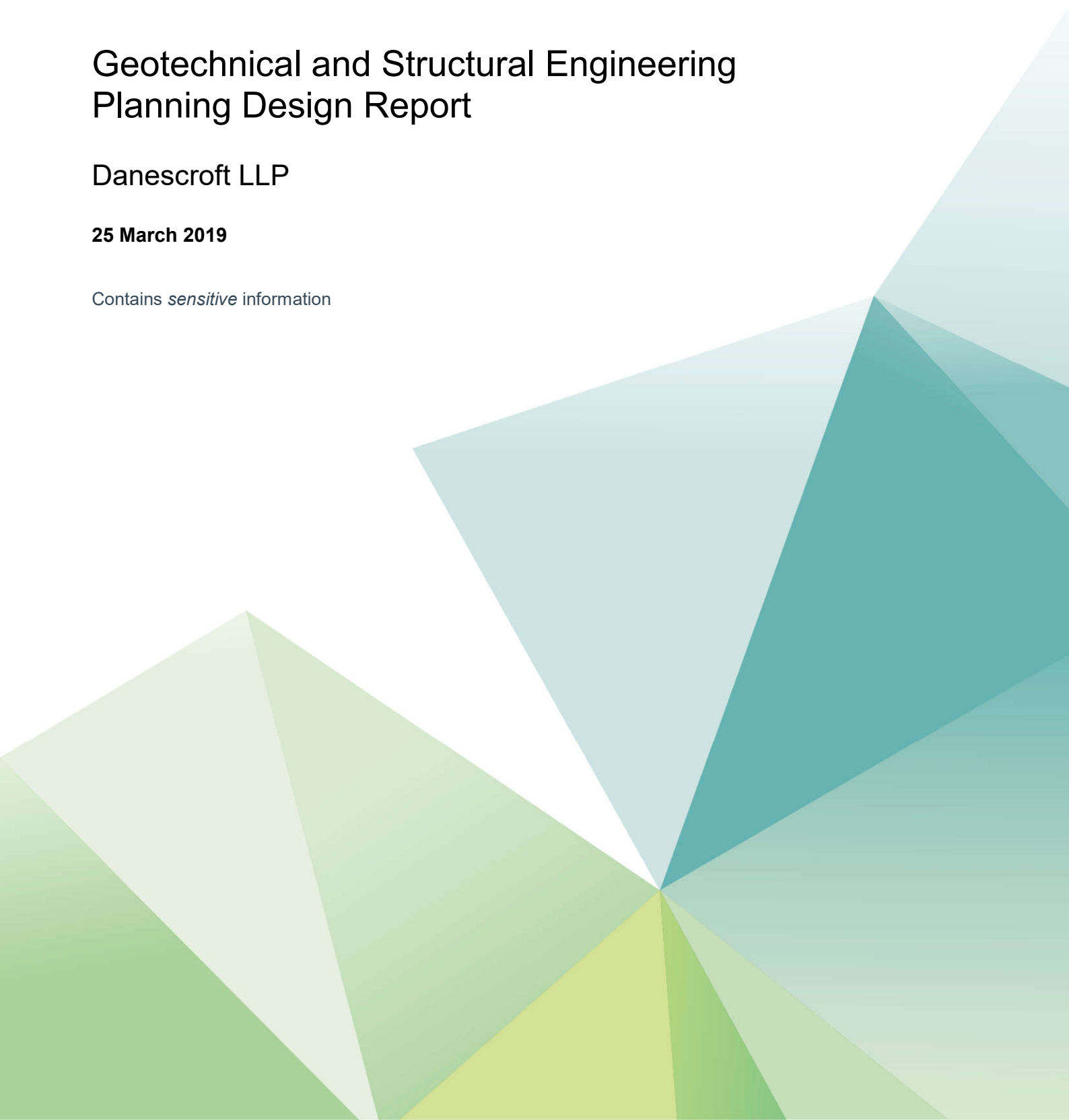
Gas Holder Site, Reading

Geotechnical and Structural Engineering Planning Design Report

Danescroft LLP

25 March 2019

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Document history

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1. Introduction

1.1. Brief

Atkins Limited (Atkins hereafter) has been commissioned by Danescroft LLP (Danescroft hereafter) to provide a structural design report to support the planning application for the proposed redevelopment of Gas Holder Site at Alexander Turner Close, Reading (Gas Holder Site, Reading).

The purpose of this report is to inform the structural options for both the superstructure and foundation of the proposed residential development based upon the geotechnical information associated with the development site available at this stage.

1.2. Proposed Development

This report specifically relates to the development of the Gas Holder Site, Reading and proposed buildings as shown in Figure 1-1 below.

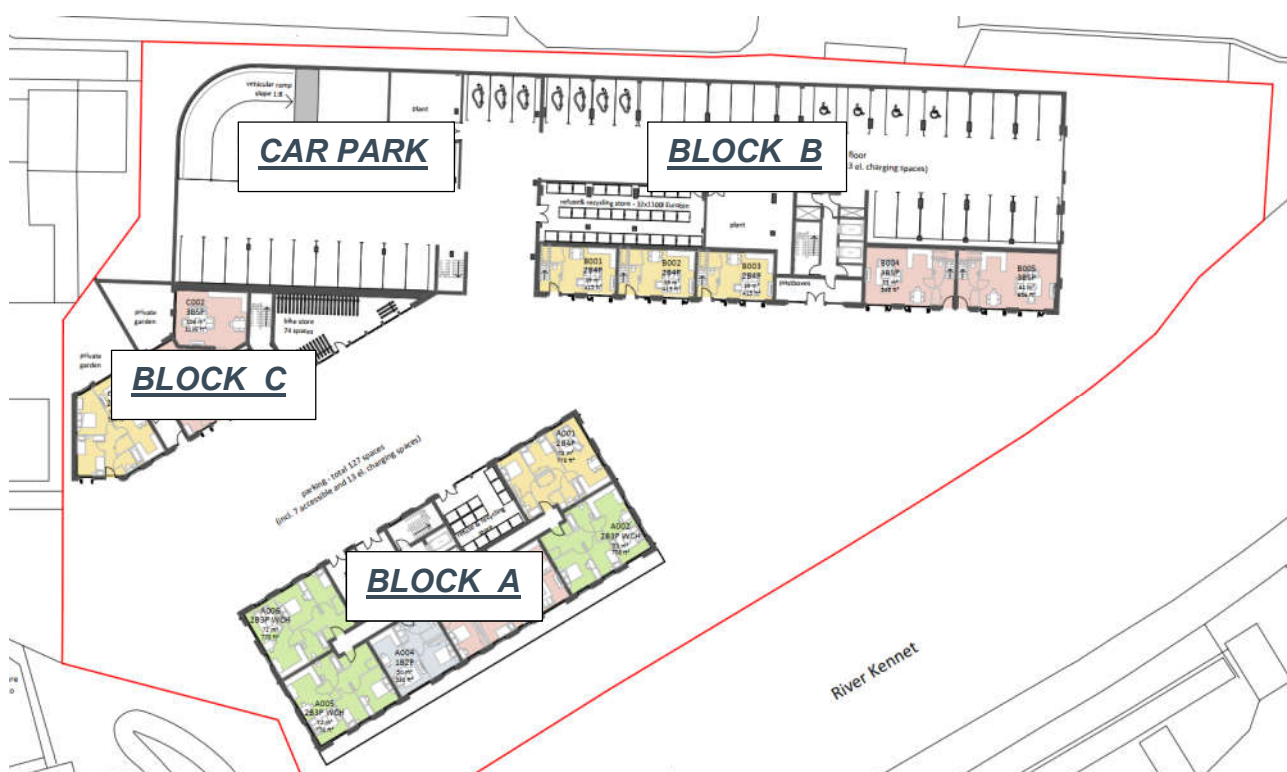


Figure 1-1 Proposed redevelopment of the Gas Holder Site, Reading (Adapted from Collado Collins Architects, 2018) and aerial photography of site location plan (not to scale)

The proposals for the development of the former gasholder site comprise the following:

- Block A: an apartment building with both 4-storey and 5-storey options considered;
- Block B: an 9-storey block with the ground and first floor car parking
- Block C: an 3-storey flats building;
- A two-storey car park.

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1.3. Site Location and Topography

The site is located at the former SGN Gasholder No. 4, Kenavon Road, Reading in Berkshire. The gasholder No. 4 site is located at the eastern end of Kenavon Drive, approximately 1500m north east of Reading town in centre in Berkshire. The site is currently used as temporary offices, car parking and vehicle storage. It occupies an area of approximately of approximately 0.7 hectares. The site is centred at approximate OS grid reference 472936E 173696N. Access is gained via Alexander Turner Close road from the west of the site.

The River Kennet is situated some 15m south east of Block A and some 25m east of Block B which flows into the River Thames some 250m to the north east. A multi-track railway line with a superstore beyond some 30m north of the site. To the west are residential flats of recent construction. The existing water tower north east of the site is to be retained. Based on the available aerial photographs, the site is generally flat at an elevation of approximately 38m AOD.

1.4. Structures within the Site footprint

Figure 1-2 below shows the existing Gasholder no.4 and associated structures on the site footprint. On the north east end corner of the site a former water tower can be found and will be retained as part of the site redevelopment plan.

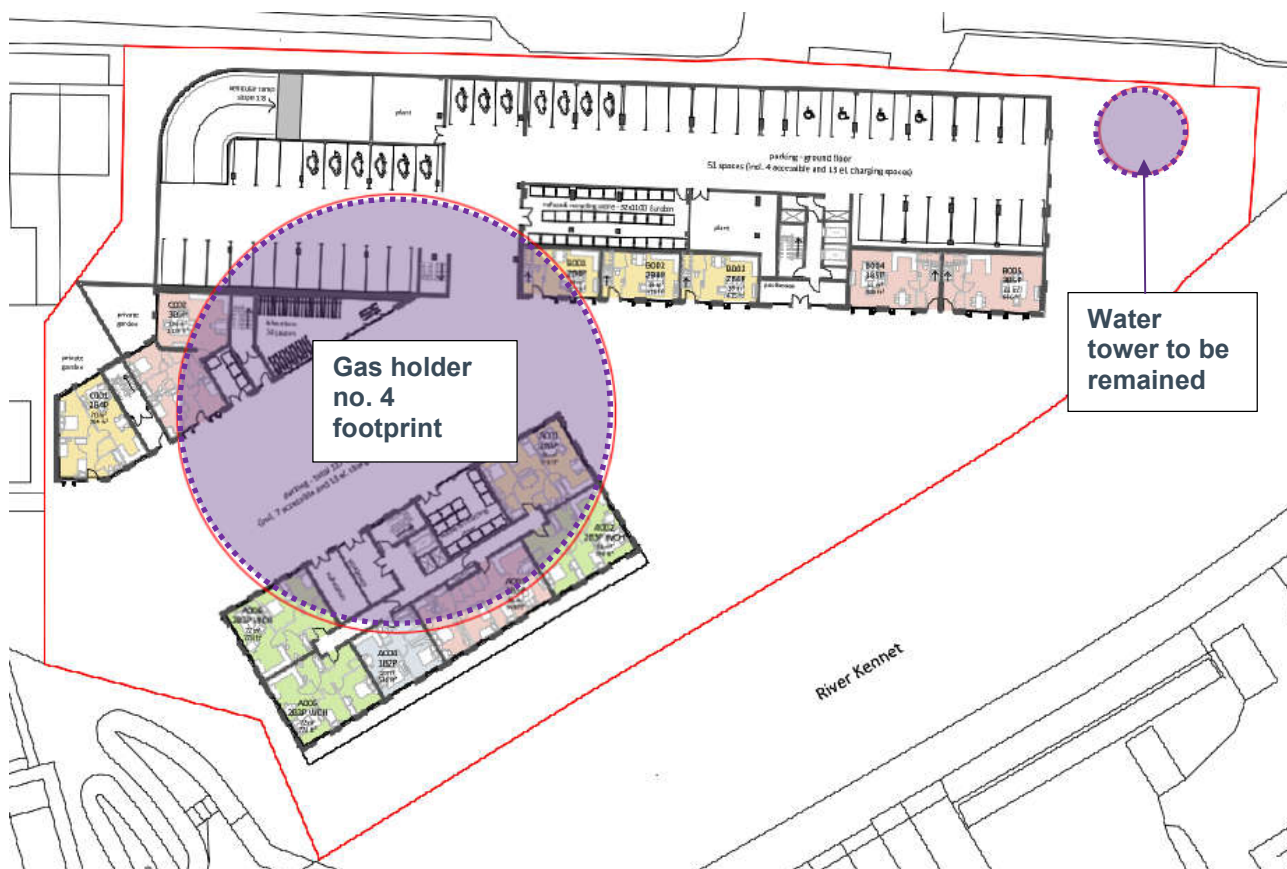


Figure 1-2 Structures within the Site footprint (red lines) and proposed building structures

1.5. Existing foundations

Based on historical information it appears that the gas holder foundations are 'Simplex' concrete piles (>600No.) with a reinforced concrete raft above. Furthermore, the existing reports on the adjacent site informed on the former gasholder No.3 being remediated and backfilled as gasholder No. 2. A cable percussion borehole (BH901) located in the remediated area shows evidence of the backfilling sequence to a maximum depth of 4.0mbgl with a concrete slab of 0.8m. The vertical extent of the excavation was limited to the natural alluvium.

Figure 1-3 below presents an excerpt of the 1930 historical plan, which is included in the Envirocheck report for the adjacent gasworks site (presented within the AIGE 2002 Ground Conditions Report) and shows the proximity of former Gasholder No. 3 (demolished).

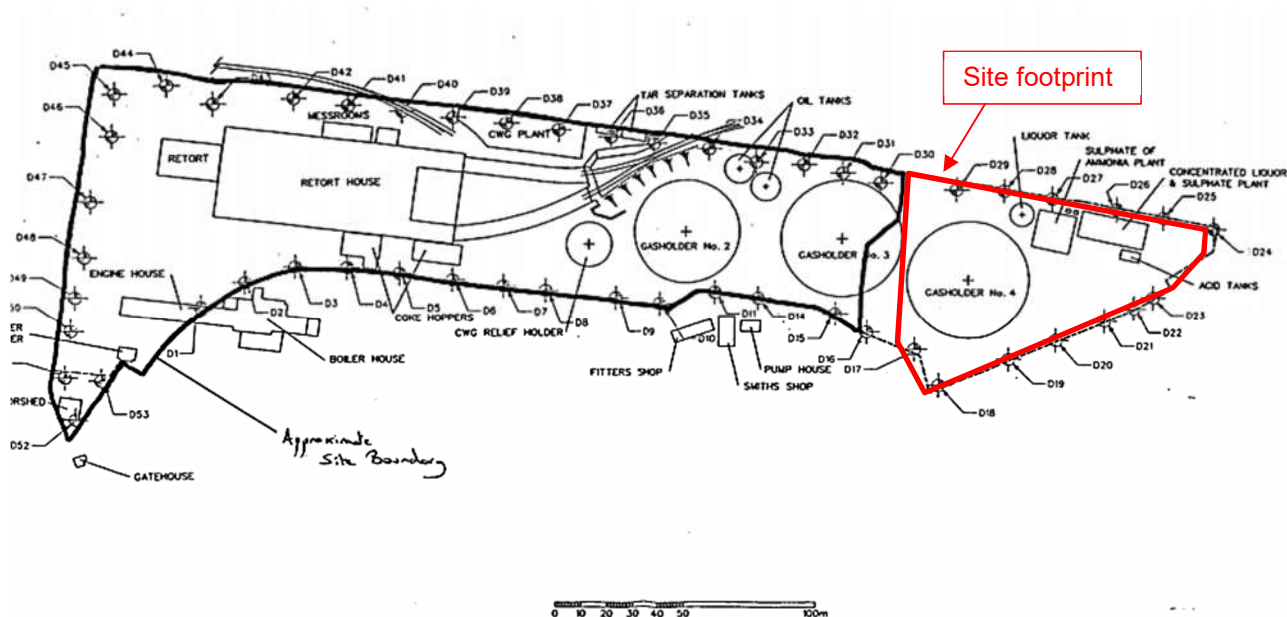


Figure 1-3 1930s historical plan showing gasholders and associated structures

2. Superstructure Solutions

2.1. Block C

This is a three-story building which accommodates 10 flats and bicycle store. The layouts are different between the ground floor and upper floors. The flats' footprint is approximately 8m by 9m and each flat on the first and second floors will have a balcony.

The building structure is proposed to be a reinforced concrete frame comprised of blade columns and flat slabs. The staircase walls will be reinforced concrete walls to provide the required lateral stability to the structure.

We would recommend that Block C superstructure to be separated from the adjacent car park RC frame to avoid cold bridging issue.

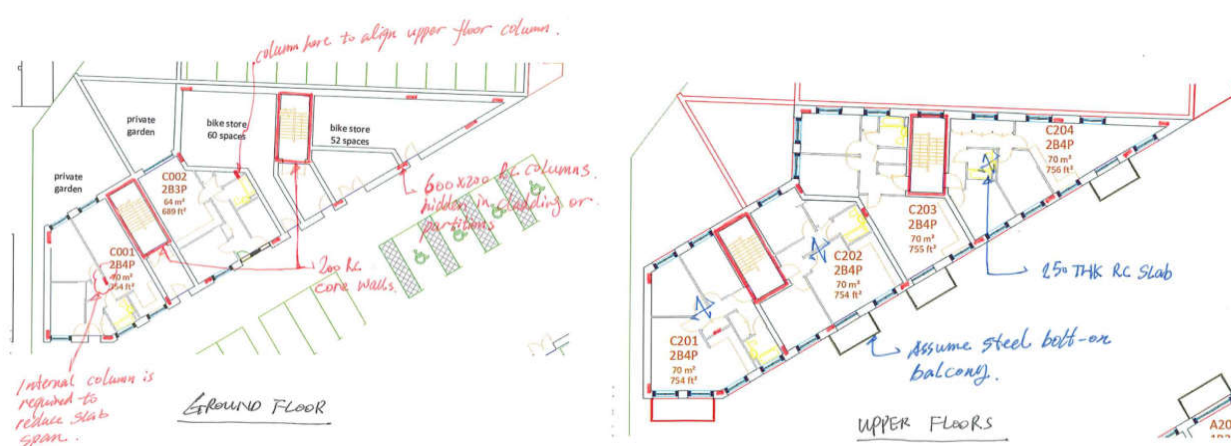




Figure 2-2 Block B ground floor layout

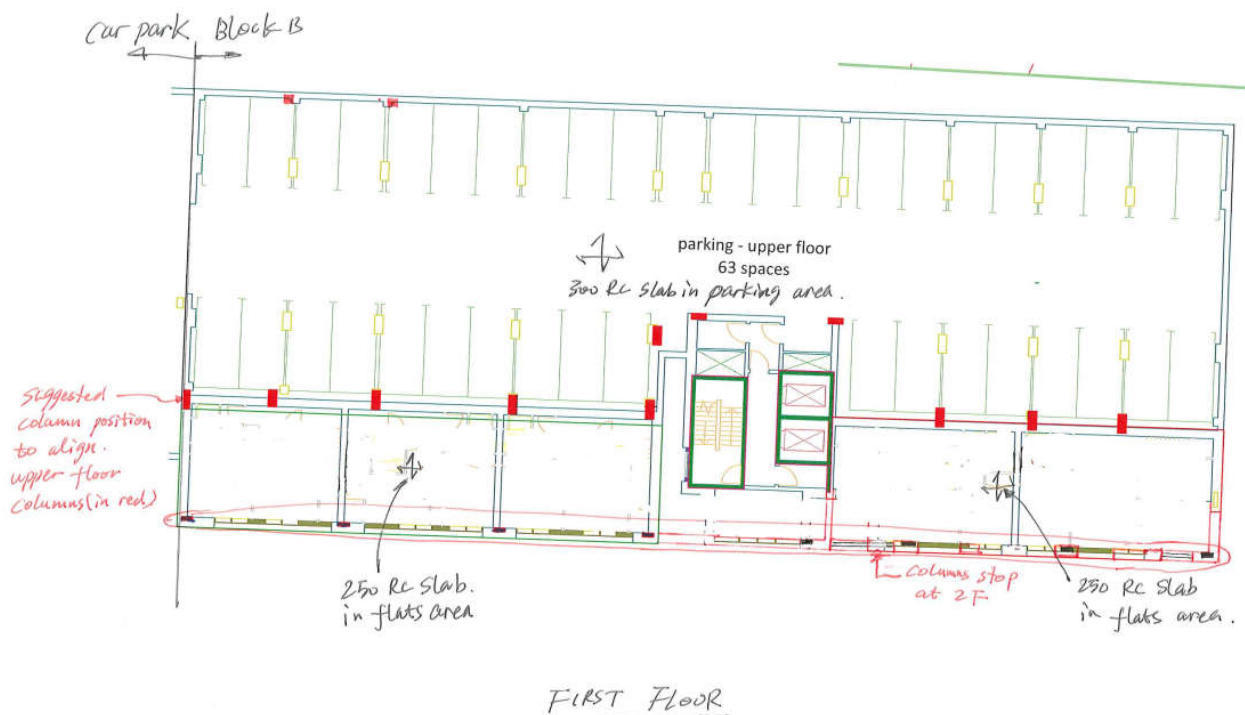


Figure 2-3 Block B first floor layout

The floor layout changes on the second floor with the building setting back on north and south elevations. Further the columns at second floor and above have been re-positioned to suit the apartment layouts and do not align with the columns at first floor level, locally. The shear walls in the towers will have to start from second floor. Therefore, on the second floor reinforced concrete transfer slabs and beams is required.

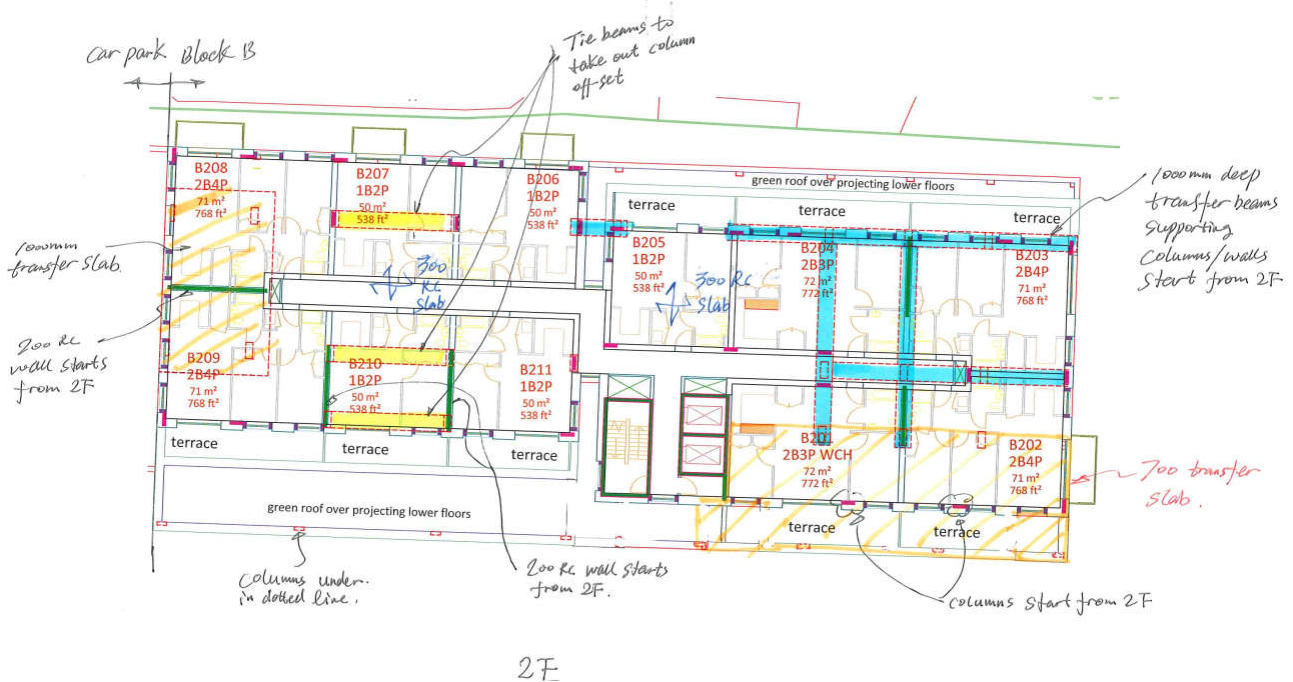


Figure 2-4 Block B second floor layout

For the upper floors, the structure is typically a 250mm thick reinforced concrete flat slab supported on blade columns. It is proposed that the projecting balconies to the apartments extend approximately 2.5m from the structure and therefore it is suggested that a diagonal tie the balcony back to the main structure is provided to limit deflection and dynamic issues.

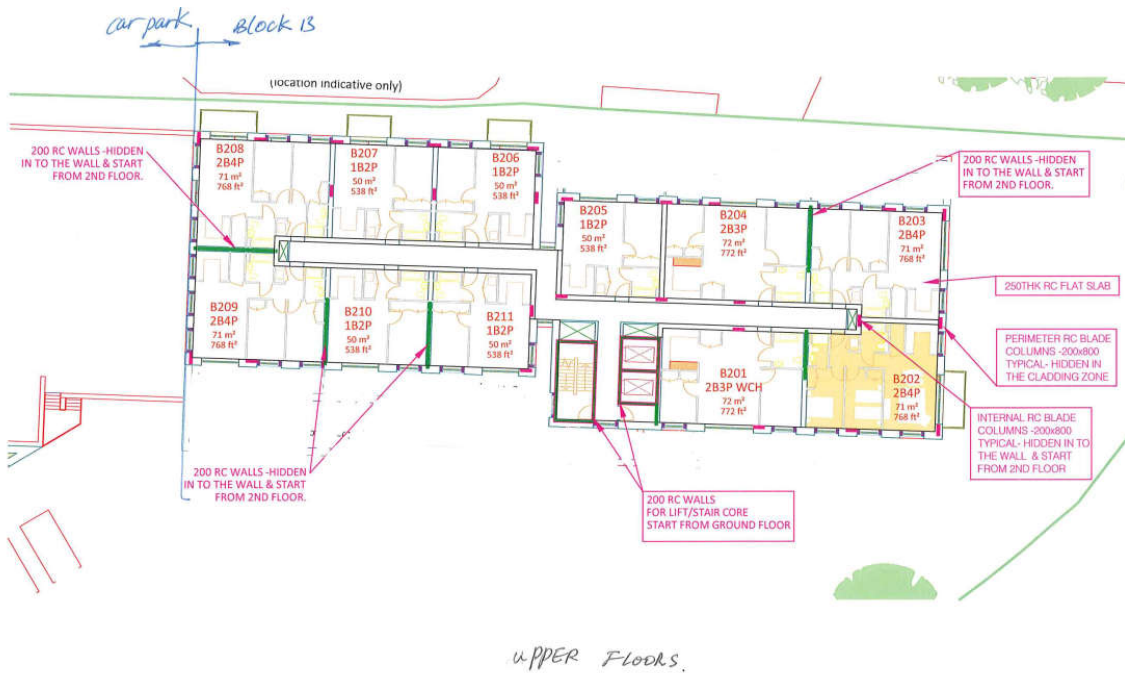


Figure 2-5 Block B upper floors layout

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2.3. Two-storey car park

It is proposed to be a reinforced concrete frame with flat slabs supported on columns and walls and is independent of the adjoining Block B and a movement joint is to be provided at the juncture.



Figure 2-6 Car park ground floor layout

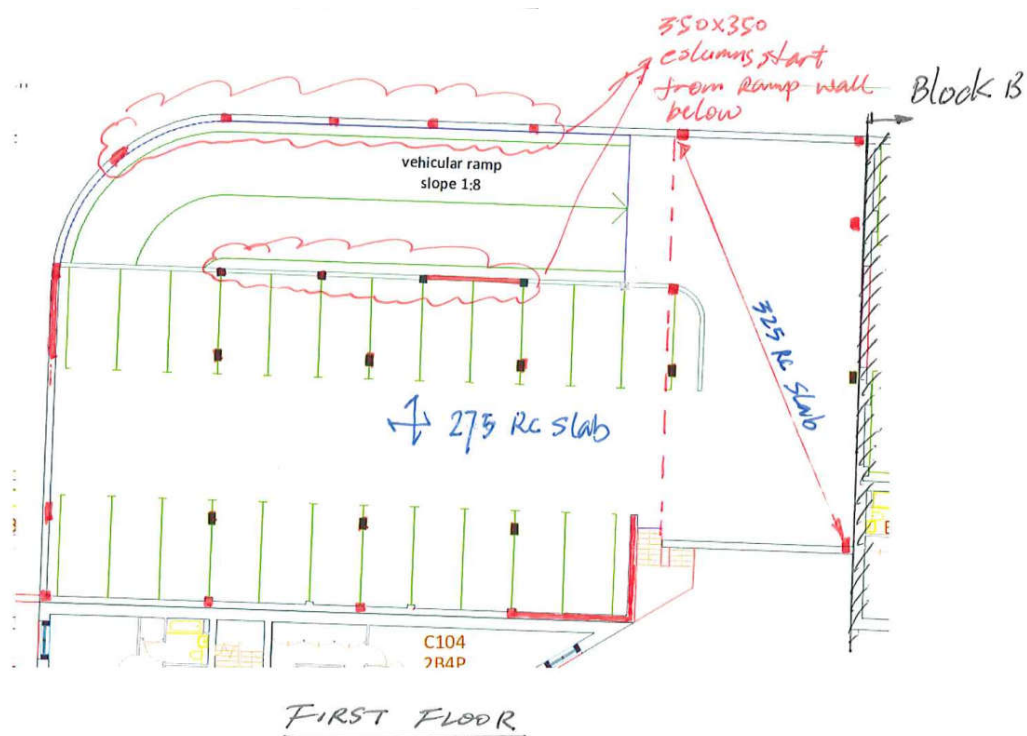


Figure 2-7 Car park first floor layout

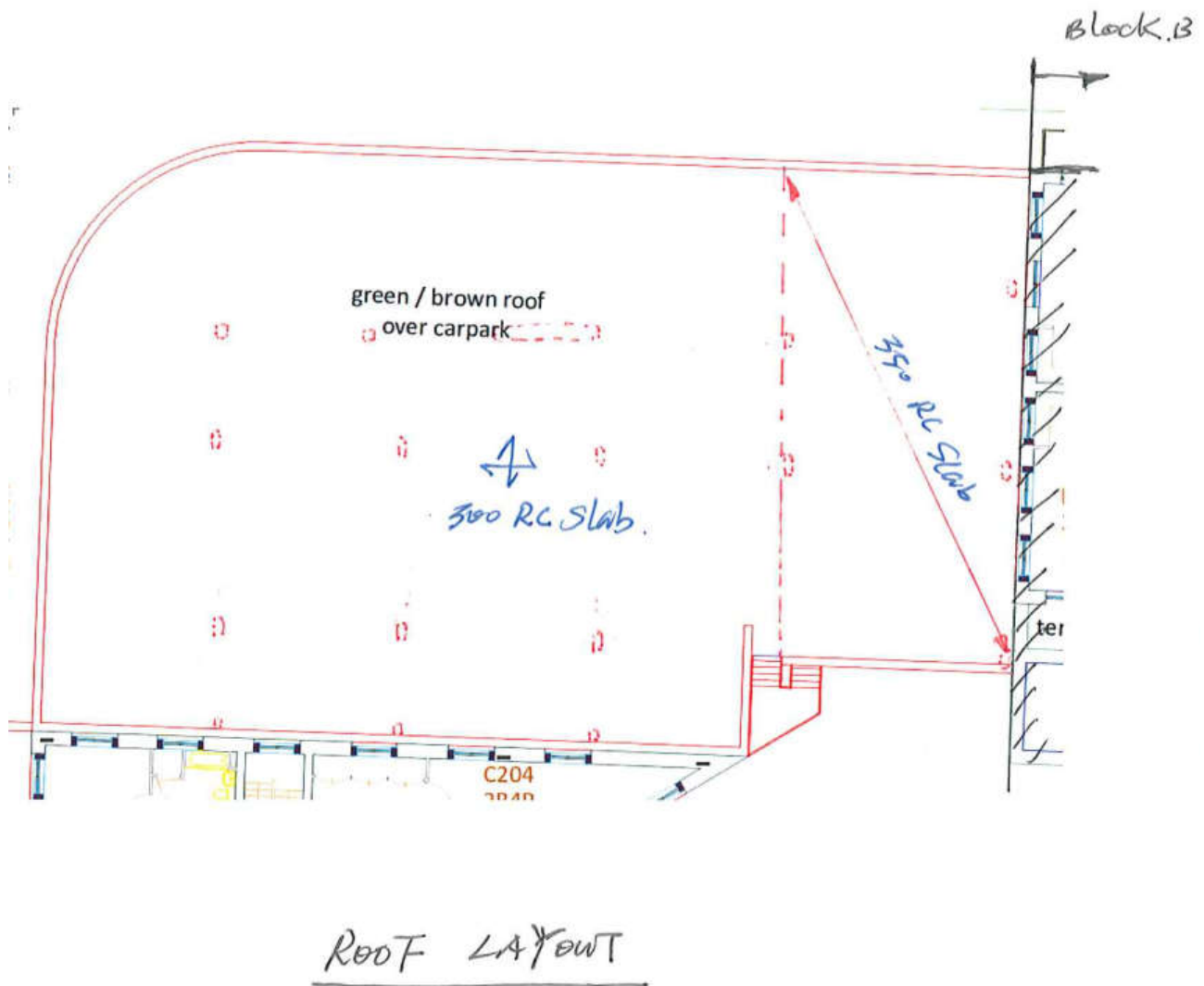


Figure 2-8 Car park roof layout

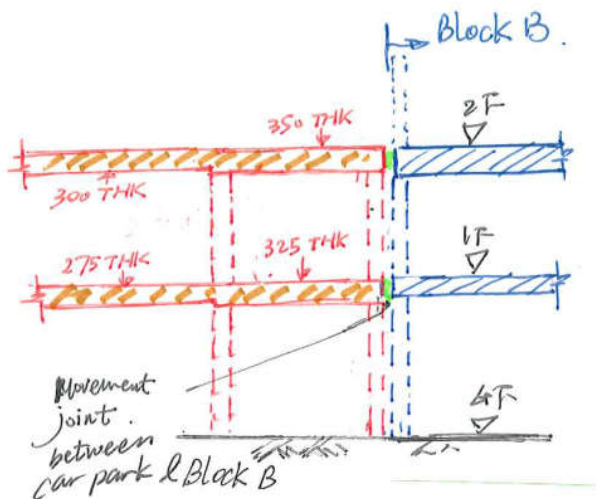


Figure 2-9 Movement joint between Car park and Block B

2.4. Block A – 4 or 5 storey building

There is a low-rise building located on the south side of the site. The original scheme is for a four-storey building although a five-storey option has also been developed. This building is predominantly located over the existing gas holder footprint and two superstructure options, reinforced concrete frame and a lightweight framing option have been considered to understand the impact on the potential foundation solution.

