Robert Bird Group

Member of the Surbana Jurong Group

Barnes Hospital

Basement Impact Assessment Report

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Date: 22/11/2021

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1.0 Introduction

Robert Bird Group (RBG) has been appointed by LS Estates Limited (the Client) to provide consulting structural, geotechnical, and civil engineering services for the redevelopment of the existing Barnes Hospital site in London. The Client has instructed RBG to produce a Basement Impact Assessment Report for Blocks A and B based on the current basement scheme and available site information.

The purpose of this report is to provide an assessment of the basement impact within its proposed location.

1.1. Disclaimer

The opinions, comments, and recommendations given in this report are based on the information obtained from the documentary sources stated. Robert Bird Group has endeavoured to assess all information provided to them but makes no guarantees or warranties as to the accuracy or completeness of this information.

LS Estates Limited may rely on this report for the purpose for which it was originally proposed. The information and recommendations contained in this report may not be used by any unauthorised person.

2.0 Site Description

The site is situated in South West London in the Borough of Richmond upon Thames. The site is bounded by South Worple Way to the north, the remaining Barnes Hospital, and adjacent plots of the development to the east with South Worple Avenue further east, residential buildings to the south fronting onto Grosvenor Avenue and a cemetery, Old Mortlake Burial Ground, to the west. Refer to Figure 2-1 for site location.

Existing buildings on site consist of the current Barnes Hospital buildings which are low rise brick buildings with no basements, and hardstanding surfaces with green space.

The site is not located within a conservation area and there are no listed buildings on the site or within 250m of the site boundary.

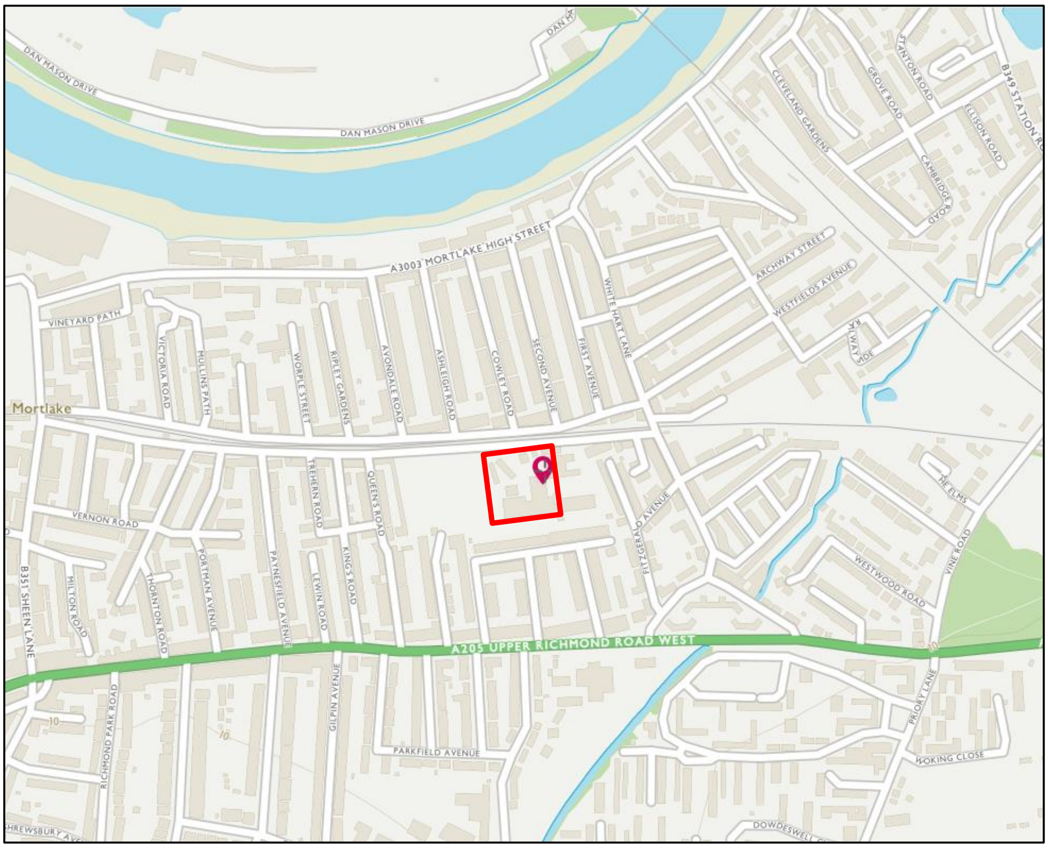

Figure 2-1: Site location

2.1. Site History

Historically, the site was a field until the Barnes Hospital was constructed in 1889 and was likely part of the agricultural landscape identified to the south of the site.

2.2. Topography

Topographical surveys indicate that the site has a ground level between +5.8 m OD and +6.5 m OD. For the topography sketch of the site see Appendix D.

2.3. Site Constraints

2.3.1 Existing Buildings and Utilities

Existing buildings on site consist of the current Barnes Hospital buildings and hardstanding surfaces with green space.

Services, including electric, gas, telecom and water, are present beneath the site according to various utility surveys. An electrical substation is located south of the site, as shown in Figure 2-2. Gas and Openreach utilities are presented in Figure 2-3 and Figure 2-4, respectively. The existing drainage on site is depicted in Figure 2-5.

Figure 2-2: UKPN Utilities around the site

Figure 2-3: Gas main utilities around the site (in dotted gray lines)

Figure 2-4: Openreach utilities on site (in black)

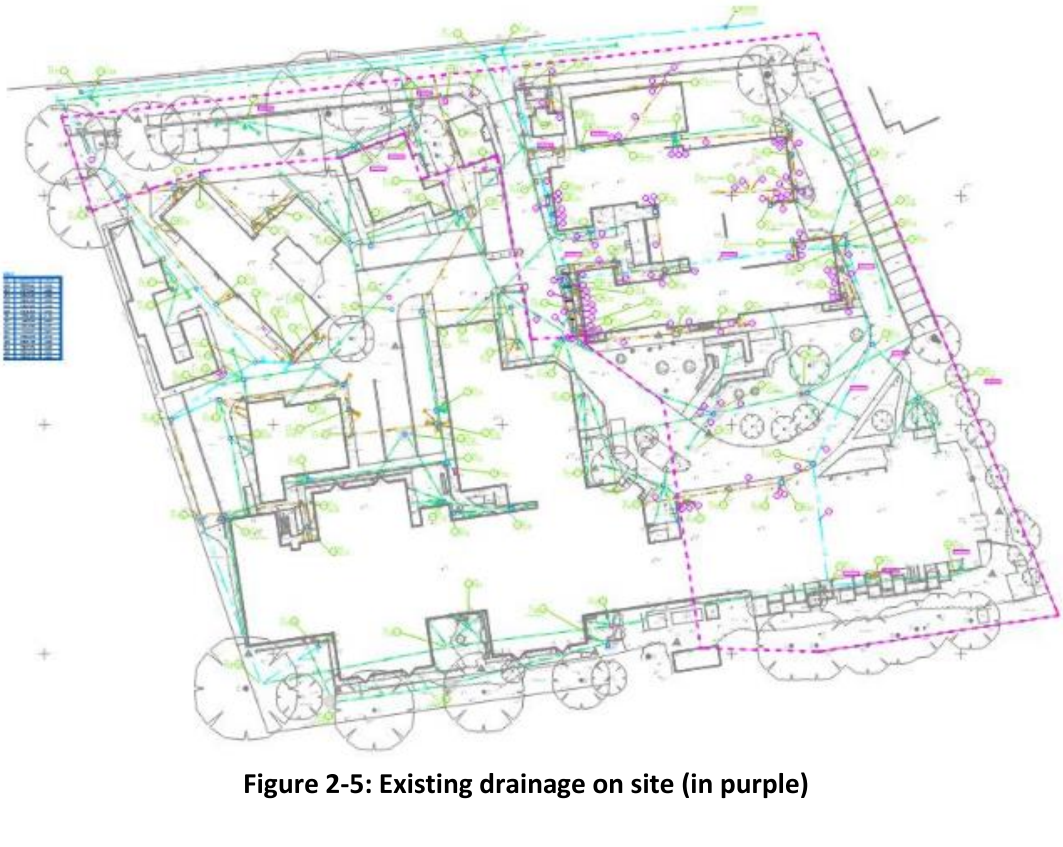

Figure 2-5: Existing drainage on site (in purple)

2.3.2 Adjacent Existing Buildings

Old Mortlake Burial Ground lies 15 m to the west of the site with the impact of the development onto the burial ground limited through architectural and construction considerations. Directly south of the site boundary lies the gardens of the residential buildings along Grosvenor Avenue which should not be impacted by the proposed development.

2.3.3 Third Party Assets

2.3.3.1 Thames Water

A Thames Water Asset search indicates a foul sewer and a water main running along South Worple Way and Grosvenor Avenue (Figure 2-6). A foul sewer runs south easterly beneath South Worple Avenue. Water main connections connect into the site to the north.

Figure 2-6: Thames Water Asset Search extract

2.3.3.2 Network Rail

Network Rail tracks lie north of the site to the north of South Worple Way. A Network Rail gantry (high voltage) is located north of site approximately 8 m from the northern site boundary (refer to Figure 2-7).

Figure 2-7: Location of Gantry over NR tracks north of site (Source: Google Maps accessed April 2021)

The horizontal distance from the extent of the proposed basement to the Network Rail assets (approximately 13 m) indicates that the Network Rail assets are beyond the zone of influence of the proposed undercroft and basement. This is assuming a 45-degree angle from the underside of the basement slab as shown in Figure 2-8 and Figure 2-9.

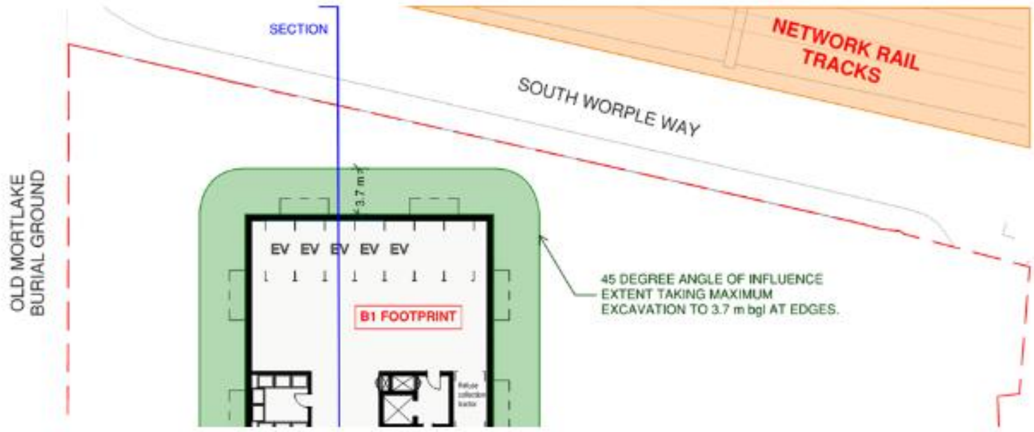

Figure 2-8: Plan view showing proposed basement footprint in relation to Network Rail tracks and 45-degree limit extent (plan view extracted from DTM Workbook dated 25th March 2021, ref: 210325-SBR-ZZ-XX-DTM)

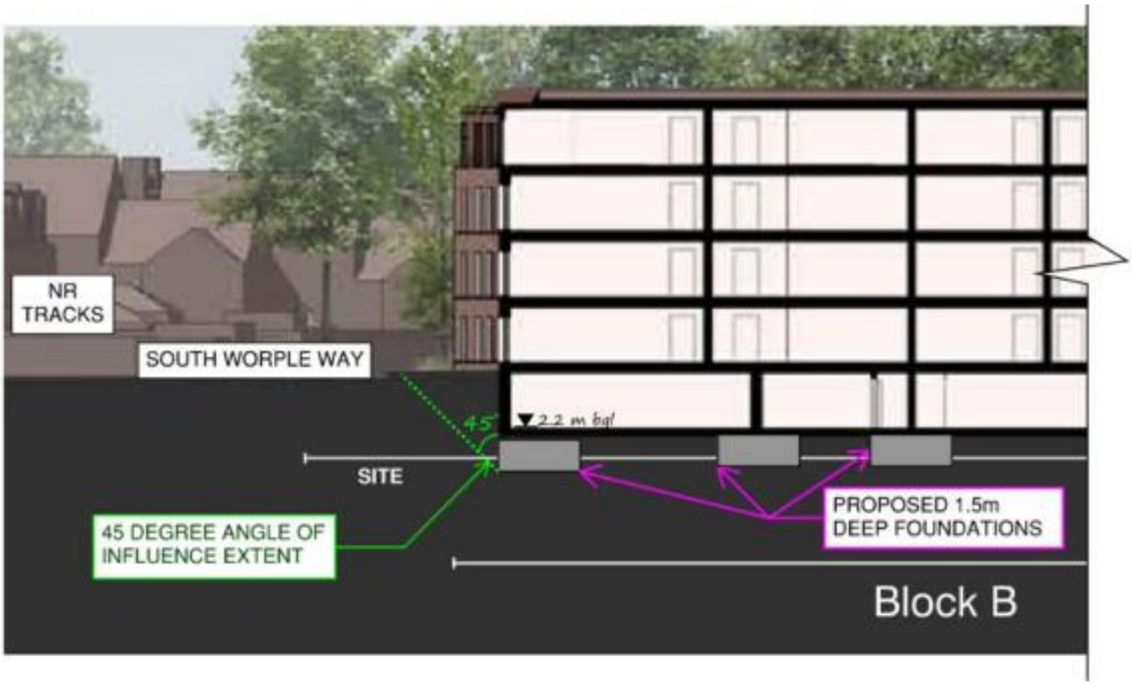

Figure 2-9: Cross Section across Block B and South Worple Way showing 45-degree excavation limit extent for NR (Cross section extracted from DTM Workbook dated 25th March 2021, ref: 210325-SBR-ZZ-XX-DTM)

2.3.4 Archaeology

The Museum of London Archaeology (MoLA) interactive map accessed by RBG April 2021 notes early prehistoric Lower Palaeolithic finds within 610 m east from site and a later prehistoric Bronze Age find approximately 740 m north east of the site. Thus, there is some minimal risk of finds within the site.

