3.5.3 Ground stability

The site is ranked as very low risk for:

- Compressible ground stability hazards.
- Collapsible ground stability hazards.
- Landslide ground stability hazards.
- Ground dissolution stability hazards.
- Potential for running sand ground stability hazards.

The site does however falls under moderate risk for:

- Potential for shrinking or swelling clay ground stability hazards.

Figure 3.21 Ground stability data key

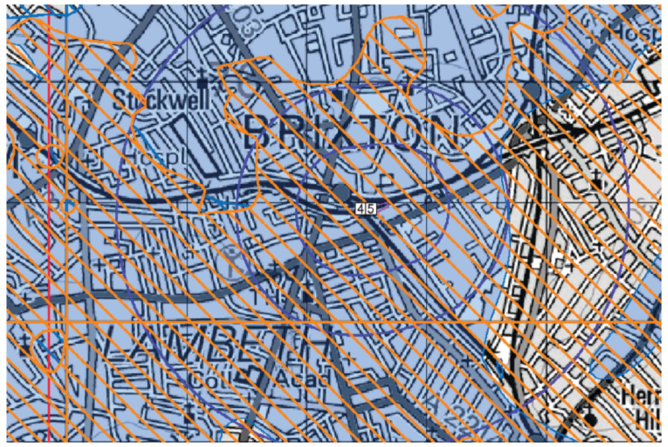


Figure 3.22 Ground stability data

3.5.4 Hydrology & flood risk

The nearest surface water feature to the site is the River Thames which is approximately 2.7km in a straight line. Due to this distance the Environment Agency (EA) does not consider this site in an area of flood risk from Rivers and Sea. The site is therefore classified as 'Flood Zone 1', which signifies land having a less than 1 in 1,000 annual probability (0.1%) of river or sea flooding (Shown as 'clear' on the Flood Map).

Confirmation is from required from Lambeth council whether the site sits in an area of critical drainage. If so, a FRA is required.

The following two maps provided by the British Geological Survey (BGS) and the EA indicate that the site could be subject to groundwater flooding under heavy pluvial conditions.

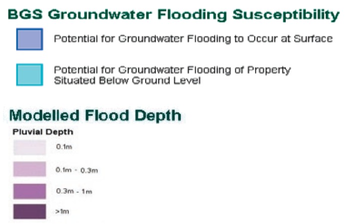


Figure 3.23 BGS & EA map key

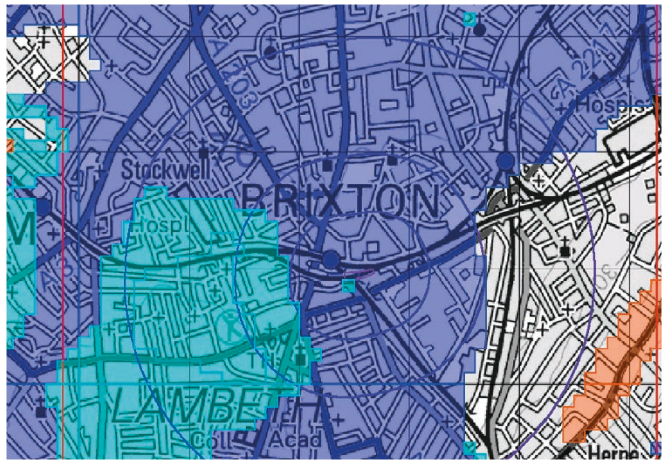


Figure 3.24 BGS groundwater flooding susceptibility

Figure 3.25 EA surface flood map

3.5.5 Ground contamination

The ground contamination maps show that the site is bordered to the South by an area highlighted as potentially contaminated due to its past industrial land uses.

The following soil chemistry concentration values have been provided by BGS:

- Arsenic - levels measured below 15mg/kg (limit of 32 considered[1]).
- Cadmium - levels measured below 1.8mg/kg.
- Chromium - levels measured between 60-90mg/kg.
- Lead - levels measured between 150-300mg /kg.
- Nickel - levels measured between 15-30mg/kg.

[1] Soil Guideline Values for inorganic arsenic in soil - Science Report SC050021 - Environment Agency

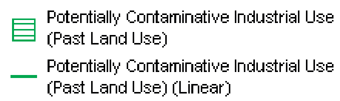


Figure 3.26 Historic land use map key

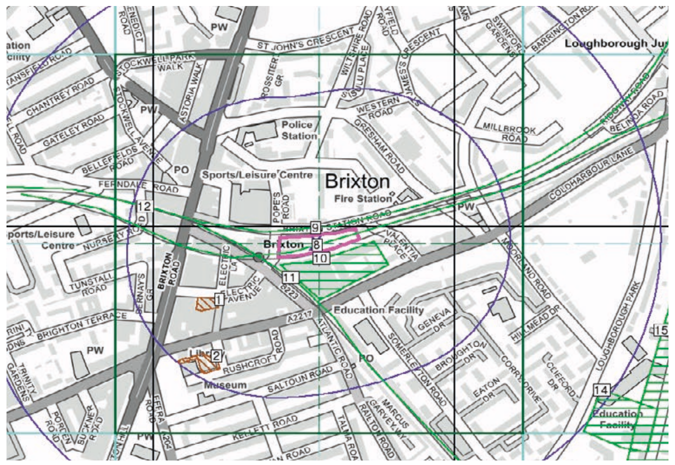


Figure 3.27 Historic land use map

3.6 Archaeology

With the location of the site being in the inner zones of London, there is a potential risk of archaeological findings. The discovery and location of these would consequently affect the foundation solution adopted. The Museum of London Archaeology show that archaeological findings are sparser in the Brixton area as opposed to Central London, with the nearest finding being a flint artefact discovered approximately 450m south of the site. Other than this, there are few findings within the neighbouring vicinity of the site, and therefore the discovery of further archaeological findings is unlikely.

However, if archaeological remains were to be found, the presence of the existing buildings on the site means that they may have been partially truncated by excavations. Previous developments were generally less sensitive to archaeological remains than is the case today. Although a high level archaeological desk study has been carried out, it is advised that a specific archaeological consultant is appointed to carry out a detailed study and risk assessment. This is advised as there is a large area on the site which has not experienced recent excavation, particularly due to the current structure not featuring any basement levels and thus a full archaeology study should be carried out by a specialist.

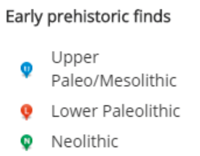


Figure 3.28 Archaeology key

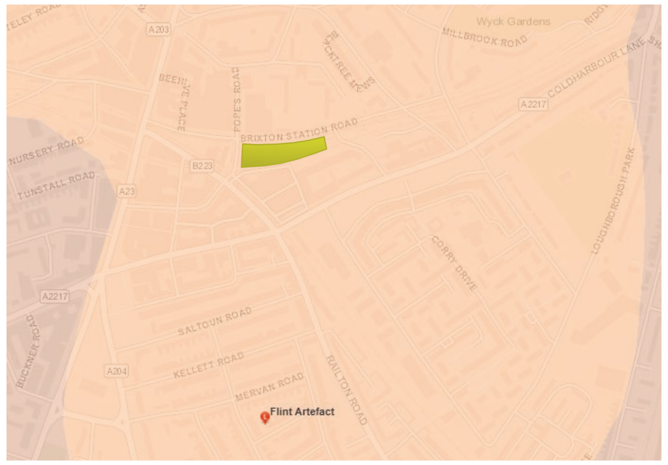


Figure 3.29 Local archaeology

3.7 Unexploded Ordnance

The Ministry of Defence has recorded the extent of damage to buildings during the raids in the Second World War (WWII) and the possible locations of Unexploded Ordnance (UXO) in Central London.

It is known that many of the bombs dropped during WWII did not explode on impact, leaving some still present beneath ground. As bomb detonators do not deteriorate and the explosives do not become inert over time, this presents an inherent health and safety risk as well as the possibility for a source of contamination.

The problem can be exacerbated as some bombs are non-ferrous: meaning they require more sophisticated and expensive detection techniques.

Although the presence of UXO is not indicated for this site, it is noted in a few of the surrounding properties. The inherent residual risk of UXO should be evaluated in the project risk assessment and a specialist consultant should be engaged, if deemed appropriate, in the next stages of design.

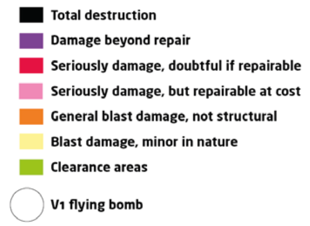


Figure 3.30 Bomb damage map key

Figure 3.31 Bomb damage map

3.8 Below Ground Features

3.8.1 Thames Water assets

A number of Thames Water assets are situated in the immediate vicinity of the site. These include combined sewers to the north, east and west. There is a 3" water pipe located to the north of the site which connects to a larger 10" distribution main that runs to the east.

Thames Water assets can be sensitive to movements generated as the ground heaves and settles from demolition, excavation, and construction activities. Potential movements and damage to pipes will need to be assessed in conjunction with obtaining an AIP from Thames Water.

The condition of these sewers is currently unknown and it is therefore recommended that surveys are to be undertaken to establish this, and any potential pre-existing movements or damage to the pipes.

A continuous monitoring regime is also likely to be required for the duration, and for a period of time after the completion, of the construction works for the proposed scheme. In addition, consideration should be given for potential remediation works that may be required.