The reinforced concrete frame option will be flat slabs supported on columns with the core walls providing the overall stability.

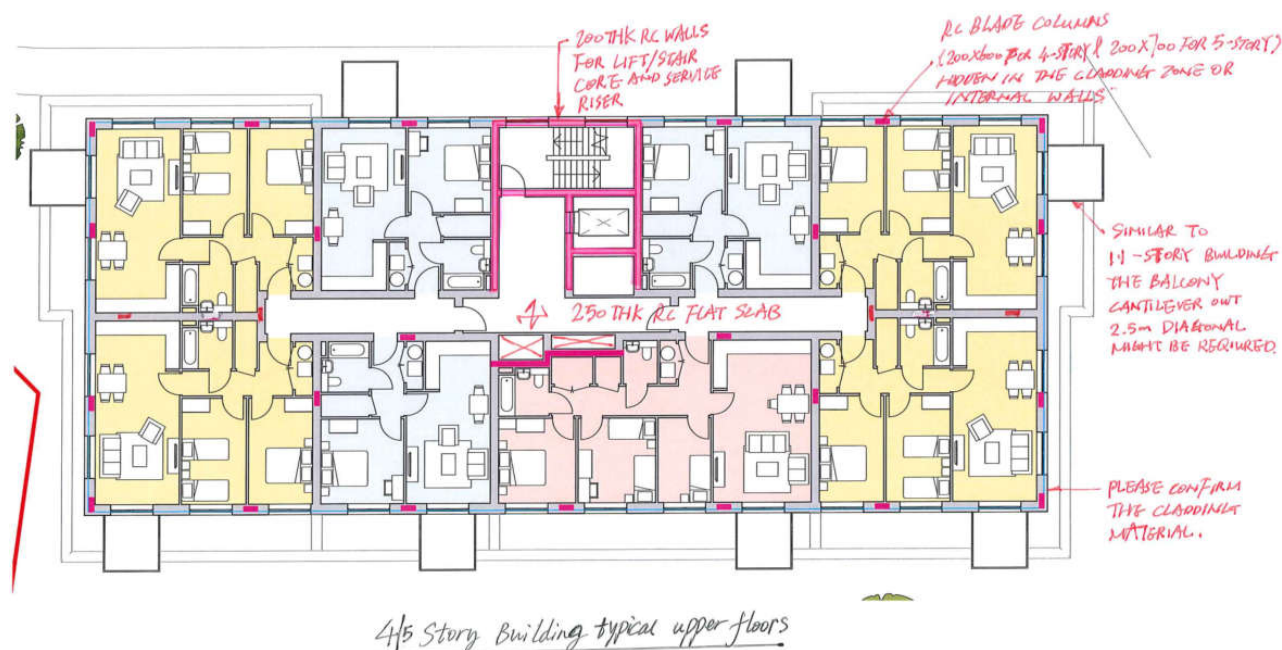


Figure 2-10 Typical floor layout – RC frame option

The implication of a reinforced concrete structure is that a piled foundation will be required to support the building loads, which will mean breaking through the existing gas holder foundation and disturbing the potentially contaminated ground.

Therefore, a lightweight superstructure option has been developed that enables the use of raft foundation solution and hence reduces disturbance to the existing gas holder.

The layout of the partitions at ground floor is not the same as the upper floor so for the lightweight option it is proposed that a reinforced concrete structure is provided up to first floor level with the lightweight framing commencing at this level and above. This lightweight framing for the upper floors could be Metframe or similar.

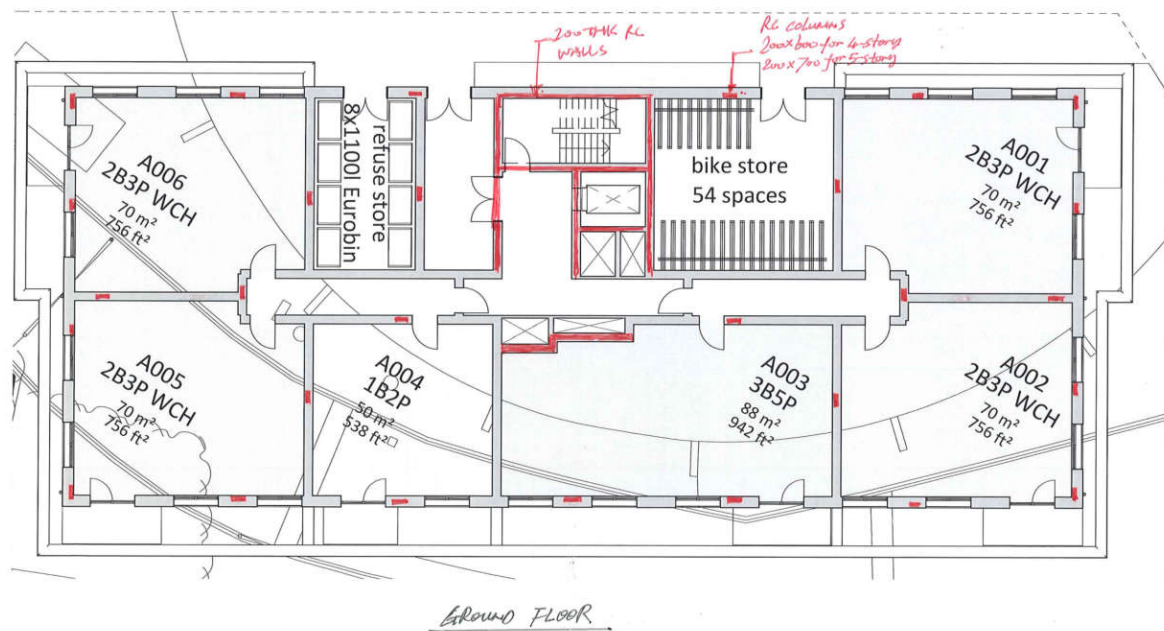


Figure 2-6 Ground floor layout – Lightweight option

Metframe is a pre-panelised system which is used to provide the load bearing structure. Joisted floors spanning between the load bearing stud walls and offer a much lighter structure. As the upper floor layouts are consistent some flat internal walls therefore can be load bearing to reduce the floor joist span.

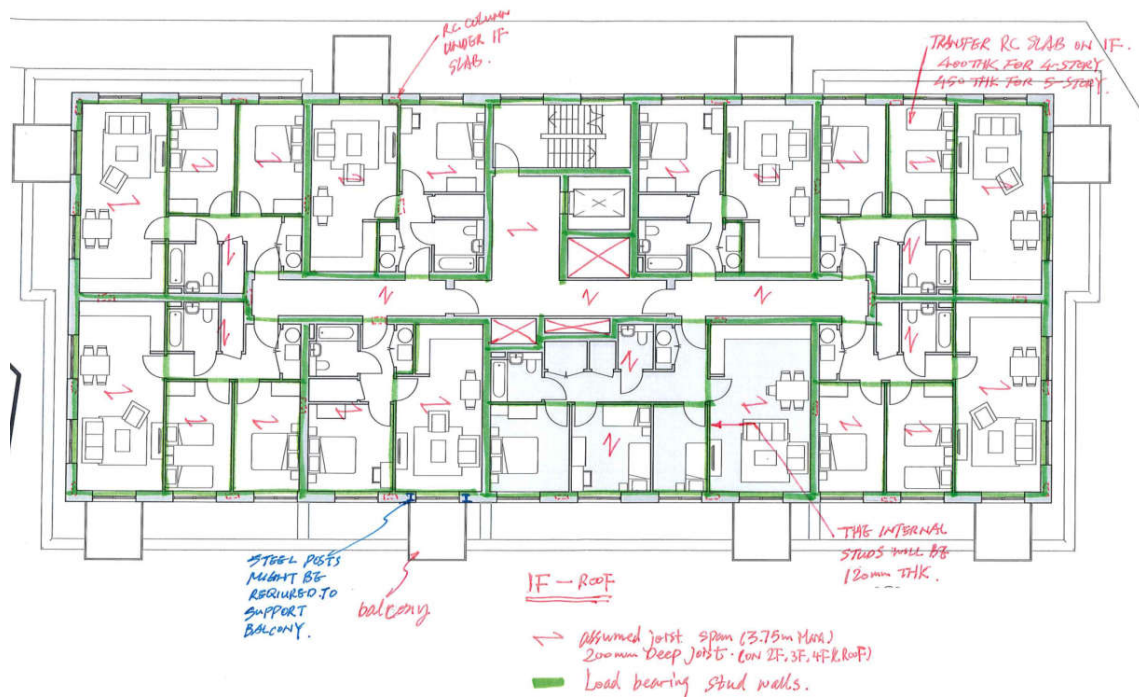


Figure 2-7 Typical floor layout – Lightweight option

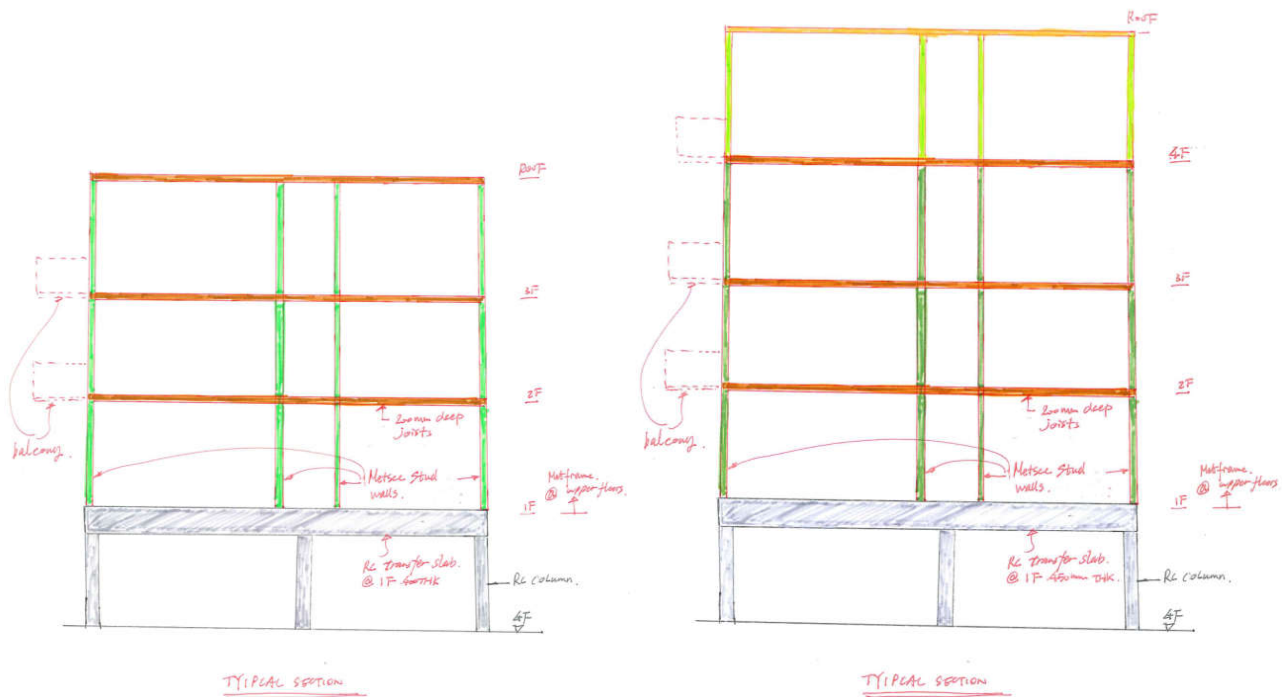


Figure 2-8 Typical sections – Lightweight option

3. Geotechnical Desk Study

3.1. Introduction

Atkins Geotechnical Engineering has carried out a Desk Study to determine a ground and groundwater model and presents geotechnical material parameters for the site to inform the design of the proposed works in accordance with EN 1997-1/2: Eurocode 7.

The study is to highlight potential ground based geotechnical and contamination risks associated with the development site and to identify where further assessment may be required to inform a strategy for addressing the identified risks and make recommendations on potential foundation and substructure options.

A full copy of the Desk Study is included in Appendix B but below are relevant extracts pertaining to the proposed foundation solutions are presented below.

3.2. Ground Conditions

The findings of the geotechnical report indicate that the site is underlain by Made Ground, Alluvium (when present), River Terrace Deposits and Chalk at depth.

Based on the historical boreholes there is no confirmation of the presence of relic foundations.

However, one borehole (AIGE, 2005) encountered concrete at depths between 4.0mbgl to 4.8mbgl which coincide with base of former gasholder no.3.

A summary of the site stratigraphy and parameters for preliminary design, based on the interpretation of the results are presented in Tables 3-8 and 3-9.

Stratum	Top of Stratum (mAOD)	Thickness of Stratum (m)
Made Ground – Removed	+37.5	3.0
Alluvium – Ignored	+34.5	1.0
RTD	+33.5	3.0
Upper Chalk (Grade Dm)	+30.5	4.5
Upper Chalk (Grade Dc)	+25	Proven to 2.0 (BH901)

Figure 3-1 Summary of Characteristic Geotechnical Parameters

3.3. Foundation Options

The selection of the final foundation solution is influenced by a number of factors relating to the ground conditions and the proposed development. These are generally associated with the ability of the ground to support the loads applied by the proposed buildings and the sensitivity of the buildings to ground movement.

The exploratory holes on the site have revealed a sequence of made ground overlying alluvium with underlying saturated granular terrace deposits and chalk at depth. The proposed structures foundation options will likely be comprised of, as follows:

3.3.1. Building B

Given the building height and heavy column/wall loads it is proposed that a piled foundation solution be adopted. Columns and walls will be supported on various pile caps and we suggest a 900mm dia. CFA pile would be preferable. The piles and pile caps will be constructed clear of the existing gas holder base. Where the corner oversails the existing gas holder, the existing base need to be broken locally to install the new piled foundation as the cantilever ground is not practical considering the span will be up to 7m. Perimeter and internal reinforced concrete ground beams are proposed to supporting cladding as well as provide lateral restraint to the pile caps where necessary.

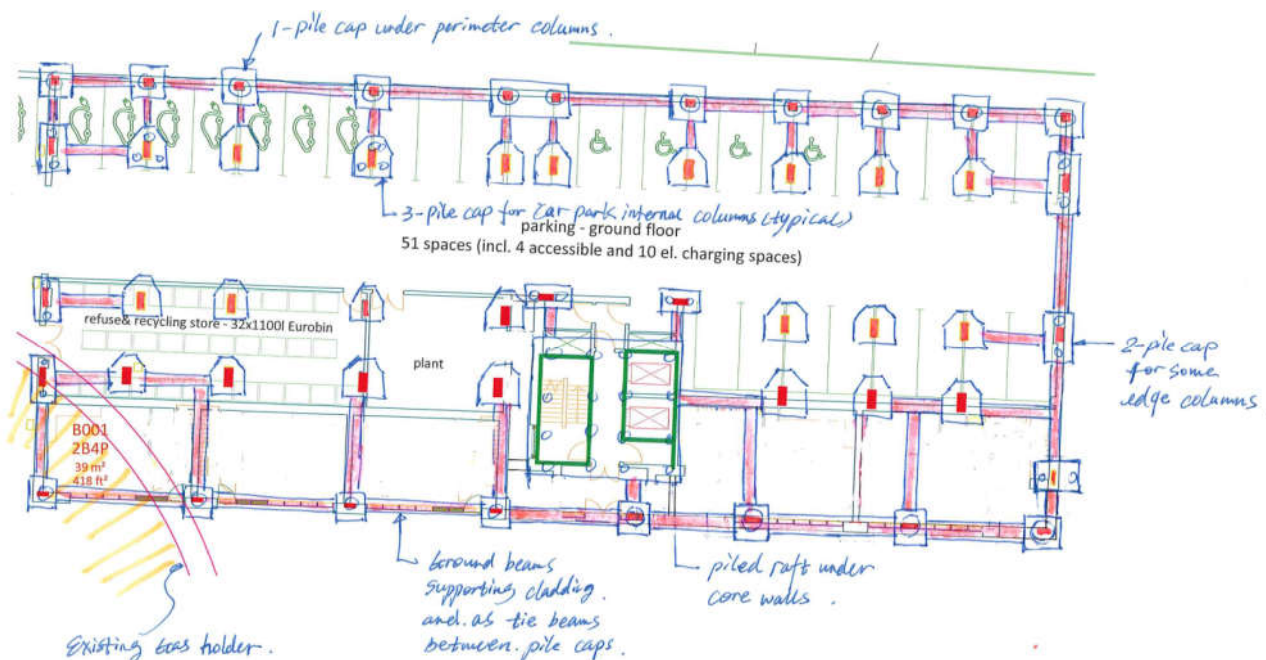


Figure 3-2 Building B foundation layout

3.3.2. Building A (4/5-storey)

In this section alternative foundation solutions are discussed relating to the two superstructure options proposed, namely reinforced concrete frame option and lightweight option. The building is located mainly over the existing gas holder and the implications on the existing base are highlighted below.

3.3.2.1. Piled foundation for RC option

The unfactored column loads of the proposed reinforced concrete frame option have been assessed and are expected to be in the order of 2500kN for a 4-storey building and 3000kN for the 5-storey alternative. Based upon this the recommendation is that a piled foundation be adopted.

The existing gas holder base will have to be broken out locally to install the new piles. As discussed in the car park and duplex houses foundation it is assumed that the gas holder base is backfilled for the piling platform preparation. Therefore, a collar will need to be installed from the existing base to the top of the piling platform at the pile locations where the base to be broken out to retain the backfill material.

To minimise the work to the existing base, single pile-cap is proposed under the columns and the piles are likely to be 900mm dia. CFA pile. A piled reinforced concrete ground beam is proposed under the walls. In addition, reinforced concrete ground beams are required to tie the pile caps as well as to support the cladding.

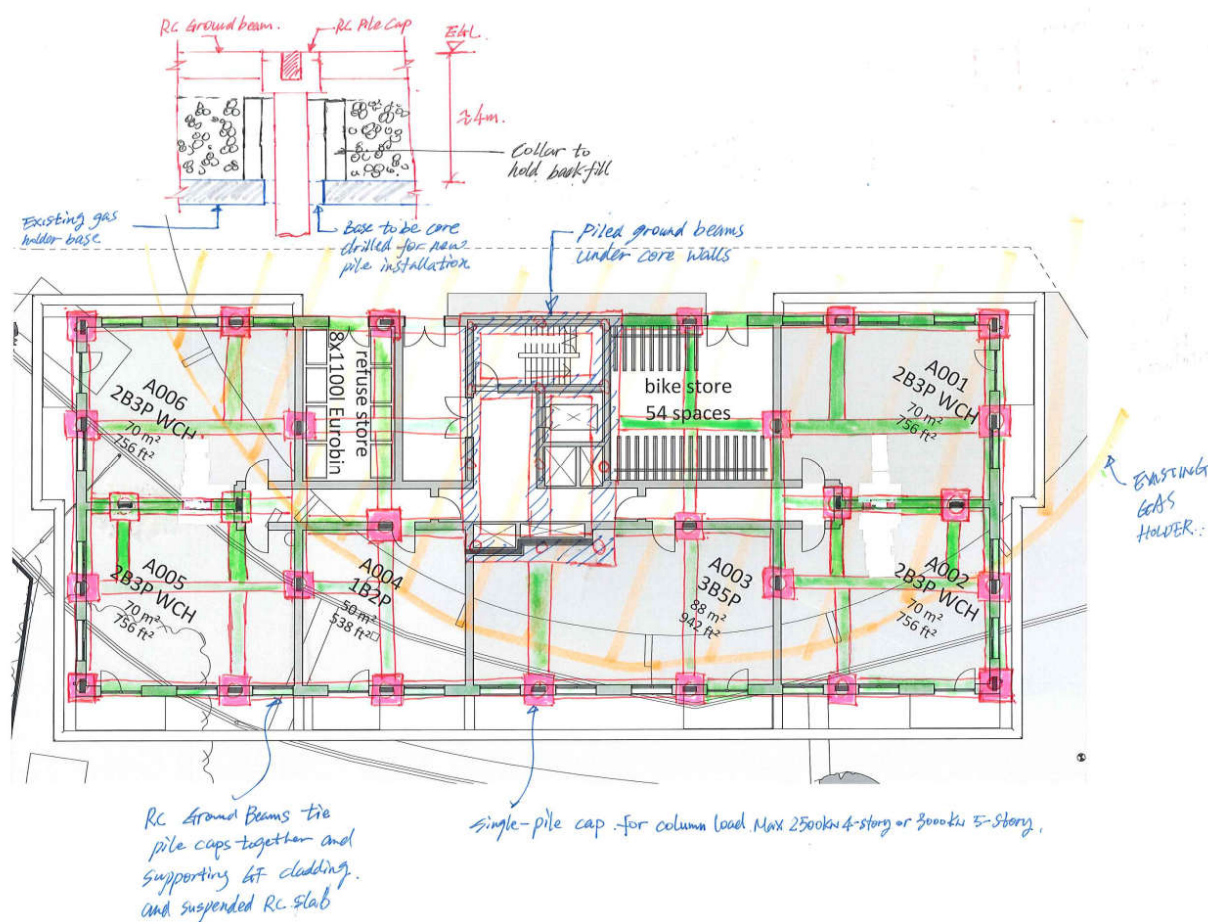


Figure 3-3 Foundation for RC frame option

3.3.2.2. A raft foundation for the light-weight option.

For the light-weight option the column/wall loads are at a maximum of 1100kN for 4-storeys and 1450kN for 5-storeys and on this basis it is feasible to adopt a raft foundation. The top of River Terrace Deposits (RTD) is at average 4mbgl similar to the top level of the existing gas holder base. It is assumed that at this depth a bearing design resistance will be about 1000kPa. Therefore, a shallow RC raft can be cast on the RTD and directly over the gas holder base, the raft will be of 900mm and 700mm thick for 5-storeys and 4-storeys respectively.

Alternatively, the raft can be cast on the well compacted backfill over gas holder base and onto a vibro stabilised improved ground outside of the gas holder footprint. This option will reduce excavations.

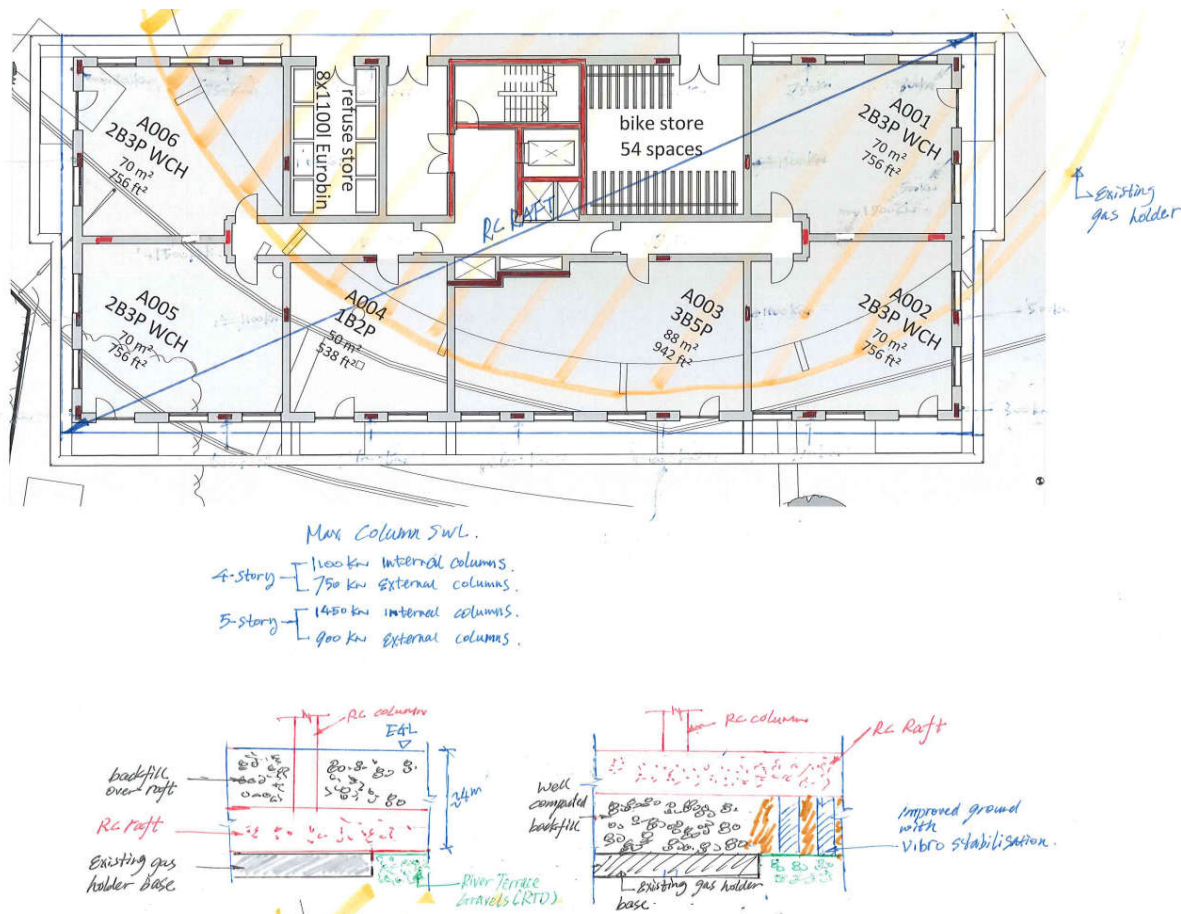


Figure 3-4 Raft Foundation for light-weight option

3.3.2.3. Pad (spread) foundation for the light-weight option.

As an alternative to a raft foundation, it is also feasible to have individual pad foundations under the reinforced concrete columns and walls.

Assuming a footing of 1.00m x 1.00m at a depth of 4m equates to a bearing design resistance of about 1000kPa. Therefore, the footing size for 4-storeys and 5-storeys can be 1.15m x 1.15m and 1.30m x 1.30m respectively. For those columns and walls within gas holder base footprint, pad foundation can be then cast directly over the base.

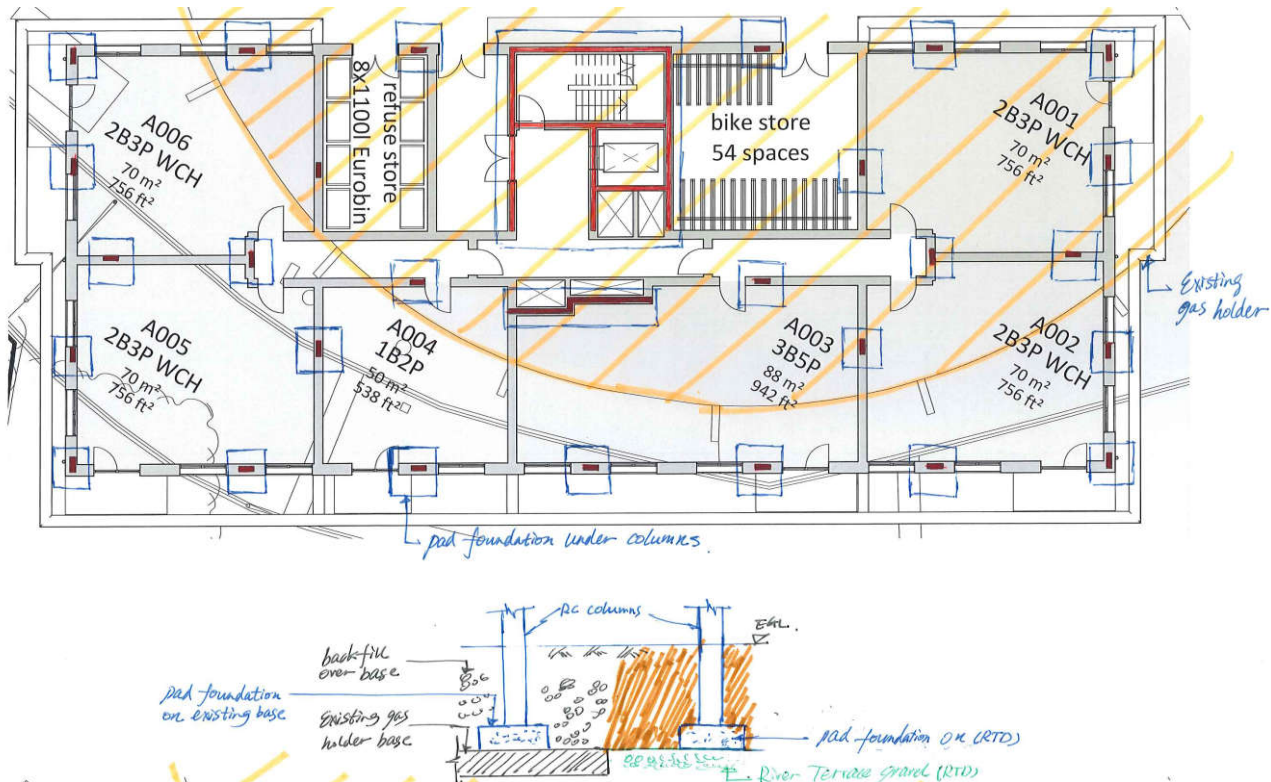


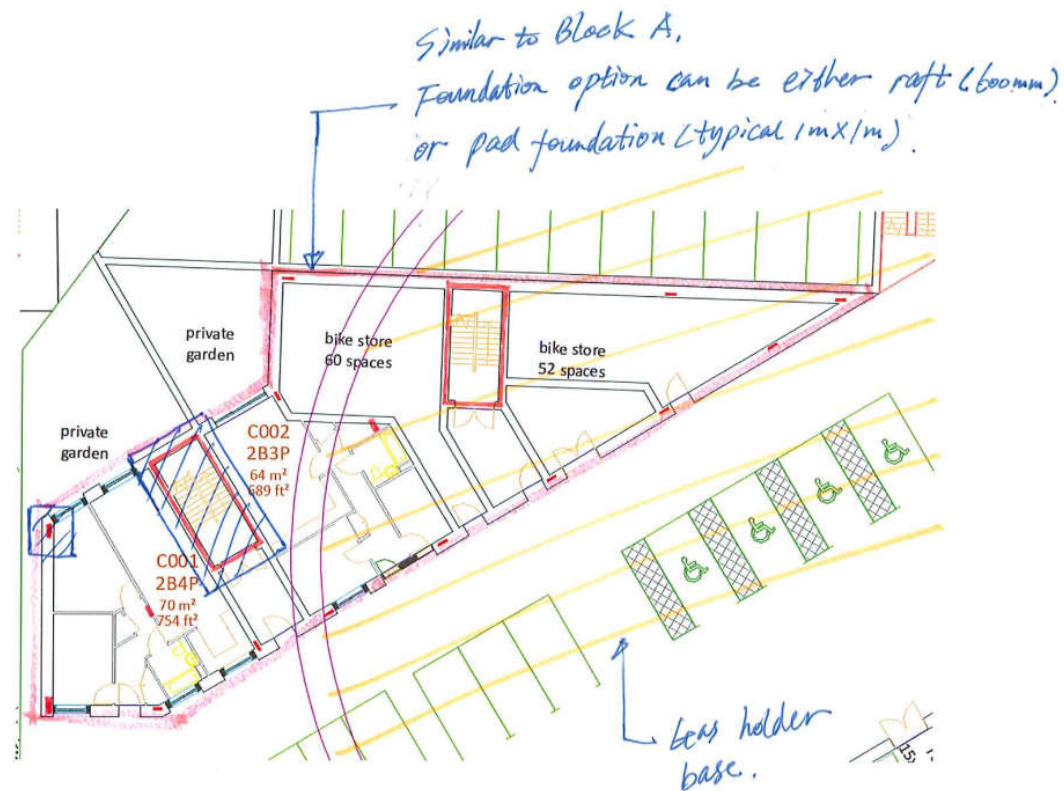
Figure 3-5 Spread Foundation for light-weight option

3.3.3. Block C and car park

These two buildings are located partially over the existing gas holder base. It is assumed that the gas holder base, which is approximate 4m bgl, will be empty after the steelwork being dismantled. Therefore, the base will be backfilled to the proposed site levels. It will be feasible to achieve allowable bearing capacity of the backfill over the existing base to maintain a spread foundation solution.