An Archaeological Desk-Based Assessment was produced by AOC Archaeology Group dated July 2021. Historically, the site was a field until the Barnes Hospital was constructed in 1889 and was likely part of the agricultural landscape identified to the south of the site. The report concludes that there is a low potential of prehistoric, roman, early historic, medieval and post medieval archaeological findings on site. There is a moderate to high potential of remains of modern age when the Barnes Hospital was constructed. An Archaeological watching brief during any intrusive works is recommended and archaeological mitigation measures should be agreed with the appropriate authorities.

2.3.5 Unexploded Ordnance

A Detailed UXO Risk Assessment was produced by 1st Line Defence dated October 2019 (doc. ref. DA8245a-00). The report states that a bomb was recorded to have landed in the east of the boundary of the site and aerial photography indicated two buildings removed in the south east of the site. This may have been due to the bombing but is not confirmed in records. Rubble and lack of access in the removal of the buildings bring increased risk of UXO being unnoticed within this area. As a hospital in use during WWII, the site would have been accessed and checked regularly. The Risk Assessment concludes a low to medium risk of UXO and recommends a UXO Risk Management plan and site specific UXO briefings for all works on site. In Medium risk areas, a UXO Specialist should be on site during any intrusive works as well as an intrusive magnetometer survey during borehole or piling operations. As shown in Figure 2-10, the plot of the current proposed development lies within a low risk of UXO.

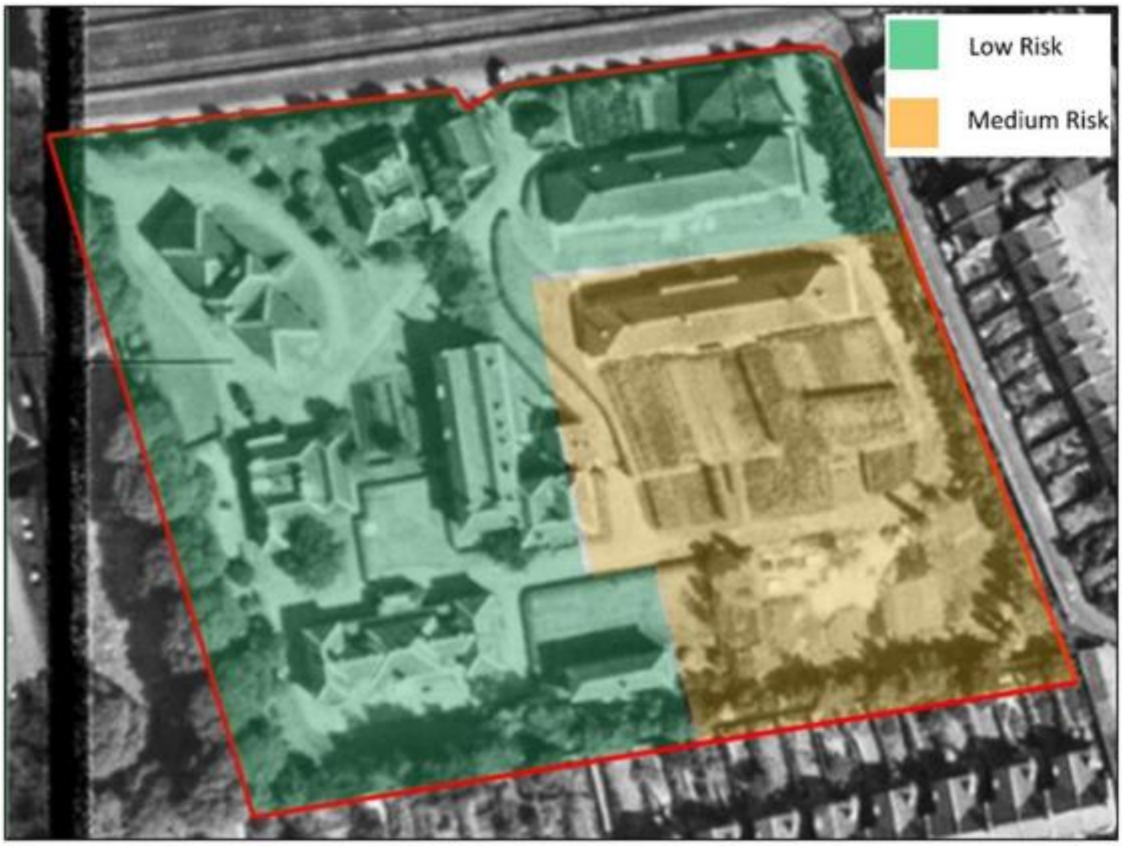

Figure 2-10: Site Risk UXO Plan extracted from Detailed UXO Risk Assessment by 1st Line Defence, October 2019

2.3.6 Ecology and Existing Trees

A Preliminary Ecological Appraisal by Aspect Ecology dated July 2021 (doc. ref. 5222-05 EcoApp/vf1/FM/MRD) assesses on site surveys conducted August 2017 and July 2018. The report concludes that the existing buildings and hardstanding provide no ecological value, whilst the grass and trees provide at most a low ecological value at a local level. There are no statutory or non-statutory nature conservation within the site.

An Aboricultural and draft ecological impact assessment plan by Crown Aboricultural Consultants dated August 2021 based on a previous basement scheme highlights the ecological constraints from the various existing trees bounding the site. These are illustrated in Figure 2-11 and Figure 2-12. The current proposed basement lies within the modified Root Protection Area (RPA) of tree T6 requiring the tree to be removed unless an “above ground foundation with a ventilated void is installed”. Canopies of existing trees will need to be pruned to provide access to construction vehicles and to an appropriate extent for the proposed development. Existing trees to the north of the site are noted to be constraining the excavation of the proposed pathway and access road to the depth of existing surface and subbase.

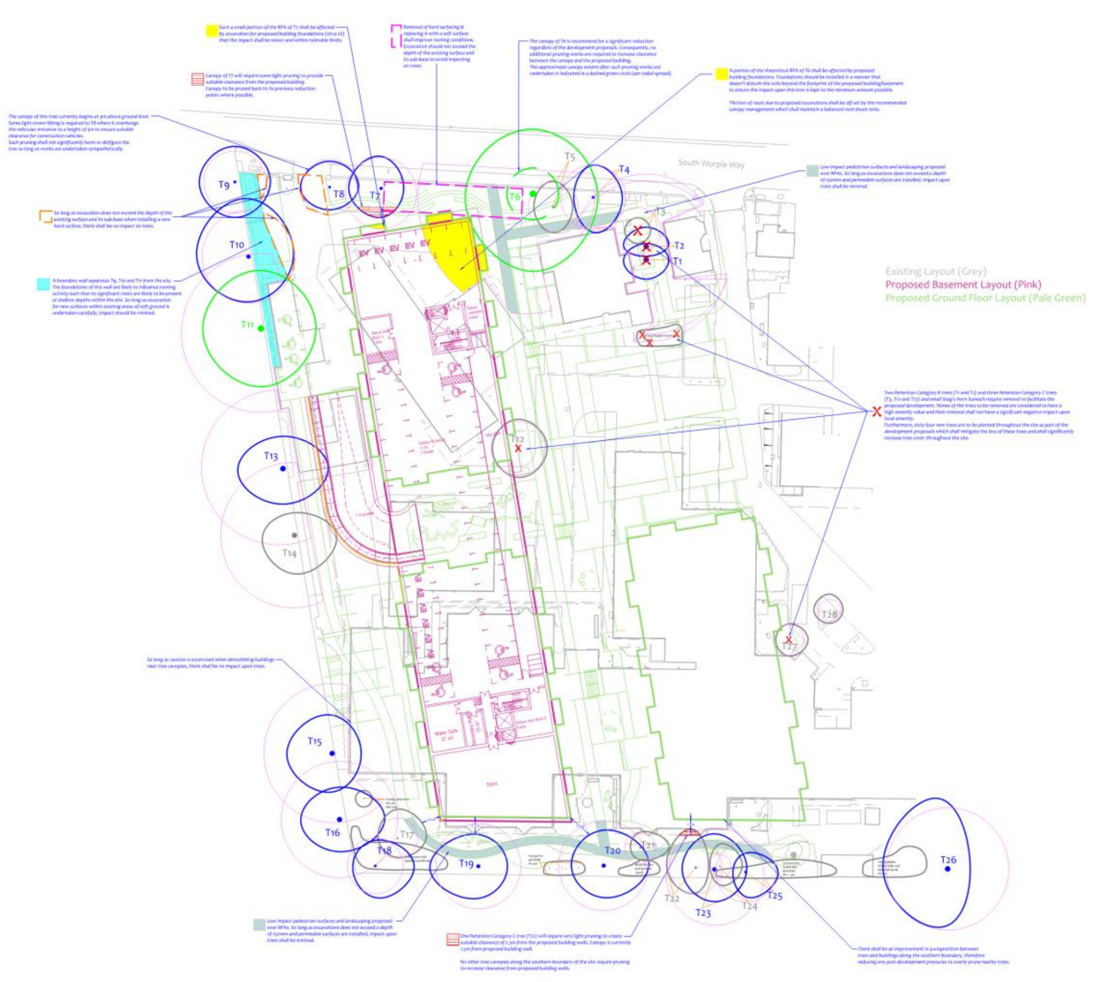

Figure 2-11: Draft Impact Assessment Plan extracted from Crown Aboricultural Consultants