3.8.2 Telecommunications

A statutory utilities search reveals that a variety of telecommunications cables, including BT Openreach and a third party leased from Vodafone, are present within the site. These are likely to be located beneath the surrounding pavements and will require third party approvals.

These will need to be worked around or require diverting, which will be explored at future stages with the involvement of the relevant affected companies.

3.8.3 UKPN

There are multiple electrical substations present in and around the site. Furthermore, there are also a variety of mains cables running alongside the south border of the site.

Works will require third party approval to be sought from UKPN to work around, or remove and reinstate, the substation present on site.

3.8.4 Gas networks

There is the presence of a Low Pressure Mains gas pipe entering the site from the east that runs alongside the north boundary.

The records provided by SGN only show pipes owned by them. Privately owned gas pipes or pipes owned by other Licensed Gas Transporters (GT) may be present in this area. There is an area to the south ast of the site that is fed by ES Pipelines Ltd. Their pipelines originate from the South and do not affect the site.

Safe digging practices in accordance with HSE publication HSG47 "Avoiding Danger from Underground Services" must be used to verify and establish the actual positions of the mains, pipes, services and other apparatus on site before any mechanical plant is used.

The works should be carried out in such a manner that SGN are able to gain access to their apparatus throughout the duration of works operations.

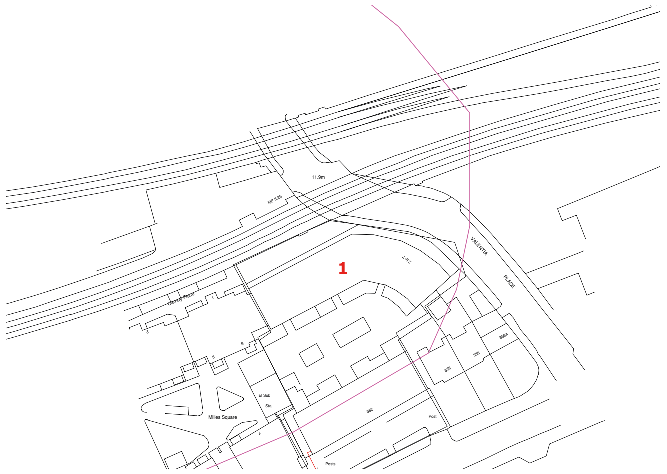


Figure 3.32 ES Pipelines map

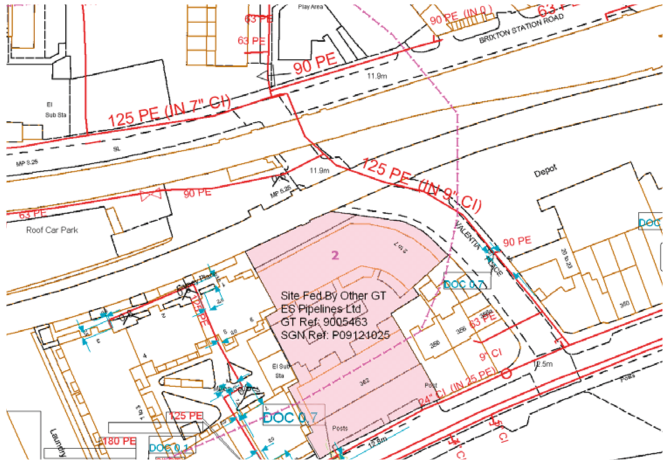


Figure 3.33 GN map

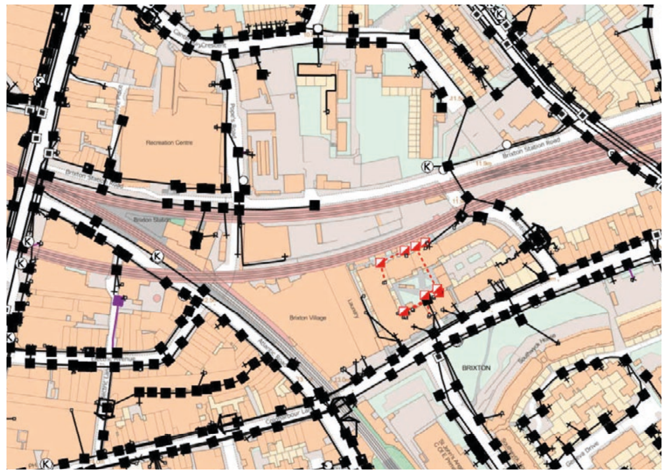


Figure 3.34 BT Openreach map

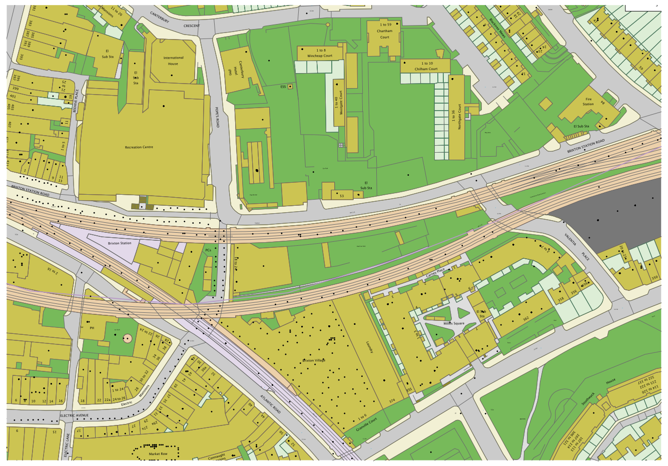


Figure 3.35 Vodafone map

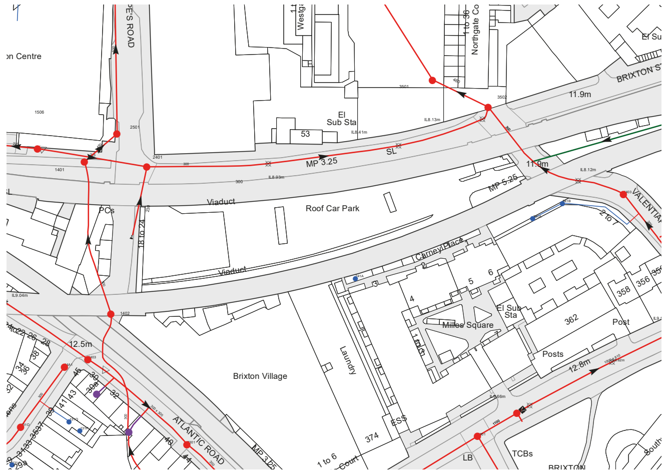


Figure 3.36 Thames Water sewer map

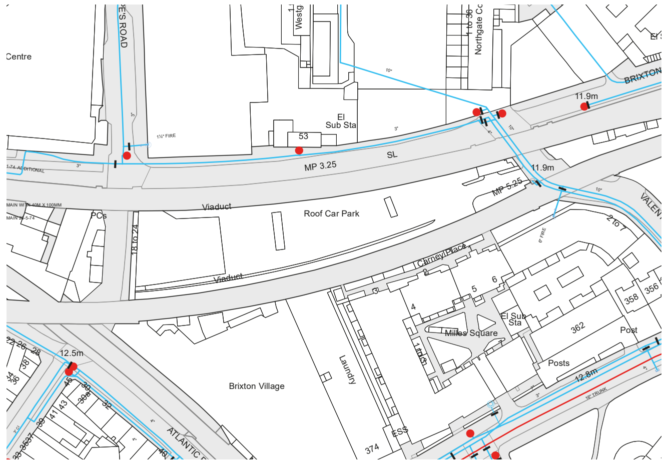


Figure 3.37 Thames Water water pipe map

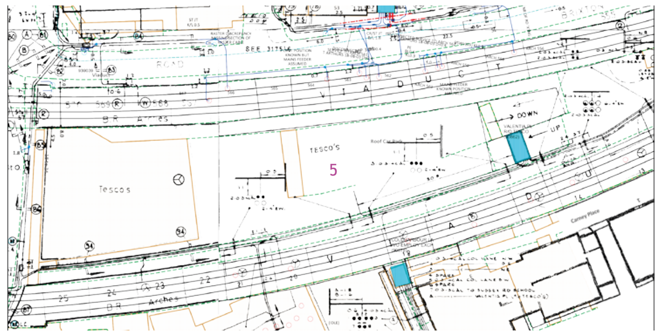


Figure 3.38 UKPN asset map

3.9 Site Constraints

The following information is intended to give a general overview of potential project constraints that have so far been identified in relation to the current proposals. These are not exhaustive and should be considered in conjunction with information from the wider design team.

These issues should be considered in more detail as the project moves into the next stages of design with appropriate recognition in the project risk register.

Generally speaking the major constraints are likely to arise from:

- Thames Water assets (sewers/water pipes) surrounding the site.
- Interface with Network Rail assets along north and south sides of the site.
- Site access, logistics and spatial planning with regards to construction activities.

3.9.1 Party walls & neigbouring structures

There are currently no known party wall conditions with the existing structure at Pope's Road. As outlined earlier, the site is separated from neighbouring properties by the north and south railways, as well as roads east and west. However, it should be assumed that the archway foundations will present a constraint; this will need to be verified in the next stage of design.

Consideration should however be given to the nature of construction is close proximity to the railway arches and any inherent constraints. The effect of the construction activities that will be associated with the proposed development on the adjacent railway arches should be considered in more detail in the next stage of the design.