Alternatively, a combined raft foundation can be proposed to support the superstructures within the existing gas holder base footprint. This will be similar option that has been discussed in Block B foundation solution.

For those foundations that are located outside of the existing gas holder footprint replacement of the Made Ground and Alluvium with engineered fill material maybe be required or alternative ground improvement could be adopted to achieve a suitable bearing capacity. Refer to section 5.6 and 5.7 of the Geotechnical Engineering Desk Study appended to this report for further information.



FOUNDATION

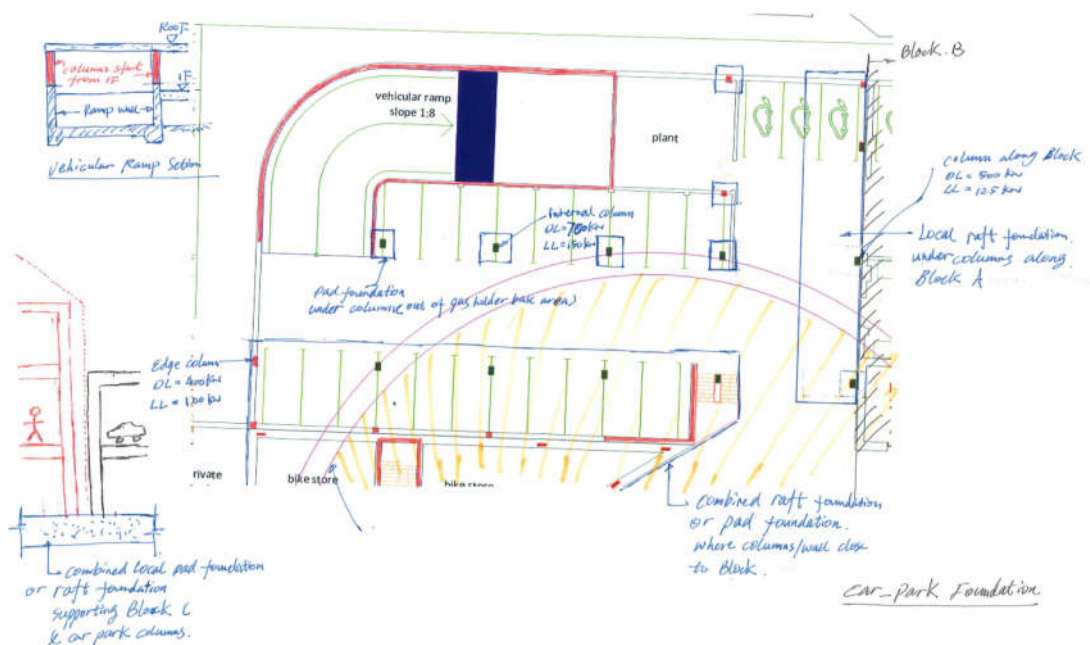
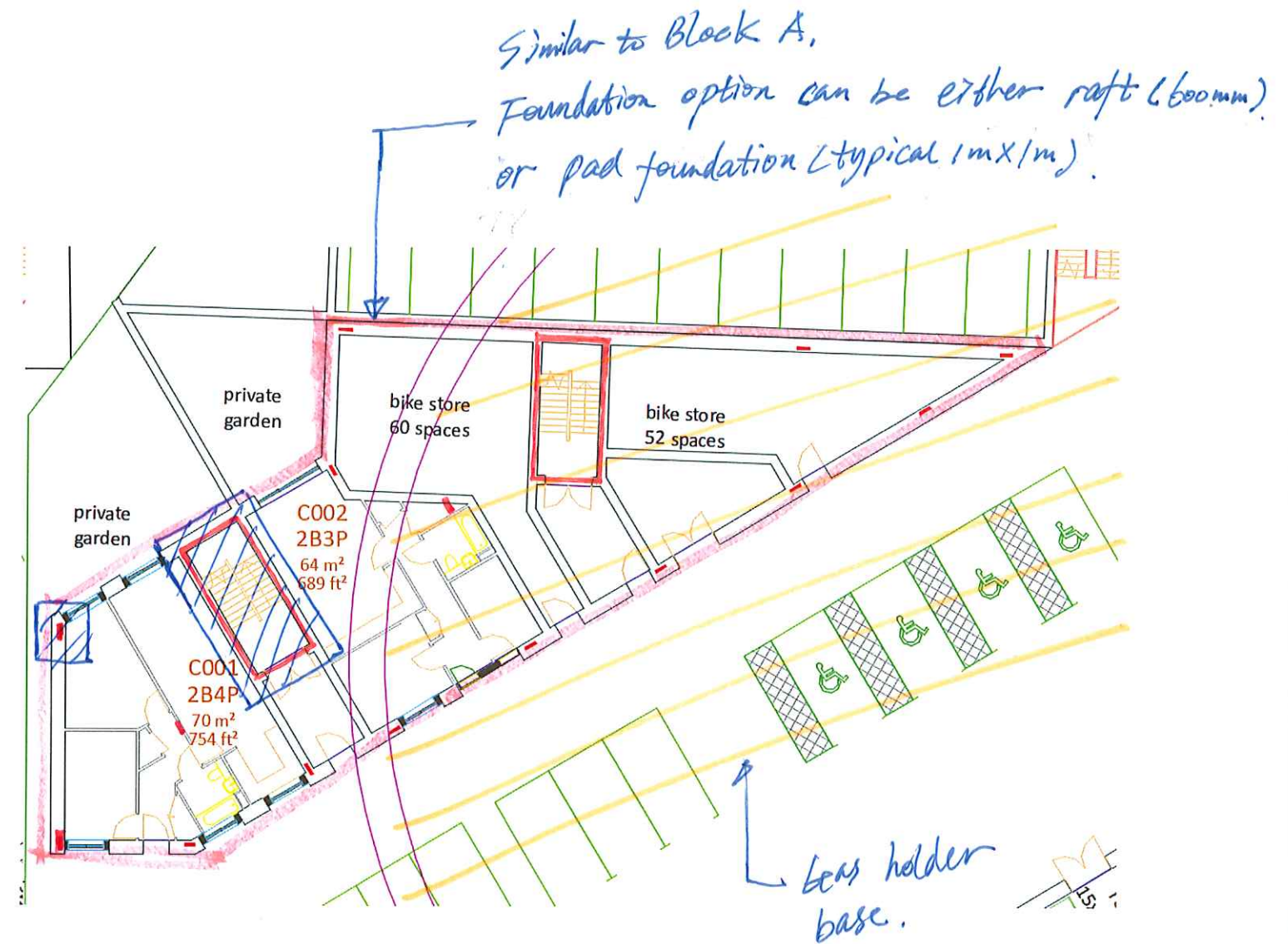
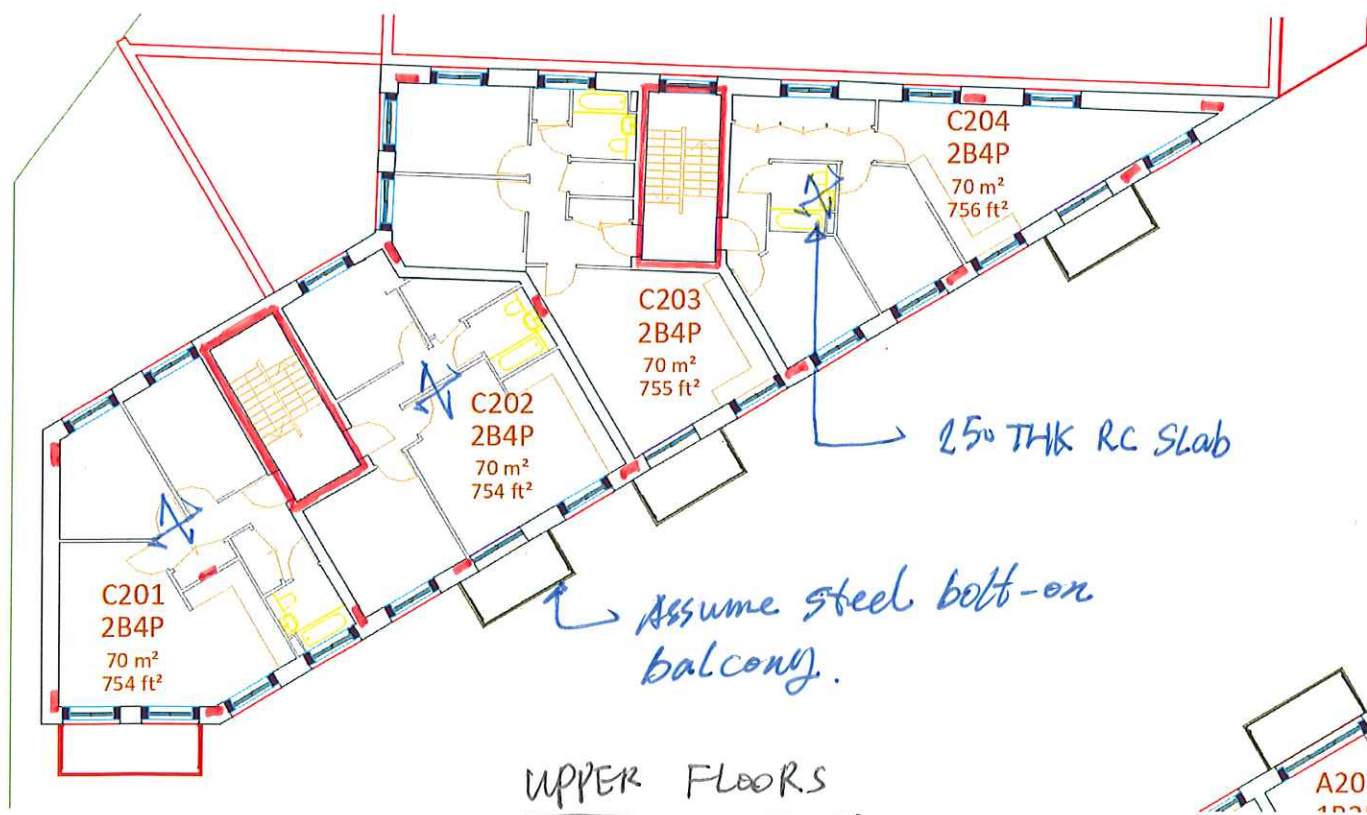
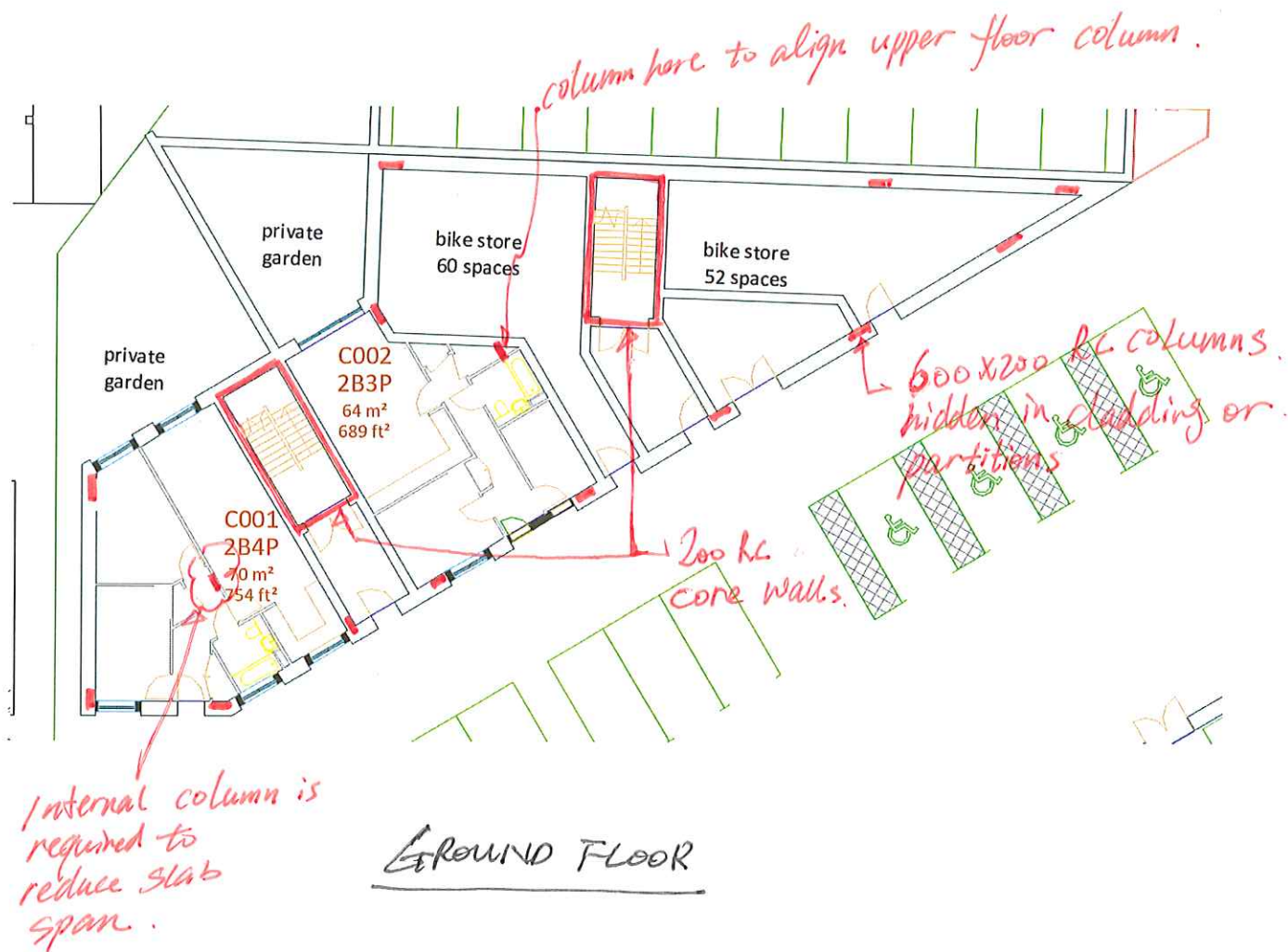


Figure 3-6 Car park and Block C foundations

Appendices

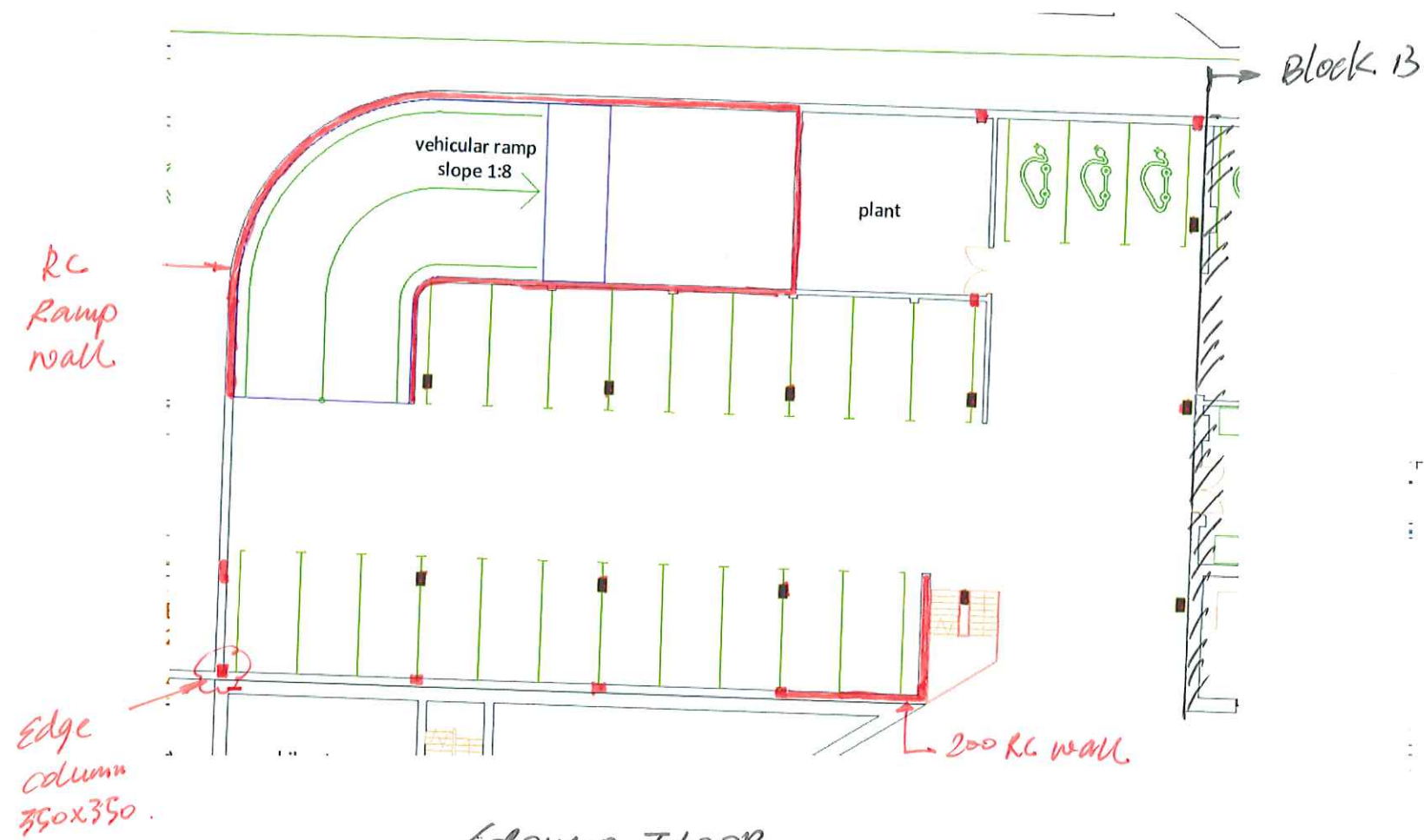
Appendix A. Structural Sketches



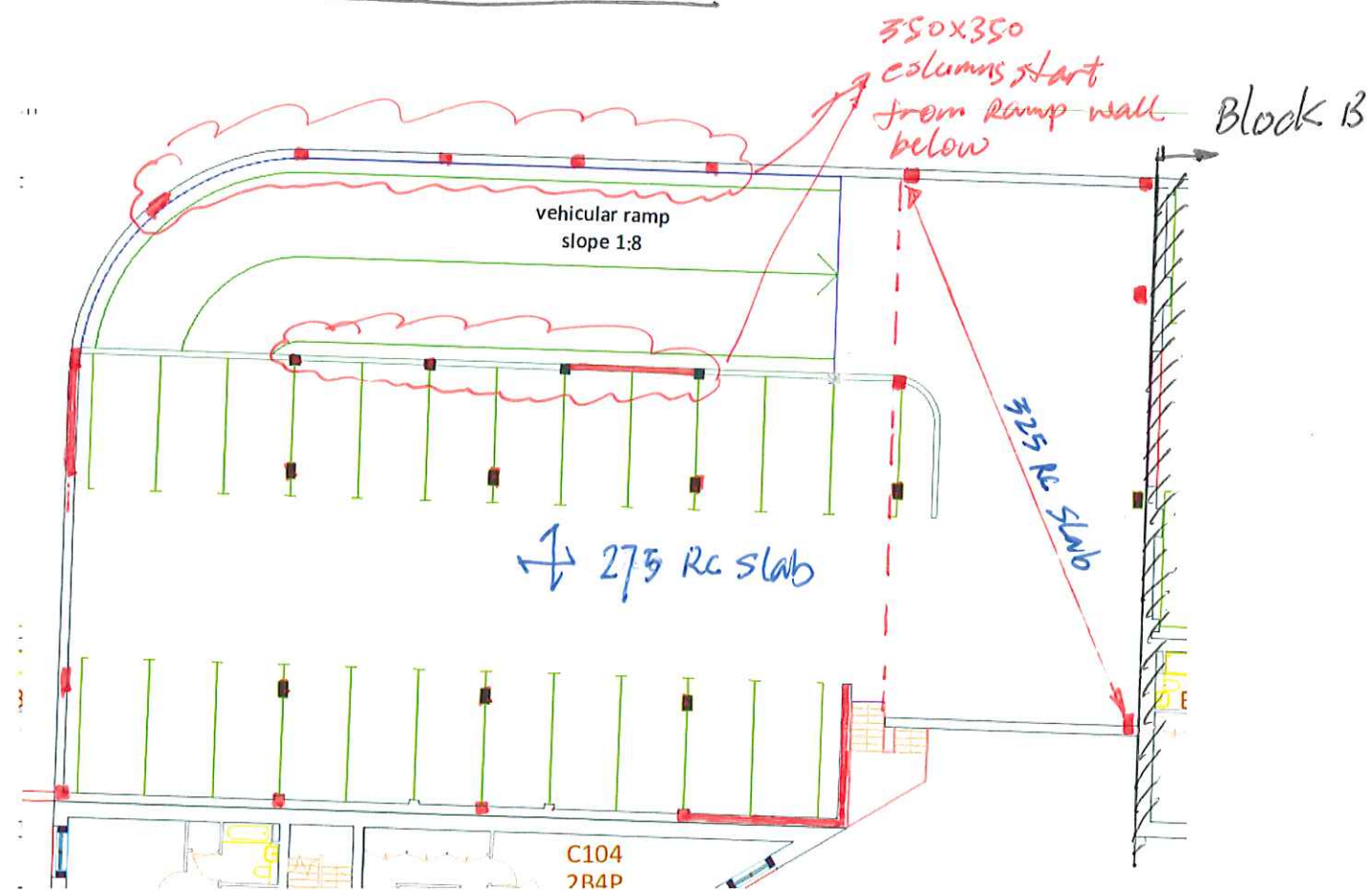
SEN - Reading

ATK - Structural sketch - 002 Rev.2.

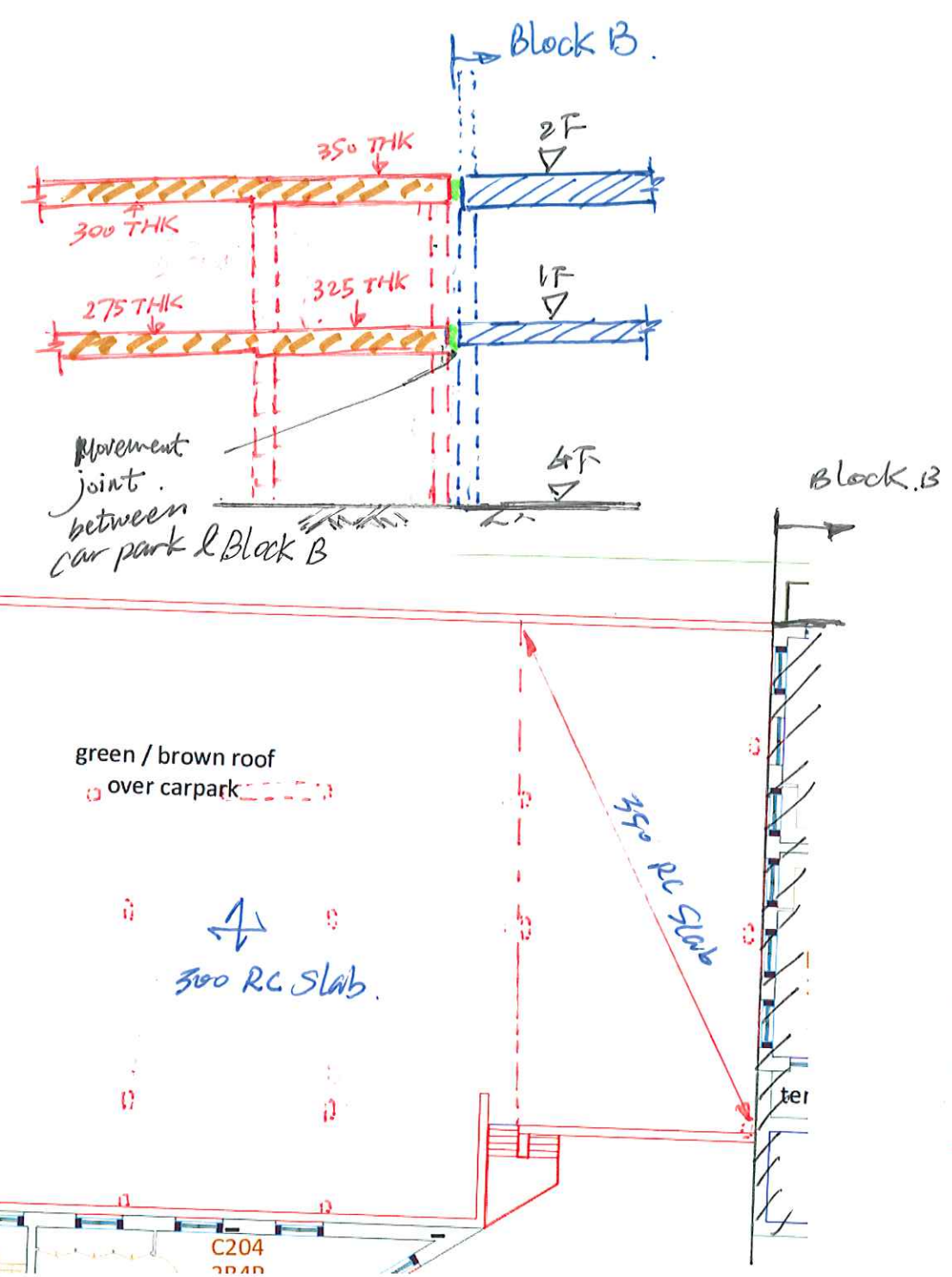
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GROUND FLOOR