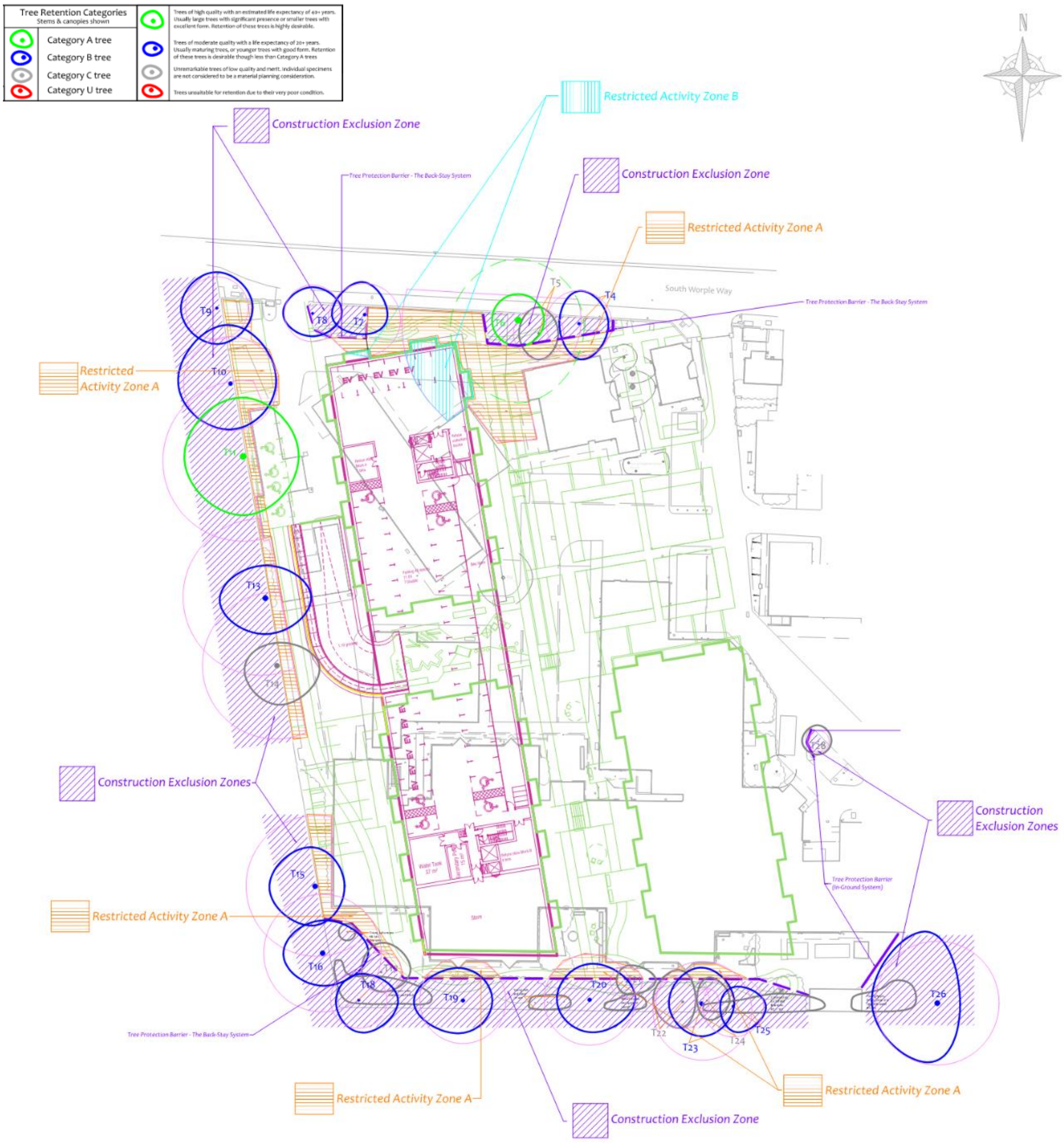

Figure 2-12: Tree Protection Plan extracted from Crown Aboricultural Consultants

3.0 Ground Conditions

3.1. Desk-based Geological Review

British Geological Survey (BGS) maps show that the area of the site consists of superficial deposits of Kempton Park Gravel Member underlain by London Clay formation followed by Lambeth Group, Thanet Sands, and Chalk.

There is no record of historic BGS boreholes onsite, however there are several located within its vicinity. Two shallow boreholes, TQ27NW11 and TQ27NW12 less than 10m deep, are located to the north east and south east of the site, respectively. A deep borehole close to TQ27NW12, TQ27NW423, located approximately 290m south east of the site showed Made Ground underlain by mottled clay 1.7 m below ground level. Based on the BGS map and the borehole's proximity to Beverley Brook watercourse this is Alluvium. Alluvium is also indicated in TQ27NW12 described as "Clay Mottled". BGS maps does not indicate the site to be within the alluvium pocket surrounding Beverley Brook therefore Alluvium is not expected within site. This is supported by the lack of Alluvium within TQ27NW11 further away from Beverley Brook. Made Ground was underlain by the gravel member proven up to 8.3 m bgl, underlain by London Clay up to 150 m below ground level (bgl). Ground levels in the three boreholes give top of Made Ground ranging between +6.3 m OD to +6.9 m OD. Ground water was recorded to range between +2.36 m OD and +3.69 m OD. Table 3-1 gives a summary of the anticipated site geology based on the existing BGS information.

Table 3-1 Summary of anticipated site geology based on existing BGS information

Stratum	Level at Top of Stratum (m OD)	Thickness (m)
Made Ground	+6.9 to +6.3	0.9 to 1.7
Kempton Park Gravel	+6.0 to +4.0	6.1
London Clay[1]	-2.1	Up to 37.3
Lambeth Group[2]	Not Proven	Not Proven
Thanet Sands[2]	Not Proven	Not Proven
Chalk[2]	Not Proven	Not Proven

[1] The depth of London Clay was proven only to a thickness of 37.3m in borehole TQ27NW423.
[2] The Lambeth Group, Thanet Sand and Chalk were not encountered within any borehole as no boreholes within proximity of site terminated before reaching the top of these strata.

3.2. Ground investigation

A site-specific ground investigation was conducted by RSK between the 9th to 29th December 2019 followed by gas and groundwater monitoring. Findings and interpretation were presented in the RSK Ground Interpretation Report (GIR) – Geo-environmental and Geotechnical Site Assessment (ref: 1920884-R01 (02)). This ground investigation aimed to establish ground conditions and monitor ground gas and groundwater to determine a ground model for the proposed site. The investigation specifically targeted areas close to potential sources of contamination such as a diesel tank and substations to determine the extent of the contamination. The scope of the site investigation consisted of:

- 4No. boreholes (BH01 to BH04) to the London Clay up between 8 m and 30 m in depth.
- 11No. shallow window samples between 2 m and 5 m in depth.
- Groundwater monitoring set up within the Kempton Park Gravels in 4No. boreholes.
- Ground gas monitoring set up in 6No. Window Samples.
- SPTs during boring of exploratory holes.
- Geotechnical, geo-environmental and chemical testing from on-site soil and water samples.

The onsite exploratory holes conducted during this ground investigation show that Made Ground is underlain by Kempton Park Gravel, followed by London Clay. Figure 3-1 shows the location of these boreholes and Figure 3-2 shows the anticipated geological cross-sections for east and west of Plot A of the overall Barnes Hospital site.

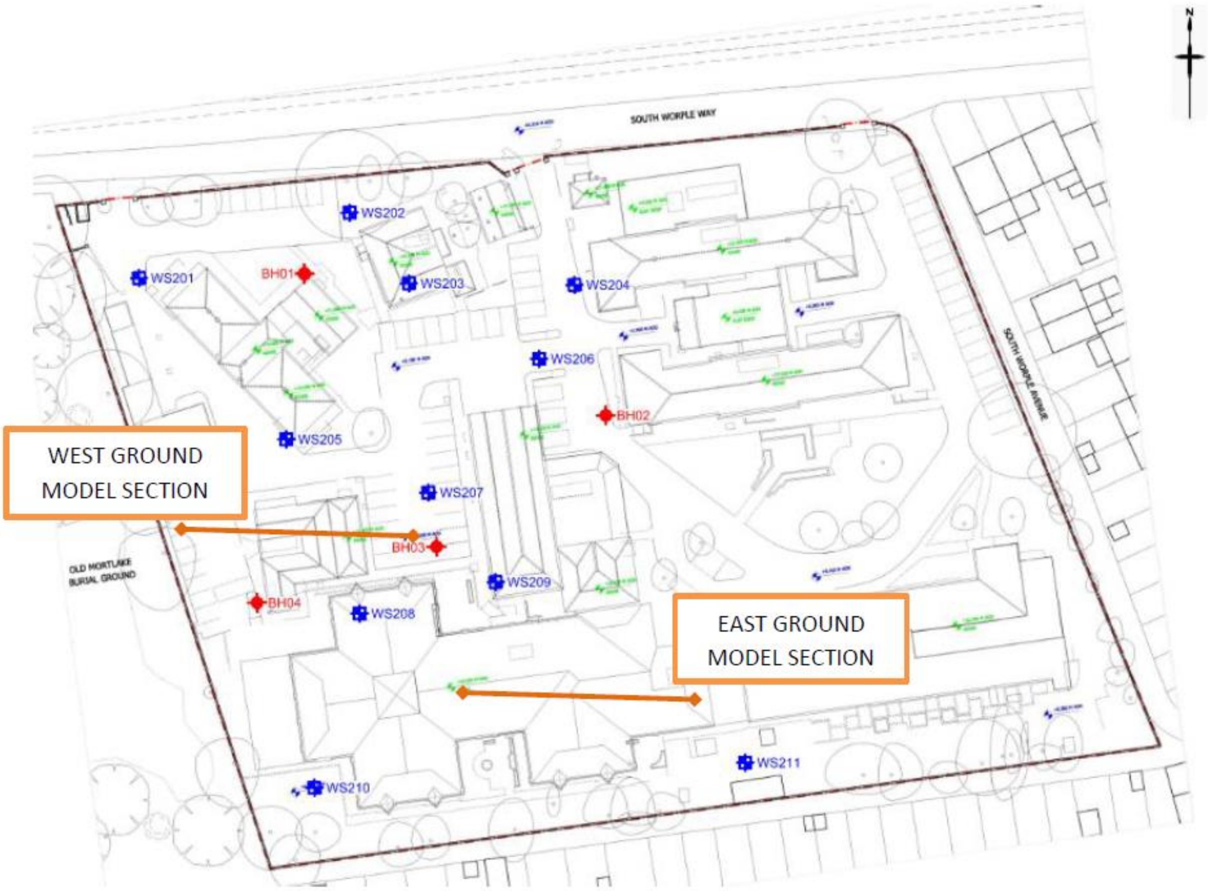

Figure 3-1: Exploratory borehole location plan of site-specific ground investigation (extracted from RSK GIR 1920884 R01 (02) dated 22nd April 2020)

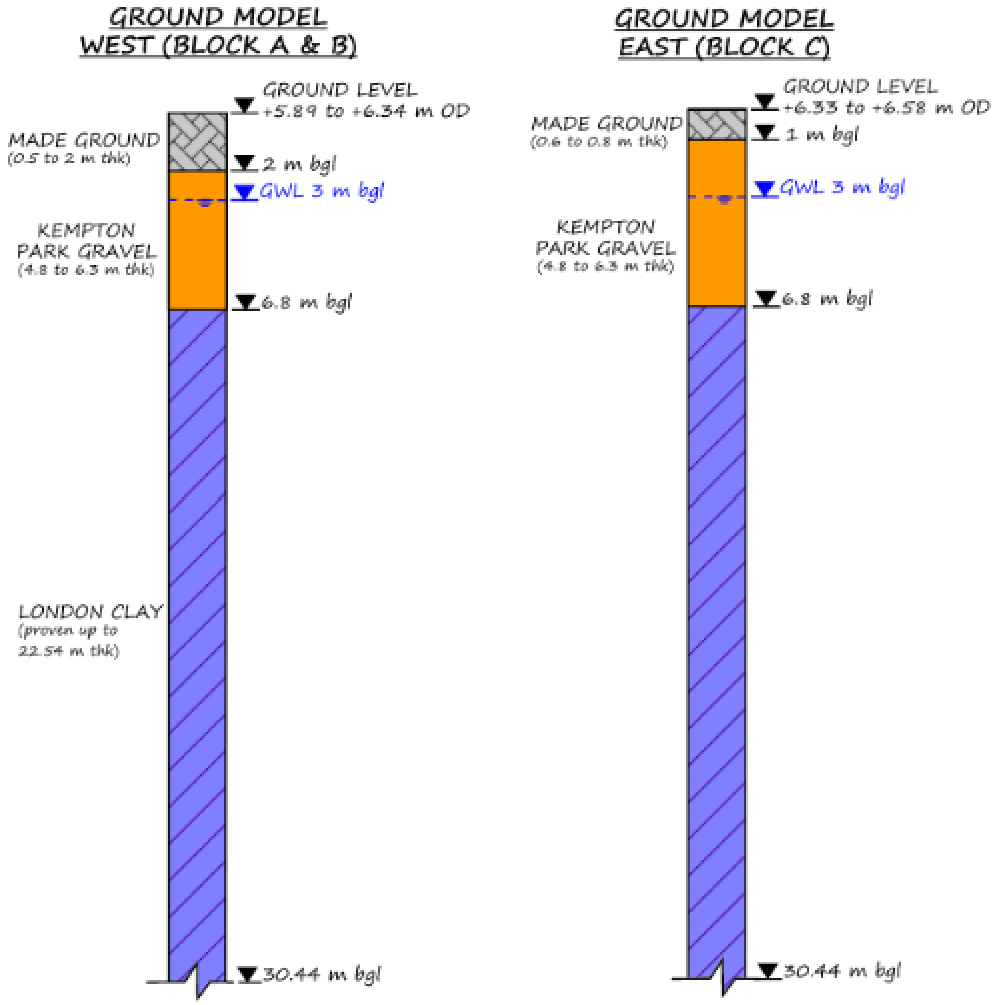

Figure 3-2: Section of expected geology on site

3.3. Stratigraphy

Based on the findings of the Ground Investigations throughout the site, the encountered geology on site is summarised as follows.

3.3.1 Made Ground

Made Ground was recorded within all exploratory holes. The Made Ground thickness ranged between 0.5 m and 2 m. Made Ground encountered was described as asphalt overlying granular material. Localised sandy clay with frequent gravel sized brick fragments and brick cobbles was noted in BH03. Volatile organic compounds were recorded from onsite disturbed samples but were at low concentrations to be insignificant. The thickness of the Made Ground was the shallowest in the south east of the site, reaching the underlying Kempton Park Gravels at depths of 0.6 m bgl and 0.8 m bgl within WS211 and WS209, respectively. Borehole records suggest that the bottom of the Made Ground strata slopes east to west with a 2 m depth proven in BH03.