3.9.2 Site access

With respect to the proposed construction, consideration should be given to aspects such as:

- Grounds access to the site via Pope's Road and Valentia Place is restricted by the neighbouring railway arches. Restricted access may pose potential constraints on delivery of on-site materials and equipment.
- Located nearby is the A23, a TFL operated 'Red Route', which experiences heavy congestion and is an important part of the TFL network.
- On-site storage may be restricted.
- On-site welfare facilities may be restricted.

3.9.3 Network Rail assets

The presence of the continuous arch structures owned by Network Rail either side of the site, north and south, pose an inherent constraint to the development in multiple ways.

Firstly, construction works cannot approach the live overground tracks during operational hours. Therefore, the interface with Network Rail will likely constrain crane logistics.

The interface between the existing structures and the proposed development should be further explored and Network Rail have been approached to make them aware of the fact proposed works are in the pipeline as well as a request for as-builts to explore the interface in future stages.

At this stage an 'Asset Protection Initial Enquiry Questionnaire' has been logged with Network Rail. An AIP will likely be required to gain Network Rail's approval for construction works happening in the vicinity of their assets.

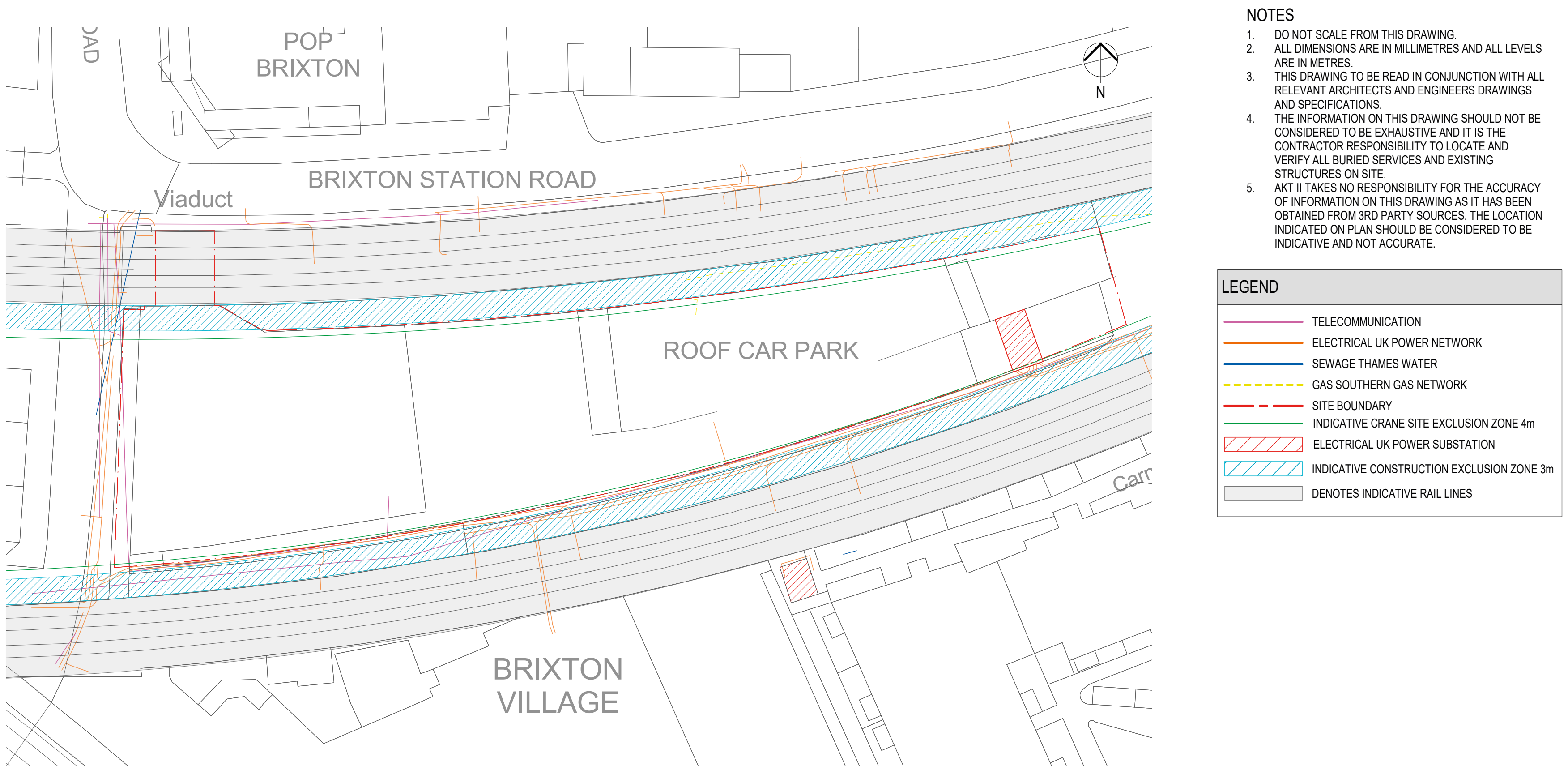


Figure 3.39 Site constraints

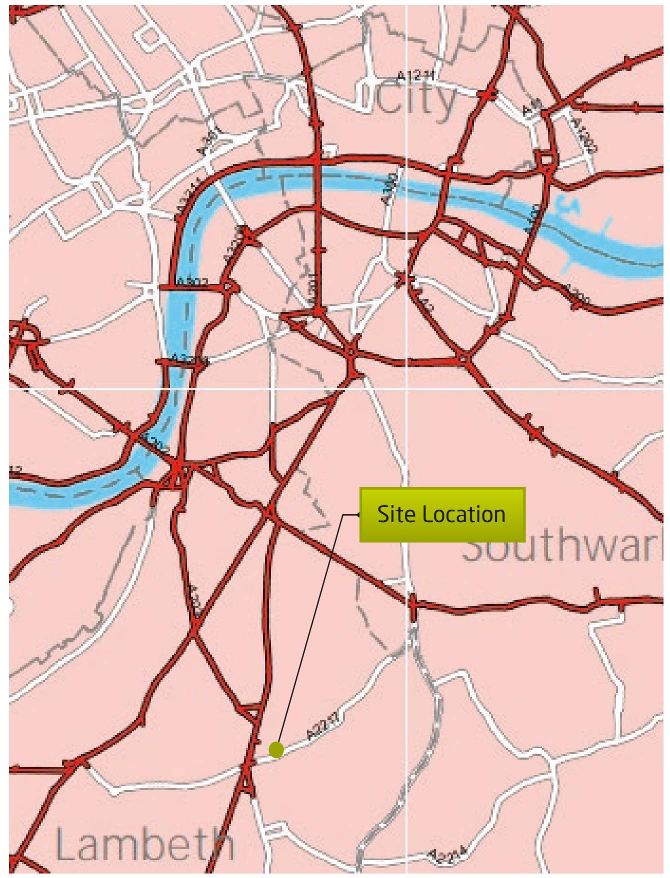


Figure 3.40 TFL Red Routes

3.10 Proposed Investigations

The following section outlines AKT II recommendations for specialist investigations to be undertaken at the earliest available opportunity. These investigations are intended to provide further information on parameters required for more detailed structural design, and to reduce/mitigate the associated risks.

These investigations include:

- Project specific site investigation.
- CCTV drainage surveys.
- Condition surveys of the Thames Water sewers in the immediate vicinity of the site.

3.10.1 Geotechnical and geo-environmental investigation

An initial summary of the anticipated ground conditions has been discussed in section 3.6 of this report. A large proportion of this information requires confirmation or further investigation through a detailed site investigation.

The scope of this investigation should cover the following:

- Independent specialist desk study.
- Establishing the soil profile throughout the site through additional boreholes.
- Testing of soils, through intrusive investigation, to establish their geotechnical parameters and subsequently facilitate the design of various structural and civil items.
- Recommendations on foundation solutions.
- Indication/example of piled foundations for the current proposals.
- Establishing the groundwater conditions.
- Environmental and contamination testing of soils and groundwater.

Further information on the geotechnical and geo-environmental investigation can be found in the appendices.