FIRST FLOOR

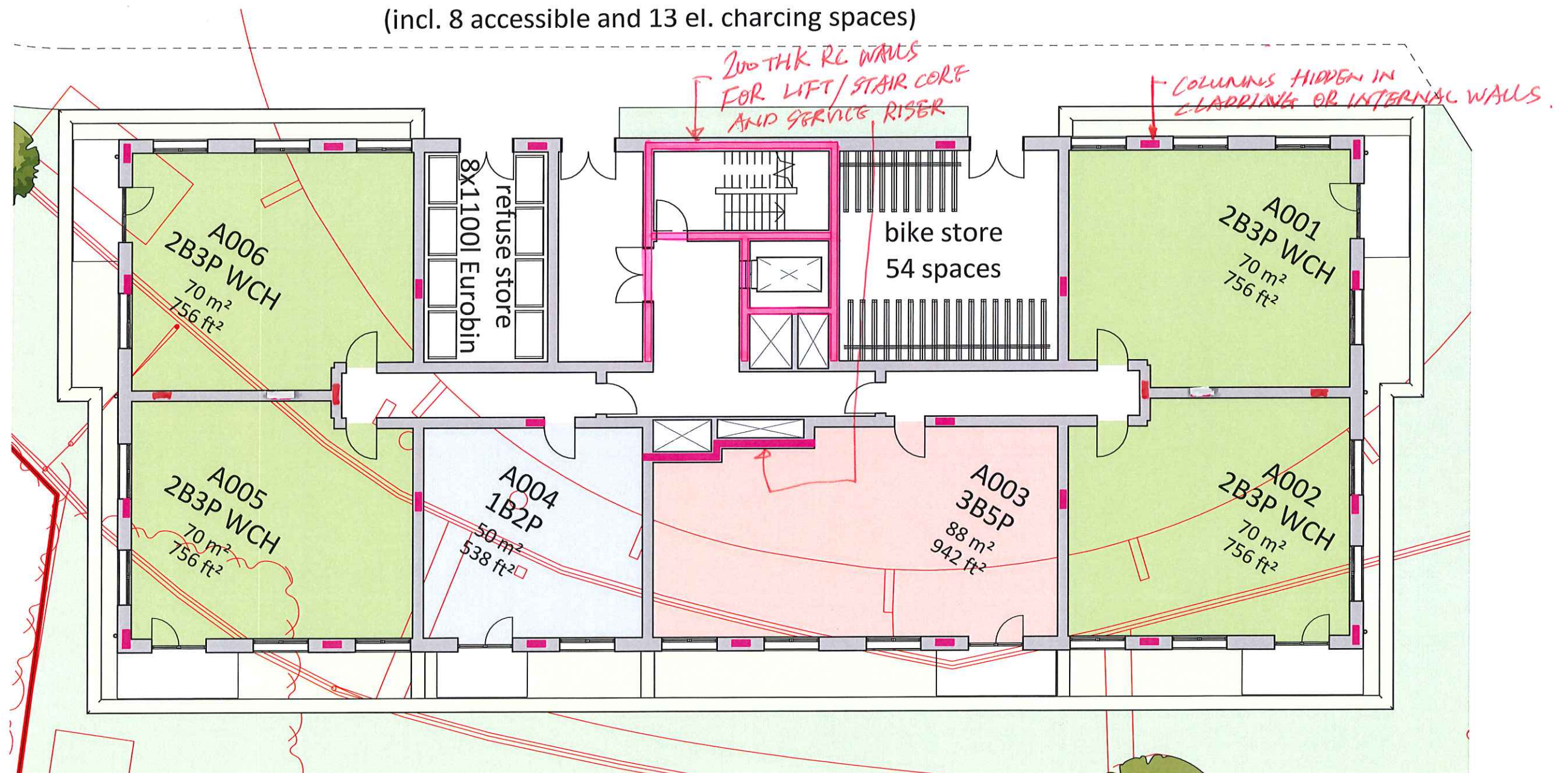


ROOF LAYOUT

SKN - Reading

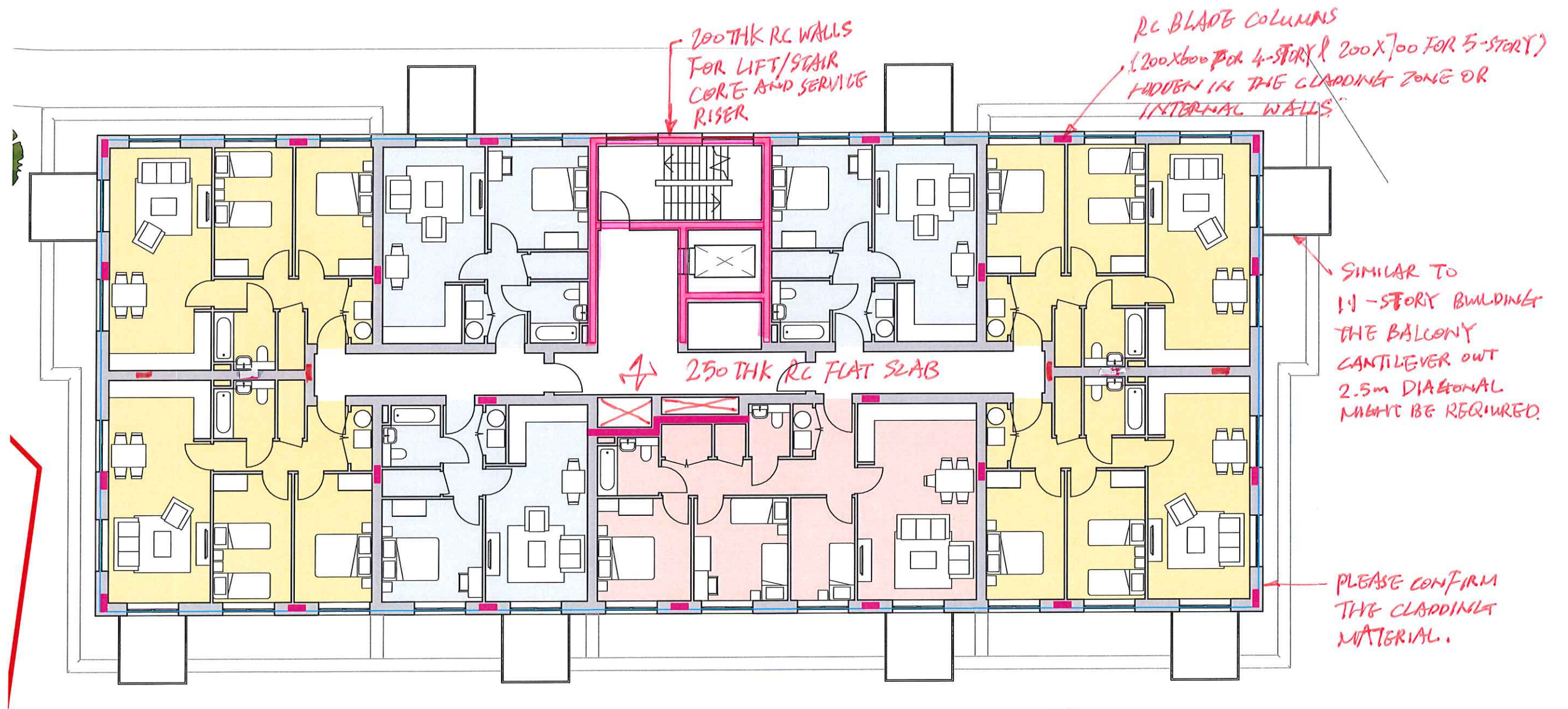
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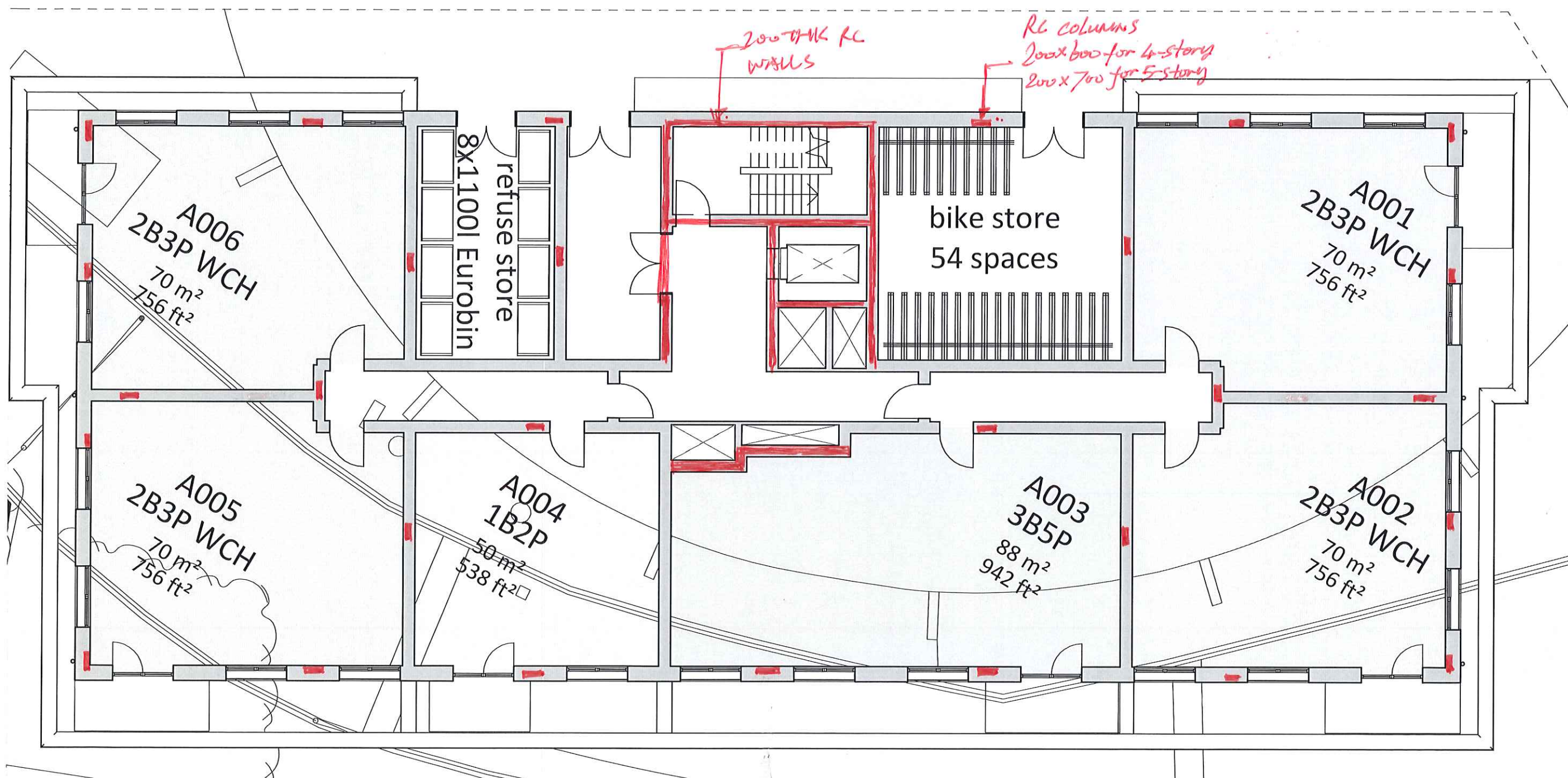
4/5 Story Building 4F

Stan-Reading
ATK Structural Sketch - 004 Rev. 1



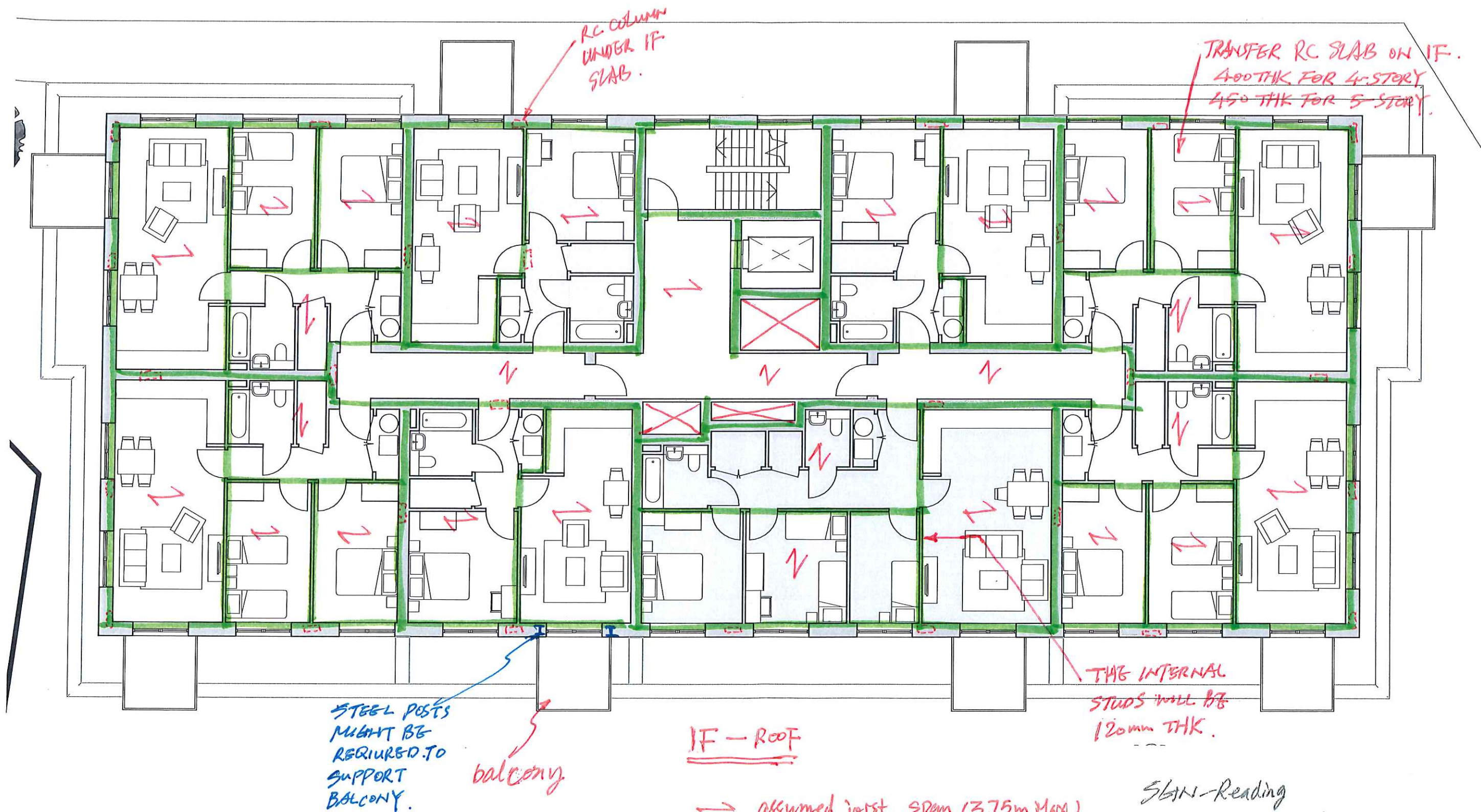
4/5 Story Building typical upper floors

SGN-Reading
ATK Structural Sketch - 004 Rev 1



Ground Floor

SEM-Reading
 Structural Sketch_005_Rev 1
 4/5 story Building 1/4



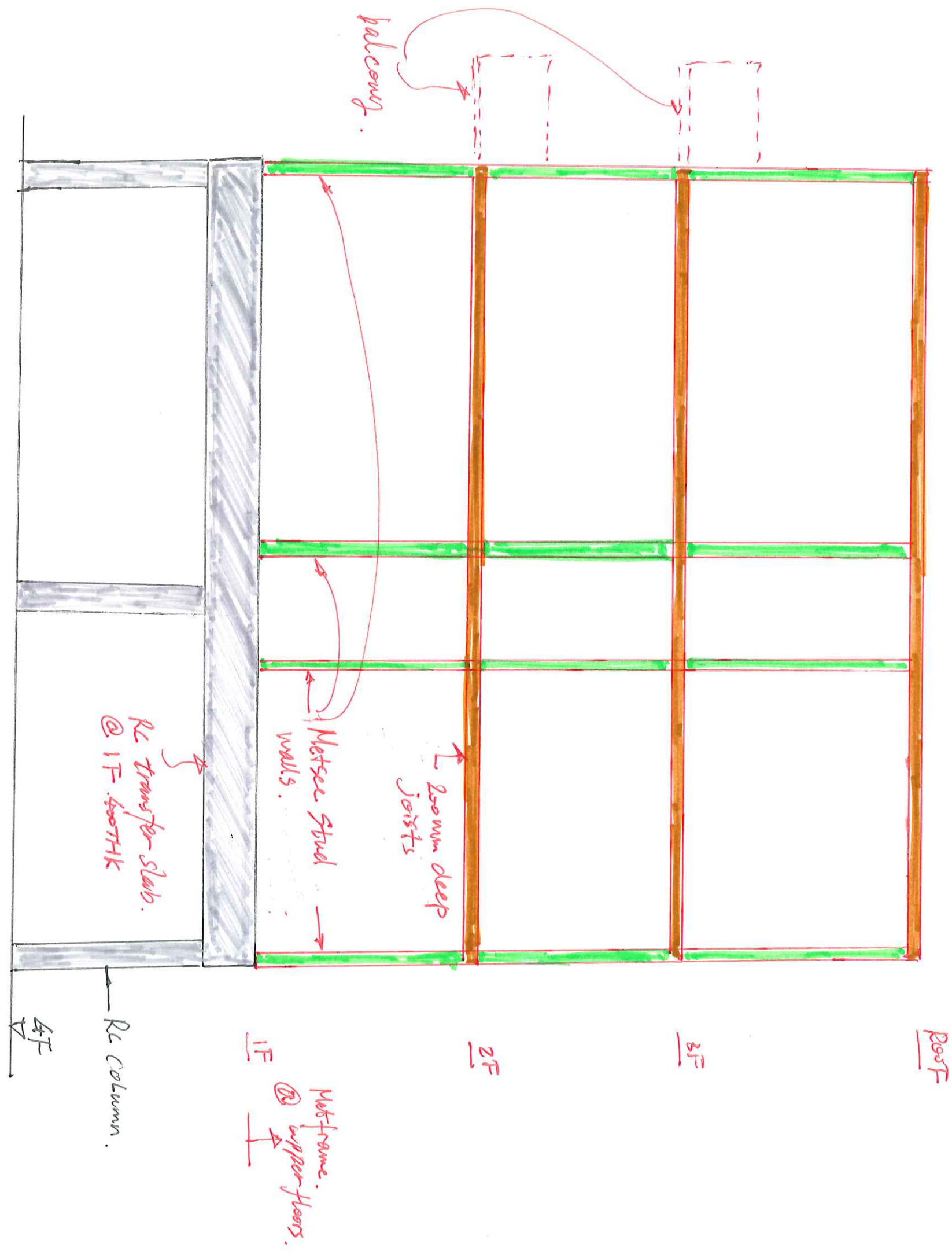
SGW-Reading

ATK Structural Sketch.005 - REV 1

4/5 Story Building

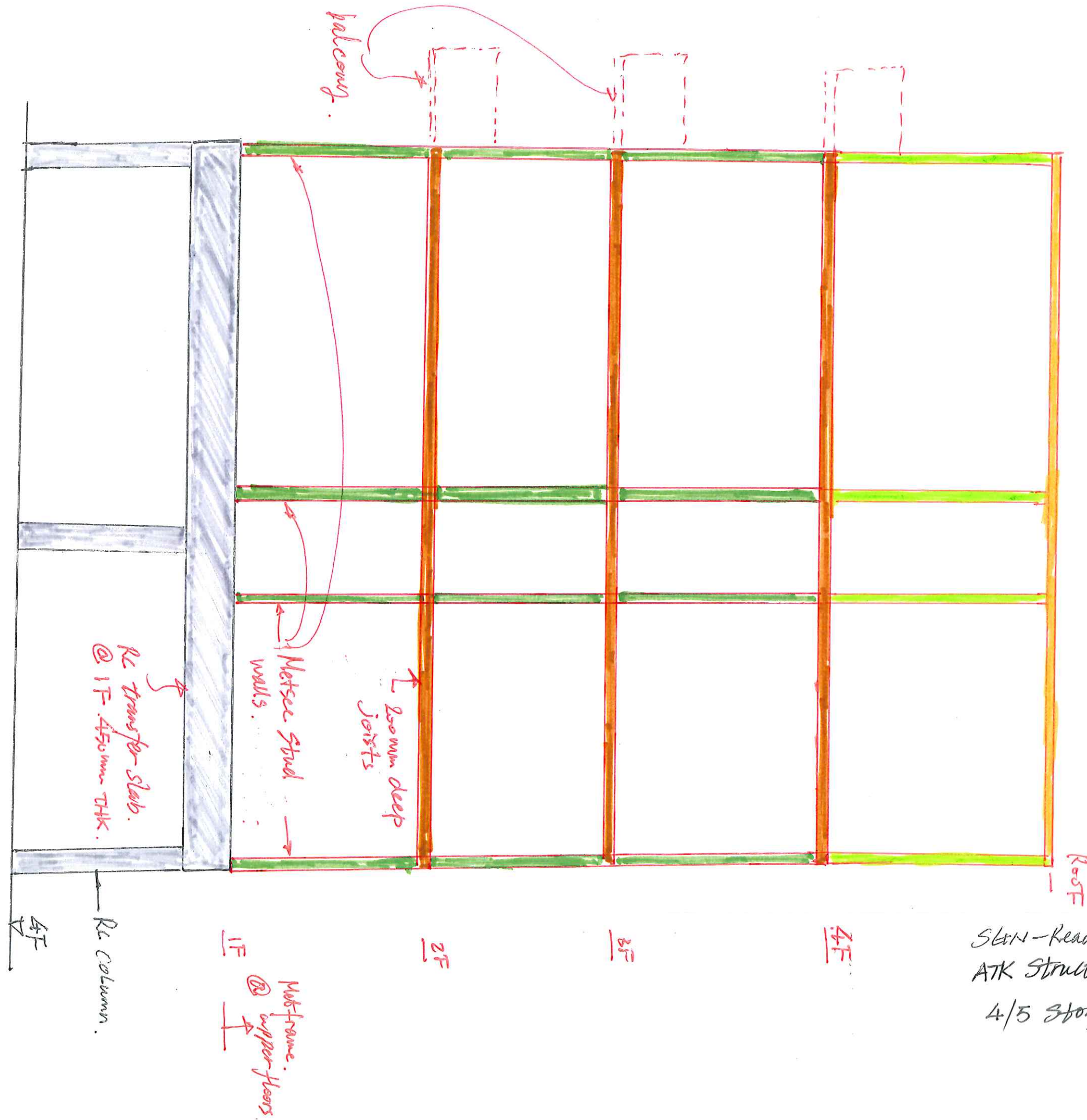
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TYPICAL SECTION

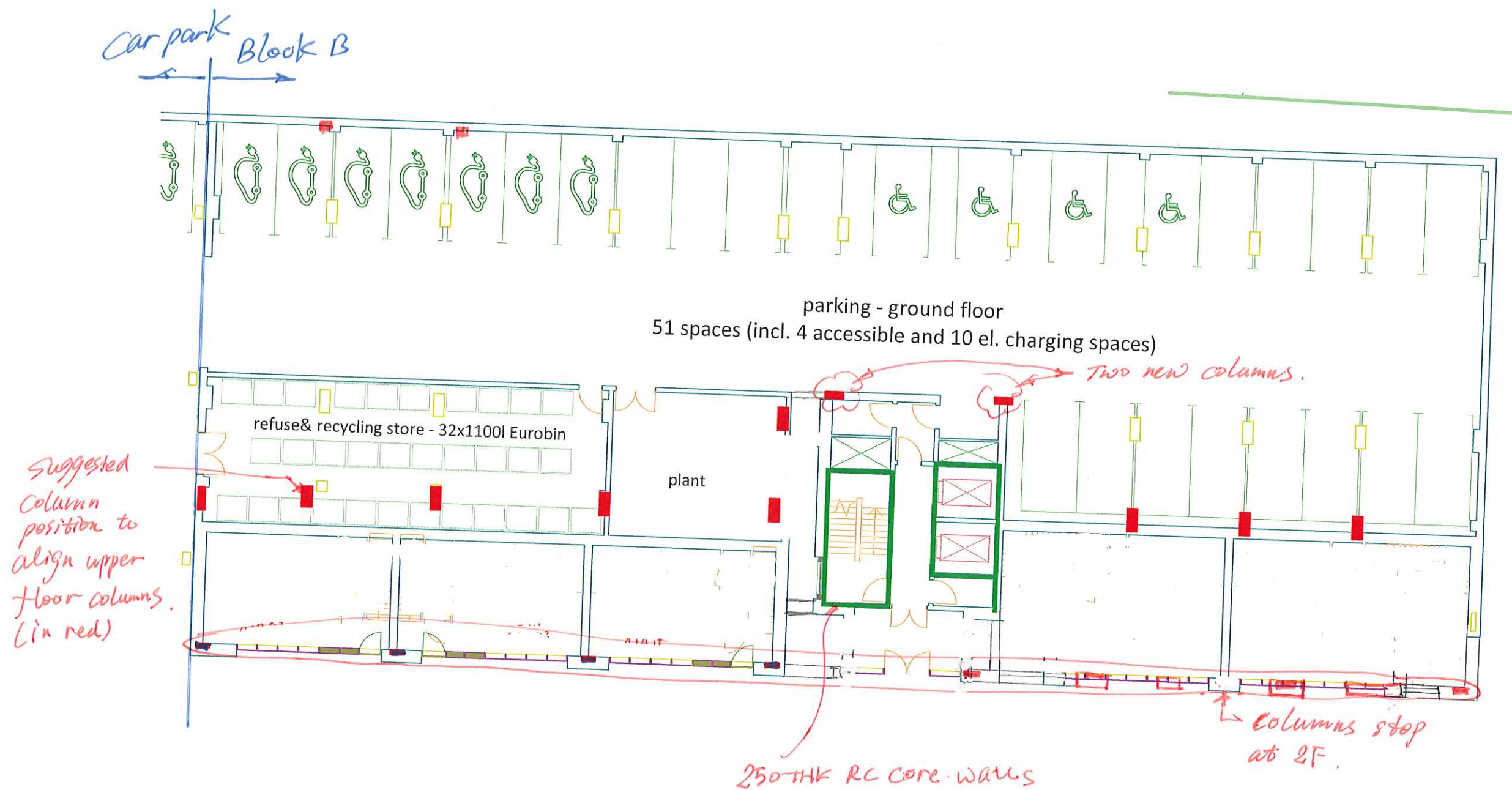


SKN-Reading,
ATK Structural Sketch.003.. Rev1
4/5 Story Building 3/4

TYPICAL SECTION



SKN-Reading
 ATK Structural Sketch.005 Rev1
 4/5 Story Building 4/4



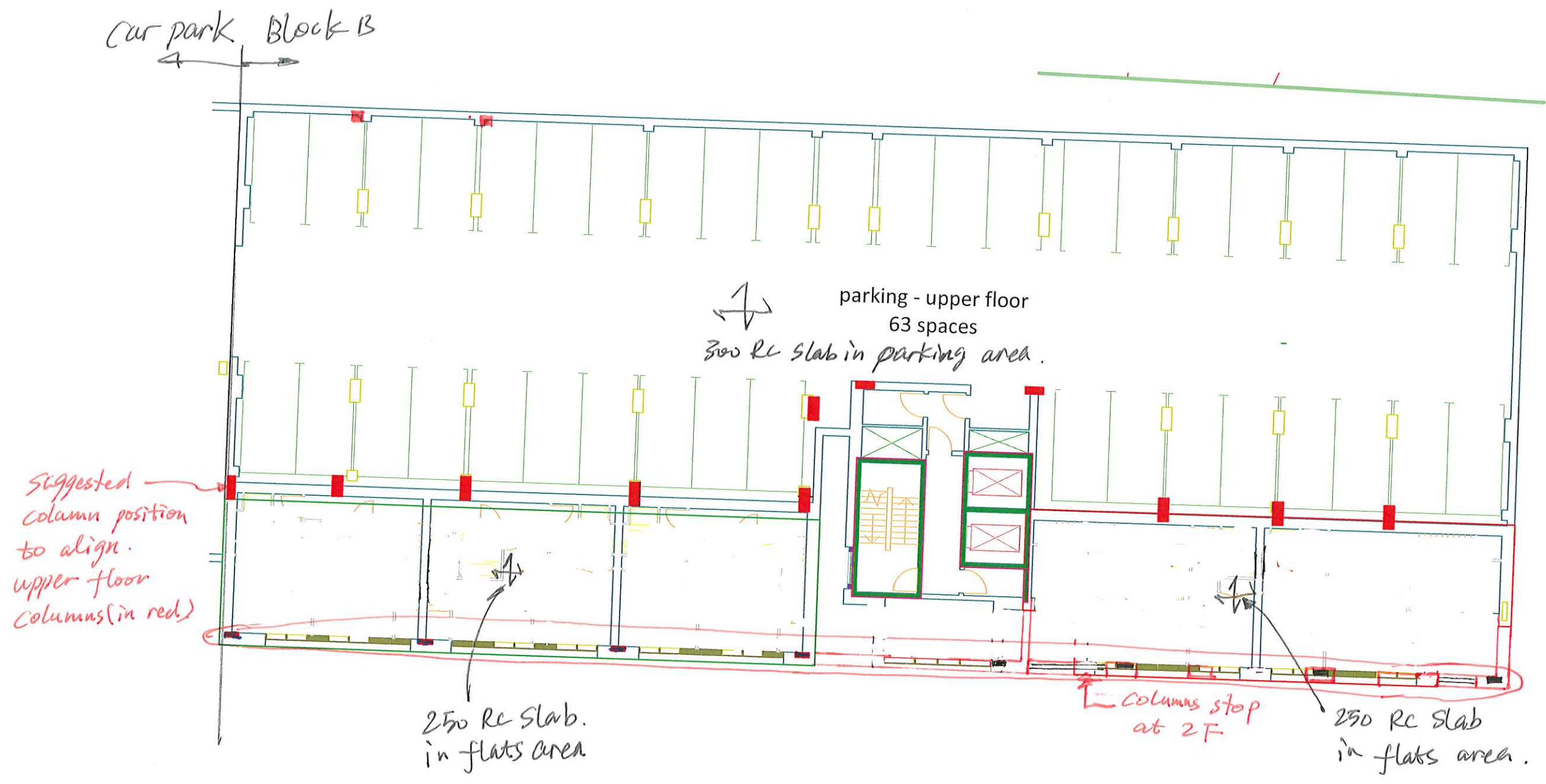
GROUND FLOOR

SKETCH - Reading

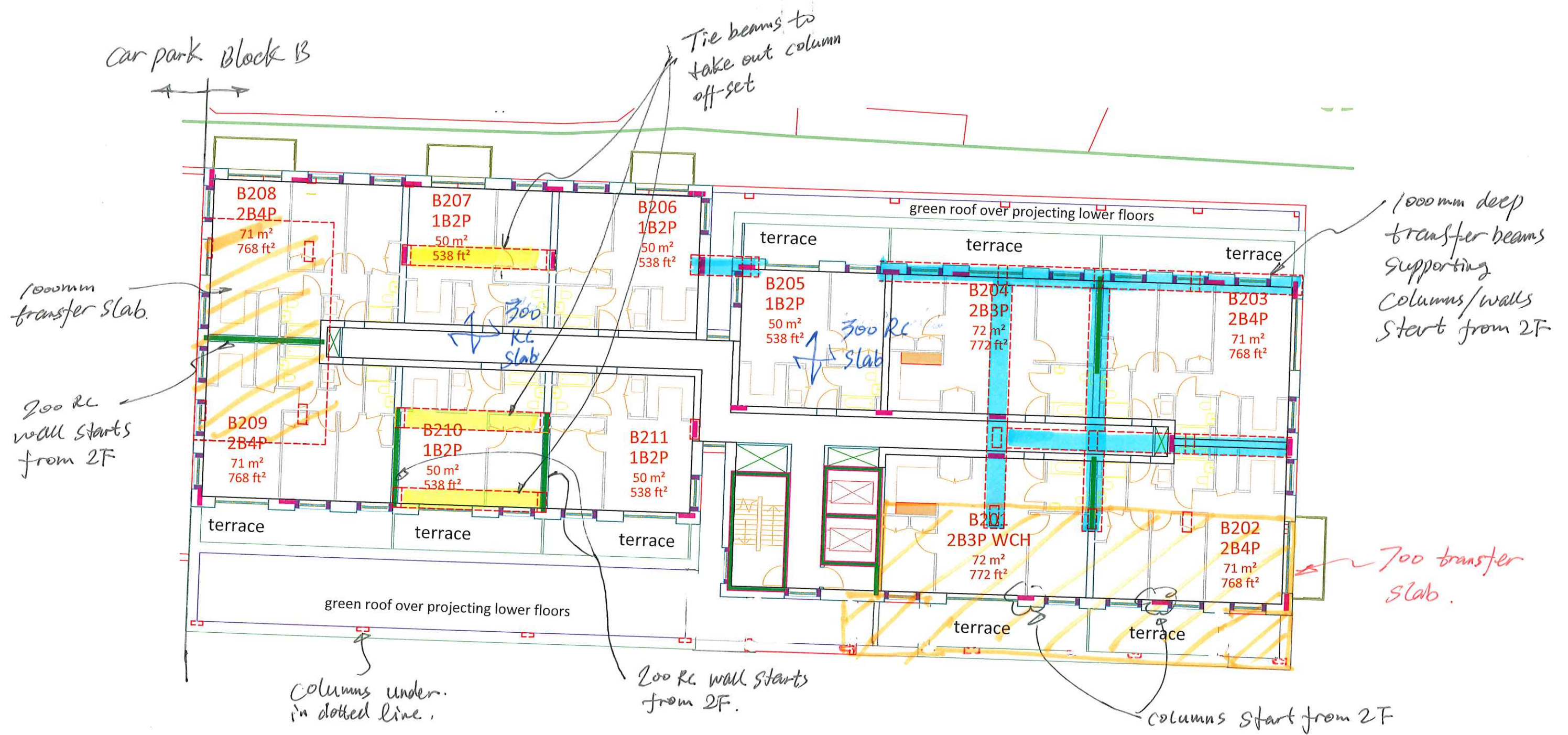
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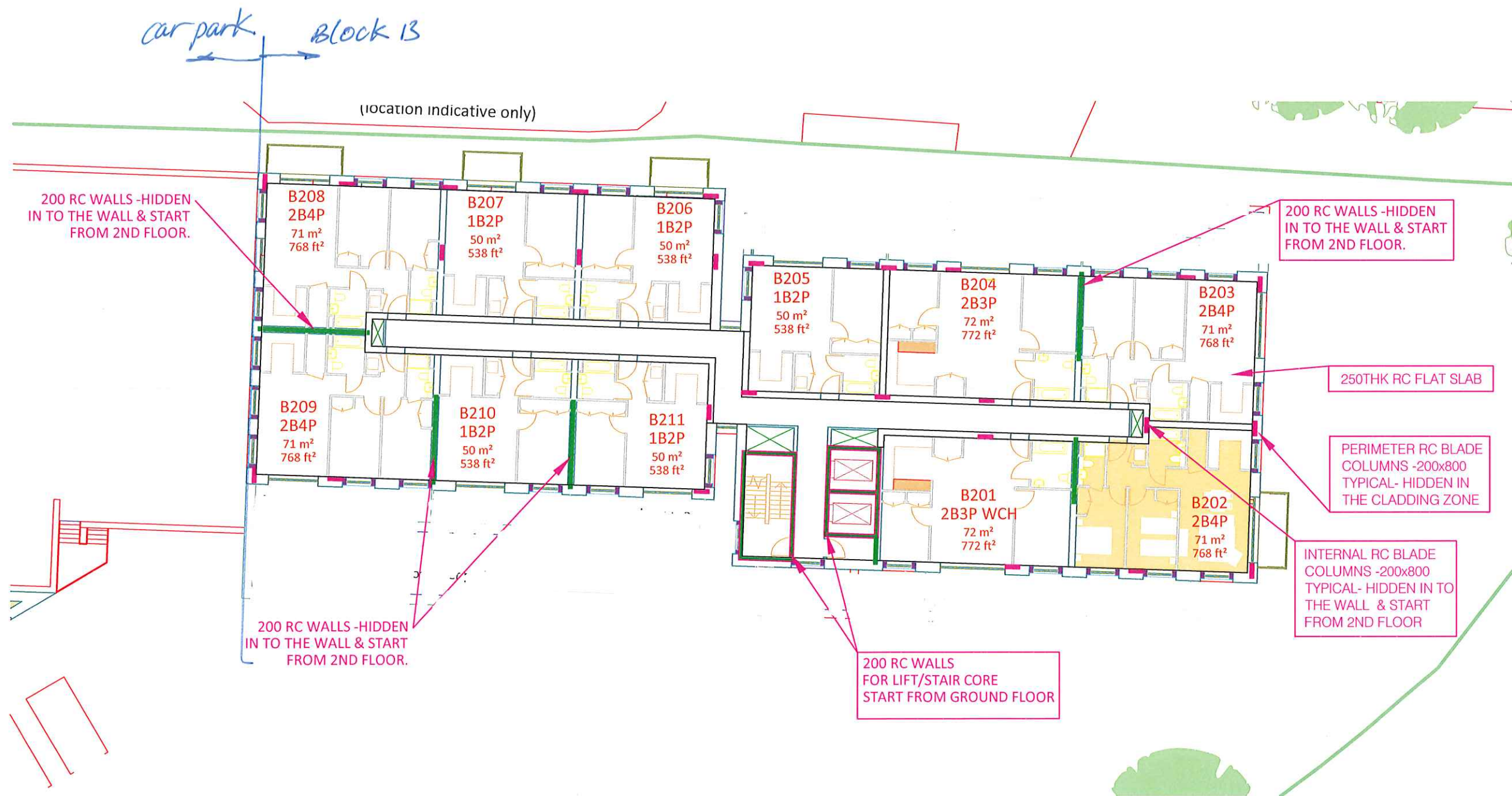