3.3.2 Kempton Park Gravels

Kempton Park Gravels were encountered in all the exploratory holes. The stratum thickness ranged between 4.8 m to 6.3 m. Top of stratum was encountered between 0.5 to 2 m bgl with the depth of the stratum proven between 6.8 to 7.9 m bgl. The material was generally described as slightly clayey becoming very gravelly fine to coarse sand and sandy to very sandy gravel. Gravel was subangular to rounded fine to coarse. A firm to stiff gravelly sandy clay with occasional silt lenses cohesive stratum was encountered above the gravel in north and north west of site between 0.5 m bgl up to 2.45 m bgl within window samples (WS201, WS202, WS201, WS204, WS205 and WS208) and BH04.

3.3.3 London Clay

London Clay was encountered in all 4 deep boreholes, BH1 to BH4. Top of London Clay consisted of firm to stiff brown weathered clay underlain by stiff to very stiff, closely fissured dark grey to grey silty clay. Bottom of London Clay was not proven but was present up to the full depth of BH01 at 30 m bgl.The depth and thickness for each stratum are summarised in Table 3-2.

Table 3-2: General Succession of strata encountered

Stratum	Exploratory holes encountered	Depth to top of stratum m bgl	Proven thickness (m)
Made Ground	WS201 to WS211 and BH1 to BH4	0.00 (GL)	0.5 to 2.00
Kempton Park Gravel	WS1 to WS11	0.50 to 1.20	Proven to the full depth of the investigation (4.45m)
	BH1 to BH4	1.00 to 2.00	4.80 to 6.30
London Clay	BH1 to BH4	6.80 to 7.90	Proven to the full depth of the investigation (30 m bgl)

3.4. Groundwater

The closest body of water is Beverley Brook to the south west of the site approximately 270m from the southern boundary and the River Thames is located approximately 330 m north of the site. This means groundwater is likely to flow from east to west across the site. Groundwater strikes during the site investigation was recorded between 3.6 m bgl and 4.9 m bgl, +1.99 m OD and +1.31 m OD, respectively.

Table 3-3 presents the groundwater levels recorded during the 2019 to 2020 ground investigation showing a groundwater table between 3.67 m bgl to 3.1 m bgl or +2.6 m OD to +3.10 m OD.

Table 3-3: Groundwater level data from The Phase 2 Environmental and Geotechnical Site Investigation report from RPS

Monitoring Well	Stratum	Ground level elevation (m OD)	Depth of Water m bgl (m OD)		
			19/12/19	06/01/20	20/01/20
BH01	Kempton Park Gravel	6.28	3.67 (2.61)	3.60 (2.68)	3.58 (2.70)
BH02		6.20	3.18 (3.02)	3.12 (3.08)	3.10 (3.10)
BH03		5.89	3.29 (2.60)	3.21 (2.68)	3.20 (2.69)
BH04		6.34	3.51 (2.83)	3.50 (2.83)	3.48 (2.85)

Groundwater information suggests flow in a westerly direction. It is noted that groundwater monitoring occurred during the winter season only and will therefore not reflect the seasonal variations of the groundwater table. For design, a conservative groundwater table is taken at 3 m below ground level.

This monitoring was only undertaken for the shallow groundwater level. The deeper groundwater level, which was struck at 7.5 m bgl (-1.605 m OD) was not monitored. Groundwater ingress seeped into BH03 causing BH03 to terminate at 12.5 m bgl.

The groundwater piezometer plan for the site is illustrated in Appendix E.

3.5. Hydrology

The River Thames lies roughly 330 m north of the site, where it flows in a northerly direction (Figure 3-3). Lost River, currently still a watercourse, Beverley Brook is located 290 m south west of the site running north towards the River Thames.

A Flood Risk Assessment by Arup dated November 2018 (document ref: BAH-FRA-2018) classes the site to be within Flood Zone 1 and concludes a low risk of flooding from surface water and groundwater.

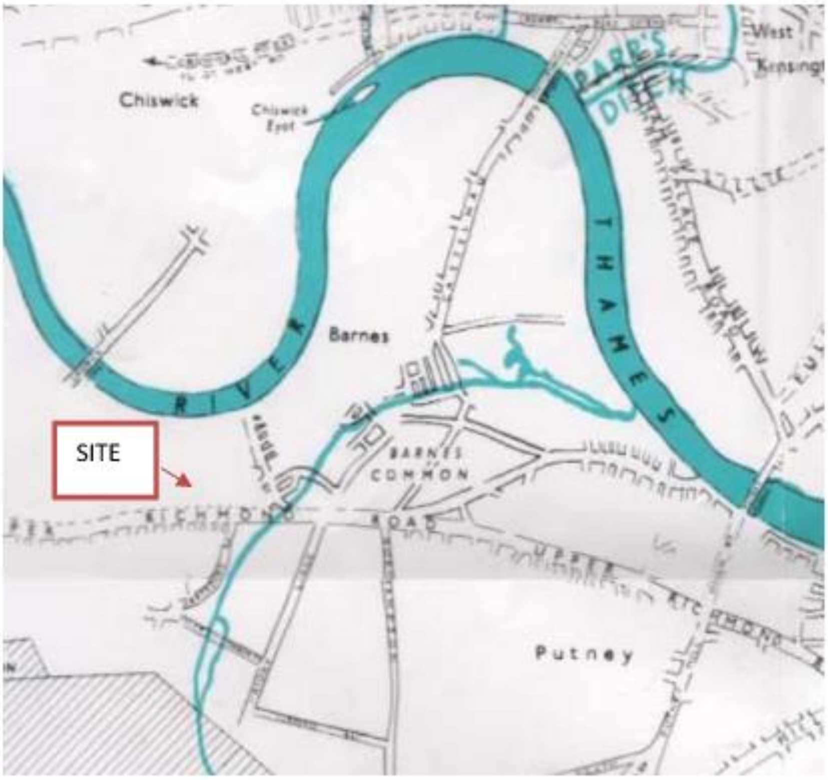

Figure 3-3: Approximate location of site relative to River Thames and Beverley Brook

3.6. Hydrogeology

Magic maps, accessed April 2021, indicate the bedrock and superficial deposits aquifer designations as unproductive and Secondary A, respectively. The Environmental Agency defines unproductive strata as “rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.” Secondary A aquifers are described as “permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers”. As such the groundwater vulnerability of the site is low. The site is not located within a groundwater Source Protection Zone (SPZ).

The Chalk is classified to be a Principal Aquifer.

3.7. Land Contamination

Arup conducted a Phase 1 Ground Contamination desktop study dated October 2018 and RSK produced a desk based Geo-environmental Site Assessment dated March 2019. These identified various sources of potential contamination. This informed the ground investigation and sampling to target these areas, as shown in Figure 3-4.

Based on the site-specific chemical and geo-environmental testing, the RSK GIR identified elevated concentrations of lead and “aromatic hydrocarbons” within the Made Ground. These are not considered harmful to human health or are of high volatility with any remaining risk to human health mitigated by covering with hardstanding surface. Soft landscaping proposed areas require further testing to confirm no soil contamination within the Made Ground or to apply a “clean capping layer to break the potential pollutant pathway”. No harmful soil contamination was recorded in the Kempton Park Gravels. There is low risk to future users from the volatile organic compounds detected on site. Gas hazard was classed as CS1, the lowest Characteristic Situation for risk of ground gas.

No asbestos was detected within the tested samples however the preliminary remediation strategy recommends an onsite asbestos survey on the existing buildings to confirm absence of asbestos.

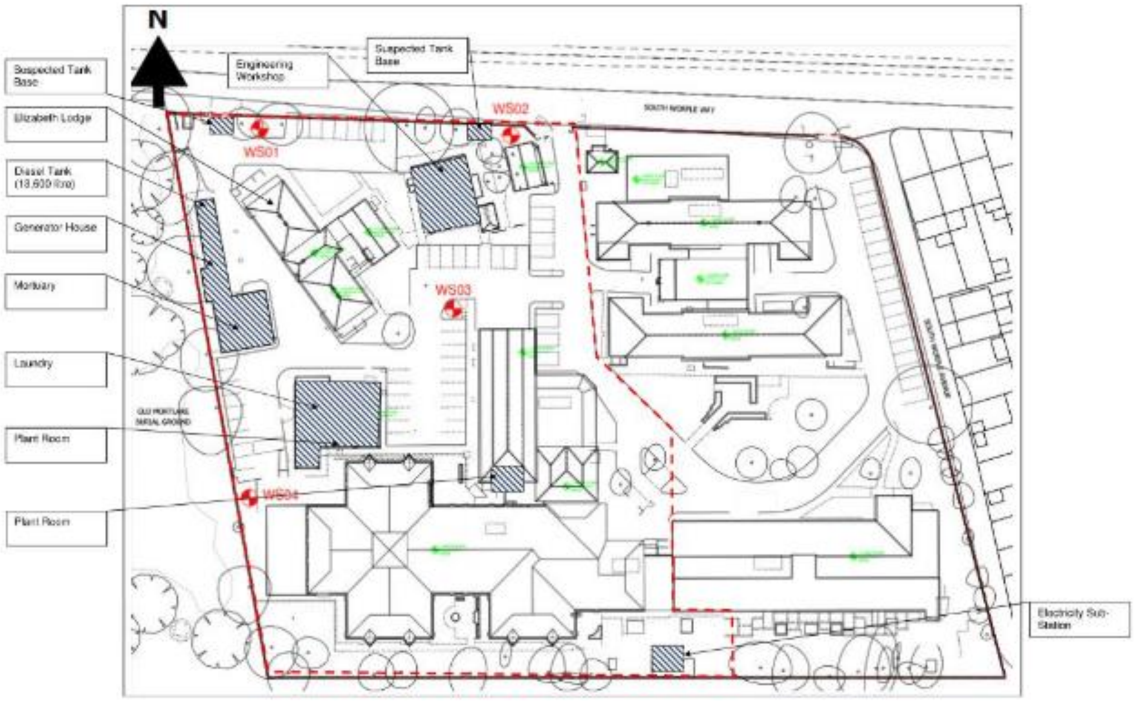

Figure 3-4 Location plan of window samples adjacent to targeted sources of potential contamination (extracted from RSK GIR ref: 1920884 R01 (02) dated 22nd April 2020)

The report notes that due to the presence of organic contaminants at depths where potable water pipes are typically laid, there is potential risk of contamination into these sources and mitigation measures and a revised assessment should be considered once pipe strategies are designed. There is a low likelihood of leachable contamination into the groundwater.

The report provides a preliminary remediation strategy for all stages of the development recommending a watching brief during demolition, an asbestos survey undertaken prior to demolition, removal of fuel within the fuel storage tanks on site, supervision during excavation, Waste acceptance Criteria to be applied to all identified contaminated waste and preparation of an action plan for discovery of unexpected contaminants. A Working Practice and Verification Plan are also presented in the RSK GIR, refer to the RSK GIR for full details. Likely further contamination related planning condition requirements including an excavation risk assessment, and a final remediation strategy may be required.

4.0 Overview of Proposed Structures

The proposed development comprises three residential buildings, Block A, B & C, and the refurbishment of an existing two-storey recreation hall into residential units, providing 106 residential apartments, and associated parking and landscaping. Block A is 3 storeys high while Blocks B and C are 4 storeys high. There is also a single-storey basement which extends below the footprint of Blocks A & B which links the two buildings. The basement contains plant room, cycle and refuse stores and car parking.

5.0 Proposed Substructure Design

5.1. Foundations

The preferred foundation option for Blocks A and B is a pad foundation for the internal basement columns and a strip foundation along the perimeter for the retaining walls. The basement slab will be suspended and supported by typically 3x3x1.5m deep RC pad footings. The cores will be supported on a larger 1.5m deep RC pad foundation. The basement slab will be designed to resist the uplift forces from heave and groundwater. The heave uplift forces can be reduced by introducing a compressible heave board which allows for a reduced basement slab thickness. The proposed foundation for Blocks A and B is illustrated in Appendix A.

An alternative foundation option for Blocks A and B has been explored. A 600mm deep RC raft slab which covers the entire basement footprint has been analysed. The reinforced concrete raft will spread the load of the basement columns and transfer these to the soil in bearing. The advantage of a raft foundation is the relative ease of constructability with a flat soffit. The analysis show that the foundation deflections exceeded the allowable, therefore this foundation option was taken forward.

The retaining walls and foundations are designed for the worst-case scenario of the ground water level, which is 3m bgl and including seasonal and accidental fluctuations it is taken as 1.5m bgl.

5.2. Basement

In order to form the undercroft basement, a permanent retaining system is required. A reinforced concrete retaining wall is proposed to form the basement perimeter. The retaining wall will be capable of retaining soil in the temporary and permanent cases. It is envisaged that the basement will be constructed using either and open cut excavation with batter or temporary sheet piles. In both cases the basement will be fully constructed, with the ground floor slab propping the retaining walls, before backfilling or removal of the sheet piles. It is therefore assumed that the wall does not need to act as a cantilever in temporary case to resist lateral loads from the soil.