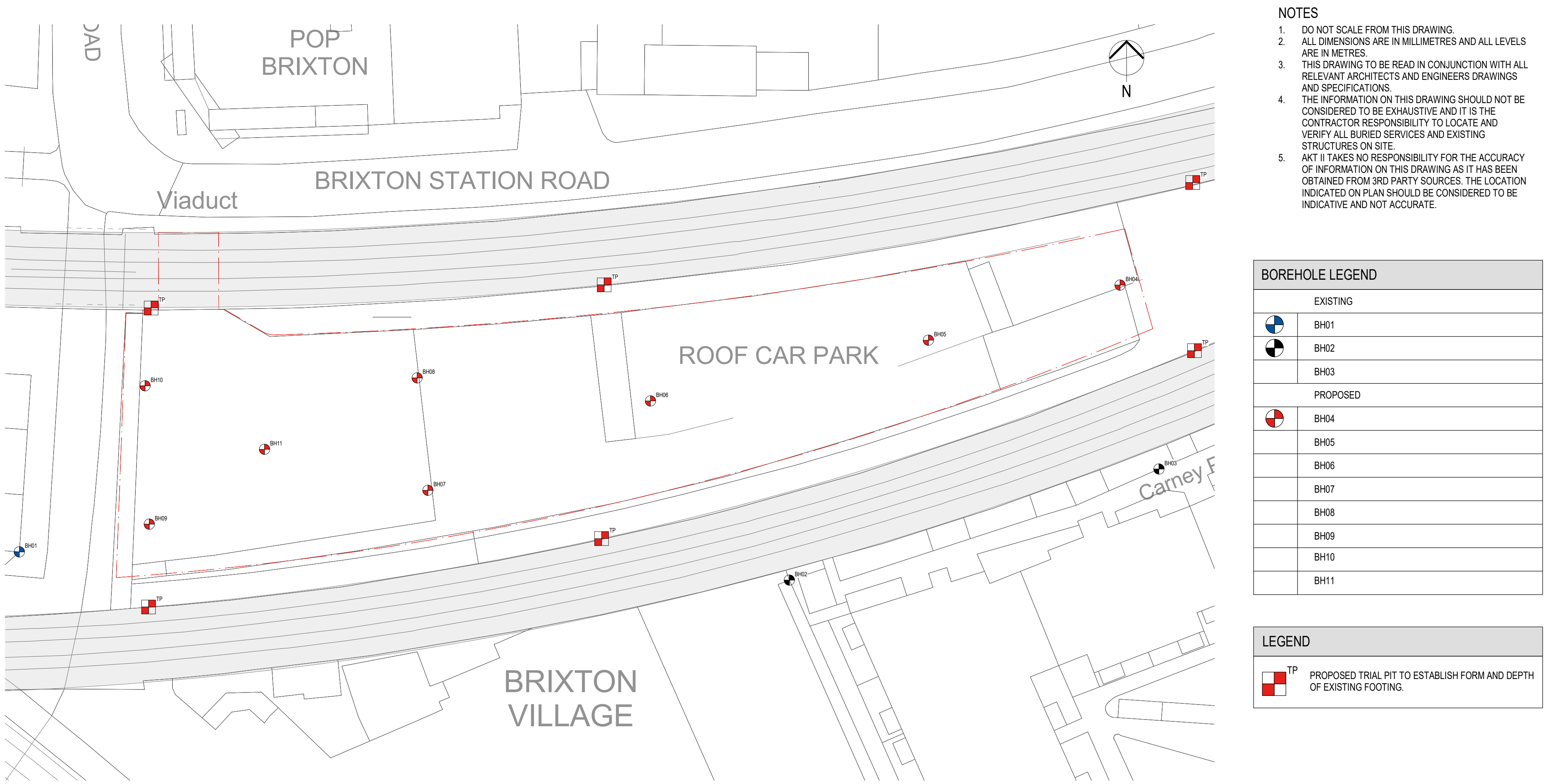


Figure 3.41 Proposed investigation

4 Superstructure

4.1 Overview

This section contains a summary of the above ground structure in relation to the current proposals for information.

The current proposals involve both a 21 storey office and a 9 storey office, connected from levels L03 to B2. At the shared L01, there will be a mezzanine level that splits the shared first two storeys.

Both of the structures will be of reinforced concrete (RC) construction. The first basement level, B1, is to be a mezzanine under the west building, whereas B2 will feature a ground bearing slab to prevent the ingress of water between pile caps.

Figure 4.1 Superstructure overview

5 Substructure

5.1 Overview

This chapter outlines the main aspects of the below ground structure with a narrative on foundation options for the current proposals. It should be noted that the following information and solutions presented are preliminary only, pending the completion of a project specific site investigation. Completion of the site investigation as mentioned above will also facilitate more adetailed design of the foundation system.

The current proposals include 2 basement levels that will be boxed out using perimeter retaining walls. Due to the nature of the basement, it is likely to be of a secant pile construction combined with an internal liner wall and capping beam.

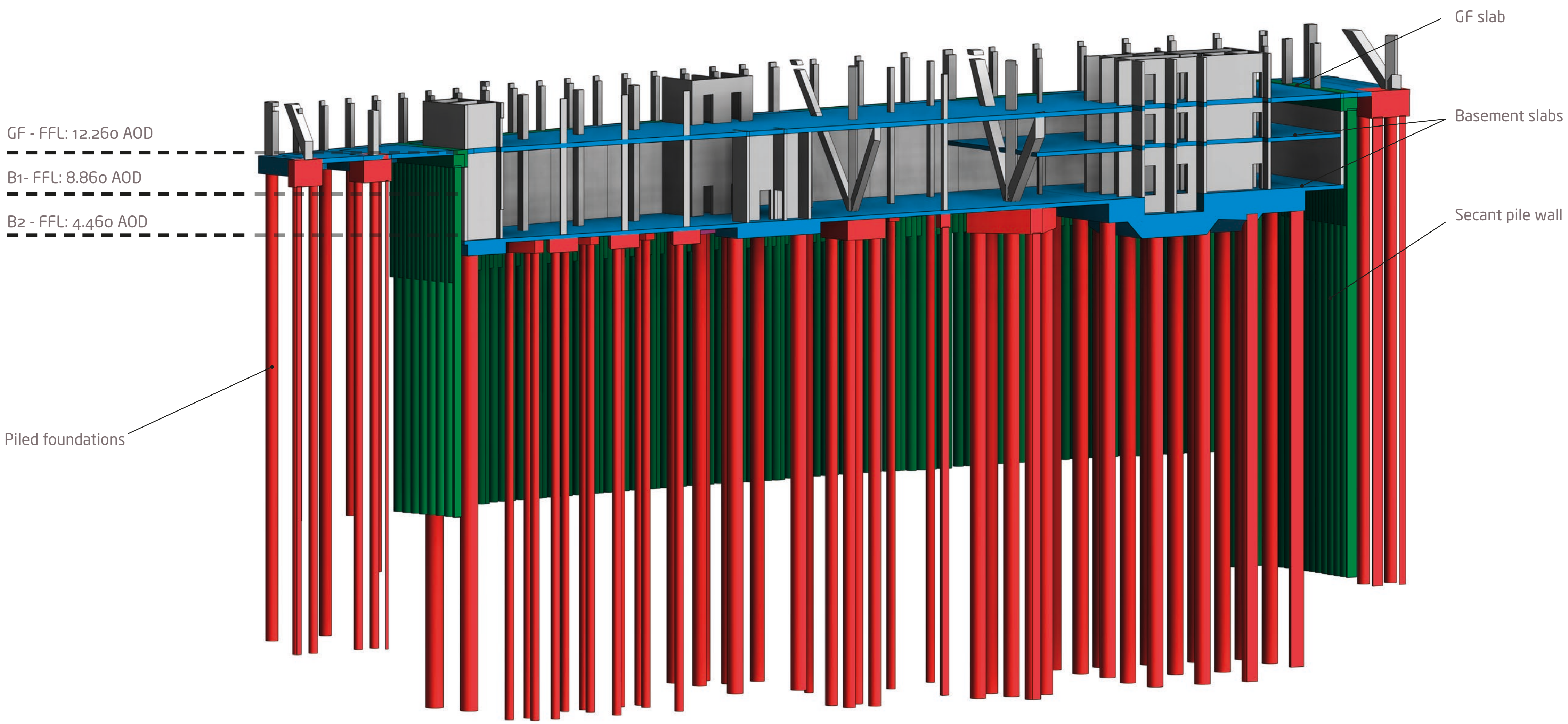
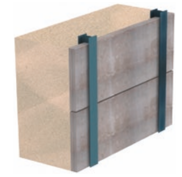
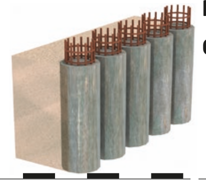
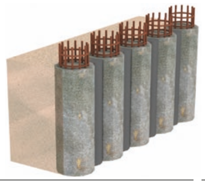
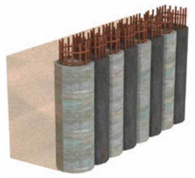
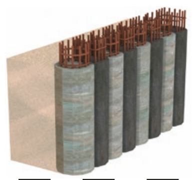


Figure 5.1 Substructure overview

5.2 Retaining Structure

Options for the basement retaining wall construction are summarised in this section by providing a general overview on typical characteristics, advantages/disadvantages, and any additional remarks. The solutions will be refined as more detailed design is undertaken, however an initial zone has been coordinated to allow the flexibility of all available options. At the present stage, it is thought that a secant piled wall construction would provide an adequate solution due to the depth of the basement and the ground conditions that are anticipated on site. This will need to be confirmed in the next stage of design.Foundation Design