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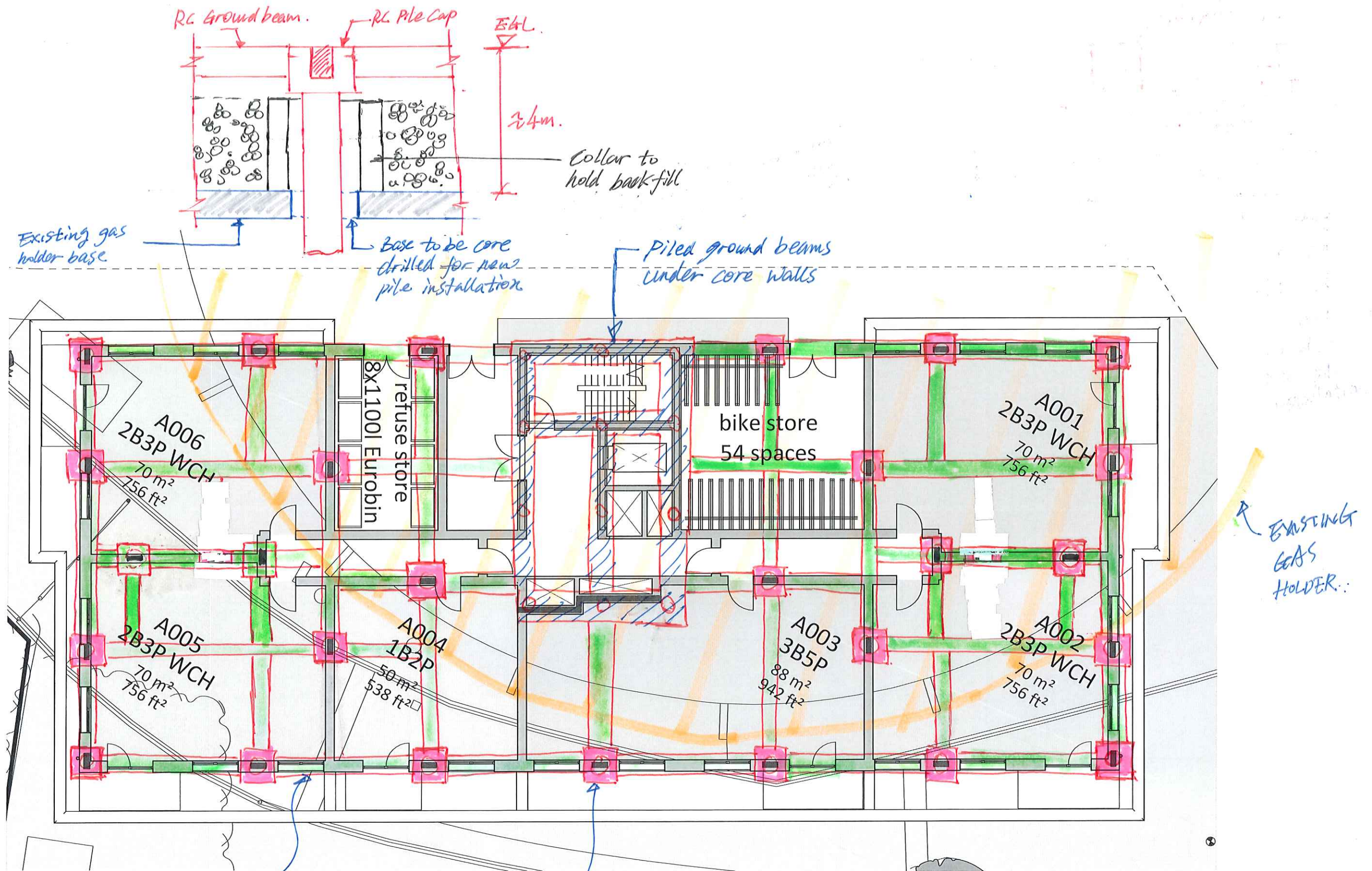
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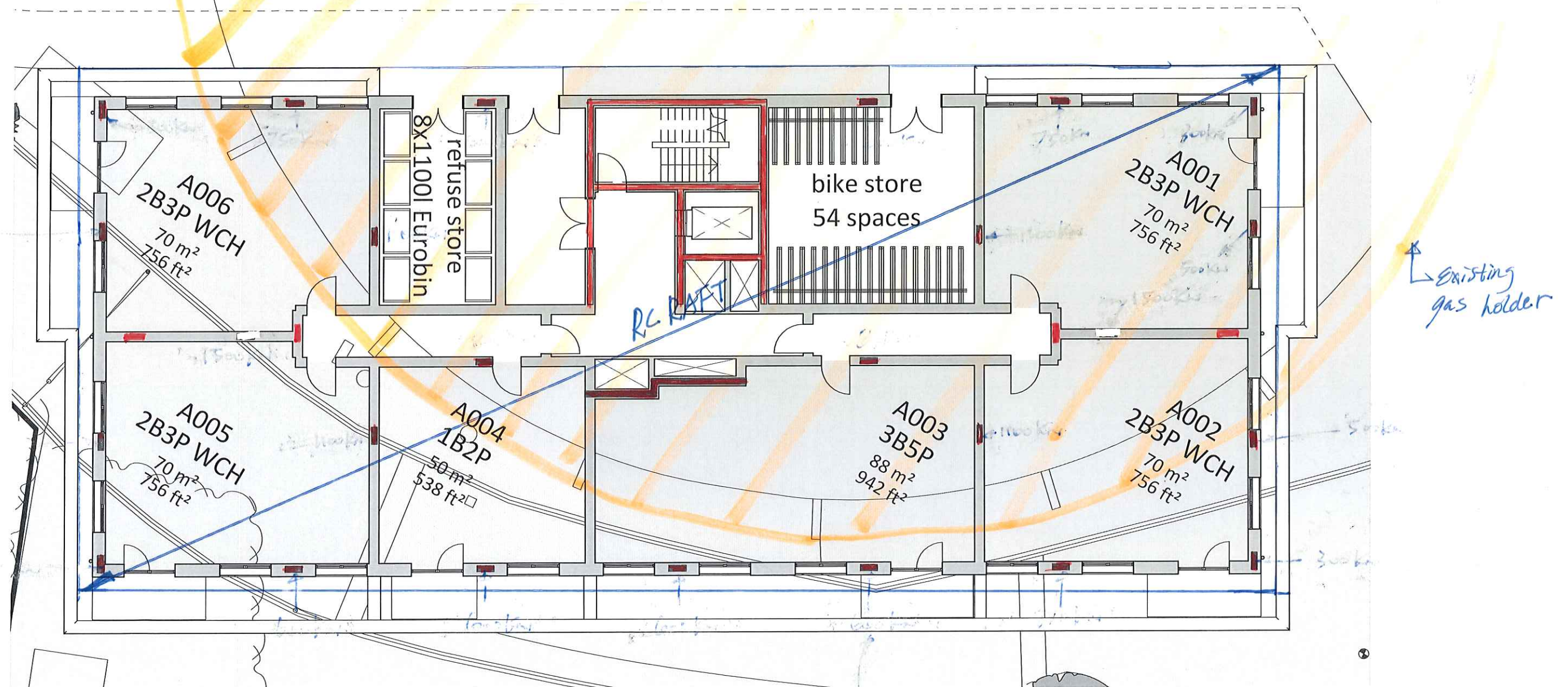
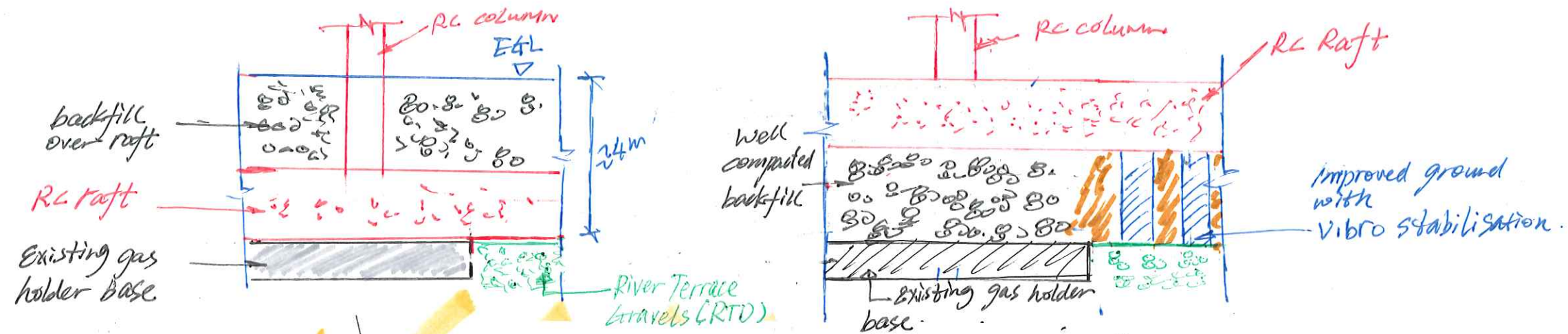
SKN - Reading.
 ATK Structural Sketch-006 Rev 1
 08/03/2019. 4/4.



RC Ground Beams tie pile caps together and supporting 6F cladding and suspended RC slab

single-pile cap for column load. Max 2500kN 4-story or 3000kN 5-story.

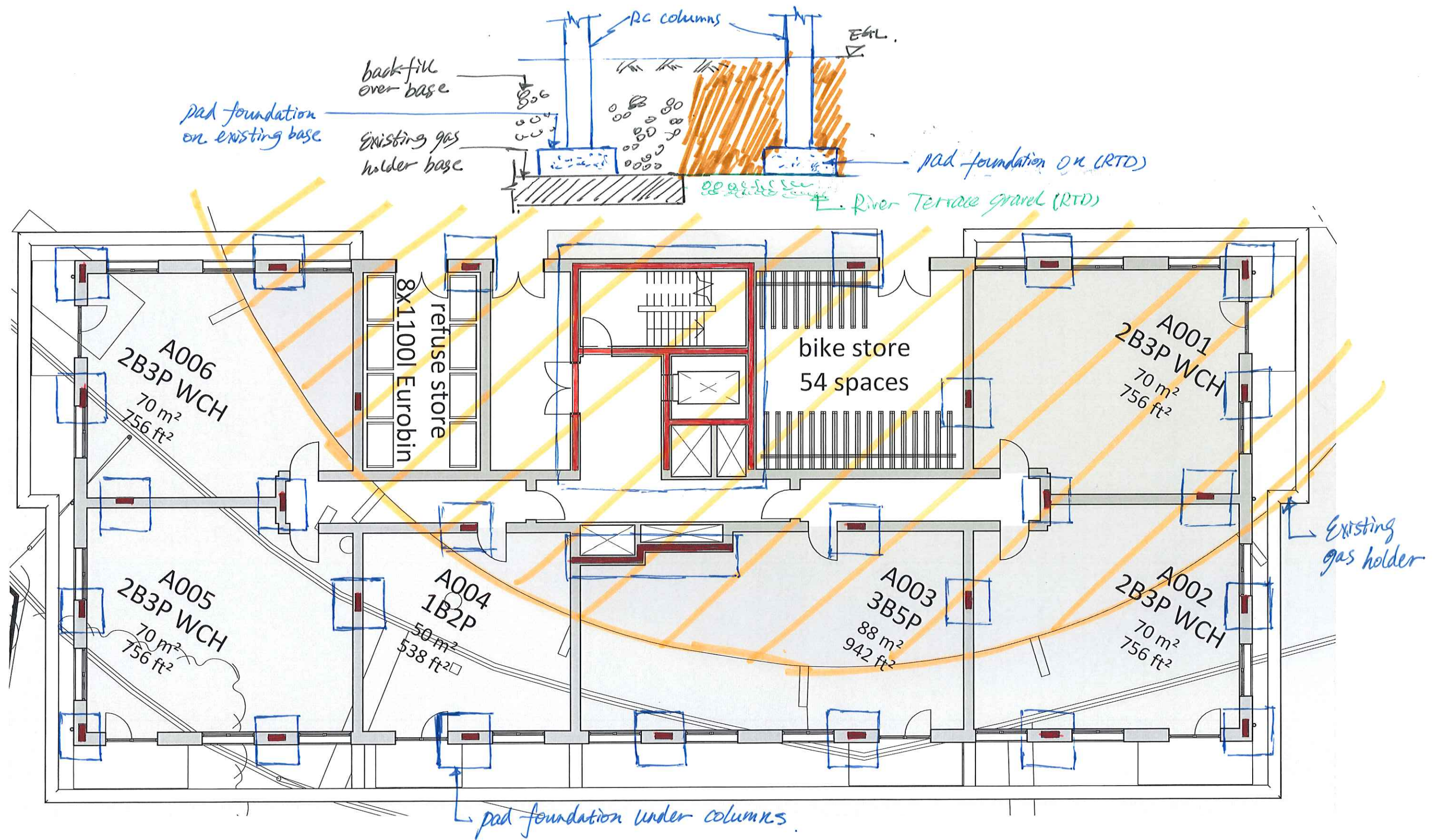
4/5 story building.
RC frame foundation.



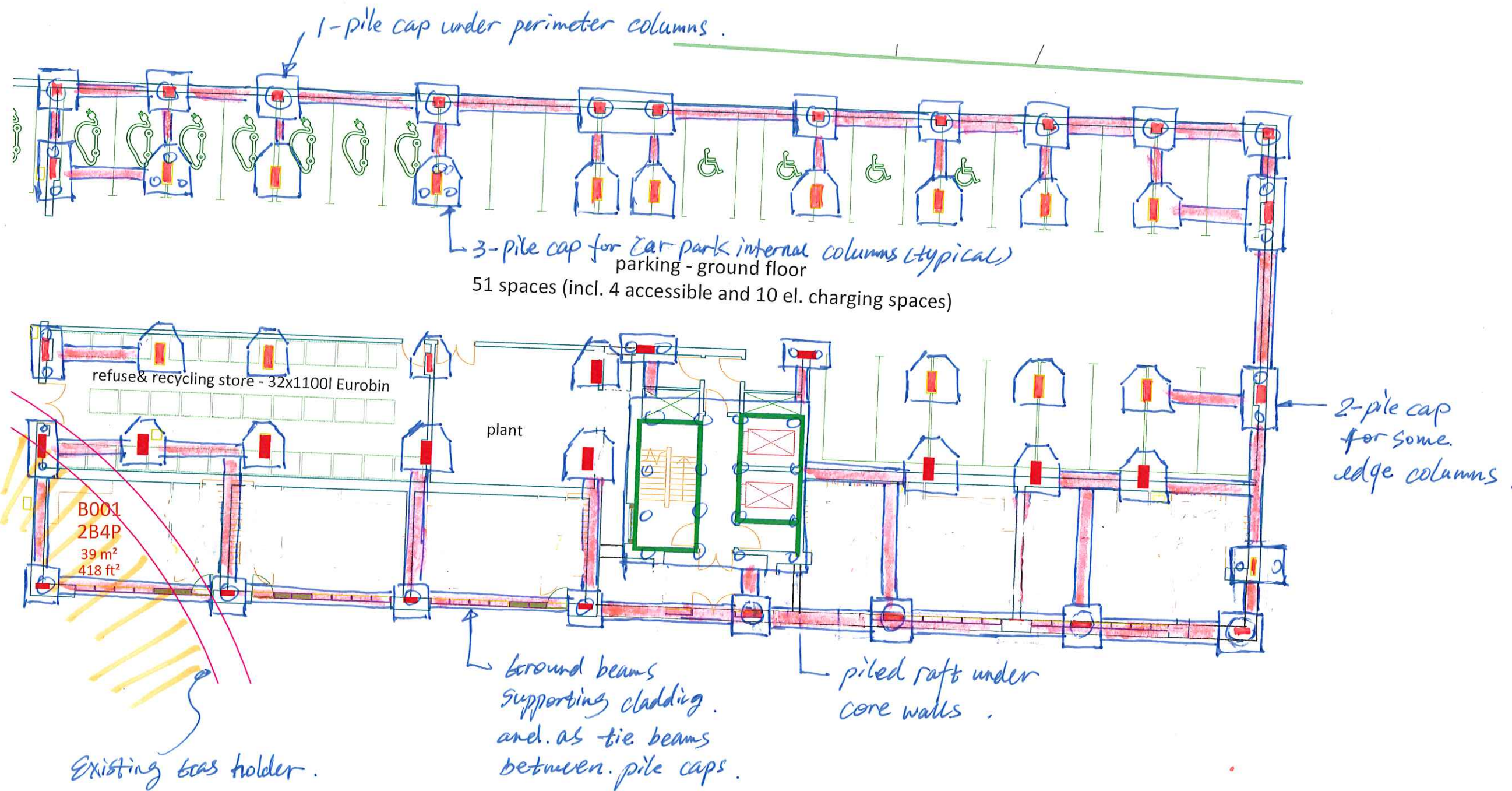
Max Column SWL.

- 4-story — 1100 kN internal columns.
750 kN external columns.
- 5-story — 1450 kN internal columns.
900 kN external columns.

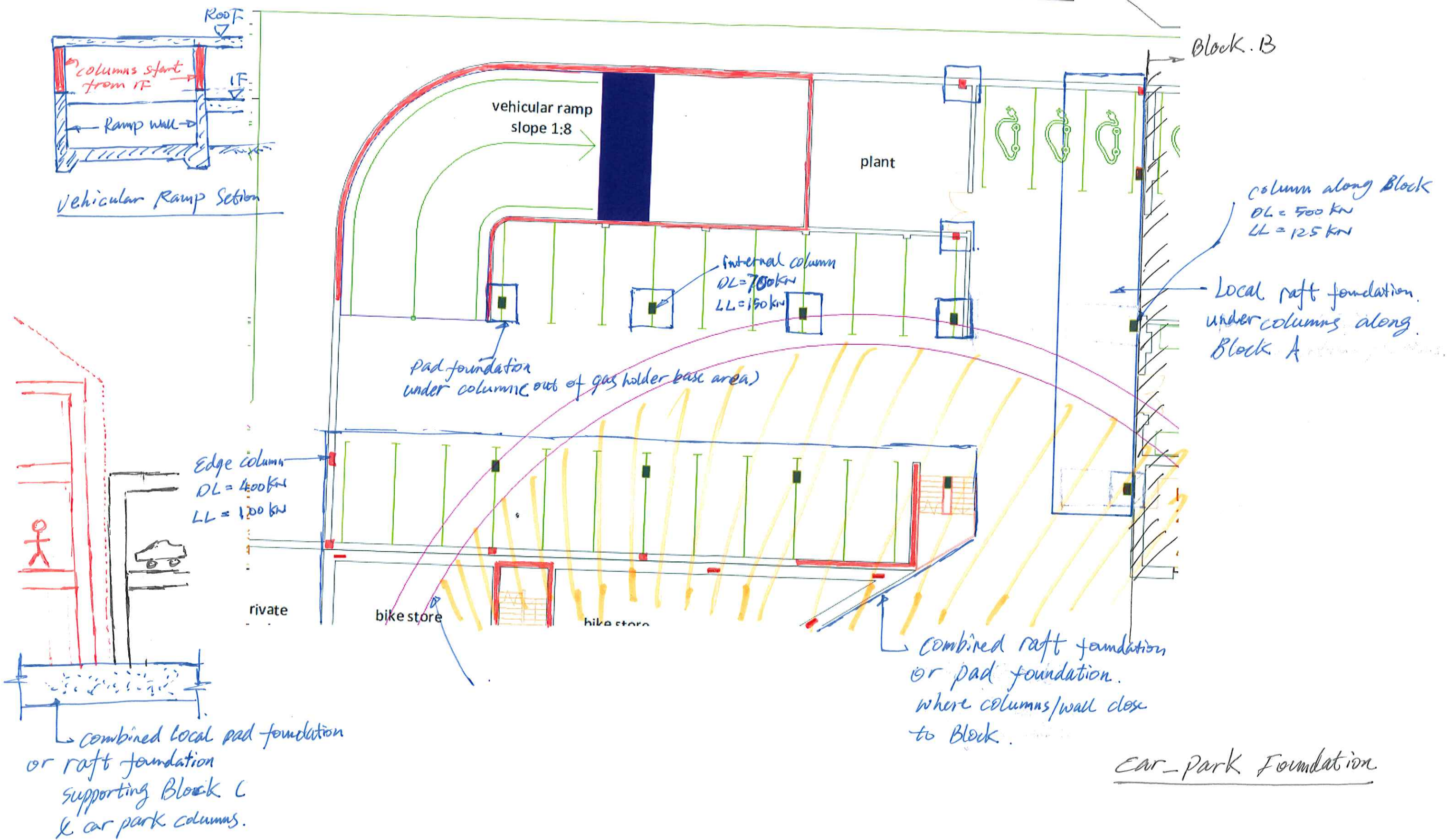
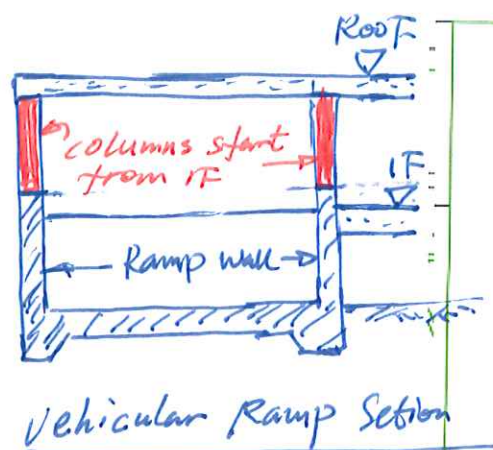
4/5 Story Building.
Light-weight option.
Raft Foundation.



4/5 Story building
 Light-weight option
 spread foundation



Block B Foundation



Appendix B. Geotechnical Engineering Desk Study

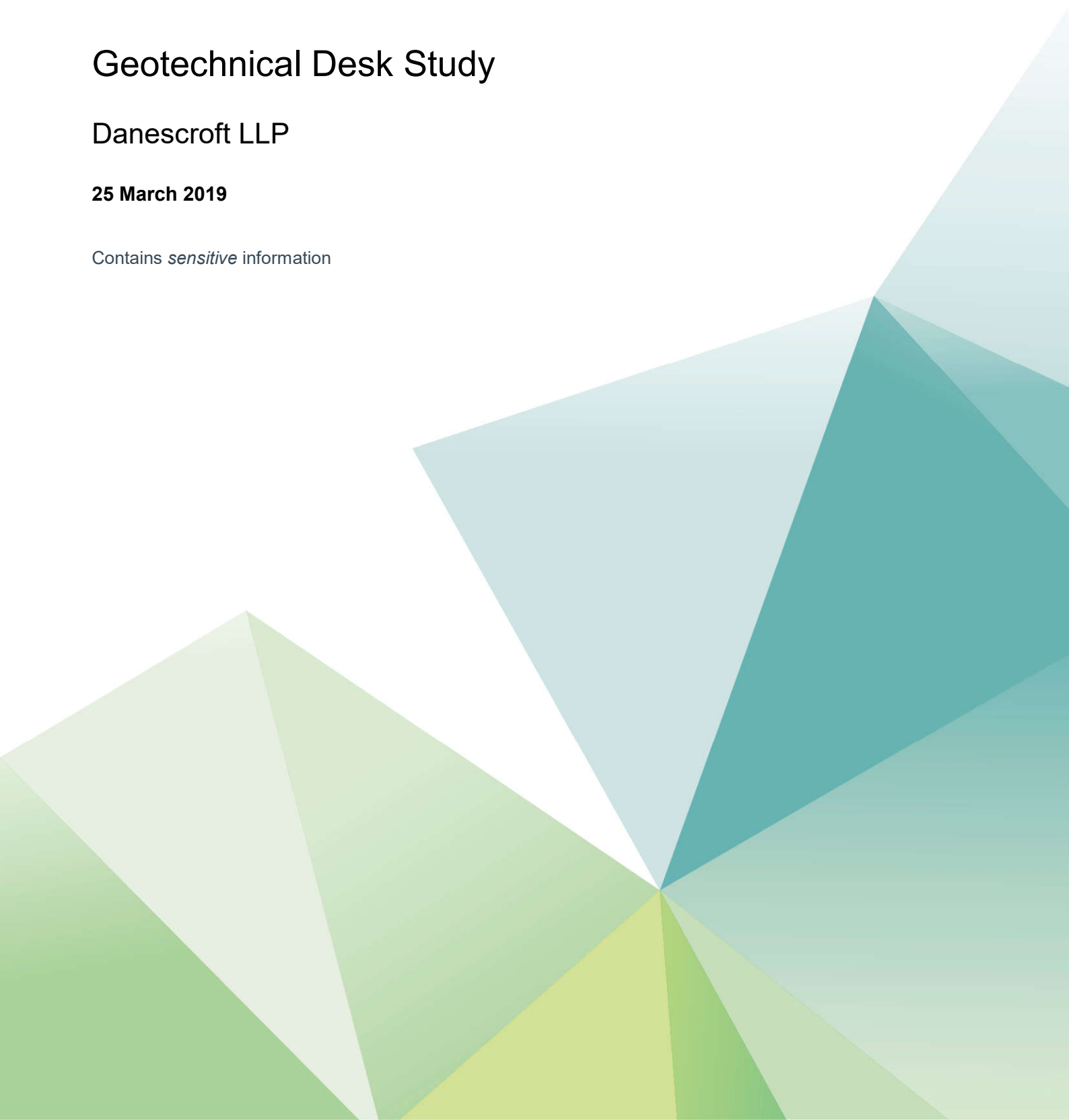
SGN Reading Gasholder

Geotechnical Desk Study

Danescroft LLP

25 March 2019

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Notice

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This document has 34 pages including the cover.

Document history

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1. Introduction

1.1. Brief

Atkins Limited (Atkins hereafter) has been commissioned by Danescroft LLP (Danescroft hereafter) to provide a high level Geotechnical Desk Study report for a proposed redevelopment of the Gas Holder Site, Reading. This report determines a ground and groundwater model and presents geotechnical material parameters for the site to inform the design of the proposed works in accordance with BS EN 1997 (Eurocode 7).

The purpose of this report is to highlight potential ground based geotechnical risks associated with the development site and to identify where further assessment may be required to inform a strategy for addressing the identified risks. The report will aim to make preliminary recommendations on potential foundation and substructure options. Geoenvironmental aspects of the Site will be addressed by WSP in a separate report.

1.2. Proposed Development

The proposals for the development of the former Gasholder site comprise the following:

- Block A: 5-storey block of 30 apartments;
- Block B: 9-storey block containing 96 apartments;
- Block C: 3-storey flats building; and
- A 2-storey car park.

No basements are proposed at present. Traditional shallow foundation options will be considered as appropriate solutions for structures which are generally lightly loaded, such as two to three storey buildings. Piled and / or raft foundation options will be considered for more heavily loaded structures, or where ground conditions are unfavourable.

Appendix A presents current redevelopment plans at the time of writing this report.

1.3. Scope and objective of report

The objective of this Desk Study report is to collate and review information related to the site in order to obtain an understanding of the existing site conditions, structures, anticipated geology and to identify significant geotechnical risks and constraints pertinent to the proposed development.

The objectives of this report are:

- To identify the existing ground-based site conditions based on desktop research;
- To review the ground conditions based on information from the British Geological Survey (BGS) and previous ground investigation works;
- To identify the significant underground assets running beneath/in close proximity to the site;
- To present preliminary substructure scheme design options; and
- To compile a Risk Register detailing identified ground-based risks for the proposed scheme and ultimately a set of recommendations for future work based on the findings within this report.

1.4. Geotechnical category

In accordance with Eurocode 7 and British Standards, the project has been assigned a Geotechnical Category 2, which is described as conventional types of structure and foundation with no exceptional risk or difficult soil or loading conditions. This will be assessed and subject to change at each stage of the project.

1.5. Limit of study area

This report specifically relates to the proposed redevelopment of the eastern end of the former SGN Reading gasworks site and proposed buildings as shown in Figure 1-1 below. This eastern end shall be referred as the 'Site' hereafter.