The wall shall be load bearing for the floors above and will be supported by a strip footing founded within the Kempton Park Gravels. To prevent overturning and sliding, the footing beneath the retaining wall must be of appropriate dimensions

If due to constraints it is not possible to construct the ground floor slab before backfilling the soil, temporary propping of the wall is necessary to provide enough lateral support for the retained soil. However, this is not desirable and should be avoided.

The basement construction will not affect the ground water flow due to the average groundwater level being below the underside of the proposed basement slab. Figure 5-1 illustrates the basement retaining wall with the groundwater level. Local temporary dewatering might be required during construction of the basement and footing.

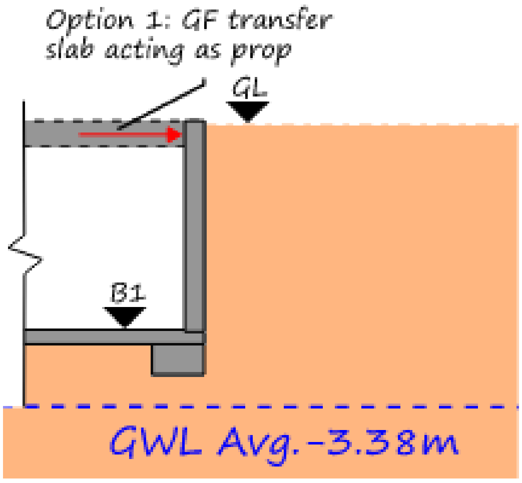

Figure 5-1: Basement retaining wall with supporting strip footing and GWL

5.3. Basement Construction Sequence

Residual risks from the site conditions will be mitigated through an appropriate construction sequence.

5.3.1 Construction Sequence

The construction sequence for Blocks A & B basements consist of the following stages:

1. Install groundwater wells around the perimeter of the excavation footprint;
2. Reduce the groundwater level below foundation level;
3. Install temporary sheet piles where applicable;
4. Excavate to foundation level at the basement footprint by use of an open cut excavation method with a battered wall or sheet pile wall depending on the site constraints;
5. Construct the pad and strip footings onto the soil;
6. Construct the entire basement which includes the basement slab spanning onto the pad and strip footings, the RC retaining walls and the RC transfer slab at ground floor level;
7. Backfill of the soil to the proposed ground level;
8. Construct the superstructure;
9. Remove the wells, the groundwater will rise to its initial level.

The excavation footprint of Blocks A & B and the construction stages for a typical section are presented in Sketch 4427-RBG-SK-S-004 which is found in Appendix B.

RBG acknowledge that the formation level for the basement foundation is below the natural groundwater level. The open cut basement construction methodology would mean that a dewatering strategy would be needed to reduce the groundwater level to below the foundation level.

5.3.2 Dewatering Scheme

Dewatering in open cut excavation is typically provided by providing a well point. The contractor would need to assess the impact of site dewatering on any neighbouring structures/assets and gain the required approvals for discharging any pumped water. Site dewatering would be required until the structure is completed and fit out.

5.4. Ground Movements

Ground movements adjacent to the basement will arise due to demolition, excavation, and construction of the new buildings. Ground movements will occur in the short term and long-term conditions.

Horizontal movements are likely to arise from deflection of the retaining walls supporting the sides of the basement excavation. The retaining walls will therefore be temporarily propped during construction to limit deflections. Excavations on top of the London Clay and surcharge loadings are also likely to induce vertical movements in the form of heave (due to the basement excavation works) and settlement (due to the long-term permanent surcharge loadings).

The dewatering activities, demolition of the existing buildings, subsequent excavation of the basement, and construction of the proposed building will result in unloading and loading in the vicinity of its footprint.

The ground movements due to dewatering activities are predicted to be a few millimetres as the settlement as the dewatering is compensated by the unloading activities from the building demolition. The ground movements from the proposed basement have been assessed and are considered to have a minor impact on the adjacent buildings/roads and no detailed damage assessment was deemed necessary.

Ground movements due to the basement excavation and concrete reinforce wall installation is deemed to be negligible. The proposed retaining wall is a shallow wall retaining only approximately 3m of soil which are mainly Made Ground and Kempton Park Gravels. The basement is not located close to any sensitive asset that might be affected by the minimal ground movements of the basement construction. It is concluded that ground movements due to basement construction will not pose a risk to the project.

6.0 Impact of the Proposed Development on Drainage, Sewage, Surface Water

The following sections provide a summary of the existing and proposed drainage strategy. Refer to Sections 3.5 and 3.6 for the summary of the existing flood risks on site.

6.1. Existing Sewer Infrastructure

Asset records provided by Thames Water indicate that there are surface water and foul sewers in South Worple Way to the North of the site, along with a foul sewer to the East in South Worple Avenue.

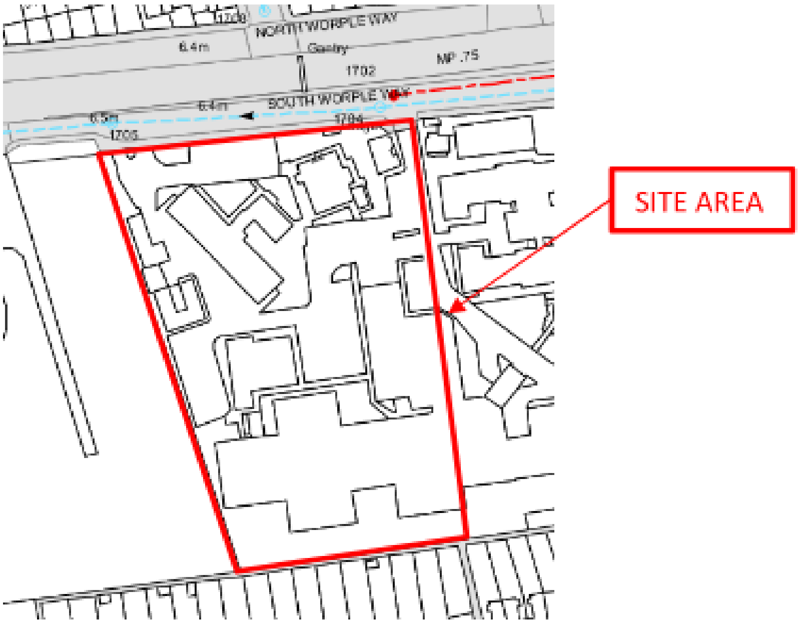

Figure 6-1: Thames Water Asset Records

A CCTV survey undertaken in October 2019 by Sumo Services shows that the site currently drains into the public sewers within South Worple way via two combined connections for the surface water and 2 foul connections for the foul drainage.

The existing drainage on site is widespread, with a large network of surface and foul pipework being used to drain the majority of the site to South Worple Way. There are areas to the South of the site, South of the main existing building, which are currently drained via soakaways. The existing topography of the site suggests that overland flows be captured within the site and drain to South Worple Way's sewer.

6.2. Proposed Drainage Strategy

6.2.1 Surface Water

In accordance with the London Plan, Local planning policies and the draft NPPF (National Planning Policy Framework), the proposed design has sought to include the use of SuDS. The proposal will provide a solution which reduces flood risk and improves the quality of the water discharging from site. Surface water run off for the development is to be managed on site to reduce the existing run off rate to 5l/s for the 30 year storm, inclusive oGL 6.34f 40% climate change. These rates were agreed with the LLFA (Lead Local Flood Authority) within the previously issued FRA and confirmation has been received that the flow rate of 5l/s is acceptable as long as we can show that the exceedance flows from the 100-year storm events are managed, these can be seen in Table 6-1.

Table 6-1: Storm flow rates

Storm Event	Existing Site Run off (l/s)	Proposed Run off rate (l/s)
1 in 1 year	59	4.9
1 in 30 years	113	5
1 in 30 years (inc. 40% CC)	N/A	5

The volume of attenuation required for the development was calculated by ensuring that the 30-year storm inclusive of 40% climate change could be attenuated without any flooding occurring. The reduction of the 30-year storm flow rate to 5l/s is a 96% reduction in flow rate.

Table 6-2: Catchment Areas

Type	Existing (m^2)	Proposed (m^2)
External Hardstanding	3960	2916
Roof	3040	2837
Soft Landscaping	1060	2307
Total	8060	8060

In order to achieve these discharge rates, the development will need to provide approximately 276m^3 of storage in the form of multiple SuDS techniques.

6.2.2 Foul Water

The peak discharge rate of the foul network is to be confirmed by the MEP engineer at Stage 3.

Foul water will be collected via MEP specified pipes and conveyed to the basement or ground floor of each building. Foul flows from GF and above will be discharged via gravity. Foul water from within the basement will be collected via a foul drainage system within the basement slab and then pumped to combine with the foul drainage system from above. This will then discharge into the Thames Water Sewer system in South Worple Way via a singular connection. The foul water system will be kept separate from the surface water drainage systems.

Refer to Appendix C for the locations of the proposed foul and surface water drainage outfalls, along with an overview of the drainage strategy.

7.0 Conclusions

The latest proposed basement will be a box structure consisting of shallow concrete retaining walls with a suspended slab with pads and strip foundations. According to site specific ground investigations and groundwater monitoring the groundwater is taken to be below the basement formation level. To enable the pad construction, local dewatering might be required.

The proposed basement will not impact the current groundwater flow on site as the proposed new basement will only be a shallow basement located above the existing groundwater levels monitoring on site. The primary flow will be able to still flow within the Kempton Park Gravels. The existing groundwater flows towards the west and it should be able to still flow in this direction.

Ground movements due to the basement excavation and concrete reinforce wall installation is deemed to be negligible. The proposed retaining wall is a shallow wall retaining only approximately 3m of soil which are mainly Made Ground and Kempton Park Gravels. The basement is not located close to any sensitive asset that might be affected by the minimal ground movements of the basement construction. It is concluded that ground movements due to basement construction will not pose a risk to the project.

There are existing services and utilities within the footprint of the proposed basement which will need to be rerouted.

Based on the site-specific chemical and geo-environmental testing, the RSK GIR identified elevated concentrations of lead and “aromatic hydrocarbons” within the Made Ground. These are not considered harmful to human health or are of high volatility with any remaining risk to human health mitigated by covering with hardstanding surface. The report provides a preliminary remediation strategy for all stages of the development recommending a watching brief during demolition, an asbestos survey undertaken prior to demolition, removal of fuel within the fuel storage tanks on site, supervision during excavation.

8.0 References

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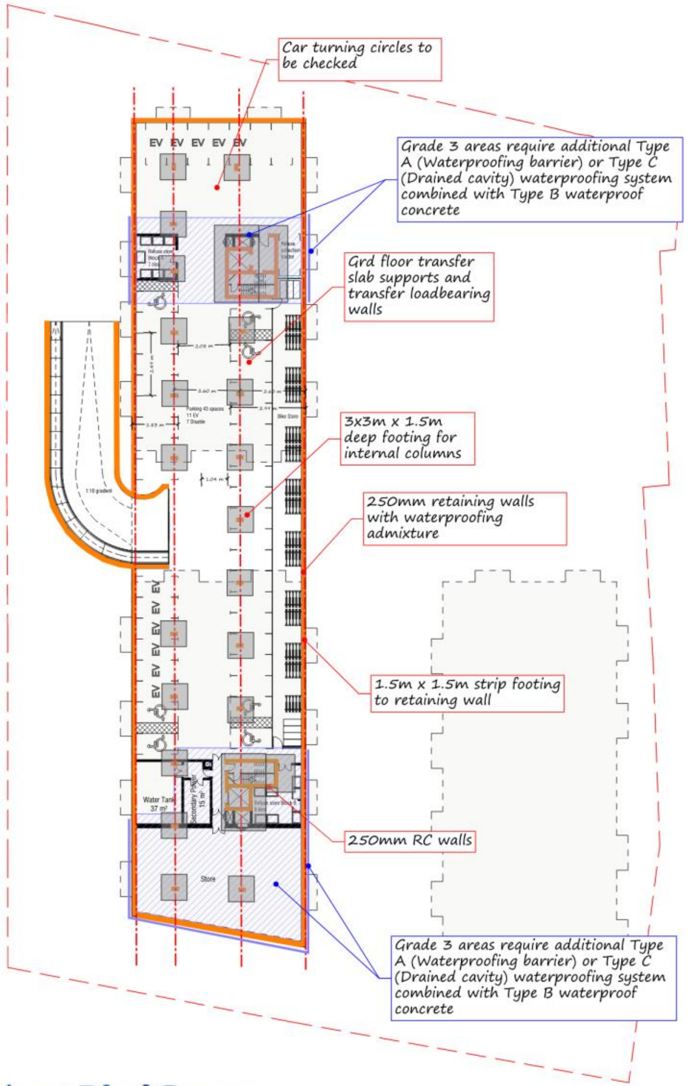
Appendix A