	Wall construction	Temporary / permanent support	Typical wall depth	Typical retained height	Usual installation tolerance: verticality	Advantages / disadvantages	Remarks	Suitability
	**King post wall** **Steel UC soldiers and timber or RC (or RC / PSC + grouting) skin wall / lagging**	Usually only temporary support	King posts typically 6 to 20 m	3.5 m as cantilever 12 to 15 m anchored	1:100	Generally only used where groundwater is below formation level. Not feasible in soft and loose soils	Where good construction tolerances apply, the wall surface may be used as a permanent back shutter to an RC wall. generally only used where groundwater is below formation level. Not feasible in soft and loose soils.	✗
	**Steel sheet piling**	Temporary or permanent support (e.g. in car park basements)	Typically 10 to 15 m Max pile length: ~30 m	8 to 12 m as single propped wall	1:75	Vibration and noise can be overcome in some soils by use of hydraulic press equipment. Risk of declutching by obstructions.	Reuse of sheet piles will often determine cost viability of temporary sheet piling. Possible difficulties installing through dense gravels.	?/✗
	**RC piles** **Contiguous piles**	Temporary and permanent support (where RC facing wall is used)	12 to 20 m	6 to 15 m propped or anchored	1:100	Cheapest form of RC piles when installed by CFA equipment. Not a water resistant wall.	Non-interlocking of piles means little or no water resistance. Can be used with jet grouting to provide permanent water and soil exclusion.	?/✓
	**RC piles** **Hard / soft secant**	Temporary and permanent support, see note regarding durability	12 to 20 m propped or anchored	6 to 15 m	1:125	The use of a weak concrete mix to allow economical excavation of secant by male piles may also have durability disadvantages long t	May only be considered water-resistant in the short term.	✓
	**RC piles** **Hard / firm secant**	As for hard / soft secant				The use of a stronger mix for female piles than that used for hard / soft secants may improve water-resistance and durability long term.	Possible solution due to extent of basement and likely ground conditions to be encountered.	✓✓
	**RC piles** **Hard / hard secant**	Temporary and permanent support, usually permanent	15 to 30 m	10 to 20 m propped or anchored	1:125 to 1:200	Depth limited by vertical tolerances which influence depth of cut secant joint and their water resistance. Avoids the use of slurry.	Female pile may be reinforced with UB section, male by UB or circular rebar cage. Shear plates may be welded to UBs before insertion for floor connections.	✓
	**Diaphragm walls installed by grab**	Permanent (if temporary, then left in place)	15 to 30 m	12 to 25 m propped or anchored	1:125	Heavy installation plant and increasing difficulties in disposal of slurry pose disadvantages.	Solution to deep walls in variable soil conditions with water retention. Dificulties may arise with excavation of obstructions, natural or otherwise. The wall surface may serve as the final finished surface for some applications.	✗
	**Diaphragm walls installed by cutter**	Permanent (if temporary, then left in place)	15 to 50 m	12 to 35 m propped or anchored	1:400	Improved installation tolerances, but minimum job size influenced by large mobilisation and demobilisation costs.	Solution to deep walls in variable soil conditions with water retention. Dificulties may arise with excavation of obstructions, natural or otherwise. The wall surface may serve as the final finished surface for some applications.	✗

5.3 Foundation Design

5.3.1 Pile foundations

Broadly speaking, there are two types of foundation solution: shallow foundations and deep foundations. The choice of foundations is very much dependent on the extent of the development; greater massing generally leads to greater foundations loads. The design of foundations is predicated on the exact ground conditions which will need to be confirmed in the next stage.

For smaller structures shallow foundations such as pad and strip footings are often a suitable solution. These spread the loads on to the founding soil strata. However with large structures, especially towers, the magnitude of the loads are such that they exceed what is feasible or efficient at shallow depths.

In such cases the loads need to be transmitted to deeper strata where the soil or bedrock can be significantly stronger. Deep foundations generally come in the form of piles which can simply be considered as columns embedded in the ground.

Pile foundations come in different types and form of construction, three of the most common techniques are summarised below:

- **Bored and cast in-situ piles:** These systems are well developed and comparatively cost effective for large applications. However, loose soils and high water tables often require bentonite slurry (which commands considerable site storage) or additional steel casing to support the borehole. The casing can be extracted and re-used or left in place where it is more economical.
- **Continuous flight auger (CFA) piles:** Can be economical and often pose the least noise and vibration issues of all piling techniques. This technique is often used in situations where temporary casings would otherwise be required however, CFA rigs in the UK are not generally capable of achieving piles greater than 750mm in diameter or 30m in depth therefore the capacities are limited accordingly.
- **Driven Piles:** Can take the form of steel or precast concrete sections driven into the ground (at the head or the base) by a drop hammer or diesel hammer. The percussive nature of the installation means that considerable noise and vibrations are produced. Significant difficulties are encountered when attempting to drive piles greater than circa 600mm wide or through very stiff soils. Buried obstructions can also pose restrictions. In some cases a borehole can be pre-drilled.

For the reasons noted earlier in this section, the foundation solution for the current proposals will feature piles or grouped piles with a pile cap. The final type and method of construction will go hand in hand with the development of the overall project and with the completion of the geotechnical site investigation. However, at this stage a number of observations can be made from the design and investigation undertaken thus far. These will be considered in further detail in the next stage of design.

Where constraints pose a project risk or unknown, appropriate record should be made in the risk register with more clarity being provided as the project moves through the next stages of design.

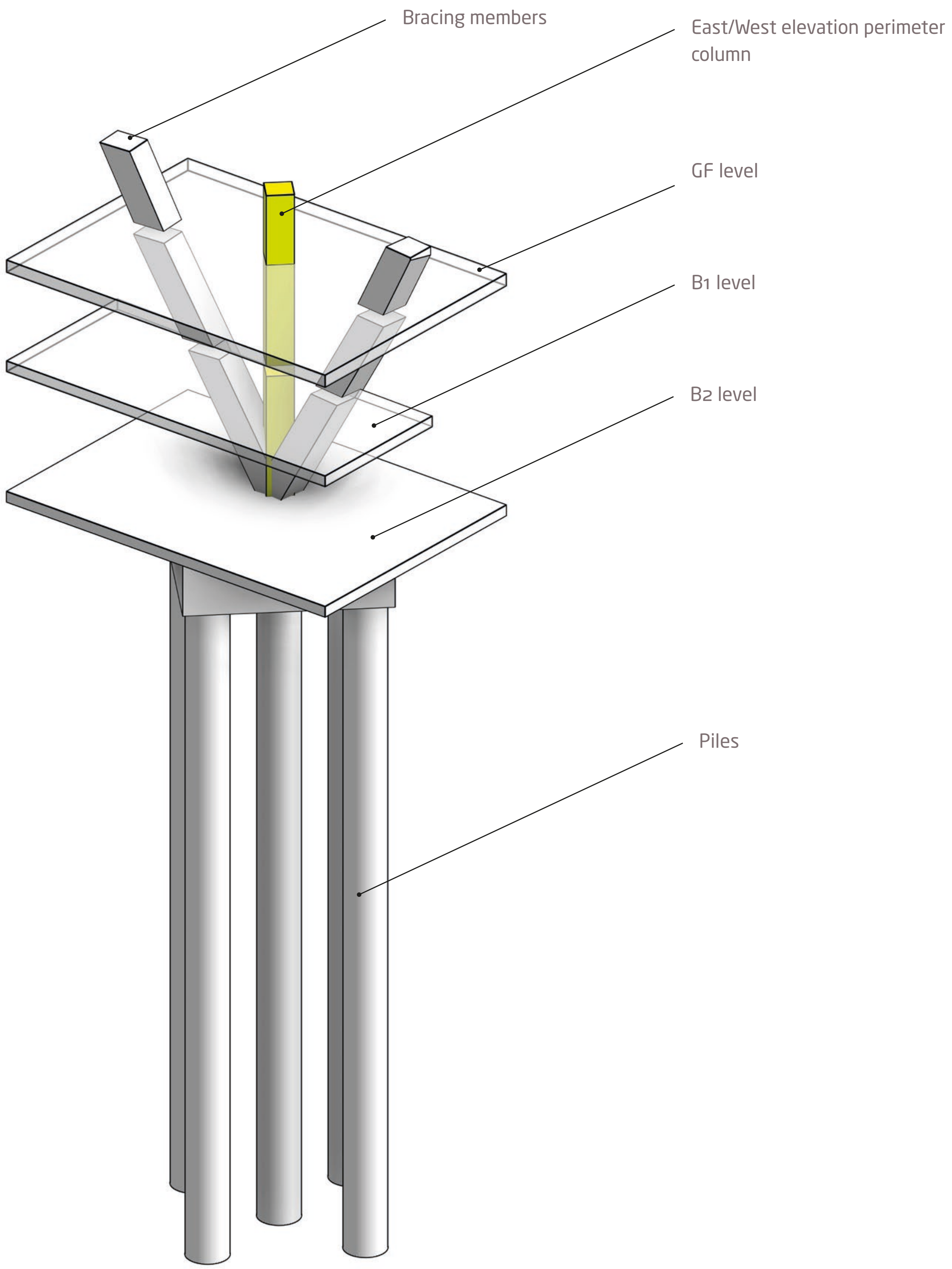


Figure 5.2 Typical foundation solution with bracing elements

5.4 Waterproofing Strategy

This section covers the structural aspects of providing water resistant design to the basement areas of the development. It covers the basement floor and walls only with respect to protection against groundwater. It uses BS 8102 : 2009 "Code of Practice for protection of below ground structures against water from the ground" as its primary reference.

The client should be aware that waterproofing to basements is a risk based process and it is recommended that they are familiar with the ICE guide "Reducing the Risk of Leaking Structure – A Clients' Guide". Both this and the BS 8102 : 2009 recommend a waterproofing specialist / designer is included in the design team.

The information provided in this report together with:

- Intended basement grade including any future flexibility
- Desk study highlighting:
  - Level and variation in the watertable;
  - Contamination and risk of soil gases;
  - Architectural requirements and recommendations of the basement spaces;
  - Ventilation, heating and drainage requirements and implications;
  - A full comparative cost assessment including any future maintenance costs;
  - Risks associated with not carrying out maintenance;
  - Costs associated with remedial works due to system failure;

will allow recommendations on the final choice of basement waterproofing system to be made by the design team with the client.