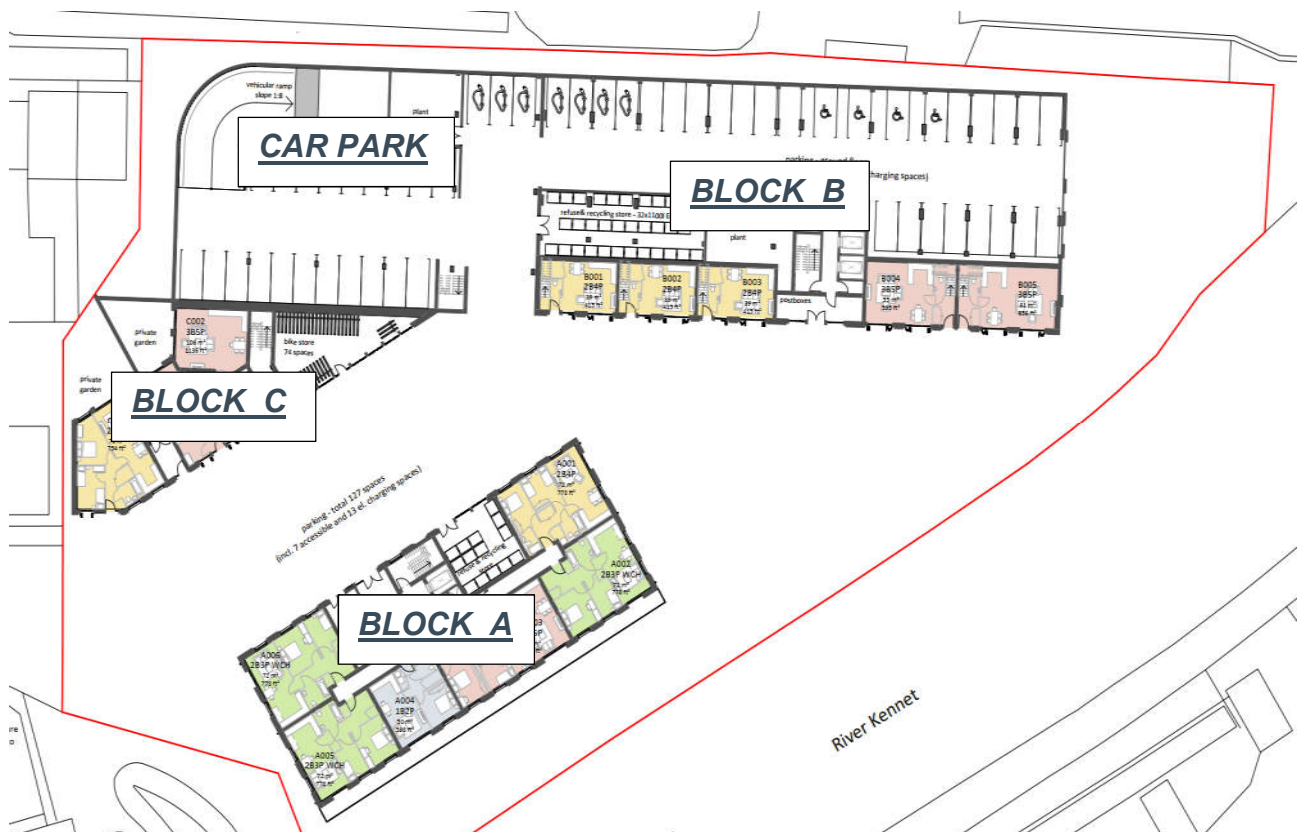


Figure 1-1 Proposed redevelopment of the SGN Reading Gasholder site (Adapted from Collado Collins Architects, 2018) and aerial photography of Site location plan (not to scale)

2. Existing Information

2.1. Sources of Information

Table 2-1 presents the sources of information used in the preparation of this report and a summary of the information received.

Table 2-1 Sources of information

Subject	Type	Reference and additional comments	Source
Topography	Maps and Aerial Photography	Google Maps	Google (2018)
	Topographical data	Google Maps	
Geology	BGS Online GeoIndex	British Geological Survey, "Geoindex onshore"	British Geological Survey (2018)
	Maps		
	Historical reports and borehole records	British Geological Survey, "Geoindex onshore"; Desk Study Report 42 Kenavon Drive, Reading, Berkshire; Ground Conditions Report, The Leasing Group Site, Kenavon Drive, Reading, Berkshire; Clarification Ground Investigation Report 42 Kenavon Drive, Reading, Berkshire Excerpt of Gas Journal	British Geological Survey (2018); AIG Engineering Group Limited (2005); AIG Engineering Group Limited (2002) AIG Engineering Group Limited (2005) Gas Journal (1924)
Environment	Historical Maps	Freely available historical Ordnance Survey mapping websites	-
	Hydrology and Hydrogeology	Human Health & Controlled Waters Quantitative Risk Assessment Report 42 Kenavon Drive, Reading; Ground contamination remediation options appraisal and remediation method statement; Ground contamination remedial statement 42 Kenavon Drive, Reading, Berkshire	AIG Engineering Group Limited (2008); AIG Engineering Group Limited (2008); AIG Engineering Group Limited (2005)
Additional	Unexploded Ordnance	Zetica Map (Zetica, 2013)	Zetica (2017)

2.2. Site Location and Topography

The Site is located at the former SGN Gasholder No. 4, Kenavon Road, Reading in Berkshire. The Gasholder No. 4 Site is located at the eastern end of Kenavon Drive, approximately 1500m north east of Reading town centre in Berkshire. The Site is currently used for temporary offices, car parking and vehicle storage. It occupies an area of approximately 0.7 hectares. The Site is centred at approximate OS grid reference 472936E 173696N. Access is gained via Alexander Turner Close road from the west of the Site.

The River Kennet is situated some 15m south east of Block A and some 25m east of Block B which flows into the River Thames some 250m to the north east. A multi-track railway line with a superstore beyond is located some 30m north of the Site. To the west are residential flats of recent construction. An existing water tower located in the north east corner of the Site is to be retained. Based on the available aerial photographs, the Site is generally flat at an elevation of approximately 38m AOD. A site location plan is provided as shown in Figure 2-1 below.



Figure 2-1 Site location plan (Adapted from ©Google, not to scale)

2.3. Site History

A gas works opened on the site in 1886 and underwent several phases of development and redevelopment until gas manufacture ceased in the mid-1970s. Generally, gas production processes were undertaken in the western part of the gasworks site, with gas purification, storage and by-product processing being undertaken in the eastern area (See Figure 2-2). Following demolition of most of the former gas works adjacent structures in the late 1960s/early 1970s, the site was utilised as a gas distribution depot and storage yard prior to redevelopment in the 1990s.

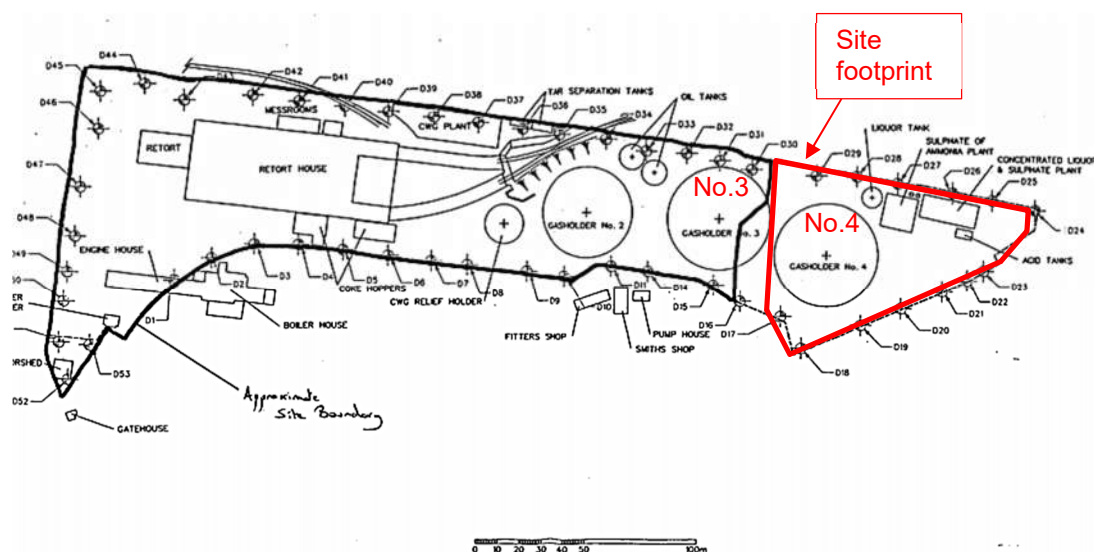


Figure 2-2 1930s historical plan showing Gasholders and associated structures (not to scale)

2.4. Current condition of Gasholder No. 4 Structure

The former gasworks Gasholder No. 4 structure as shown above in Figure 2-2 remains on-site and has not been demolished. The structure is assumed to be founded 4mbgl as per adjacent former Gasholder No. 3 (demolished) information obtained from AIGE historical records. Also, from Google maps aerial imagery, the structure appears to be about 50m in diameter with the wall elements made of steel and raising 3m above ground approximately. At this stage it is unknown whether the Gasholder has been backfilled or remained empty.

2.5. Unexploded Ordnance

The Zetica unexploded ordnance (UXO) risk map (shown in Appendix C) for the Site indicates that the site lies within a region of low risk. Low risk is defined as areas with a bomb density of 15 bombs per 1000 acres or less.

3. Existing Structures

The following section includes descriptions of the existing structures that currently lie within the gasworks footprint. Area plans taken through the Site are presented in Appendix A. The information available was taken from existing reports from previous work undertaken as part of the adjacent gasworks site redevelopment.

3.1. Structures within the Site footprint

Figure 3-1 below shows the existing Gasholder No.4 (shaded area in purple) and associated structures on the Site footprint including the River Kennet walls (shaded area in yellow). On the north east end corner of the site, a former water tower (shaded area in purple) can be found and is deemed to be retained as part of the site redevelopment plan.



Figure 3-1 Structures within the Site footprint (red lines and shaded areas) and proposed building structures

3.2. Existing foundations

Based on historical information it appears that the Gasholder No. 4 foundations may be supported by 'Simplex' concrete piles (>600No.) with a reinforced concrete raft above, if of similar construction to the Gasholder No. 3 in the adjacent site to the west. Furthermore, the existing reports on the adjacent site informed on the former Gasholder No. 2 and No. 3 being remediated and backfilled. A historical cable percussion borehole (BH901) carried out in Gasholder No. 3, located in the adjacent site showed evidence of the backfilling sequence to a maximum depth of 4.0mbgl with a concrete slab of 0.8m thickness beneath the backfill. The vertical extent (maximum depth) of the original excavation to form the Gasholder No. 3 structure is understood to have been limited to the top of the natural River Terrace Deposits. No records are currently available with respect to the construction of Gasholder No. 4 and River Kennet Walls.

Figure 2-2 presented above as an excerpt of the 1930 historical plan, which is included in the Envirocheck report for the adjacent gasworks site (presented within the AIGE 2002 Ground Conditions Report), shows the proximity of former Gasholder No. 3 (demolished) to the proposed development site.

4. Ground Conditions

4.1. Geology

The anticipated ground conditions beneath the Site are discussed in this chapter and have been assessed using the following sources:

- British Geological Survey (BGS) 1:50,000 scale Sheet 268 for Reading, Solid and Drift Edition (2000);
- Historical Borehole Logs from the British Geological Society (BGS) website (Appendix B)
- online BGS Geology of Britain viewer

The BGS maps indicate the geology beneath the Site underlain by a superficial cover of Alluvium overlying River Terrace Deposits with Upper Chalk at a depth (circa 7.0mbgl) as shown in Figure 4-1. This is confirmed by the local BGS borehole logs, which also note variable thickness of the overlying Made Ground. Based on the sources listed above, it could be anticipated that the geological sequence indicated on the BGS boreholes would be encountered underlying the Site. Two historical site-specific boreholes are provided in Appendix B.

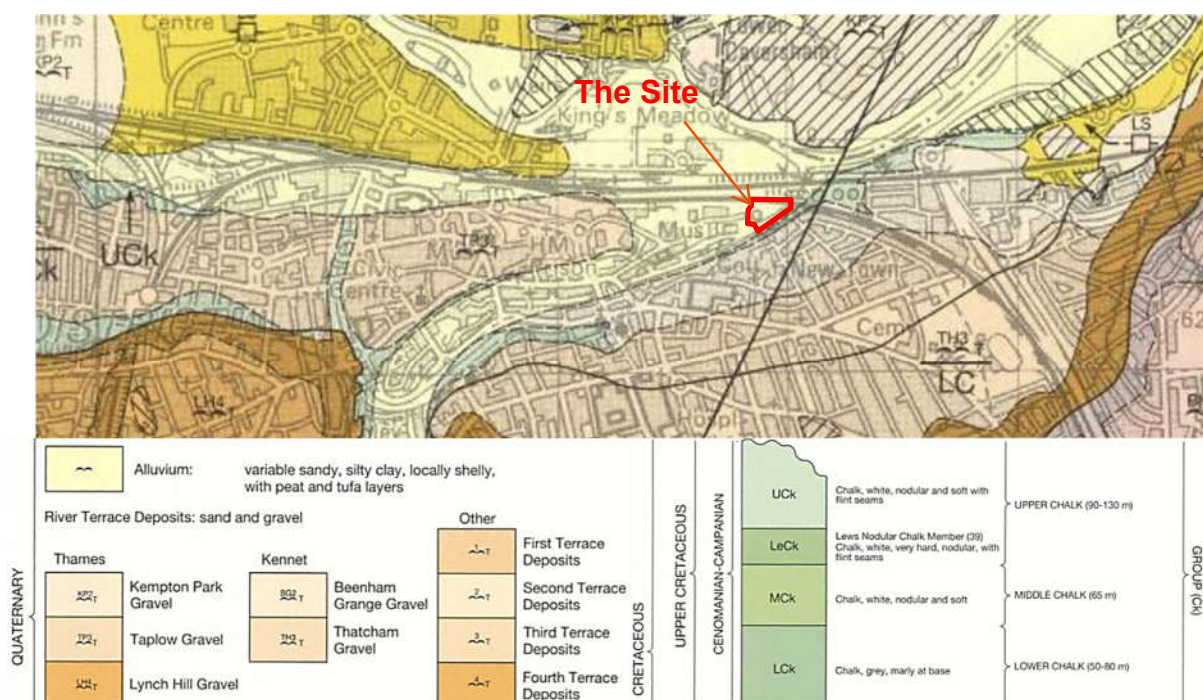


Figure 4-1 Drift and Solid Map of Reading (Reproduced with the permission of the British Geological Survey ©NERC. All rights Reserved)

4.2. Made Ground

The historical borehole logs show the Made Ground to have an approximate thickness of between 2.1m and 3.3m. The Made Ground typically comprises Top Soil/Fill (loose brick fragments, concrete rubble to boulder size, ashes, wood, slag, white fibres) and loose brown silty fine sand to coarse gravel with soft to firm greenish grey locally slightly sandy clay. Due to the variable nature of Made Ground, it is not recommended for use as a founding stratum.

Old buried foundations including concrete slabs associated with the historical development of the site should also be expected locally across the site.

4.3. Alluvium

Underlying the Made Ground, alluvium is anticipated. This comprises firm brown sandy silty clay with black organic streaks and black peaty fragments becoming loose brown very clayey fine to coarse sand with strong hydrocarbon odour. Approximate thickness of 1.0m.

4.4. River Terrace Deposits

Some of the nearby borehole logs suggested River Terrace Deposits (RTD) possibly from the Kempton Park Gravel Formation. The RTD comprises medium dense black-stained medium to coarse angular to sub-round flint gravel with little fine to coarse sand and rare cobbles.

4.5. Seaford and Newhaven Chalk Formations (undifferentiated)

The online BGS Geology of Britain viewer shows the bedrock beneath the site to comprise the Seaford and Newhaven Chalk Formations (undifferentiated) of the White Chalk Subgroup, (formerly Upper Chalk).

The Chalk encountered was recorded as structureless (Grade Dm) and comprised of white cream grey sandy slightly gravelly silt with flint and chalk cobbles. Gravel of fine occasionally medium and coarse of chalk and flint. Hydrocarbon odour and visible contamination was observed at the top.

Standard Penetration Tests (SPT) showed the competency of the Chalk to increase with depth as the degradational effects of weathering of the material decreased with the chalk becoming a weak white Chalk (Grade Dc) at depth with clasts becoming medium to high density. The boreholes were of insufficient depth to identify the presence of structured chalk.

4.6. BGS Archive Information

A search was made of the British Geological Survey (BGS) archives for borehole information pertinent to the sites. A total of nine borehole records were identified and are included in Appendix B.

The geological information obtained was based on records dating back to 1990. Thus, the logging standards will vary and should be considered when being used to derive the anticipated ground profile.

A review of the records indicates that out of the nine boreholes, two are situated adjacent to Block A (proposed development to the south westernmost part of the Site), eight records proved the top of the Chalk stratum, seven records contained groundwater information, and all provided in-situ data but no laboratory test result data.

4.7. Nearby historical ground investigation reports

4.7.1. AIGE Ground Investigation, 2002

The ground investigation was designed by AIG Engineering Limited (AIGE) to undertake an assessment of potential significant risks associated with ground contamination at the site, with specific regard to its continued use under the then current conditions (offices, workshops and vehicle storage). The findings of the site investigation and assessment were produced in a Ground Conditions Report in November 2002.

The fieldwork was carried out in October 2002 comprising:

- Four cable percussion boreholes with standpipe installations;
- 14No. boreholes using a drive-in sampler system together with 5 combined gas/groundwater standpipe monitoring installations;
- Chemical analysis of selected soil and groundwater samples;
- In-situ and laboratory geotechnical testing;

- Monitoring of soil gas and groundwater regimes.

4.7.2. AIGE Ground Investigation, 2005

The ground investigation was designed by AIG Engineering Limited (AIGE) to undertake a reassessment of potential significant risks associated with ground contamination at the site in relation to two possible residential redevelopment schemes. The findings of the site investigation and assessment were produced in a Clarification Site Investigation Report in December 2005.

The fieldwork was carried out between 28th September and 12th October 2005 comprising:

- Five light cable percussion boreholes, designated BH901 to BH905 with standpipe installations;
- 28No. drive-in sampler boreholes, designated DS701 to DS721 twelve with standpipe installations;
- 32No. trial pits, designated TP801 to TP830, TP/BH903A and TP/BH904;
- Subsequent laboratory chemical analysis of selected soil and groundwater samples;
- Soil gas and groundwater monitoring from borehole standpipes.

The nature and characteristics of the various geological units encountered during the 2002 and 2005 AIGE investigations for the adjacent site have been summarised by segmenting the site into four proposed development areas as per the excerpt of proposed scheme and exploratory hole location plan drawing 100199/2-002 shown in Figure 4-2.

- Demise 1
- Demise 2
- Demise 3/4
- Demise 5

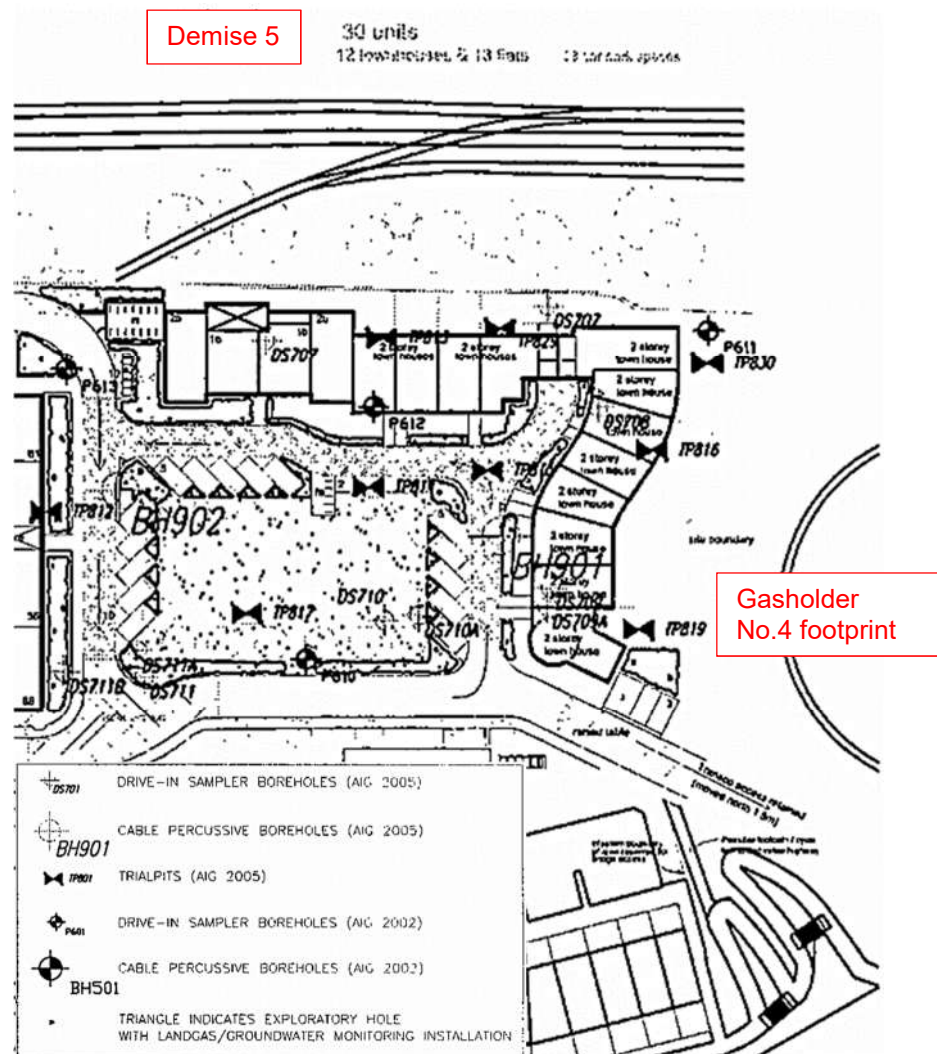


Figure 4-2 Nearby AIGE GI 2002 & 2005 showing Development Site Area “Demise 5” (easternmost) which is closest to the Site

Site Area Demise 5 is located adjacent to the Site footprint where the former Gasholder No.3 was located. BH901 is located within the former Gasholder No. 3 area footprint.

The former Gasholder No.3 was remediated and backfilled as Gasholder No.2. Exploratory locations BH901, DS708, DS709, DS709A, TP815, TP816 and TP819 were in the remediated area and show evidence of the backfilling sequence to a maximum depth of 4.0mbgl in BH901.

4.8. Expected Stratigraphy

The general stratigraphy of the Site based on BGS and nearby/on-site information is summarised in Table 4-1. Table 4-2 presents a summary of the number of historical exploratory hole records available and the number of which are located within the Site.

Table 4-1 Summary of ground conditions described in BGS and nearby/on-site borehole logs

Material	Stratigraphy	Elevation to top of stratum - Range (average) m AOD	Thickness of stratum Range (average) m	Typical Description
Made Ground	Quaternary/ Holocene	37.1 – 38.15 (37.5)	2.1 – 3.3 (3)	Brown dark grey brown silty clayey SAND and fine to medium sub angular to sub rounded GRAVEL with occasional concrete cobbles. Gravel of flint occasional concrete and brick fragments metal and decaying wood fragments. Strong hydrocarbon odour.
Alluvium (when present)		34.15 – 35.2 (34.5)	0.45 – 1.6 (1)	Soft to firm black brown blue gravelly CLAY. Gravel of fine occasionally medium sub angular flint. Hydrocarbon odour.
River Terrace Gravels		33.15 – 34 (33.5)	2 – 4 (3)	Black grey silty sandy fine to medium sub angular GRAVEL
Seaford and Newhaven Chalk Formations (undifferentiated) – Grade Dm	Upper Cretaceous	29.4 – 31.7 (30.5)	Proven to 4.5m	Structureless CHALK comprised of white cream grey sandy slightly gravelly SILT with flint and chalk cobbles. Chalk clasts of low density
Seaford and Newhaven Chalk Formations (undifferentiated) – Grade Dc		25	Proven to 2.0m	Structureless CHALK comprised of cream white very silty sandy fine to coarse sub rounded to sub angular GRAVEL of chalk and flint with flint and chalk cobbles. Chalk clasts are medium to high density.

Table 4-2 Summary of the number of historical exploratory hole records available and the number of which are located within the Site

Historical GI records	No. of boreholes / window sample holes	Trial Pits	Exploratory holes within Site	
			Boreholes / Window Samples	Trial Pits
BGS (2018)	9	0	2 (SU77SW91 & -92)	0

AIGE 2002 GI (Section 4.7.1)	28	0	0	0
AIGE 2005 GI (Section 4.7.2)	33	32	0	0

4.9. Hydrology and Hydrogeology

The River Terrace Deposits are a minor aquifer. The Chalk is a major aquifer. The canalised River Kennet lies approximately 30m offsite to the south east. The Site lies within a designated Zone III (Total Catchment) groundwater source protection zone. The River Thames lies approximately 250m offsite to the north.

Perched groundwater was encountered within the Made Ground and Alluvium between 1.6mbgl and 2.1mbgl. The highest standing perched groundwater levels recorded in three standpipes from adjacent AIGE 2005 GI are between 1.2 and 1.6mbgl. Groundwater was struck within the River Terrace Deposits at depths of between 2.5 to 3.5mbgl. The highest standing groundwater levels recorded within standpipes from adjacent AIGE 2005 GI with a response zone within the RTD or Chalk was at 1.75mbgl.

The presence of granular Made Ground on the site is discontinuous. It is considered that groundwater underlying the site is formed by smaller incremental areas of perched water rather than being representative of a larger groundwater body. Further investigation is required to characterise the groundwater regime.

4.10. Ground Contamination

The existing reports on the site show evidence that the Gasholders would have been set in large pits, filled with water to provide a seal, and were able to rise and fall with the change in volume of the gas stored. The base of the holders would have accumulated tar and contaminated water over time. Tar was often used as lubricant for the Gasholders, so it may be found spread around the perimeter of the concrete bases. Also, contaminants may have been spread around the adjacent site during site clearance, thus contaminating parts of the site where they would not normally have been found. The normal practice was to empty underground storage tanks and the bases of Gasholders before backfilling them with rubble. However, semi-solid sludges were not always removed, and some tanks may not have been cleared at all. Furthermore, during the demolition process there is the possibility that asbestos containing materials could have been spread about the adjacent site in an uncontrolled manner.

Soil contamination and geoenvironmental aspects of the Site will be covered by WSP in a separate report.

4.11. Chemical Ground Conditions

4.11.1. Visual and Olfactory Evidence

Visual and olfactory evidence of contamination was identified in the historical boreholes in the Site and in the nearby site within near surface soils. Olfactory evidence predominantly comprised hydrocarbons type odours. Visual and olfactory evidence of contamination was found within the Made ground, RTD and Chalk.

4.11.2. Ground Aggressivity

The chemical testing (undertaken by AIGE) for the adjacent site carried out in accordance with BRE Special Digest 1 classification for brownfield (Made Ground) and natural (RTD and Chalk) conditions, indicated the following results for aggressiveness of soil to buried concrete. The results are summarised in Table 4-3 for each stratum.

Table 4-3 Concrete aggressiveness

Stratum	Design Sulphate (DS) Class	Aggressive Chemical Environment for Concrete (ACEC) Class
Made Ground	DS-2	AC-2
RTD	DS-2	AC-2

Stratum	Design Sulphate (DS) Class	Aggressive Chemical Environment for Concrete (ACEC) Class
Seaford and Newhaven Chalk Formations (undifferentiated)	DS-1	AC-1s

Further site-specific testing should be undertaken to confirm the above results are representative of the conditions on the Site.

5. Geotechnical Assessment

5.1. Site Overview

The findings of this report indicate that the site is underlain by Made Ground, Alluvium (when present), River Terrace Deposits and Chalk at depth.

Based on the historical boreholes there is no confirmation of the presence of relic foundations. However, relic foundations and both redundant and active buried utilities are likely to be present across the site, see Section 5.4).

However, one borehole (AIGE, 2005) encountered concrete at depths between 4.0mbgl to 4.8mbgl which coincide with base of former Gasholder No.3.

5.2. Development Proposal

The proposed development is understood to comprise of approximately 130 new units spread across the site. The buildings vary from 2-storey to 11-storey developments across the site-wide area red line boundary, See Figure 1-1).

The redevelopment generally involves the demolition of the existing Gasholder No.4 and associated buildings which occupy the Site, and the construction of approximately three plots (residential). There are currently no basements envisaged at this stage with an area to be utilised for car parking.

To facilitate the demolition of existing structures, excavation works and construction of the proposed buildings within the masterplan, liaison with the owners of utilities and assets within the area, residents adjacent to the site, highways specialists and tree specialists shall be required.

The proposed development will involve the construction of a high-rise building using reinforced concrete (RC) frame structure with 11 floors. The column loads (unfactored) of the proposed building have been assessed at this stage of design development and are expected to be in the range of 1500kN to 9100kN. Piled foundations will be required for this structure.

The medium-rise building using a RC frame structures or a combination of RC frame and lightweight superstructure with 4-5 floors. Here a raft option could be feasible as the maximum column loads are about 1000kN to 3000kN.

5.3. Characteristic Geotechnical Parameters

A summary of the site stratigraphy and parameters for preliminary design, based on the interpretation of the limited available data are presented in Tables 5-1 and 5-2.

Table 5-1 Summary of the Site Stratigraphy

Stratum	Top of Stratum (mAOD)	Thickness of Stratum (m)
Made Ground	+37.5	3.0
Alluvium	+34.5	1.0
RTD	+33.5	3.0
Seaford and Newhaven Chalk Formations (undifferentiated) – Grade Dm	+30.5	4.5
Seaford and Newhaven Chalk Formations (undifferentiated) – Grade Dc	+25	Proven to 2.0 (BH901)

Table 5-2 Summary of Characteristic Geotechnical Parameters

Stratum	Unit Weight [kN/m ³]	SPT 'N' Value	Estimated Effective Friction Angle based on SPT 'N' Average Value ^[1] [°]
Made Ground			N/A
Alluvium			N/A
River Terrace Deposits	19	21 to 44	35
Seaford and Newhaven Chalk Formations (undifferentiated) – Grade Dm	19	8 to 23	31 ^[2]
Seaford and Newhaven Chalk Formations (undifferentiated) – Grade Dc	19	15 to 30	33 ^[2]

^[1] CIRIA Report 143, Standard Penetration Test, 1995

^[2] CIRIA Report C574, Engineering in Chalk, 2002

5.3.1. Design Assumptions

Preliminary piled and spread foundation design was carried out using Eurocode 7 and UK's National Annex and CIRIA C574 guide for piles in Chalk. These will be based on-site borehole data available to date which indicate structureless Chalk with depth.

The preliminary design for the piles assumed zero frictional support from the Made Ground/Alluvium to the top of RTG (ca. 4mbgl) and the groundwater table was assumed to be at 1.0m bgl.

5.4. Excavations and Earthworks

Excavations will likely encounter obstructions across the entire site. The predominantly concrete and brick obstructions are likely to require breaking out prior to foundation installation. For example, the maximum depth of obstructions encountered during the works in the adjacent site to the west, recorded that at Gasholder No. 3, a 0.8m thick concrete slab was encountered at 4.0mbgl. However, deeper obstructions were also likely as it is understood that driven piles were encountered which had been driven through the Gasholder No 3's base. This evidence is corroborated by the historical gas journal information where it is documented that more than 600 No. "Simplex" concrete piles were driven in and a reinforced concrete raft then placed upon the piles.

Additionally, shallow foundation obstructions from the existing tanks and plants from the gasworks on site are likely. Shallow excavations in the generally granular made ground deposits will require temporary trench support or battering of excavation sides.

Perched groundwater is likely to be encountered locally at shallow depths (<1.5m) below ground level within the Made Ground and Alluvium deposits. Some form of groundwater control such as sump pumping will be required to control groundwater ingress at shallow depth but dewatering and cut-offs are likely to be required for excavations taken into the saturated granular River Terrace Deposits.

It is recommended that the Made Ground and Alluvium (where present) is excavated within the footprint of all proposed structures to facilitate removal of subsurface obstructions or alternatively, if appropriate, probing is carried out at proposed pile locations. Different material types from all excavations should be stock piled separately for assessment.

5.5. Foundation Options

The selection of the final foundation solution is influenced by a number of factors relating to the ground conditions and the proposed development. These are generally associated with the ability of the ground to support the loads applied by the proposed buildings and the sensitivity of the buildings to ground movement.

The available exploratory holes at the former Gasholder site have revealed a sequence of Made Ground overlying Alluvium with underlying saturated granular River Terrace Deposits and structureless Chalk at depth. As described in Section 5.2 the proposed structures foundation options will likely be comprised of, as follows:

- For **Building A (5-storey)**:
(with reinforced concrete frame)
 - *Option 1*: Piled foundations (penetrating through the existing Gasholder base);
 - *Option 2*: A raft foundation bearing on the River Terrace Deposits.
- (mix between reinforced concrete frame and light weight superstructure)
 - *Option 3*: A raft foundation founded at shallower depths;
 - *Option 4*: Pad (spread) foundations with suspended floor slabs.

For both, options 3 and 4, the Made Ground / Alluvium may be replaced or improved to achieve a minimum design bearing resistance and limit differential settlements particularly where the building footprint bridges between the existing Gasholder and the natural ground as presented in Section 5.6 below.

- For **Building B (9-storey)**:
 - Piled foundations.
- **Block C and car park**
 - Spread foundations with suspended floor slabs provided the Made Ground / Alluvium is replaced or improved to achieve a minimum design bearing resistance as presented in Section 5.6 below.