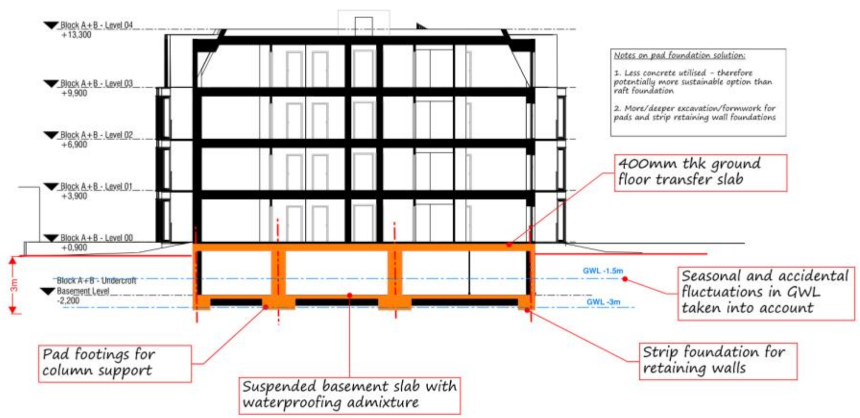
Foundation Scheme Sketches

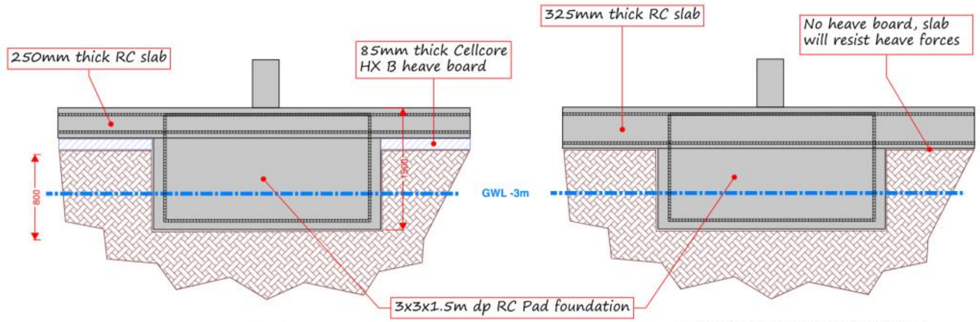
Barnes Hospital - Project

BASEMENT STRUCTURAL LAYOUT



SECTION THROUGH BLOCK A&B





OPTION 01 HEAVE BOARD **OPTION 02 NO HEAVE BOARD**

BASEMENT SLAB THICKNESS/BUILD UP

General Notes

1. GF slab assumed as transferring all the loads from block walls above.

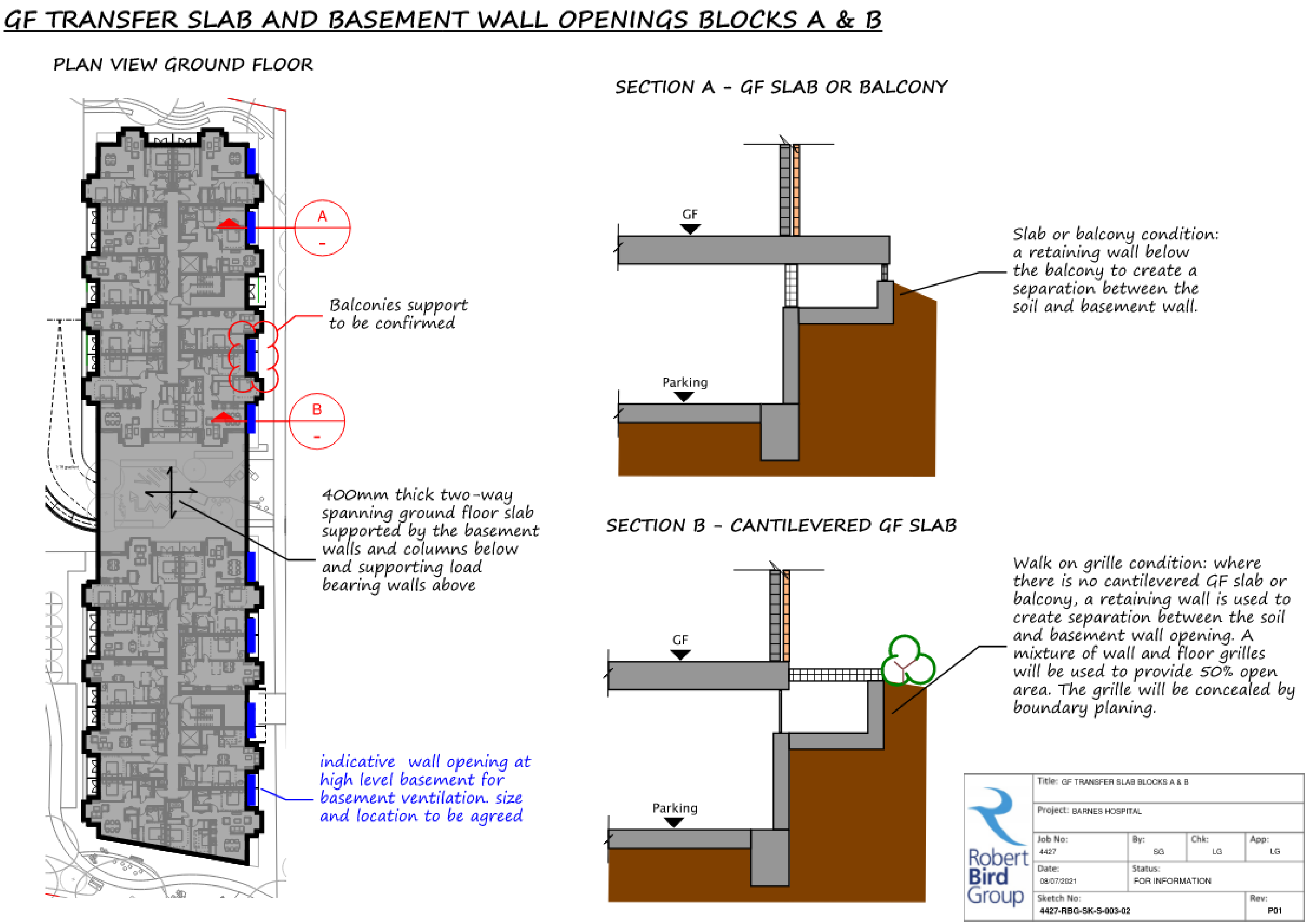
2. Excavations assumed as open-cut and dewatering measures will be required throughout the basement and superstructure construction.

3. Basement walls retain more than 0.6m, therefore a combined system of Waterproofing equivalent to Grade 3 around the basement perimeter and basement slab as per NHBC requirements.

4. A waterproofing Type B concrete system for the basement is assumed to be achieved by structurally integral construction including concrete waterproofing admix to achieve Grade 2 environment. A combined system or additional line of defence is required to achieve a Grade 3 environment. The additional waterproofing system combined with Type B waterproof concrete can be external/internal membrane systems (Type A) or drained cavity systems (Type C)

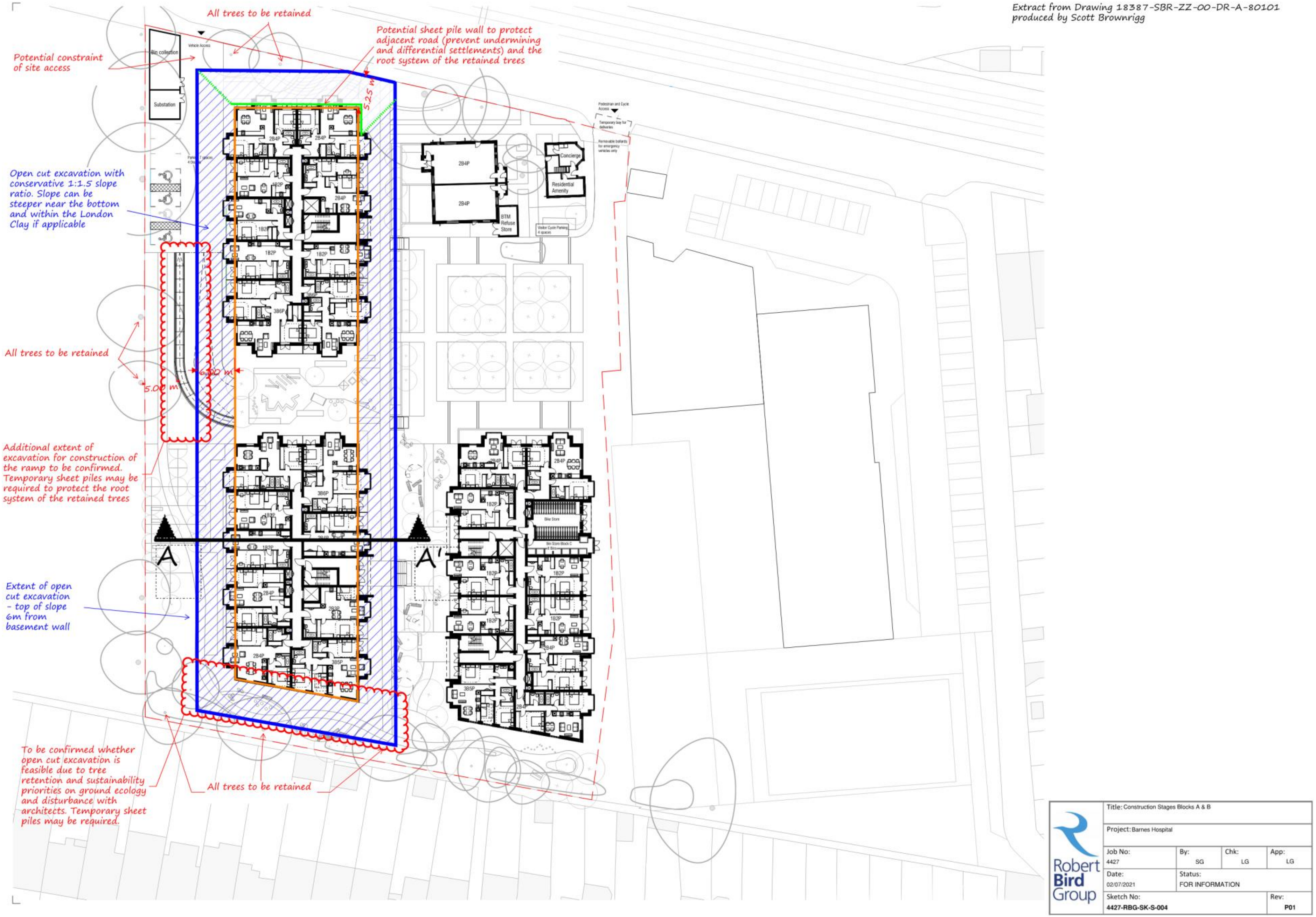
Client: LS	Designer: LG	Design Checker: -	FOR INFORMATION	
Project: BARNES HOSPITAL	Drawn: LG	Approved: -	Job No: 4427	Sheet No: 4427-RBG-SK-S-002 Rev: P01
Title: FOUNDATION SCHEME BLOCKS A & B	Scale at A3: NTS	Date: 16/06/2021		

RobertBirdGroup
Member of the Surbana Jurong Group

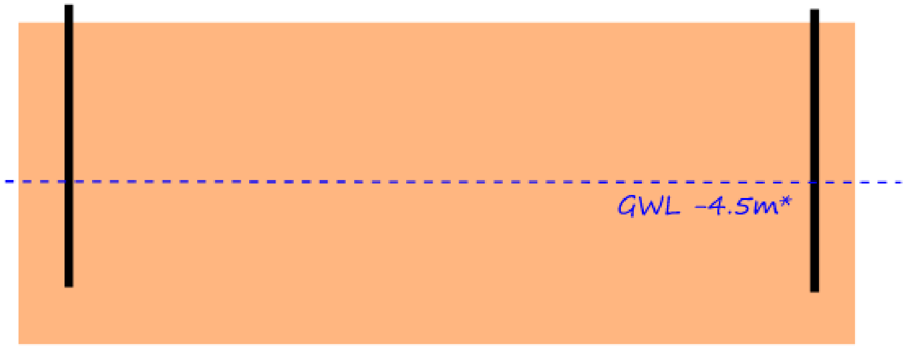

GF TRANSFER SLAB AND BASEMENT WALL OPENINGS BLOCKS A & B
PLAN VIEW GROUND FLOOR
A
B
Balconies support to be confirmed
400mm thick two-way spanning ground floor slab supported by the basement walls and columns below and supporting load bearing walls above
indicative wall opening at high level basement for basement ventilation. size and location to be agreed
SECTION A - GF SLAB OR BALCONY
GF
Parking
Slab or balcony condition: a retaining wall below the balcony to create a separation between the soil and basement wall.
SECTION B - CANTILEVERED GF SLAB
GF
Parking
Walk on grille condition: where there is no cantilevered GF slab or balcony, a retaining wall is used to create separation between the soil and basement wall opening. A mixture of wall and floor grilles will be used to provide 50% open area. The grille will be concealed by boundary planing.
Robert Bird Group
Title: GF TRANSFER SLAB BLOCKS A & B
Project: BARNES HOSPITAL
Job No: 4427
By: SG
Chk: LG
App: LG
Date: 08/07/2021
Status: FOR INFORMATION
Sketch No: 4427-RBG-SK-S-003-02
Rev: P01