Once a decision on the appropriate waterproofing system has been made, AKT II will design and take responsibility for that part of the system which is an integral part of the main structural elements, this would cover concrete water retaining structures and any designed joints within the concrete substructure. The design and performance of any waterproofing / resisting additives to concrete will be the responsibility of the supplier. The design of any waterproofing / resisting system that is not an integral part of the main structure will be the responsibility of others. The waterproofing strategy will be the responsibility of the lead consultant (unless a specialist is employed by the client) while the overall building design develops. This responsibility will pass to the main contractor once appointed, if a Design & Build form of construction contract is adopted.

The most important parameter which needs to be agreed is the grade of environment required in the basement. The project may require differing grades of environment within the basement, and the effect on this needs to be considered when assessing the available options, particularly with combined protection measures.

The following table gives guidance on the functional requirements for various types of basement usages which need to be considered by the client and design team as the grade of protection chosen influences the architectural treatment of the basement and also the active measures necessary to control the environment. These are beyond the structural aspects of basement waterproofing.

Assumed basement environment. To be confirmed.

	Grade of basement	Example of basement usage (BS 8102 : 2009)	Relative humidity	Temperature	Performance level dampness	Wetness
	**Grade 1 (basic utility)**	• Car parking • Plant rooms (excluding electrical equipment) • Workshops	> 65 % normal UK external range	Car parks: atmospheric Workshops: 15–19 °C Mechanical plantrooms: 32 °C max at ceiling level	Visible damp patches may be acceptable depending on intended use	Minor seepage may be acceptable depending on intended use. Local drainage might be necessary to deal with seepage
	**Grade 2 (better utility)**	• Workshops and plant rooms requiring drier environment than Grade 1 • Storage areas	35–50 %	Retail storage: 15 °C max Electrical plantrooms: 42 °C max	Damp areas tolerable, construction materials to contain less than the air dry moisture content. Ventilation might be required.	No water penetration acceptable
	**Grade 3 (habitable)**	• Ventilated residential and commercial areas, including offices • Restaurants • Leisure centres	40–60 %	Offices: 21–25 °C Residential: 18–22 °C Leisure centres: 18 °C for spectators 10 °C for squash courts 22 °C for changing rooms 24–29 °C for swimming pools Restaurant: 18–25 °C Kitchens: 29 °C max	No damp areas acceptable. Active measures to control internal humidity may be necessary.	No water penetration acceptable
	**Grade 3 with enhanced active ventilation / de-humidification (Grade 3 +, previously Grade 4 under BS 8102 : 1990)**	• Archives and stores • Computer server rooms • Areas requiring a controlled environment over that of Grade 3	50 % for art storage >40 % for microfilms and tapes 35 % for books	Art storage: 18–22 °C Book archives: 13–18 °C	Active measures to control internal humidity probably essential	No water penetration acceptable

6 Construction Methodology

6.1 Preface

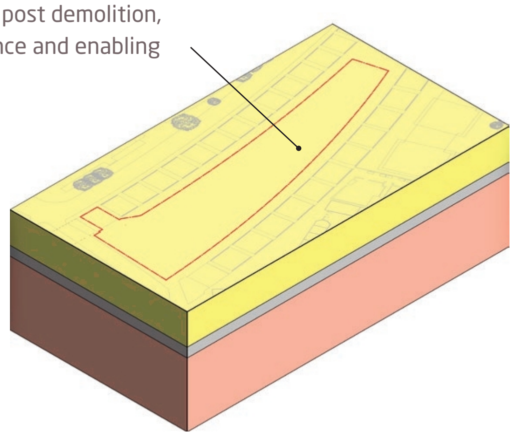
Consideration of the sequence of construction activities for any building project is an important part of the design process. Additional consideration should be placed on the temporary as well as the permanent conditions as, in some cases, this can drive the overall structural solution.

This section aims to summarise the assumed construction method for the current proposals which should be taken as indicative only. At the next stage of design an outline construction programme will be required in order to expand on the construction design and verify assumptions. It is recommended that contractor input is sought to advise on construction programme items which for the current stage has been assumed to take the form of a bottom up construction.

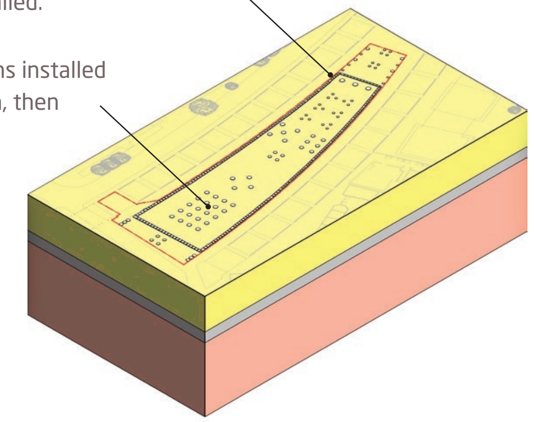
6.2 Bottom-Up Sequence

Arguably the most common method of basement construction is the bottom up sequence. This method generally offers a simpler methodology and involves constructing the substructure followed by the superstructure sequentially. Dependent on the depth of the basement and ground conditions, temporary propping of the retaining walls is often required.

A potential bottom up sequence is illustrated below which, for the purposes of this report, has been simplified. Further details on the sequence and any unique items should be sought in the next stage of design.

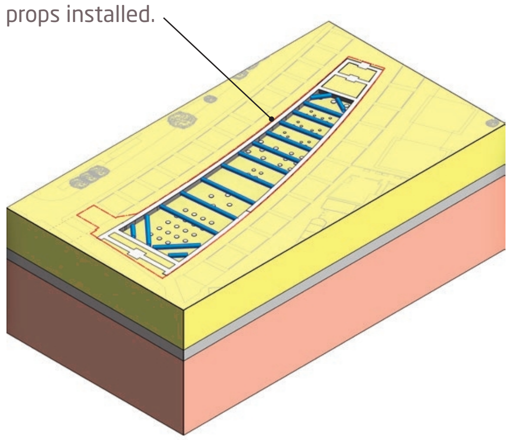


0. Site post demolition, clearance and enabling works.

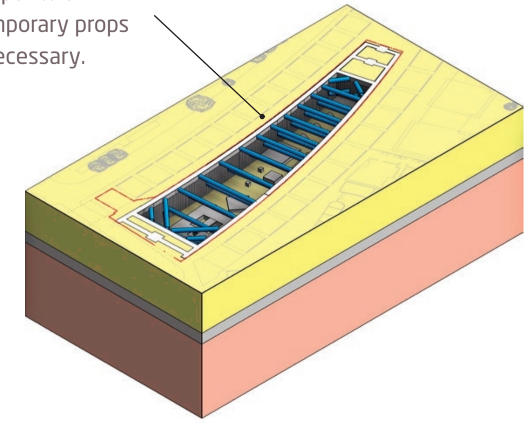


1. Secant pile wall and perimeter capping beam installed.

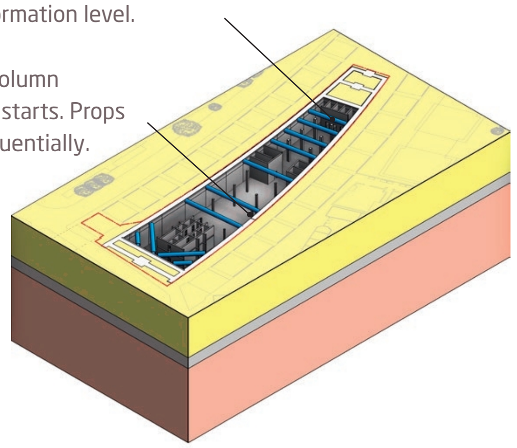
2. Pile foundations installed to required depth, then backfilled.



3. Excavation begins. Temporary props installed.

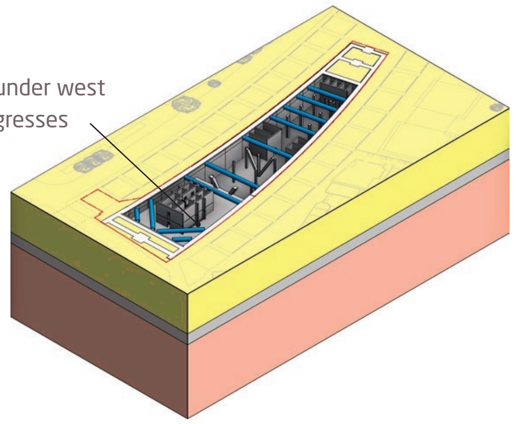


4. Excavation continues to required depth with additional temporary props installed as necessary.

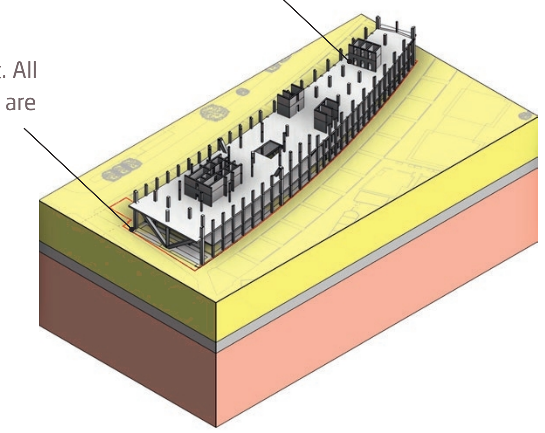


5. Pile caps and raft are cast at formation level.

6. Core and column construction starts. Props removed sequentially.

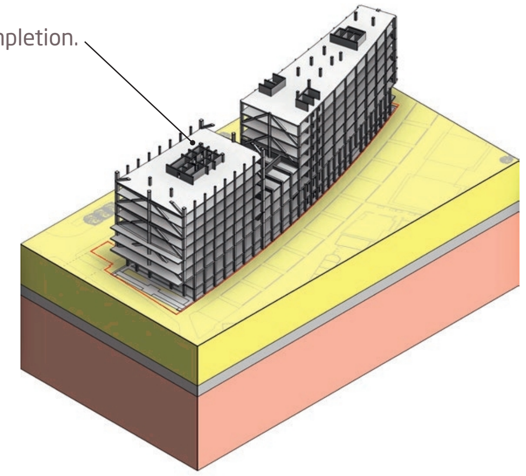


7. B1 slab is cast under west building. Core progresses accordingly.



8. GF slab is cast. All temporary props are removed.

9. Core construction continues into superstrcture.



10. Superstructure constructed to completion.

7 Design Standards

7.1 Design Standards & Guides

The proposed structure will be designed in accordance with the following standards. For the sake of brevity, National Annexes are not listed.