Two pile options were considered namely Rotary Bored and Continuous Flight Auger (CFA) piles. An assessment of the differing piled schemes considered is presented in Section 5.8 below.

5.6. Spread Foundations

A preliminary bearing capacity analysis has been undertaken in accordance with BS EN 1997-1:2004 and using the UK National Appendix document. Recommended design bearing resistances for strip and pad foundations are presented in Tables 5-3 and 5-4, respectively. The values recommended are to limit maximum anticipated total settlements to about 30mm (long-term) and governed by ULS DA1 Combination 2 (partial factors applied to soil parameters).

The following design bearing resistances have been calculated assuming a minimum SPT 'N' value of 25 (River Terrace Deposits). The same soil strength can be assumed at shallower depths assuming excavation and replacement of the Made Ground and Alluvium with engineered fill material and/or ground improvement is undertaken.

Table 5-3 Design Bearing Resistances for Strip Foundations (DA1-C2)

Strip Foundations	Design bearing resistance (kPa)*		
	Foundation Width		
Depth (mbgl.)	0.5m	1.0m	1.5m
1.0	250	300	400
2.0	400	500	550
3.0	550	650	750
4.0	700	800	900

*Assuming a minimum SPT 'N' value of 25 equivalent to a friction angle of 35 degrees.

Table 5-4 Design Bearing Resistances for Pad Foundations (DA1-C2)

Pad Foundations	Design bearing resistance (kPa)*		
	Foundation Size		
Depth (mbgl.)	1.0 x 1.0m	1.5 x 1.5m	2.0 x 2.0m
1.0	350	400	450
2.0	550	650	700
3.0	800	850	900
4.0	1000	1100	1150

*Assuming a minimum SPT 'N' value of 25 equivalent to a friction angle of 35 degrees.

Contains *sensitive* information

Buried structures and soil contamination may be encountered which will require consideration when assessing the most appropriate foundation solution for specific structures. As a result, ground improvement could be adopted for the Made Ground and Alluvium layers. Refer to Section 5.7 below for a discussion about possible ground improvement techniques.

5.7. Ground Improvement of Made Ground/Alluvium

Where the building loads are light, vibro stabilisation could possibly be undertaken beneath the foundations and floor slabs in the areas where any subsurface structures have been removed or confirmed as absent or where poor ground conditions and contamination is present to create a suitable load bearing resistance. However, consideration for the alluvium stratum known to be present underlying the Made ground will require careful consideration of ground improvement techniques such as vibro stone columns. These can be perceived as offering a pathway for contamination. Therefore, either a concrete plug at the base could be formed or variations on this option would be to use vibro concrete columns (VCCs). These may be preferred by regulators as they would create less of a potential migratory pathway for contamination and work well in cohesive materials if present.

5.8. Piled Foundations

Two piled options were considered. A detailed discussion of the reasons for and against the adoption of the differing pile types is shown in Table 5-5, below.

Table 5-5 Reasons For & Against Adoption of Differing Pile Types

Pile Type	Reasons for Adoption	Reasons against Adoption
Rotary Bored Piles	• Large range of diameters and depths may be achieved. • Largest load carrying potential. • Will be able to penetrate obstructions, possibly at reduced rate of penetration. • Temporary casing through the Made Ground/Alluvium/RTD acting as a barrier. • Relatively low-level vibrations	• Will generate arisings (potentially contaminated) which will require off-site disposal. • Higher mobilisation cost and longer installation times due to obstructions. • Larger corer may be required to penetrate obstructions resulting in an uneconomical pile design.
Continuous Flight Auger (CFA) Piles	• Does not require temporary support during construction. • Quicker and generally lower cost than rotary bored piles.	• Will generate arisings (potentially contaminated) which will require off-site disposal. • Limited ability to penetrate obstructions. Resulting in: • Pile location clearance. • Removal of obstructions prior to pile installation by excavation or pre-coring with a separate rig. • Relocation of piles resulting in additional piles/alterations to column locations/increased pile caps. • Cost and programme implications. • Pile depth/diameter limited by rig capacity. • Dependent on continuous core delivery throughout piling.

The use of bored piles may result in an excessively long piling program and lead to increases in cost. The piles ability to bore through hard stratum is a major advantage but they will require temporary support during construction. It should be noted that both forms of piling will generate potentially contaminated arisings which will require management off-site disposal and will require large volumes of water for washing down which may result in contaminant being washed into the aquifers below.

CFA piling presents an option whereby economy and flexibility can be maintained. CFA piling can extend to depths of up to 25m below ground and to diameters of up to 1200mm, the use of temporary supports will not be required as the pile bore is concreted simultaneously as the auger is withdrawn.

Noise and vibrations caused by CFA rigs are usually found to be acceptable on urban sites. A designed piling mat shall be required to be used as a platform for the rig, the Federation of Piling Specialists (FPS) provide guidance on its design and procurement.

Continuous Flight Auger (CFA) piles are likely to be the most appropriate type of piles for this development.

The charts showing the available pile capacity with depth are presented in Appendix D for the two different cases mentioned above. Indicative pile capacities based on CFA piles and using the geotechnical parameters determined in Section 5.3 and axial capacities for various pile diameters and lengths are shown in Table 5-6. The Pile capacities shown are for single isolated piles based on an overall factor of safety of 3.5 on skin friction and end bearing.

Table 5-6 Indicative Pile Capacities for the SGN Reading Gasholder Site (Based on Geotechnical Parameters in Table 5-2)

Pile Length (m bgl)	Rotary Bored Pile Design Resistance (kN)			CFA Pile Design Resistance (kN)		
	600mm	900mm	1200mm	600mm	900mm	1200mm
15	800	1400	2250	750	1400	2200
16	900	1600	2500	850	1550	2450
17	1000	1800	2800	950	1700	2650
18	1100	1950	3050	1000	1800	2800
19	1200	2150	3250	1050	1900	3000
20	1350	2300	3450	1150	2000	3100
21	1450	2450	3700	1200	2150	3250
22	1550	2650	4000	1300	2250	3400
23	1700	2900	4200	1400	2400	3600
24	1850	3050	4500	1500	2500	3750
25	2000	3300	4800	1550	2650	3950
26	2150	3500	5050	1700	2800	4100
27	2300	3750	5400	1750	2950	4300
28	2450	4000	5700	1850	3100	4500
29	2500	4200	6050	2000	3250	4750
30	2500	4500	6400	2050	3400	4950

A detailed pile design is outside the scope of this report. The final pile layout will depend on many factors including the existing and final layout of the structural columns, transfer structures, extent and location of the cores, location, impact of any buried structures and ground conditions. The exact type and dimensions of the piles to be used will be determined at detailed design stage by the specialist piling contractor. It is proposed that all pile locations be probed to the top of the Chalk by the Main Contractor prior to the commencement of piling works. Any obstructions encountered during probing should be removed and the excavated areas backfilled with arisings.

5.9. Floor Slabs

NHBC recommend adoption of suspended slabs where made ground thickness exceeds 600mm depth and these criteria are exceeded over the whole of the site area.

5.10. Pavement Construction and CBR

It is assumed that capping material will not be required for pavement construction onto granular Made Ground at the site. Based on information retrieved from the nearby site where design CBR values have been derived using IAN73/06 (Highways England, 2009) and TRRL guidance (TRRL, 1984) for the Made Ground assuming typical average construction conditions.

The recommended design values are summarised in Table 5-7. Soft cohesive spots encountered during construction should be dug out and replaced and loose granular Made Ground material should be adequately compacted in order to achieve the minimum CBR values summarised in Table 5-7.

Table 5-7 Design CBR values

Stratum	Design CBR (%)	
Made Ground	Granular	40 (assuming average construction conditions)
	Cohesive	2*
*Assuming thin construction		

It should be noted that the subgrade CBR value must be checked on site before foundation construction starts and must be equal or greater than the Design CBR.

5.11. Soakaways

Soakaway testing has not been undertaken at the site. The granular Made Ground and Alluvium, which overlies the RTD across the majority of the site, may be geotechnically suitable as a soakaway, although given the potential for remaining contamination, and to support the re-use of site won materials on site, this is not recommended without further review of the cut and fill requirements and subsequent discussions/approval by the Environment Agency.

6. Geotechnical Risk Register

This section presents the Geotechnical Risk Register for the proposed works to be undertaken for the scheme. The Geotechnical Risk Register identifies the risks and the consequences, recommends preventative or mitigation measures and re-assesses the risk in light of those measures. The geotechnical risks are discussed in terms of probability, severity and risk, as defined below:

Probability (P): The perceived likelihood of the identified geotechnical hazard actually occurring (defined as a rating in Table 6-1).

Severity (S): The perceived impact, in terms of safety, financial, temporal, legal, or operational consequence, of the occurrence of the identified geotechnical hazard on the identified receptor(s) (defined as a rating in Table 6-2).

Risk(R): The perceived level of concern which should be assigned to the identified hazard, based on the probability of occurrence, and taking into due account the perceived severity of impact and consequence on the receptor(s) (defined as a risk number in Table 6-3).

The Geotechnical Risk Register and terminology adopted for this project is based on the guidance given in HD22/08. It is a semi-quantitative assessment based on engineering judgment. The classification of probability and severity used in this Geotechnical Risk Register is summarised in Table 6-1 and Table 6-2 respectively.

The risk classification is based on:

Risk = Probability Rating x Severity Rating

The explanation of risk number is given in Table 6-3, which gives the assessed risk level and appropriate actions.

Table 6-1 Assessment of probability

Rating	Likelihood (Class Descriptor)	Class Description
4	>85%	Highly likely
3	25 – 84%	Likely (regular occurrence)
2	2 – 25%	Fairly unlikely
1	<1%	Very unlikely to occur

Table 6-2 Assessment of consequence / severity

Rating	Class Descriptor	Construction Impact	Operation / Maintenance Impact	Environmental Impact
4	Disastrous	Construction unsustainable	Scheme operation unsustainable/deaths and serious injury	Major environmental incident – Threat to public health or safety
3	Substantial	Significantly increased construction costs and operational difficulty	Increased scheme costs Injury/Illness	Environmental incident triggers damage and/or nuisance prosecution and/or compensation

Contains *sensitive* information

Rating	Class Descriptor	Construction Impact	Operation / Maintenance Impact	Environmental Impact
2	Significant	Impact to costs/programme	Effect on scheme costs	Third party environmental impact requiring management response to recover
1	Marginal	Impact to programme	Small effect on scheme costs	Any environmental impact regarded as significant.

Table 6-3 Perceived risk level and mitigation action

Risk Number	Perceived Risk Level	Action Required
13 to 16	Intolerable	Eliminate Risk
9 to 12	Unacceptable (avoid)	Avoid or transfer risk
5 to 8	Unacceptable (manage)	Risk managed by prevention or mitigation
1 to 4	Negligible	Could be ignored

A summary of the potential geotechnical risks identified at this stage are detailed in Table 6-4. The Geotechnical Risk Register will be updated as the design of the scheme progresses to take into consideration any additional information obtained.

Table 6-4 Geotechnical risk register

Hazard	Consequence	Risk Rating			Recommended Mitigation Measures	Revised Risk Rating		
		P	I	R		P	I	R
Soft Ground	Excessive differential settlement between the existing and repaired pavement resulting in an uneven road surface. Additional cost and time required for additional works.	3	3	9	Removal of unsuitable material during construction phase where appropriate. Designer to specify appropriate construction materials to limit differential movements.	1	3	3

Hazard	Consequence	Risk Rating			Recommended Mitigation Measures	Revised Risk Rating		
		P	I	R		P	I	R
Unforeseen Ground Conditions	Re-design with delays to programme and increase in cost	3	3	9	Undertake site specific geotechnical and geoenvironmental ground investigation (GI) at the Site. Designer to review and confirm ground conditions assumed for preliminary design during the detailed design and construction phases. Contractor to advise on any temporary works GI required.	2	3	6
Migration of contamination within Made Ground into underlying strata	Creation of contamination pathways Contamination of confined groundwater in Chalk	3	3	9	Designer to consider piling methodology to avoid creation of contamination pathways	1	3	3
Existing Services (Relic buried services also likely to be present)	Damage to existing services during construction phase	4	3	12	Ensure privately owned utilities are traced and located prior to construction works Identify and relocate services crossing areas of proposed construction	2	3	6
Existing River Kenneth walls	Encountering anchors causing delay to construction	2	3	6	Consideration to be given to undertaking non-intrusive geophysical surveys to identify anchors	1	3	3
Buried obstructions/ foundations	Encountering buried obstructions including old foundations/piles below Gasholder No 4, causing design issues and delay to construction	2	3	6	Consideration to be given to undertaking non-intrusive geophysical surveys to identify shallow obstructions	1	3	3
Interface between Gasholder foundations and new structures	Crossing of the new structures over the existing Gasholder footprint foundations, ring wall and the adjacent natural ground. Bearing capacity issues and differential settlements	2	3	6	Consideration to be given to ground improvement and the use of engineered fill and modification or part demolition of the ring wall and Gasholder associated elements.	1	3	3

Hazard	Consequence	Risk Rating			Recommended Mitigation Measures	Revised Risk Rating		
		P	I	R		P	I	R
Perched groundwater	Presence of perched groundwater on top of the Alluvium/RTD within the granular Made Ground layers at the site causing flooding in temporary excavations	2	3	6	Monitoring of groundwater installations should be ongoing to inform long term groundwater model for the site	1	3	3
Unexploded Ordnance	Damage to construction, plant and injury/ death to site personnel or the public	2	2	12	Undertake an UXO risk assessment of the site prior to starting construction	1	3	3
Stability of Excavations	Collapsing excavations causing damage to plant or injury to site personnel	4	3	12	Design of temporary works to be undertaken by competent person	1	3	3
Asbestos	Risk to human health	3	3	9	Review of building management records for existing asbestos registers.	1	3	3

7. Conclusions and Recommendations

7.1. Conclusions

This Desk Study Report was prepared for the proposed development in order to highlight potential geotechnical and ground based risks associated with the development and to provide a strategy for addressing those identified. The potential geoenvironmental based risks are covered in a separate report by WSP.

Potential sources of contamination are largely linked to the site's historical redevelopment which may have impacted the Made Ground and the unknown ground gas regime. The previous ground investigations conducted at the adjacent gasworks site particularly Site Area "Demise 5" identified contaminants of concern which require further assessment. There is also the potential for further sources of contamination to be present within the inaccessible areas or additional unidentified underground structures.

Furthermore, in order to identify the risks posed by these potential contaminative sources to the site sensitive receptors, it is recommended that site-specific exploratory data is sought for interpretation and quantitative assessment, and to refine the potential risks identified within this report. In order to quantify the on-site ground conditions, it is recommended that a ground investigation be carried out to quantify the geotechnical properties of the key strata at the site in order to inform optimal and safe detailed design of the proposed foundations and contamination assessment. It could also delineate and explore potential historical substructures underlying the site.

A range of foundation and ground improvement solutions have been identified as possibly being viable at the site. The choice of final solution will be dependent on the ground conditions encountered during the ground investigation, the final proposed development design, and constraints related to construction such as protected tree zones, sensitive structures such as the Network Rail assets, River Kennet Canal Trust, site access and limits on vibrations, wall movements and ground movements set by third party asset owners.

7.2. Recommendations

It is recommended that a ground investigation be carried out at the Site, in order to:

- Establish the underlying ground conditions across the Site and geotechnical engineering design parameters for substructure (foundation) design, in particular nature of the Chalk grade with depth;
- Determine the presence and chemical composition of the Made Ground and underlying layers through targeted and representative soil sampling;
- Characterise the underlying groundwater and ground gas regimes through sampling and the development of a monitoring program;
- Quantify the risk of encountering subsurface obstructions and existing foundations;
- Quantify the risk of encountering subsurface utilities/services – live and abandoned;
- Assess the need for stability assessments of adjacent third-party structures;
- To provide a preliminary waste management assessment;
- Provide recommendations for any potential remedial work and verification reporting; and
- Prior to any ground intrusive works a UXO assessment of the site should be instructed to be undertaken and its recommendations adhered through to future works.

8. References

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BS 1377-1/9 *Methods of Test of Soils for Civil Engineering Purposes – Parts 1-9* (1990) BSI.

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CIRIA C574 (2002) *Engineering in Chalk*, DTI

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Appendices

Appendix A. Drawings

A large floor plan of a building with a red line indicating a specific area. An inset shows a detailed view of this area, labeled "private garden" and "C001 2B4P 70 m² 754 ft²".

Kennet Walk

potential future
connection to
pedestrian
bridge

WORK

NOTES

- Do not scale from this drawing
- Check all dimensions on site
- Subject to site inspection
- This document is for information only and is subject to a preliminary risk analysis to be carried out by all relevant consultants

AREAS

- Refer to area schedule



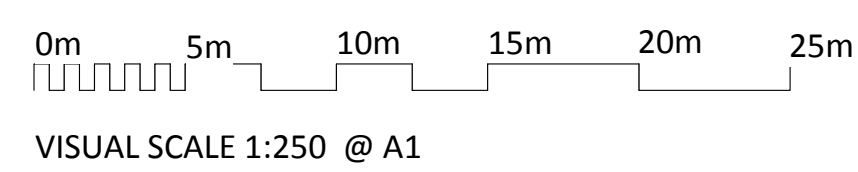
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NOTES

Any decisions to be made on the basis of this drawing, whether as to project viability, pre-letting, lease agreements and the like, should make allowance for:

- Design development
- Accurate surveys
- Accurate boundary/site ownership documentation
- Construction methods and building tolerances
- Local Authority/Statutory consents



- ☐ 1B2P
☐ 2B3P WCH
☐ 2B4P
☐ 3B5P

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Date: 25/07/17
Drawn By: LK
Checked by: RC
Scale @ A1: 1 : 250
Scale @ A3: 1 : 500
CAD File No:

Danescroft (KDPM) LLP
SGN, Reading
Proposed Plan - Ground Floor/ Site
Plan
PRELIMINARY
16035 P0-100

Revision

television

Richard Parker Road

Alexander Turner Close

Kennet Walk

existing trees along railway
(location indicative only)

green / brown roof
over carpark

green roof over projecting lower floors

green roof over projecting lower floors

public open space
below

River Kennet

[illegible]

NOTES

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AREAS

- Refer to area schedule

[illegible]

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VISUAL SCALE 1:250 @ A1

-  1B2P
 2B3P
 2B4P
 3B5P

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Scale @ A3: 1 : 500
CAD File No:

Danescroft (KDPM) LLP
SGN, Reading
Proposed Plan - Second Floor

PRELIMINARY
16035 P0-102



Richard Parker Road

Alexander Turner Close

Kennet Walk

WORK IN PROGRESS

carpark below

B308 2B4P 71 m² 768 ft²

B307 1B2P 50 m² 538 ft²

B306 1B2P 50 m² 538 ft²

B305 1B2P 50 m² 538 ft²

B304 2B3P WCH 72 m² 772 ft²

B303 2B4P 71 m² 768 ft²

B309 2B4P 71 m² 768 ft²

B310 1B2P 50 m² 538 ft²

B311 1B2P 50 m² 538 ft²

B301 2B3P WCH 72 m² 772 ft²

B302 2B4P 71 m² 768 ft²

A307 2B4P 73 m² 780 ft²

A308 1B2P 50 m² 538 ft²

A301 1B2P 50 m² 538 ft²

A303 2B4P 73 m² 780 ft²

A304 3B5P 88 m² 946 ft²

A305 1B2P 50 m² 538 ft²

A306 2B4P 73 m² 780 ft²

River Kennet

Alexander Turner Close

River Kennet

[illegible]

NOTES

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AREAS

- Refer to area schedule

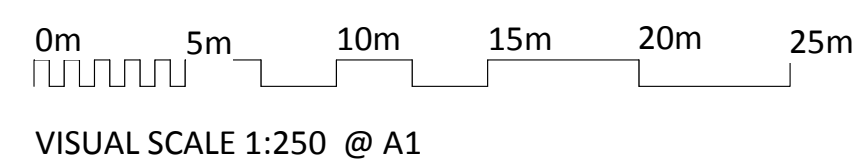
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-  1B2P
-  2B3P WCH
-  2B4P
-  3B5P

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Danescroft (KDPM) LLP
SGN, Reading
Proposed Plan - Third to Fourth
Floor
PRELIMINARY
16035 P0-103

Revision

ision

Richard Parker Road

Alexander Turner Close

Kennet Walk

existing trees along railway
(location indicative only)

carpark below

River Kennet

[illegible]

NOTES

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- Check all dimensions on site
- Subject to site inspection
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AREAS

- Refer to area schedule

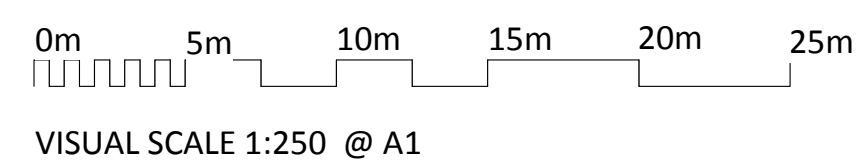
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NOTES

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- Accurate surveys
- Accurate boundary/site ownership documentation
- Construction methods and building tolerances
- Local Authority/Statutory consents



 1B2P
 2B4P

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Checked by: RC
Scale @ A1: 1 : 250
Scale @ A3: 1 : 500
CAD File No:

Danescroft (KDPM) LLP
SGN, Reading
Proposed Plan - Fifth to Eighth
Floor
PRELIMINARY
16035 P0-105



Appendix B. Historical/Nearby Ground Investigation Exploratory Hole Logs





**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 428242 : BGS Reference: SU77SW90

British National Grid (27700) : 472780,173650

[Report an issue with this borehole](#)

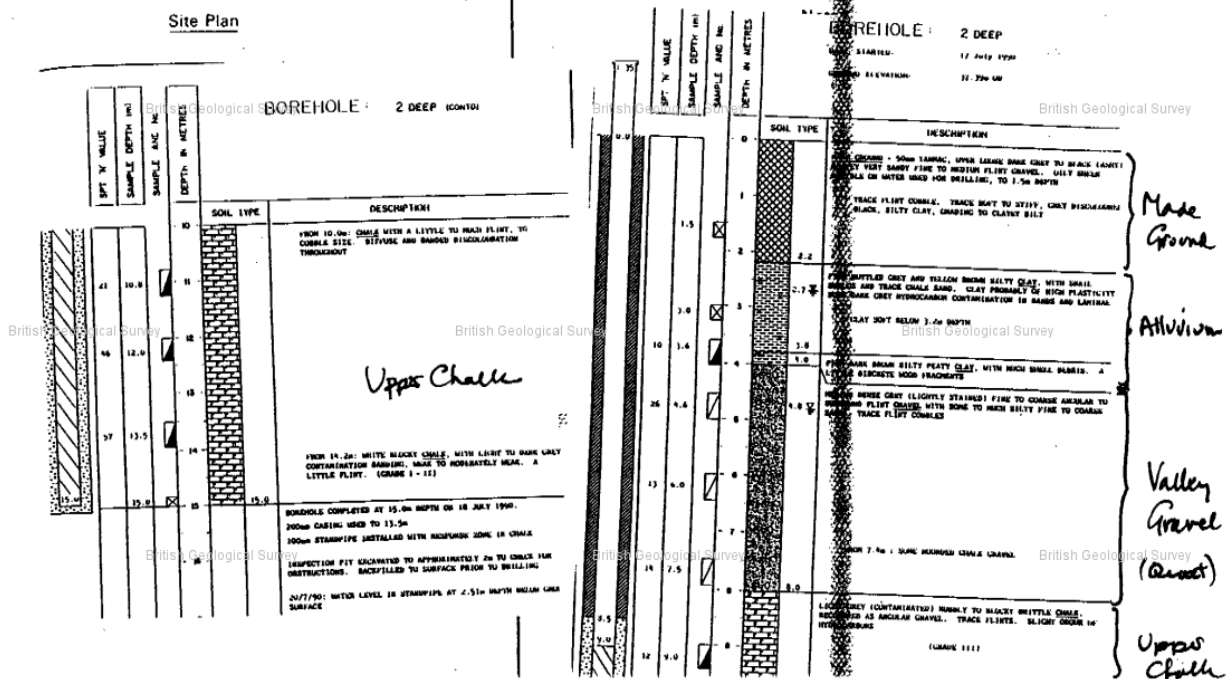
[< Prev](#)

Page 1 of 2 ▼

Next >

>>

Eastern L.S.					Thames NRA					SU 77SW 90 7278-7365				
British Geological Survey					British Geological Survey					British Geological Survey				
Reading Gas works Bore 2					Rosehaugh (Deep)					268 SU 77/171 D SU 77SW				
Licence No.					Nat. Grid Ref. SU 7278 7365									
IGS Ref. No.					Status									
Aquifer					Chalk									
Summary of Geological Section					Thickness					Depth				
Instruction 13/12/90					Tx/CO/B-1/26									
Depth bwt					Dia.									
Lining (below well top)														
From					To					Dia.				
Type														
15 m					0					9 m				
1					15 m					200 mm				
0					8.5 m					Plain Pipe				
8.5					15 m					slotted Pipe				
										Bentonite Seal				
										Gravel filter				
traction Rates					Type of Pump									
gph					Chem./Bact. Anal.					YES NO				
gpd					Well Driller									
Insufficient space has been allowed, continue in 'Notes' overleaf.														





**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 428243 : BGS Reference: SU77SW91

British National Grid (27700) : 472880,173670

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Page 2 of 2 ▼

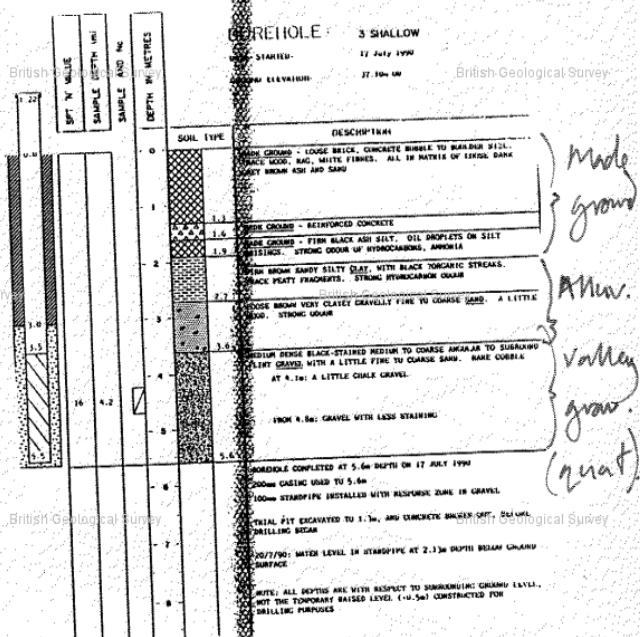
Next >



Eastern HS emavon Drive		Thames NRA Reading Gas works Bore 3 A Rosehangh site (shallow) 268		SU 77/171 E 54 7288 7367	
Licence No.		IGS Ref. No.		Nat. Grid Ref.	
Supplier client : Montagu Evans		IGS Ref. No.		Status	
Ground Level 37.10 m OD		ft. OD		Aquifer Gravel	
Level of Well Top 38.32 m OD		ft. OD		Summary of Geological Section	
Static Water Level 2.13 m bwt		ft. bwt		Thickness	
Date 13/12/96 34.97 m OD		ft. OD		Depth 5.6m	
Instruction 13/12/96 78/00/EE/46					
Depth bwt	Dia.	Linings (below well top)			
		From	To	Dia.	Type
		0	3.5 M	200 mm	Plain Pipe
		3.5	5.6 M	"	Slotted Pipe
		0.0	3.0 M	"	Pentamite Seal
		3.0	5.6 M	"	Gravel filter
Friction Rates		Type of Pump			
gph		Chem./Bact. Anal.		YES NO	
gpd		Well Driller			
sufficient space has been allowed, continue in 'Notes' overleaf.					

Site Plan

Notes





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BGS ID: 428244 : BGS Reference: SU77SW92

British National Grid (27700) : 472880,173670

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Eastern L.S. Thames NRA.
Reading Gas works Bore 3 B
Kenavon Drive, Roshangh site (Deep)

Owner *client: Montagu Evans* Licence No. *2658* Nat. Grid Ref. *SN 77/171 FSU77SW92*
Occupier *7288 7367*

Ground Level *37.10* m OD ft. OD
Level of Well Top *38.20* m OD ft. OD
Test Water Level *2.10* m bwt ft. bwt
Date *35.06* m OD ft. OD
Construction *13/12/90* *T8/100/KE/K6*

Summary of Geological Section

Thickness	Depth
	<i>14.5m</i>

Depth bwt *14.5m*

Dia.	Linings (below well top)			
	From	To	Dia.	Type
	<i>0</i>	<i>8.5m</i>	<i>200mm</i>	<i>Plain Pipe</i>
	<i>8.5</i>	<i>14.5</i>		<i>slotted pipe</i>
	<i>0</i>	<i>8.0</i>		<i>Bentonite seal</i>
	<i>8</i>	<i>14.5</i>		<i>Gravel Filter</i>

traction Rates

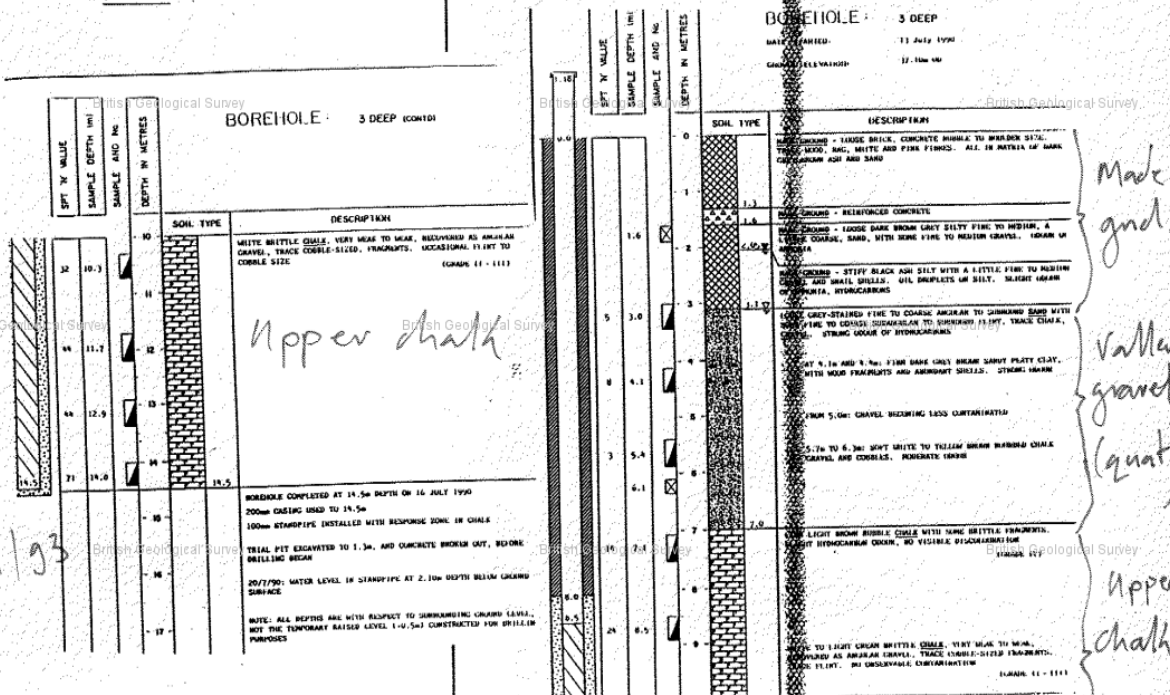
Type of Pump	Chem./Bact. Anal.	YES	NO
<i>gph</i>			
<i>gpd</i>			

Well Driller

sufficient space has been allowed, continue in 'Notes' overleaf.