Appendix B

Excavation Footprint and Construction Stages Sketches


Extract from Drawing 18387-SBR-ZZ-00-DR-A-80101 produced by Scott Brownrigg
All trees to be retained
Potential constraint of site access
Potential sheet pile wall to protect adjacent road (prevent undermining and differential settlements) and the root system of the retained trees
5.25 m
Open cut excavation with conservative 1:1.5 slope ratio. Slope can be steeper near the bottom and within the London Clay if applicable
All trees to be retained
5.00 m
6.00 m
Additional extent of excavation for construction of the ramp to be confirmed. Temporary sheet piles may be required to protect the root system of the retained trees
A
A'
Extent of open cut excavation - top of slope 6m from basement wall
To be confirmed whether open cut excavation is feasible due to tree retention and sustainability priorities on ground ecology and disturbance with architects. Temporary sheet piles may be required.
All trees to be retained
Bin collection
Substation
Concierge
Residential Amenity
BTM Refuse Store
Bike Store
Title: Construction Stages Blocks A & B
Project: Barnes Hospital
Job No: 4427
By: SG
Chk: LG
App: LG
Date: 02/07/2021
Status: FOR INFORMATION
Sketch No: 4427-RBG-SK-S-004
Rev: P01
Robert Bird Group

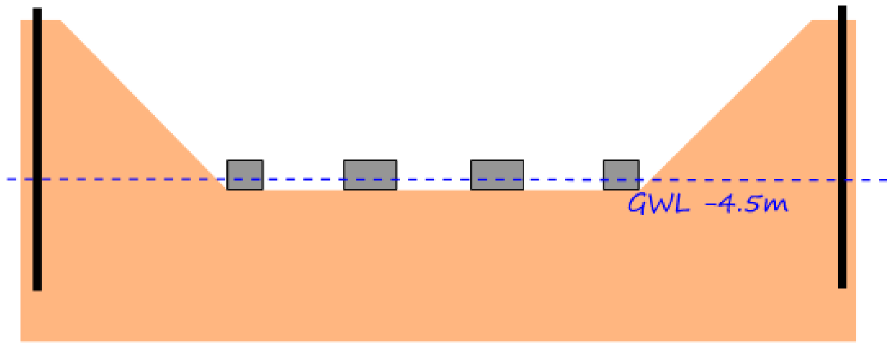
Stage 1: Install wells and dewater construction site



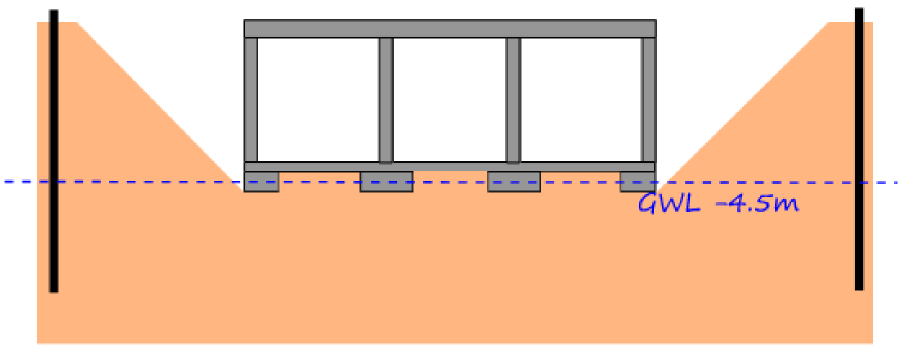
*i.e. 4.5m bgl - level taken as >0.5m below foundation level (TBC)

Stage 2: Open cut excavation with batter

Stage 3: Construct pad footings and strip foundation

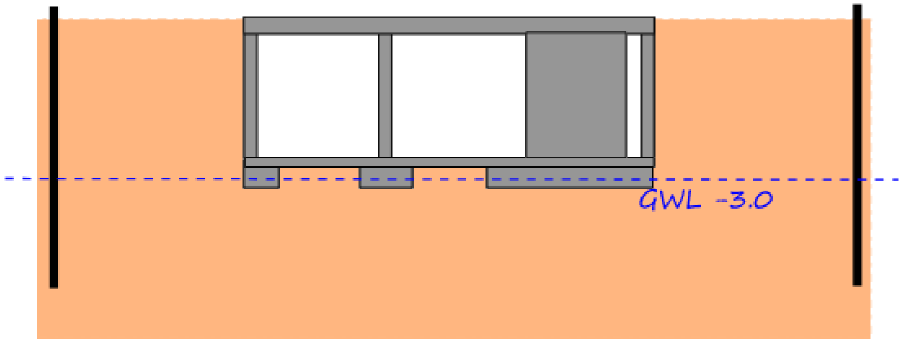


Stage 3: Construct basement (walls, columns and floors)

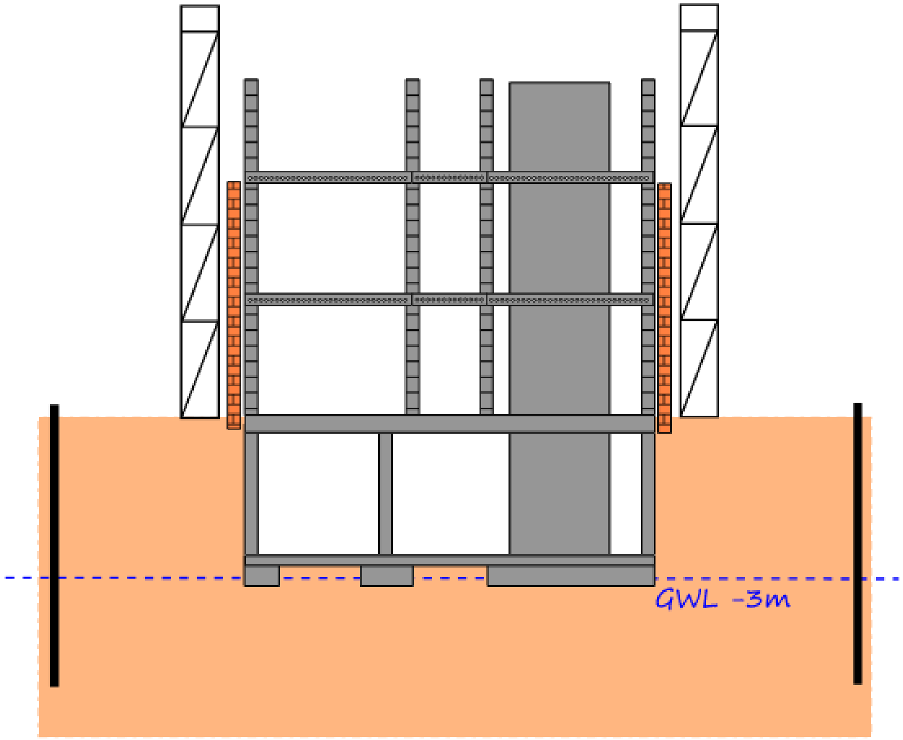


Title: SECTION A-A Construction Stages Blocks A & B			
Project: Barnes Hospital			
Job No: 4427	By: SG	Chk: LG	App: LG
Date: 02/07/2021	Status: FOR INFORMATION		
Sketch No: 4427-RBG-SK-S-004-02			Rev: P01

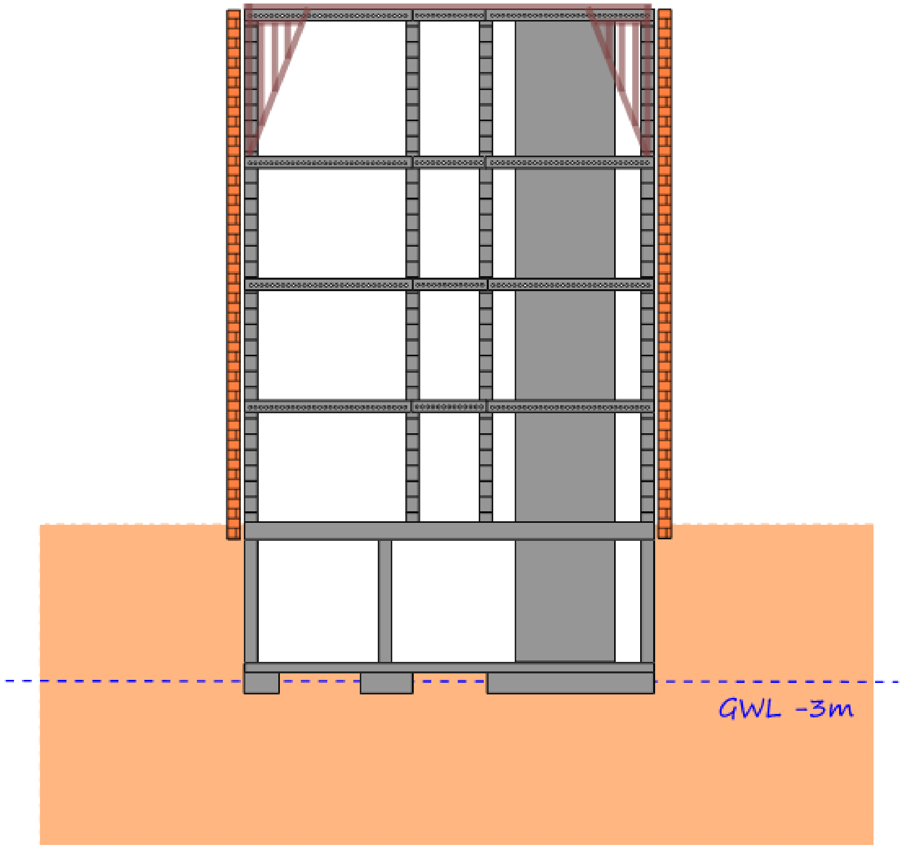
Stage 5: Backfill to ground level



Stage 6: Construct superstructure



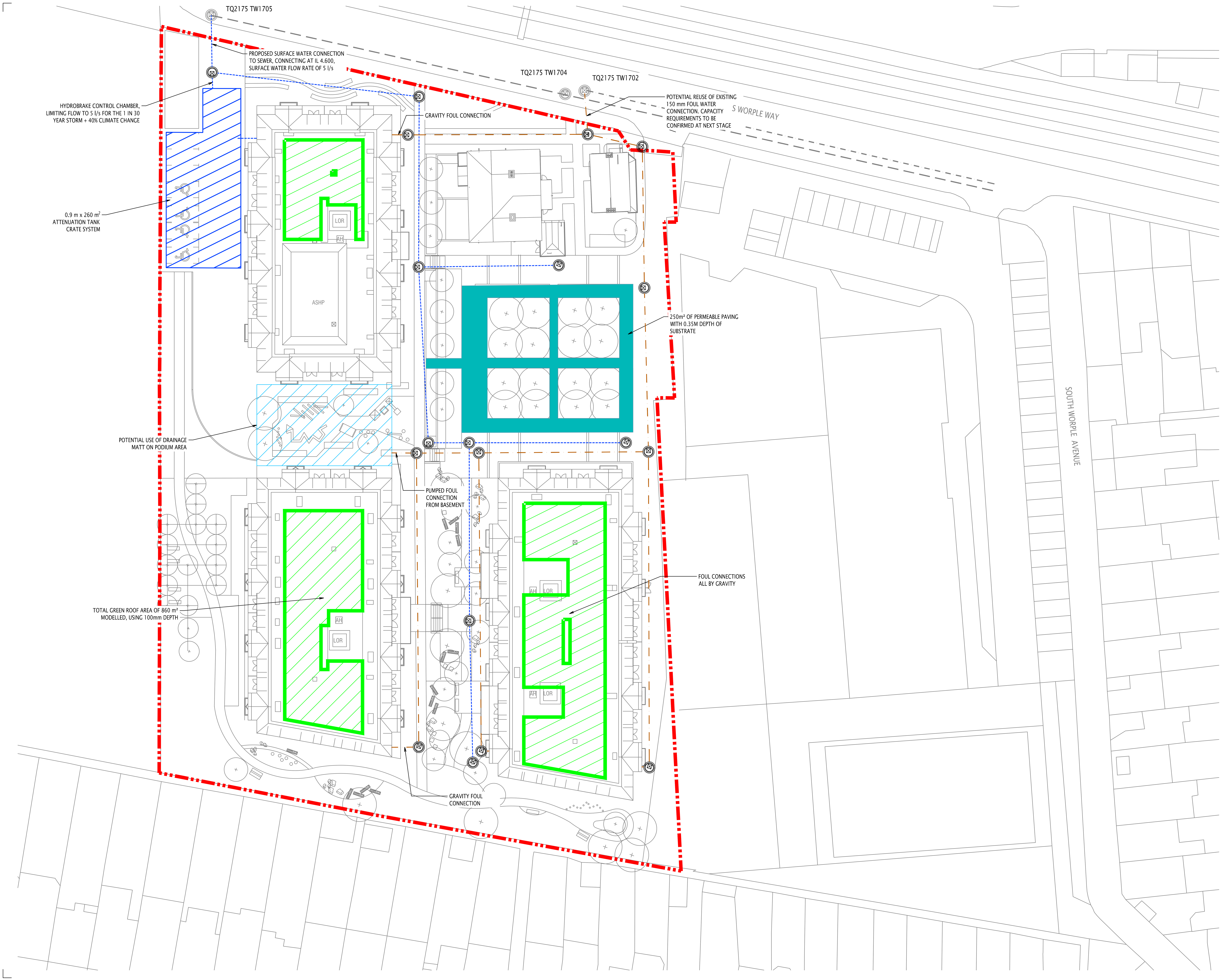
Stage 7: End of construction - remove wells - long term conditions