- BS EN 1990 – Basis of structural design
- BS EN 1991 – Actions on structures
- BS EN 1992 – Design of concrete structures
- BS EN 1993 – Design of steel structures
- BS EN 1997 – Geotechnical design

Additional guidance on geotechnical aspects and issues relating to the basement impact has been taken from the following:

- CIRIA C760 – Guidance on embedded retaining wall design, Gaba et al, CIRIA.
- Concrete Basements – Guidance on the design and construction of in-situ concrete basement structures, Narayan & Goodchild, Concrete Centre.

8 Impact Assessment

8.1 Analysis and Process

The impact assessment will be carried out in stages appropriate to the level of design. At the time of writing, the design is at the concept stage, and there are a number of assumptions that need to be validated before the impact assessment can be concluded.

The following section gives an outline of these assumptions, and the process which will be followed in order to gain the necessary third party approvals.

8.1.1 Data and Assumptions

The key information required to finalise the design can be broken into the following sub-categories. The current assumptions within each category are defined below.

Form and Loads

As the design develops, the massing of the building could be subject to change and this can affect the outcome of any analysis carried out. It is therefore essential that the form of the building is fixed prior to commencement of the approvals processes. Similarly, as the use of the building changes, the applied loads will follow accordingly.

Construction Sequence

The construction phasing shall be considered in the assessment of time dependant effects. At this stage, a traditional bottom up sequence is being assumed, however as discussed in previous sections of this report, this is subject to a number of influencing factors, and while unlikely, it is possible that this may change.

Ground Conditions

A full site investigation is required in order to establish the soil parameters necessary to complete a detailed assessment of the ground movements for comparison against relevant acceptance criteria and consultation with Network Rail.

Third Party Assets

As dialogue continues with third parties, assumptions relating to location, fabric and condition of adjacent / underground structures may change.

8.1.2 Initial Modelling

Based on the structural solution at planning, initial models will be developed once the form, construction and ground conditions have been finalised post planning. These will be used to assess the potential impact on adjacent structures.

Once a project specific site investigation is carried out, based on the findings, the aim of these analysis models will be to establish the likely magnitude of the impact on any surrounding assets, and provide values which can be used as a basis for initial discussions with third parties as necessary.

The assessment of ground movements will typically comprise of the following analysis types, addressing both vertical and horizontal movements:

- Analysis of the proposed retaining wall considering short and long term conditions, accounting for the consolidation of the clay which is linked to variation in pore water pressures and soil properties. The method and software used shall assess the horizontal movements, forces and moments of the retaining wall during excavation and construction of the proposed development.
- Review of predicted ground movements against empirical derivations and case study data (eg CIRIA C760 data). The results will be assessed against relevant acceptance criteria in order to secure the relevant formal approvals for the works to be undertaken. Any resulting requirements with regard to the Contractors' methodology will be detailed and enforced through the project specifications and preliminaries. From these initial calculations and discussions, it may be concluded that the results of the initial modelling are sufficient to gain approvals, or as agreed with third parties whether more detailed modelling is necessary.

8.1.3 Detailed modelling

Where detailed analysis is considered necessary, the initial calculations will be expanded upon through more rigorous analytical processes.

The key elements of this stage will consist of Elastic plane-strain 2D section cut analyses for assessment of lateral and vertical ground movements in regions adjacent to the excavation. A full 3D analysis of the ground may be required in some cases. The requirements of the analysis are varied depending on the approvals process of the asset in consideration, and the scope will be discussed and agreed with the relevant parties as necessary. Basement Impact Assessment

Following the outcome of the analysis described in the previous section, and appropriate consultation with third parties, the following aspects will be addressed.

8.2 Impact on Local Structures

The impact of the proposed development on the adjacent strutures will be assessed in-line with the information provided throughout this report.

A package of relevant drawings, calculations, and reports shall be prepared for review by the adjacent owners appointed structural engineer and relevant third parties. Assumed temporary works designs shall be prepared prior to the Contractor completing the final design. Listed below is a summary of the existing buildings in the immediate vicinity of the site:

- National Rail masonry archways lie immediately north and south of the site. The north and south arches are approximately 4m and 10m high, respectively, both running the length of the site. At the piers, where the arches are in contact with the ground, the below ground features are currently unknown, but are likely to feature shallow footings. Due to the nature of masonry arches, they will be sensitive to differential movement between adjacent foundations. Preliminary discussions with Network Rail have commenced as to attain a mutually acceptable ground movement, however a final criteria will need to be developed as to minimise disruption to neighbouring infrastructure.
- Pope's Road Public Toilets lie to the west of the site, on the opposing side of Pope's Road. The structure is single storey and likely to feature shallow foundations due to its size. It is not currently known if there are any basement levels.

Valentia Place is to the east of the site, crossing under both arches. Due to the narrowing of the site, no structures lie to the east beyond Valentia Place, but instead the two railways converge to a close proximity of each other.

8.2.1 Damage assessment criteria

The lateral ground movements are to be predicted at two stages: short-term and long-term. This will be performed by analysing the movement of the retaining wall alongside vertical settlement predictions in accordance to CIRIA C760 to develop a ground model of the site. Using this model, it will be possible to assess the displacements, and therefore level of impact, on the adjacent buildings. It is proposed to use the classification of visible damage to walls scheme as outlined in CIRIA C760 with reference to Burland et al, 1997, Boscardin and Cording, 1989; and Burland, 2001. Damage Category 2 'slight' will be assumed as acceptable; however, this will need to be agreed with third parties in the next stage of design.

8.2.2 Survey & monitoring

A survey and monitoring plan may be required. This would focus on surrounding structures, third party assets, adjacent pavements and and proposed/existing retaining walls.

Appropriate green, amber and red trigger levels shall be set with reference to relevant CIRIA guidance documents on the observational methodology. The scope of surveying and monitoring is likely to include:

- Movement monitoring of structures in the immediate vicinity of the site via targets surveyed using electronic levels.
- Movement monitoring of capping beams via targets surveyed using electronic levels.
- Monitoring of adjacent pavement levels via studs surveyed using electronic levels.
- Movement monitoring of retaining wall via the use of inclinometers cast in secant piles.
- Vibration monitoring using transducers placed on the foundations of the adjacent buildings.
- Crack monitoring via the use of graduated tell-tales.
- Use of extensometer bored in place to monitor heave movements in clay.

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

Notes

1 In assessing the degree of damage, account must be taken of its location in the building or structure.

2 Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.