Site Plan

Notes





**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 428461 : BGS Reference: SU77SW309

British National Grid (27700) : 472820,173830

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SU77 SW 309 [7282 7383]

Contract: Reading Cross Town Stage II				Borehole No. 13			
Client: Berkshire County Council				Sheet No. 1 of 1 Depth 0 to 10 metres.			
Equipment and Methods Light Cable Percussion Boring 150mm Diameter		Ground Level : 37.50 m.O.D.		Job Number : S39/655			
Orientation : Vertical		Coordinates :		Location :		Dates : 25/9/89 26/9/89	
Daily Prog.	Water Levels	Remarks	In Situ Tests	Samples Taken	Depth (thick)	Reduced Level	Description
				B 773	0.00	37.50	MADE GROUND (topsoil with ash and flints)
				J 774	(1.80)		
			S 6	J 775	1.80	35.70	MADE GROUND (brown mottled silty clay with bricks and chalk)
				J 776	(0.40)		
				J 777	2.20	35.30	Soft grey, green and brown mottled silty CLAY with shell fragments
				J 778	(0.60)		
				J 779	2.80	34.70	Firm grey/blue and green/brown mottled very sandy silty CLAY with occasional gravel
				U 779	(0.40)		
			C 91	B 780	3.20	34.30	Very dense brown fine to coarse SAND and fine to coarse subangular to subrounded GRAVEL
				J 781			
				B 782			
			C 73	J 783	(3.00)		
				B 784			
			C 77	J 785			
				J 786	6.20	31.30	Firm light brown/grey laminated clayey sandy SILT with occasional flints
				U 787	(0.70)		
				B 788	6.90	30.60	Very dense fine to cobble subangular to subrounded GRAVEL and brown fine to coarse SAND
			C 129	J 789			
				B 790	(2.10)		
			C 67	J 791			
				B 792	9.00	28.50	Loose brown fine to coarse SAND with gravel and numerous fine to medium gravel sized chalk fragments
			C 8	J 793	(1.00)		
					10.00	27.50	End of Borehole
Operator IM		General Remarks: Pit dug to avoid services Piezometer installed to 9.0m Water added to assist drilling 3.20m to 7.00m				Appendix 1	
Scale 10m/sheet						Sheet No.54	



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 428463 : BGS Reference: SU77SW311

British National Grid (27700) : 472950,173840

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SU 77 SW 311 [7295 7384]

Contract: Reading Cross Town Stage II				Borehole No. 15				
Client: Berkshire County Council				Sheet No. British Geological Survey Depth 0 to 10 metres.				
Equipment and Methods Light Cable Percussion Boring 150mm Diameter		Ground Level : 37.40 m.O.D.		Job Number : S39/655				
Orientation : Vertical		Coordinates :		Location :		Dates : 28/9/89		
Daily Prog.	Water Levels	Remarks	In Situ Tests	Samples Taken	Depth (Thick)	Reduced Level	Description	Legend
				B 817	0.00	6.1	MADE GROUND (brown silty clay and grey silty clay with gravel, chalk and traces of brick)	
				U 818	(2.00)			
				J 819				
				J 820	2.00	35.40		
				U 821			Soft grey and brown mottled silty CLAY with traces of decaying organic matter	
				J 822	(1.20)			
				J 823				
	28/9	Water rose to 2.90m after 20 mins		W 825	3.20	34.20	Medium dense to dense brown coarse to fine SAND and coarse to fine subangular GRAVEL	
				W 841				
				W 842				
			C 20	W 827				
			C 44	W 829	(3.80)			
			C 14	B 831				
				J 832	7.00	30.40	Stiff to weak white rubbly becomes blocky CHALK with occasional flints	
				U 833				
				U 834				
			C 24	J 835				
				B 836	(3.10)			
			S 30	J 837				
	28/9			B 838				
				U 839				
					10.00			
Continued								
Operator IM		General Remarks:					Appendix 1	
Scale 10m/sheet							Sheet No. 60	



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 428464 : BGS Reference: SU77SW312

British National Grid (27700) : 473000,173840

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SU 77 SW 312

[7300 7384]

Contract: Reading Cross Town Stage II				Borehole No. 16			
Client: Berkshire County Council				Sheet No. 1 of 2 Depth 0 to 10 metres.			
Equipment and Methods Light Cable Percussion Boring 150mm Diameter		Ground Level : 36.00 m.O.D.		Job Number : S39/655			
Orientation : Vertical		Coordinates :		Location :		Dates : 2/1/89	
Daily Prog.	Water Levels	Remarks	In Situ Tests	Samples Taken	Depth (Thick)	Reduced Level	Description
				B 843	0.00	36.00	MADE GROUND (brown silty sandy clay with gravel chalk fragments with ash and brick)
				J 844	1.00	35.00	Soft grey sandy very silty CLAY with traces of fine gravel and chalk
	3/10			U 845	1.30		
				J 846			
	2/10			J 847	2.30	33.70	Soft brown clayey SILT with pockets of fine gravel and sand, traces of decaying organic matter
				U 848			
	2/10	Water rose to 2.60m after 20mins		U 849	1.20		
				W 875			
				W 876			
			C 13	B 850	3.50	32.50	Medium dense becoming dense brown coarse to fine sandy coarse to fine subangular GRAVEL
				J 851			
			C 28	B 852			
				J 853	2.60		
			C 61	B 854			
				J 855			
				U 856	6.10	29.90	Stiff rubbly CHALK becomes blocky with depth, occasional flints. (Grade IV becomes III)
			S 9	B 857			
				B 858			
				B 859			
				J 860			
				U 861	6.00		
				J 862			
				B 863			
	2/10		S 40	J 864			
				J 865			
					10.00		
Continued							
Operator IM		General Remarks: Chiselling flint 12.01 to 12.60m (1 hour)					Appendix 1
Scale 10m/sheet							Sheet No 64



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 428465 : BGS Reference: SU77SW313

British National Grid (27700) : 473010,173840

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SU 77 SW 313 [7301 7384]

Contract: Reading Cross Town Stage II				Borehole No. 17				
Client: Berkshire County Council				Sheet No. 1 of 2 Depth 0 to 10 metres.				
Equipment and Methods Light Cable Percussion Boring 150mm Diameter		Ground Level : 35.90 m.O.D.		Job Number : S39/655				
Orientation : Vertical		Coordinates :		Location :		Dates : 24/10/89 27/10/89		
Daily Prog.	Water Levels	Remarks	In Situ Tests	Samples Taken	Depth (Thick)	Reduced Level	Description	Legend
				B 1035	0.00	35.90	MADE GROUND (brown silty sandy clay with gravel and bricks)	
				J 1036	0.50	35.40	Firm brown friable silty CLAY with traces of fine gravel and shells	
				J 1037	1.10	34.80	Soft grey sandy very silty CLAY with fragments of decaying wood and plant remains and occasional pockets of silt and sand, becomes peaty with depth	
				U 1038				
				U 1039				
				J 1040				
				U 1061				
				W 1062				
				W 1063				
				J 1043	3.30	32.60	Medium dense becoming dense brown coarse to fine SAND and coarse to fine subangular GRAVEL	
				C 12				
				J 1044				
				J 1045				
				C 20				
				J 1046				
				J 1047				
				U 1948				
				U 1049				
				B 1050				
				J 1051				
				B 1052				
				U 1053				
				J 1054				
				B 1055				
				J 1056				
				S 44				
					10.00	25.90	Continued	
Operator NF		General Remarks: Chiselling flint bend 8.0 to 8.3m (1/2 hour)					Appendix 1	
Scale 10m/sheet							Sheet No. 68	



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 428468 : BGS Reference: SU77SW316

British National Grid (27700) : 473050,173840

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SU77SW 316 [7305 7384]

Contract: Reading Cross Town Stage II				Borehole No. 20				
Client: Berkshire County Council				Sheet No. 013 Depth 0 to 10 metres.				
Equipment and Methods Light Cable Percussion Boring 150mm Diameter		Ground Level : 35.70 m.O.D.		Job Number : S39/655				
Orientation : Vertical		Coordinates :		Location :				
				Dates : 12/12/89 17/10/89				
Daily Prog.	Water Levels	Remarks	In Situ Tests	Samples Taken	Depth (Thick)	Reduced Level	Description	Legend
				B 1084	0.00		MADE GROUND (brown silty clay with chalk gravel traces of brick)	
				J 1085	(0.80)			
				J 1086	0.80	34.90		
							Soft dark brown silty CLAY with traces of decay organic matter and shells	
				U 1087	(1.10)			
				W 1123				
				W 1124	1.90	33.80		
				B 1088	(0.60)		Soft Black/grey very silty CLAY with pockets of sand and fine gravel small pockets of decaying organic matter	
				B 1090	2.50	33.20		
				UK			Dense to medium dense brown coarse to fine SAND and coarse to fine subangular GRAVEL	
			C 19	J 1092				
				B 1091				
			C 50	J 1094				
				B 1093				
					(4.30)			
			C 30	B 1095				
				J 1096				
			C 19	B 1097				
				J 1098				
				J 1099	6.80	28.90		
				U 1100			Weak locally stiff white to yellowish white rubblely to blocky CHALK frequent flints. (Grade IV to III)	
				U 1101				
				J 1102				
				B 1103				
			S 33	J 1104	(4.20)			
				B 1105				
			S 40	U 1106				
				J 1107				
					10.00			
Continued								
Operator IM		General Remarks: Piezometer installed to 6.0m Pit dug to avoid services Permeability test made at 4.52m Chiselling flints 11.50m to 15.00m					Appendix 1	
Scale 10m/sheet							Sheet No. 80	



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 428464 : BGS Reference: SU77SW312

British National Grid (27700) : 473000,173840

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5U77SW/312

Contract: Reading Cross Town Stage II						Borehole No. 16		
Client: Berkshire County Council						Sheet No. 2 of 3 Depth 10 to 20 metres.		
Equipment and Methods Light Cable Percussion Boring 150mm Diameter			Ground Level : 36.00 m.O.D. Coordinates :			Job Number : S39/655 Location : Dates : 2/1/89		
Orientation : Vertical								
Daily Prog.	Water Levels	Remarks	In Situ Tests	Samples Taken	Depth (Thick)	Reduced Level	Description	Legend
				U 866	10.00		Stiff rubbly CHALK becomes blocky with depth, occasional flints. (Grade IV becomes III)	
				J 867 B 868	(6.00)			
			S 44	J 869				
		Flints bend 12.10 to 12.60m		B 870	12.10	23.90	Weak white blocky CHALK with occasional flints. (Grade III)	
				U 871				
				J 872 B 873	(2.90)			
			S 53	J 874				
2/10					15.00	21.00	End of Borehole	
General Remarks: Chiselling flint 12.01 to 12.60m (1 hour)								
Operator IM							Appendix 1	
Scale 10m/sheet							Sheet No. 65	



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 428462 : BGS Reference: SU77SW310

British National Grid (27700) : 472900,173840

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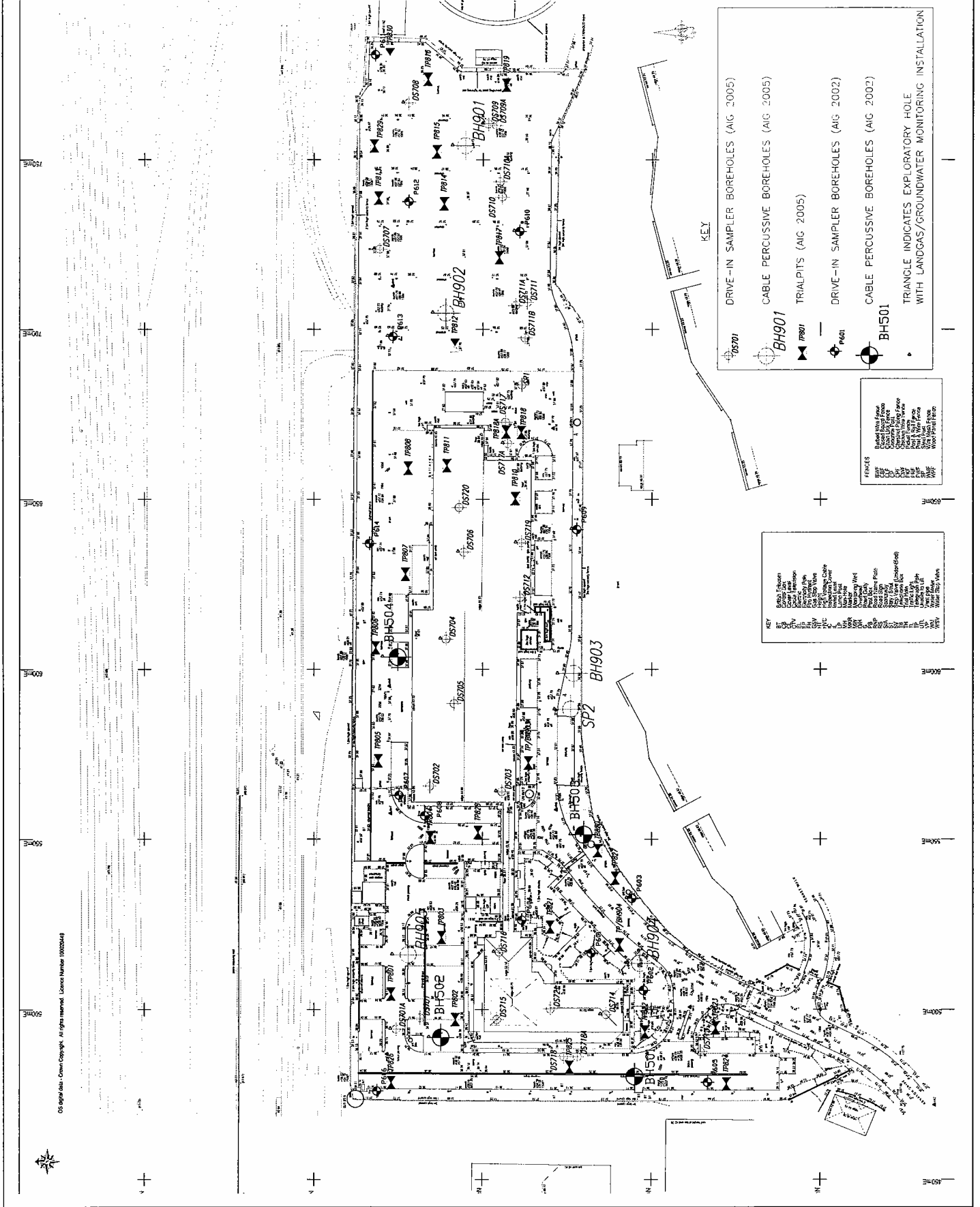
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SU 77 SW 310

[7290 1384]

Contract: Reading Cross Town Stage II				Borehole No. 14			
Client: Berkshire County Council				Sheet No. 1 of 1			
Equipment and Methods Light Cable Percussion Boring 150mm Diameter				Ground Level : (m.O.D.) 37.50			
Orientation : Vertical				Coordinates :			
Job Number : S39/655				Location :			
Dates : 27/9/89							
Daily Prog.	Water Levels	Remarks	In Situ Tests	Samples Taken	Depth (Thick)	Reduced Level	Description
				B 794	0.00	6.1	MADE GROUND (Brown silty clay with traces of organic matter and zones of loose ash, chalk, brick, clinker and concrete)
				U 795	(2.40)		
				J 796			
				U 797	2.40	35.10	
				J 798	(0.50)		Soft to firm grey brown mottled silty CLAY with occasional fine gravel
	27/9	Water level rose to 2.50m in 20 minutes	C 15	B 799 J 800	2.90	34.60	Medium dense becoming dense coarse to fine SAND and coarse to fine subangular to subrounded GRAVEL
			C 54	B 801 J 802	(2.70)		
			C 43	B 803 J 804			
				J 805	5.60	31.90	Firm white remoulded CHALK with lithorelics of weak chalk, becomes rubbly with depth. (Grade IV becomes grade III)
				B 807			
			S 6	J 808			
				B 809			
				U 810	(4.40)		
			S 16				
	27/9				10.00	27.50	End of Borehole
Operator IM		General Remarks:					Appendix 1
Scale 10m/sheet							Sheet No. 57



AIG Engineering Group

BASILDON OFFICE
Powers Way, Clongrove, South East, Essex, SS14 3JG
Tel: (01768) 740000 Fax: (01768) 740005

Project
42 KEMOND DRIVE READING

Drawing Title
EXPLORATORY HOLE LOCATION PLAN

Client
PROMISING FACTOR LTD & FRESH OPENINGS LTD

Drawn by
-
Checked by
-
Approved by
-
Date
11/12/05

Scale
1:500000

Drawing No.
10019972 - 001

Rev.
A

- KEY
- DRIVE-IN SAMPLER BOREHOLES (AIG 2005)
 - CABLE PERCUSSIVE BOREHOLES (AIG 2005)
 - TRIALPITS (AIG 2005)
 - DRIVE-IN SAMPLER BOREHOLES (AIG 2002)
 - CABLE PERCUSSIVE BOREHOLES (AIG 2002)
 - TRIANGLE INDICATES EXPLORATORY HOLE WITH LANDGAS/GROUNDWATER MONITORING INSTALLATION

- KEY
- DRIVE-IN SAMPLER BOREHOLE
 - CABLE PERCUSSIVE BOREHOLE
 - TRIALPIT
 - DRIVE-IN SAMPLER BOREHOLE
 - CABLE PERCUSSIVE BOREHOLE
 - TRIANGLE INDICATES EXPLORATORY HOLE WITH LANDGAS/GROUNDWATER MONITORING INSTALLATION

- FINISHES
- Asphalt
 - Gravel
 - Concrete
 - Brick
 - Stone
 - Wood
 - Plaster
 - Paint
 - Other

Project Name
KENAVON DRIVE, READING

Project No.
100199

Co-ords: 754E - 405N

Hole Type
CP

Location: 42 Kenavon Drive, Reading. Berkshire

Level: 38.150

Scale
1:50

Client: Promising Factor Ltd & Fresh Openings Ltd

Dates: 29/09/2005

Logged By
MNC

	Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests		Water Strikes	Well
					Depth (m)	Samp	SPT Results	
	Tarmacadam		0.20	37.95	0.20	B		
1	MADE GROUND comprising brown very silty to silty clayey fine to coarse sand and gravel				1.00	D		
2	MADE GROUND comprising brown silty fine to coarse sand and fine to coarse gravel predominantly of concrete brick and occasional flint		1.50	36.65	1.50	B		
					2.00	D		
					2.10	W		
3	MADE GROUND comprising of soft greenish grey locally slightly sandy clay		2.50	35.65	2.50	S	N=7 (2,2/2,2,1,2)	
					2.50	D		
					2.50	B		
					3.00	D		
4	Concrete		4.00	34.15	4.00	D		
					4.50	C	(25,50 for 18mm)	
					4.50	D		
5	MADE GROUND comprised of brown dark grey silty very sandy fine to medium sub angular gravel predominantly of flint with concrete fragments		4.80	33.35	4.50	B		
			5.00	33.15	5.00	B		
6	Medium dense brown dark grey very sandy to sandy fine sub angular to sub rounded GRAVEL predominantly of flint (Terrace Gravel)				5.50	C	N=25 (4,6/6,5,7,7)	
					5.50	D		
					6.00	D		
7					7.00	C	N=27 (3,5/5,6,8,8)	
					7.00	D		
					7.00	D		
					7.00	B		
8					8.00	D		
9	Structure less CHALK comprised of white cream grey sandy slightly gravelly SILT with flint and chalk cobbles. Gravel of fine occasionally medium and coarse of chalk and flint. Chalk clasts of low density (Grade Dm) (Upper Chalk)		8.50	29.65	8.50	S	N=50 (2,4/8,11,15,16)	
					8.50	D		
					8.50	D		
					8.50	B		
10								

Continued next sheet

Remarks: Inspection pit excavated to 1.2m. Chisel between 1.2 to 1.5m (1hr) 4 to 4.5m (2hr) 4.5 to 4.7m (0.75hr). Sunk at 200mm diameter from GL to 9.0m. 1m seal installed in 200mm casing between 8.2 to 9.2m. Sunk at 150mm from 9.0 to 15m. Ground water struck at 2.1m, rose to 1.5m after 20 min.

Project Name
KENAVON DRIVE, READING

Project No.
100199

Co-ords: 754E - 405N

Hole Type
CP

Location: 42 Kenavon Drive, Reading, Berkshire

Level: 38.150

Scale
1:50

Client: Promising Factor Ltd & Fresh Openings Ltd

Dates: 29/09/2005

Logged By
MNC

	Stratum Description	Legend	Depth (m)	Level (m AOD)	Samples & Tests		Water Strikes	Well	
					Depth (m)	Samp	SPT Results		
11	Structure less CHALK comprised of white cream grey sandy slightly gravelly SILT with flint and chalk cobbles. Gravel of fine occasionally medium and coarse of chalk and flint. Chalk clasts of low density (Grade Dm) (Upper Chalk)				10.00	S	50		11
					10.00	D	(5,7/10,16,19,5 for 11mm)		
					10.00	B			
12	Becoming gravelly to very gravelly of fine to coarse predominantly of flint. Chalk clasts of medium to high density (Grade Dm)				11.50	S	50		12
					11.50	D	(8,13/21,29 for 75mm)		
					11.50	B			
13	Structure less CHALK comprised of cream white very silty sandy fine to coarse sub rounded to sub angular GRAVEL of chalk and flint with flint and chalk cobbles. Chalk clasts are medium to high density. (Grade Dc) (Upper Chalk)		13.00	25.15	13.00	S	50		13
					13.00	D	(2,3/8,15,17,10 for 42mm)		
					13.00	B			
14									14
15	End of Borehole at 15.00 m		15.00	23.15	14.50	S	50		15
					14.50	D	(4,6/10,17,23 for 75mm)		
					14.50	B			
16									16
17									17
18									18
19									19
20									20

Remarks: Inspection pit excavated to 1.2m. Chisel between 1.2 to 1.5m (1hr) 4 to 4.5m (2hr) 4.5 to 4.7m (0.75hr). Sunk at 200mm diameter from GL to 9.0m. 1m seal installed in 200mm casing between 8.2 to 9.2m. Sunk at 150mm from 9.0 to 15m. Ground water struck at 2.1m, rose to 1.5m after 20 min.



Appendix C. Zetica UXO Map

UNEXPLODED BOMB RISK MAP



SITE LOCATION

Map Centre: 472924,173718



LEGEND

-  **High:** Areas indicated as having a bombing density of 50 bombs per 1000acre or higher.
-  **Moderate:** Areas indicated as having a bombing density of 15 to 49 bombs per 1000acre.
-  **Low:** Areas indicated as having 15 bombs per 1000acre or less.

-  **military**
-  **industry**
-  **UXO find**
-  **transport**
-  **dock**
-  **Luftwaffe targets**
-  **utilities**
-  **other**

How to use your Unexploded Bomb (UXB) risk map?

The map indicates the potential for Unexploded Bombs (UXB) to be present as a result of World War Two (WWII) bombing.

You can incorporate the map into your preliminary risk assessment* for potential Unexploded Ordnance (UXO) for a site. Using this map, you can make an informed decision as to whether more in-depth detailed risk assessment* is necessary.

What do I do if my site is in a moderate or high risk area?

Generally, we recommend that a detailed UXO desk study and risk assessment is undertaken for sites in a moderate or high UXB risk area.

More often than not, this further detailed research will conclude that the potential for a significant UXO hazard to be present on your site is actually low.

Never plan site work or undertake a risk assessment using these maps alone. More detail is required, particularly where there may be a source of UXO from other military operations which are not reflected on these maps.

If my site is in a low risk area, do I need to do anything?

If both the map and other research confirms that there is a low potential for UXO to be present on your site then, subject to your own comfort and risk tolerance, works can proceed with no special precautions.

A low risk really means that there is no greater probability of encountering UXO than anywhere else in the UK.

If you are unsure whether other sources of UXO may be present, you can ask for one of our **pre-desk study assessments (PDSA)**

If I have any questions, who do I contact?

tel: **+44 (0) 1993 886682**

email: uxo@zetica.com

web: www.zeticauxo.com

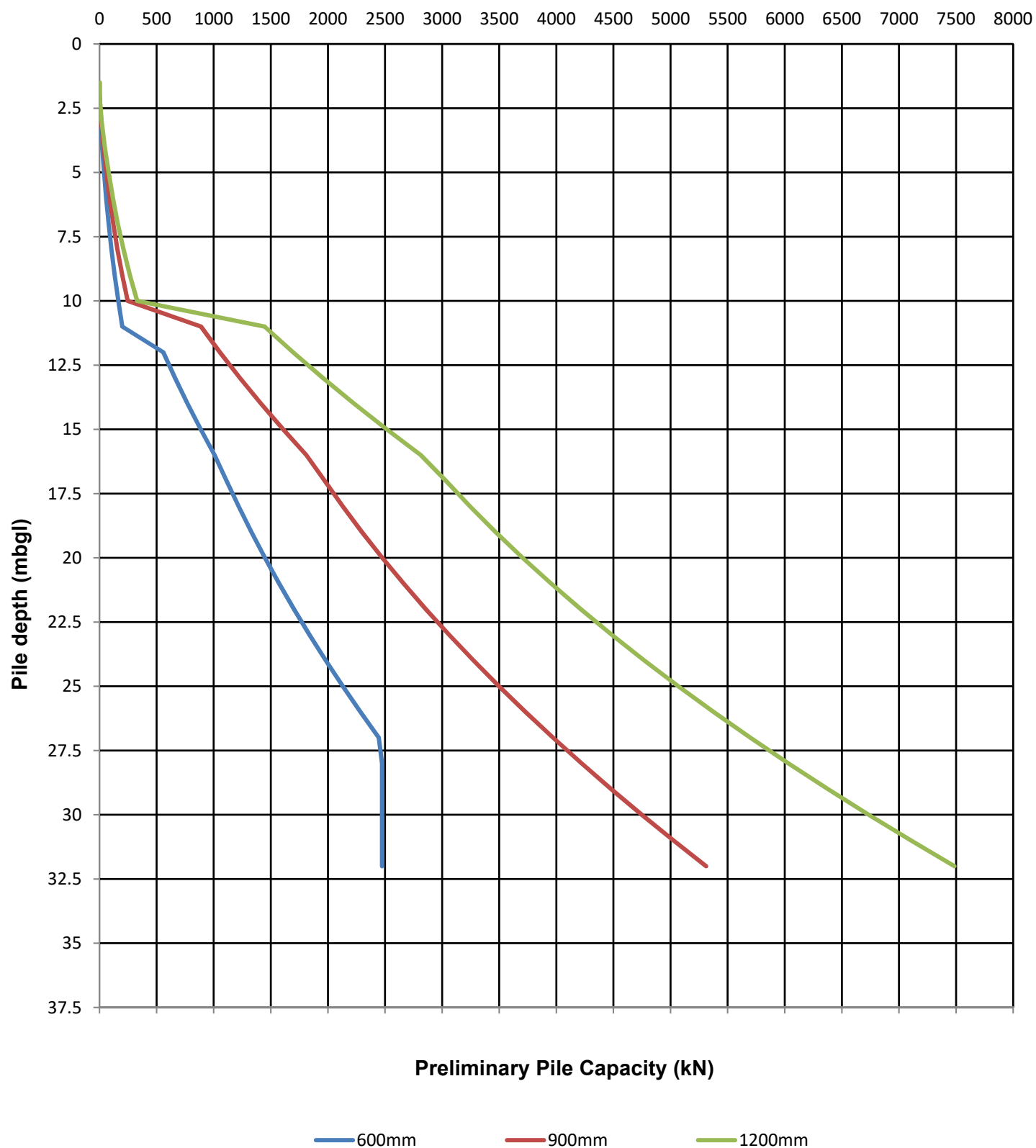
The information in this UXB risk map is derived from a number of sources and should be used in conjunction with the accompanying notes on our website: (<https://zeticauxo.com/downloads-and-resources/risk-maps/>)

Zetica cannot guarantee the accuracy or completeness of the information or data used and cannot accept any liability for any use of the maps. These maps can be used as part of a technical report or similar publication, subject to acknowledgment. The copyright remains with Zetica Ltd.

It is important to note that this map is not a UXO risk assessment and should not be reported as such when reproduced.

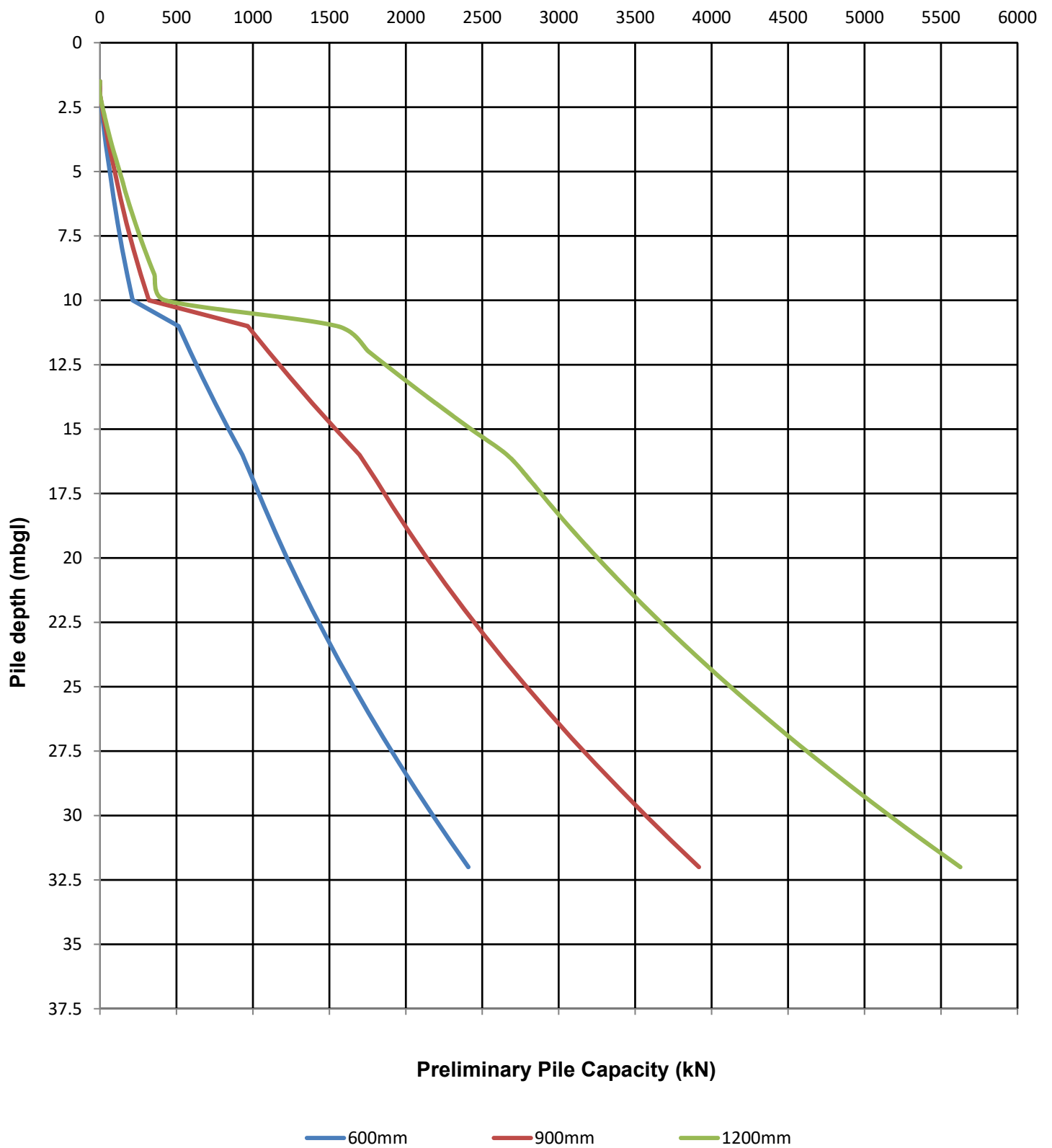
*Preliminary and detailed UXO risk assessments are advocated as good practice by industry guidance such as CIRIA C681 'Unexploded Ordnance (UXO), a guide for the construction industry'.

Appendix D. Pile Bearing Capacity with depth



**SGN Reading Gasholder
Bored Pile
GEO Design Compressive Resistance DA1C2**

Figure 01



**SGN Reading Gasholder
CFA Pile
GEO Design Compressive Resistance DA1C2**

Figure 02

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