Robert Bird Group	Title: SECTION A-A Construction Stages Blocks A & B			
	Project: Barnes Hospital			
	Job No: 4427	By: SG	Chk: LG	App: LG
	Date: 02/07/2021	Status: FOR INFORMATION		
	Sketch No: 4427-RBG-SK-S-004-03			Rev: P01

Appendix C

Proposed Drainage



KEY TO HEALTH AND SAFETY SYMBOLS

- INDICATES A RESIDUAL RISK REQUIRING A COMPULSORY ACTION
- INDICATES A RESIDUAL RISK REQUIRING A PROHIBITIVE ACTION
- INDICATES A RESIDUAL RISK AS A WARNING
- INDICATES A RESIDUAL RISK FOR INFORMATION

LEGEND

- POTENTIAL GREEN ROOF AREAS
- ATTENUATION TANK
- DRAINAGE MATT
- PERMEABLE PAVING
- FOUL WATER PIPE
- SURFACE WATER PIPE
- EXISTING PUBLIC COMBINED SEWER
- EXISTING PUBLIC SURFACE WATER SEWER
- FOUL WATER MANHOLE
- SURFACE WATER MANHOLE
- EXISTING TW MANHOLE
- SITE BOUNDARY

Rev	Revision Description	By	App	Date
P05	RED LINE BOUNDARY UPDATED	JH	JG	18.11.21
P04	GREEN ROOF HATCH UPDATED	JH	JG	14.10.21
P03	AREAS UPDATED	GK	JG	23.09.21
P02	NETWORKS UPDATED	VS	JG	06.08.21
P01	FOR INFORMATION	VS	JG	09.07.21

Scale	1	2	3	4	5	6	7	8

DO NOT SCALE DRAWINGS, USE FIGURED DIMENSIONS
REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

Structural, Civil & Construction
Engineering Consultant

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Client
LS ESTATES

Project
BARNES HOSPITAL SITE

Title
DRAINAGE GENERAL ARRANGEMENT

Date JULY/2021	Drawn J.BELL
Scale at A1 1:250	Designer G.KIM
Suitability Code S2	Design Checker -
Job Number 4427	Approved L.RAPSON

FOR INFORMATION

Drawing Number	Revision
4427-RBG-XX-00-DR-CV-86001	P05

Appendix D

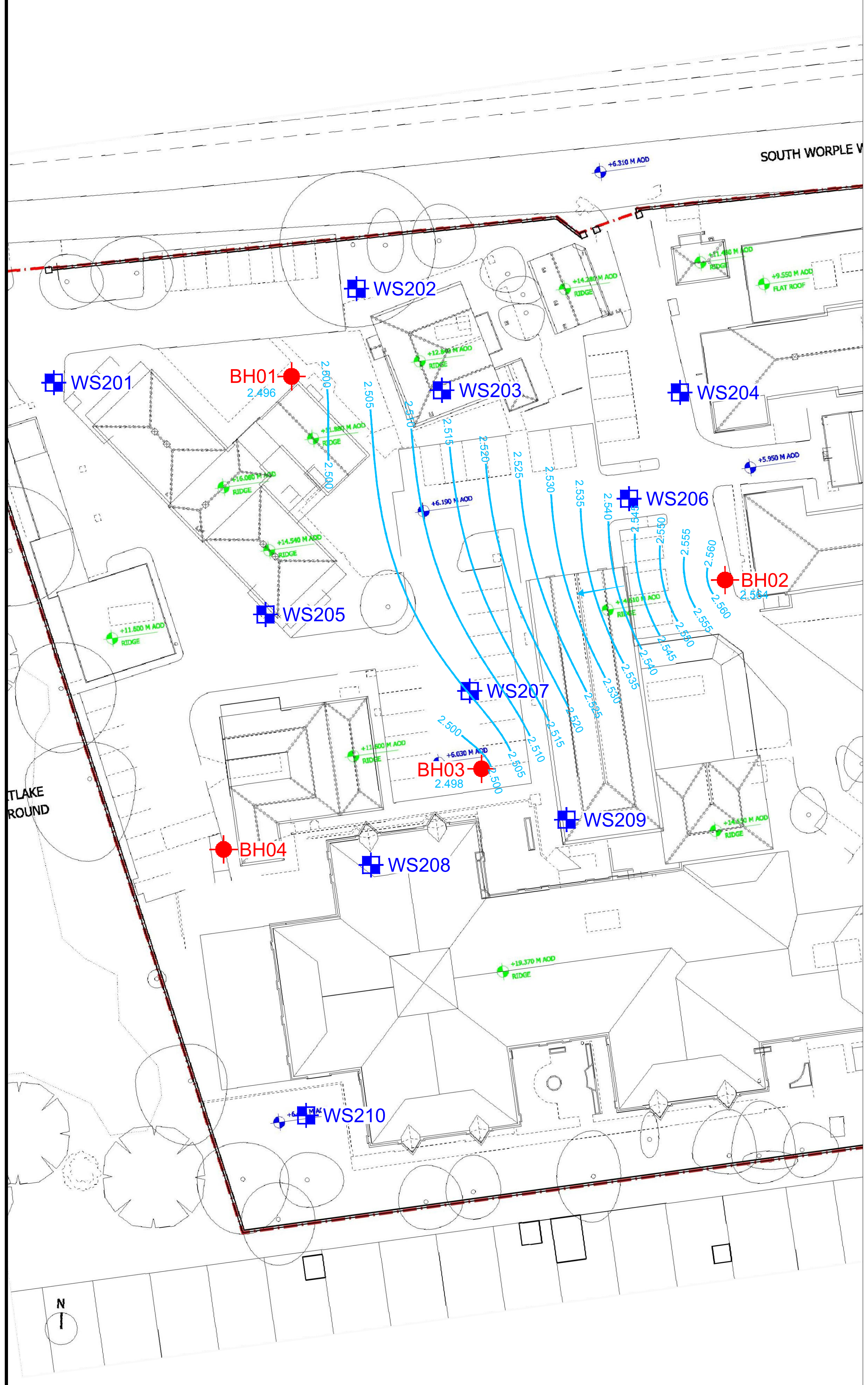
Topography


COORDINATE TABLE
Notes: Grid Origin and Level Datum are referenced to XYZ Surveys drawing "2016/527" which has been inserted into this model for background reference.
SUMO SERVICES Ltd
www.sumoservices.com
Title
TOPOGRAPHIC SURVEY
Client
BEADMANS
Project
BARNES HOSPITAL
Date Completed: SEPTEMBER 2019
Post Code: SW14 8SU
Surveyed: PS
Drawn: PS
Checked: MB
Scale
1:200@A0
Dwg No
01

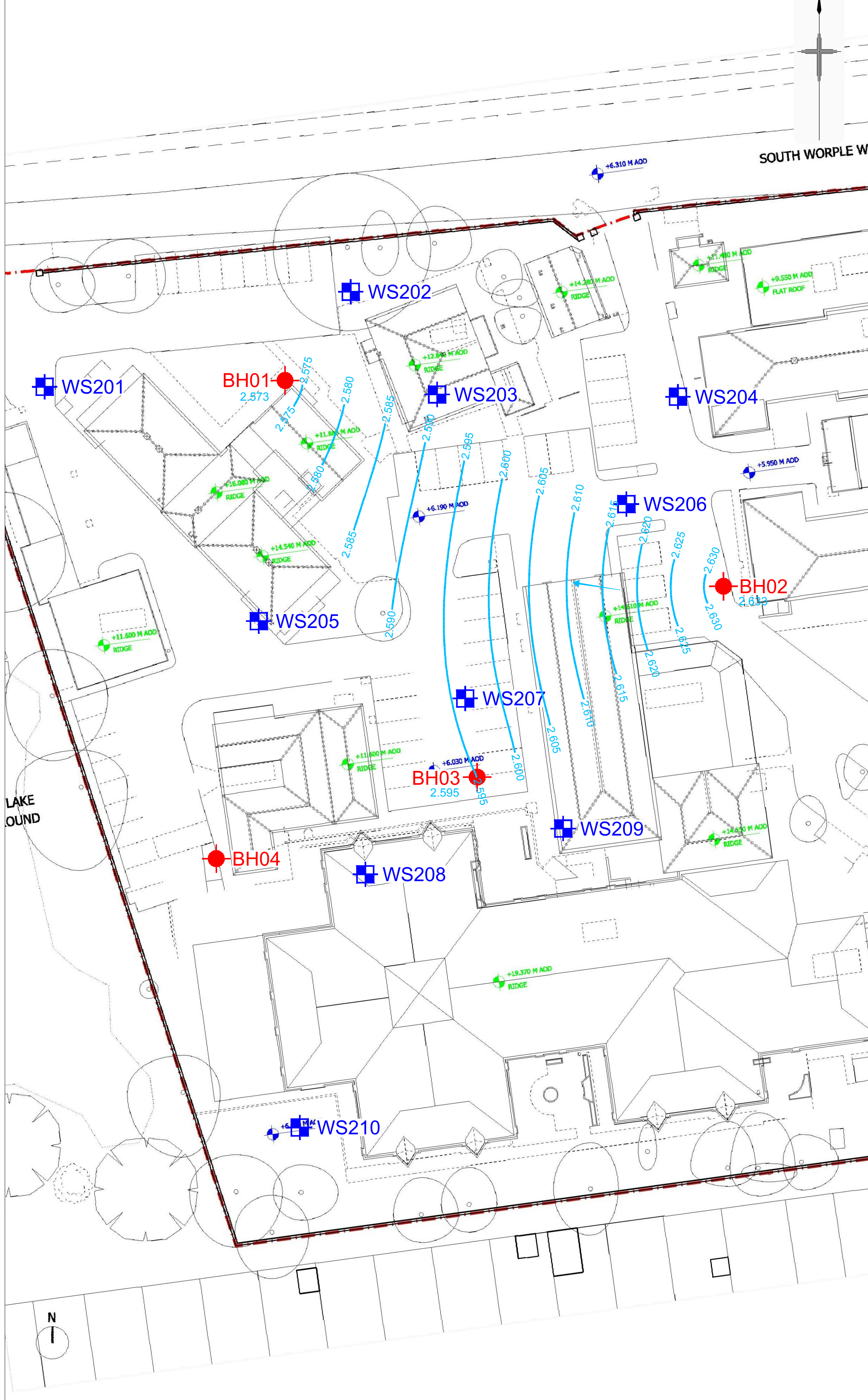
Appendix E

Groundwater Flow Plan View

Piezometric Data: 19.12.19



Piezometric Data: 06.01.20



LEGEND

- Site Boundary
- Borehole Location
- Window Sample Location
- 6.943 Groundwater Level (mAOD)
- 7.05 Groundwater Contour (mAOD)
- Groundwater Flow Direction

Rev.	Date	Amendment	Drawn	Chkd.	Appd.

RSK

18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
United Kingdom

Tel: +44 (0) 1442 437500
Fax: +44 (0) 1442 437550
Email: info@rsk.co.uk
Web: www.rsk.co.uk

Client

LS ESTATES LIMITED

Project Title

BARNES HOSPITAL
PLOT A

Drawing Title

GROUNDWATER
PIEZOMETER PLAN

Drawn	Date	Checked	Date	Approved	Date
SAY	20.01.20	HA	20.01.20	ZH	20.01.20

Scale	Orig Size	Dimensions
1:600	A3	Metres

Project No.	Drawing File
1920884 (R01-00)	1920884 (R01-00) Fig 3.dwg

Drawing No.	Rev.
FIGURE 3	P1

Scale 1 : 600

0 8 16 24 32 40m

FS 538679

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