Figure 8.1 CIRIA C760 damage criteria

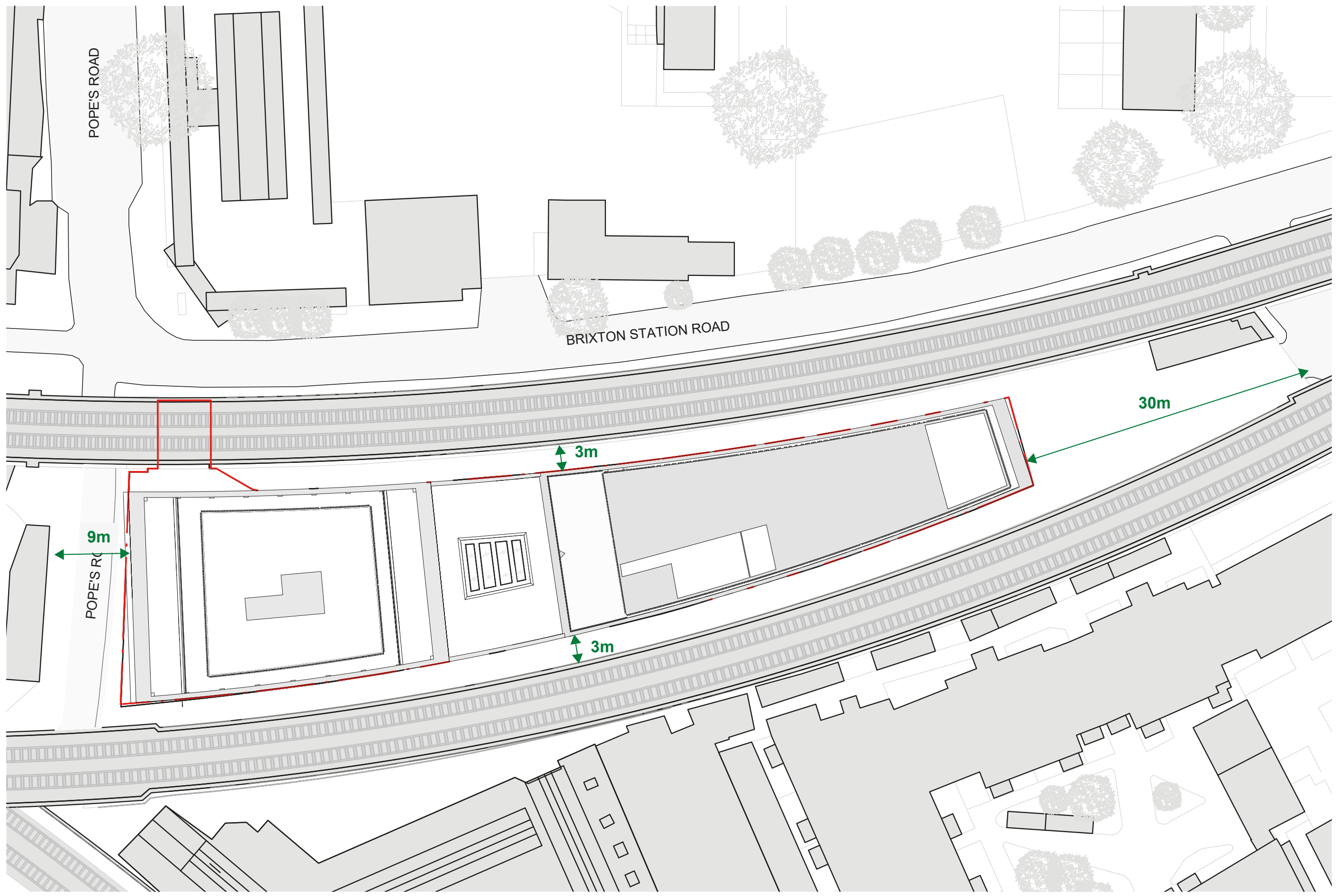


Figure 8.2 Proposed site plan with approximate distances to neighbouring structures

8.3 Impact on Local Assets

8.3.1 Utilities approval

Searches undertaken during Stage 1 indicate that there are a number of utilities present on, and around, the proposed site. Prior to any construction activities, dialogue will need to be initiated with the relevant third parties to acquire the necessary approval. These utilities were outlined in detail in Section 3.8.

8.3.2 Highway approval

The proposed basement construction borders both Pope's Road and Valentia Place. It is expected that the proposed construction activities are likely to impact these public highways. To help mitigate this, an Approval in Principle (AIP) document shall be prepared in accordance with the provisions of the Highways Agency and the London Borough of Lambeth. Where appropriate, assumptions on temporary works shall be outlined within the AIP.

The final methodologies are to be determined by the Contractor, who shall be expected to adhere to the specifications of the permanent works. It will be expected that the Contractor will liaise with the relevant third parties to obtain the necessary licenses for temporary works supporting adjacent highway structures.

8.3.3 Construction management plan

Reference is to be drawn to the draft Construction Management Plan (CMP) included in the submission and the notes related to phasing contained within this report. This will be further developed during the subsequent stages of design and planning of the works following the appointment on a main contractor. This should outline relevant planning items such as: programme duration, construction vehicles movements, types, and numbers, in addition to the temporary arrangements for the highways used during construction.

Throughout the CMP, reference is made to minimising disruption to neighbouring assets. This is achieved through measures such as the implementation of strict site working hours and the requirement for noisy demolition and construction works to require a section 61 prior agreement. Further mitigation is provided by items such as dust control during demolition and groundworks by fine water spray.

In summary, the CMP outlines a 169 week construction programme, however reference should be made to the document for more specific items where required.

8.4 Impact on Local Geological & Geotechnical Conditions

8.4.1 Groundwater flow

Historical boreholes indicate that water is first encountered approximately 2.4m below ground level. The proposed retaining wall is to be designed accordingly to take into account the effects of the appropriate hydrostatic load, with both short and long term properties. It should be noted that this is a preliminary estimation of the groundwater conditions, and is subject to change upon completion of the site investigation outlined earlier in this report.

Due to the presence of groundwater within the London Clay stratum, buoyancy uplift loads may be present. It is likely this will need to be considered on a short-term basis only, as over time the hydrostatic profile will reach an equilibrium point. As a result of this, the structure will need to be able to resist any associated up-lift loads. Prior to the site investigation, it has been assumed that a drainage blanket will not be required; however this is subject to change.

Referring to the British Geological Survey (BGS), no major aquifers are located in proximity to the site, however, it should be noted that the nearest is a chalk aquifer in South East London.

As the basement extends into the water table, as suggested by the historical boreholes, it is important to consider the effects of the proposed development on the local groundwater flow. As a result of the use of a secant pile wall, the basement will act as an obstruction to any groundwater that currently passes through. However, as the site is bounded east and west by two roads with no below ground structure, it is expected that local groundwater will be able to flow around the proposed basement when. Consequently, the basement construction at Pope's Road is unlikely to have a significant impact on the shallow groundwater level.

8.4.2 Surface water flow

The vast majority of the site is currently paved or featuring hard standing. This is not expected to change with the proposed development, and therefore no change in surface water flow is foreseen.

8.4.3 Water level

As the basement extends below the point at which water is first encountered, it is anticipated that dewatering will be required throughout the basement excavation and construction. The groundwater level will be controlled through the use of dewatering and a cofferdam secant pile wall to prevent further water ingress. The proposed construction methodology will take this into account, and a specific monitoring system will be employed during the basement construction.

On a short-term basis, a slight variation in the water table is therefore to be expected. However, under long-term conditions, a significant variation in the water table from its current state is unlikely.

8.4.4 Flood risk

Flood risk is typically evaluated as a result of independently evaluating the risk of groundwater and surface water flooding. It is highly likely that a perched or elevated water table will be encountered during the construction of the basement, and therefore the following protection measures will be considered:

- External tanking membrane.
- Reinforced concrete liner wall.
- Cavity drainage system.

In terms of surface water flooding, the EA indicated that the site varies between a very low and low risk of flooding, with adjacent areas of medium flood risk on the two neighbouring roads to the east and west of the site.

A detailed assessment of the associated flood risk and mitigation methods has been prepared for Pope's Road. Reference should be made to the flood risk assessment (FRA) included in this submission.

8.4.5 Land/slope stability

A statuary search by the Landmark Information Group indicates that the site is at a very low risk for the potential of collapsible ground stability hazards. In addition to this, the potential for compressible ground stability hazards was also marked as being very low. During construction, the site can be considered in a temporary state. At this time, land stability will be provided through the appropriate temporary works propping, to alleviate any substantial movement that may cause instability to surrounding assets.

A topographical survey of the site shows that the majority of the site sits at approximately 12.5m AOD, and is effectively level across the entire site, with a slope of only 1 degree. As a result, the site is at a low risk of slope instability.

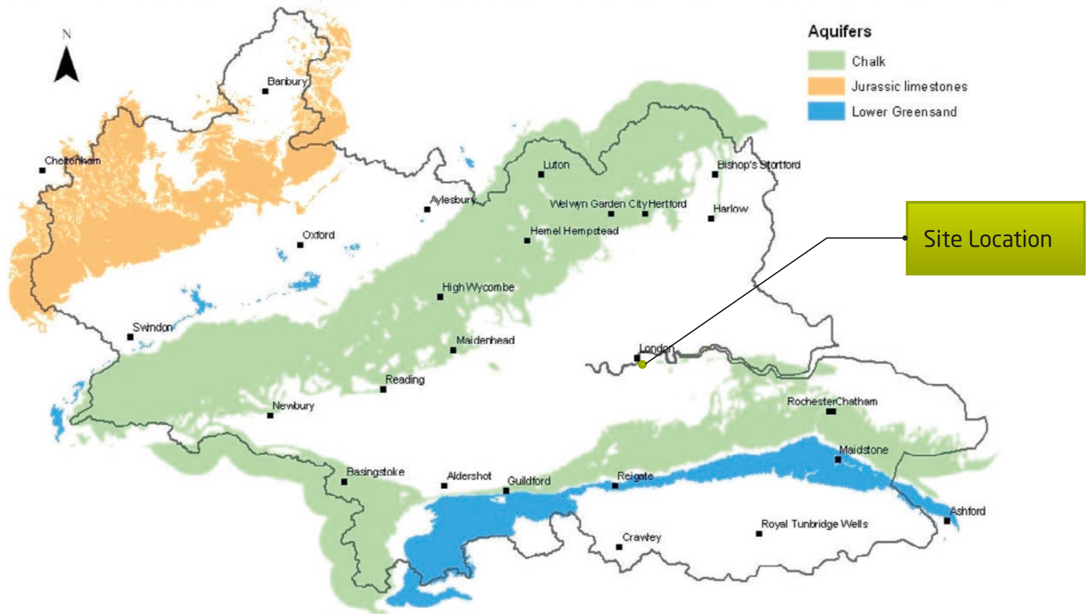


Figure 8.3 Nearest aquifer in Thames Water Basin

9 Conclusion

The information presented throughout this report provides an overview of the proposed development at Pope's Road, with emphasis on the substructure and Basement Impact Assessment.

As noted in the previous sections of this report, the framework, design philosophy, and procedures above will form the basis for the detailed analysis and assessment works that will subsequently be required to secure the necessary third party approvals prior to commencing works on site.