4.2m below ground level. Further monitoring recorded groundwater within the boreholes to be nominally 3m below ground level.

4.0 Hydrogeology and Hydrology

As part of the Phase 1 Preliminary Investigation report undertaken by HBPW LLP an Environmental Data Research has been undertaken using the Landmark Envirocheck Product. Key findings are as follows:-

1. The nearest surface water course is the Longford River (Secondary River) 200m away at its closest point which flows to the south towards the Thames. The GQA Grade is River Quality B.
2. The site is not shown to be affected by flooding from Rivers or Sea.
3. The site is not shown to be affected by surface water flooding. Although BGS lists the site due to its basement to present a risk of groundwater flooding.
4. Aquifer designation for the site is as follows:-
    - Superficial deposits (Sands and Gravels) – Principal Aquifer
    - Bedrock (Mudstone) - Unproductive strata.
    - Groundwater Vulnerability – Major Aquifer
    - Source Protection Zone – The site is not in a SPZ

Based on the findings of the Phase 2 Site Investigation works the site is located over London Clay bedrock. The depth from current ground levels to the upper layer of the bedrock is nominally 5.6m. The clay bedrock is overlain with superficial deposits (Taplow Gravel). The recordings of the groundwater encountered during the Phase 2 site investigation and subsequent visits to record groundwater levels would correlate with the anticipated hydrogeology at the site location with regards to perched water levels and potential for associated hydraulic conductivity

The perched aquifer is classified under the ‘Major Aquifer’ category for groundwater Vulnerability. The presence of a perched aquifer will need to be considered and accounted for in the design of the basement structure to have regard to hydrostatic forces acting on retaining walls and hydrostatic uplift acting on the basement slab.

Groundwater monitoring at the site suggests that groundwater level is stabilised at 3m below ground level. The site is assumed to be subject to some form of groundwater flows at varying depth within the perched aquifer above bedrock. The groundwater flow in the Borough is known to be in an easterly direction from higher ground towards the River Thames.

4.1 Flooding

A Flood Risk Assessment (FRA) has been undertaken for the proposed development by RAB Consultants. A summary of their findings is included below:-

- There have been no recorded instances of the site experiencing flooding. Although local records show flooding locally in July 2007 but not at the site location.
- With regard to fluvial flood risk according to the Environmental Agency’s flood map the site lies in Flood Zone 1, which is assessed as having less than a 1 in 1000 year annual exceedance probability, consequently the site is considered to be at a very low risk of flooding from this source.
- On the basis of the 2010 SFRA the site has not experienced groundwater flooding.
- The site is not considered to be at risk from Coastal or Tidal flooding.

- With regards to Pluvial (surface water) flood risk the FRA has considered the risk to the site from surface water flooding. Using the Environmental Agency's flood maps for surface water the FRA classifies the site as having a low risk of flooding with potential for flood depths to reach 0.25m. The site has a surface water flooding annual probability of occurrence of less than a 1in 1000 years

The FRA concludes that no significant sources of flooding have been identified.

4.2 GROUNDWATER FLOWS

The depth to underside of basement slab is nominally 4m below ground level, this is 1.6m above the bedrock and sits above the water strike level in the boreholes (4.2 and 4.5m) and below the level of settled water level of 3m below ground level.

The Planning Advice Note published by LBRuT– Good Practice Guide on Basement Development suggests that basements constructed just above or below the groundwater table may obstruct groundwater flow around them. However, it is reasonable to conclude that the groundwater flows as a result of the proposed development will not be adversely affected due the following factors:-

- The site has not experienced groundwater flooding in the past.
- There are no large; or buildings with significant subterranean structures in the locality of the development, accordingly groundwater will be able to flow unhindered around the development.
- The depth from ground level to groundwater table is such that any potential rise in groundwater as a result of the development tending to obstruct groundwater flows is unlikely to adversely affect neighbouring buildings.
- The railway line situated 80m to the west of the site is located in a cutting, the approximate ground level at the cutting is 12.5m (AOD), compared to the site ground level which is nominally 16m (AOD). As the groundwater flow is deemed to flow in an easterly direction towards the River Thames, this would suggest that only groundwater flows extending back up to the railway cutting have the potential to be affected by the development. The adjacent photo shows the cutting nearest to the site, taken looking north from the bridge on Holly Road.

- The exiting drainage strategy is to dispose surface water to ground by means of infiltration. For the proposed development it is proposed to dispose of surface water by a restricted connection to the public sewer, this will reduce the volume of water disposed locally into the ground during storm events, helping to reduce groundwater level and flows.

In light of these considerations it is concluded that groundwater flows will not be adversely affected by the proposed development.

4.2 Drainage

A drainage strategy for the development has been developed by HBPW LLP. The strategy outlines the drainage proposals and demonstrate that the development does not increase the flood risk to neighbouring properties or the public sewer and also the wider infrastructure system.

Drawings showing the proposed drainage strategy are included in Appendix B.

A pre application enquiry has been submitted to Thames Water for the proposal to connect to the public foul sewer in the High Street. Thames Water has confirmed that there is adequate capacity in the infrastructure to accommodate the development's predicted flows. Thames Water have also indicated in principle acceptance to the connection of the surface water discharge to the public sewer, subject to the flows being restricted.

The potential residual risk affecting the proposed development, neighbouring properties and infrastructure have been considered: these include the risk to site drainage and water supply infrastructure caused by pump failure, blockage or surcharging of the site and public sewer network. These risks can be managed by the design of the site drainage by incorporating the following:-

- Use of non-return valves so that in the event of the public sewer flooding the site drainage is not surcharge causing flooding.
- In the event of failure of the pumps to the site drainage, a storage tank is proposed to provide storage for 24 hours for foul water.
- Surface water flows from the site are restricted, excess flows in exceedance of the site discharge rate is to be stored in an underground tank.
- A number of SuDS principles are proposed which will delay the time period from rainfall capture to rainfall entering the public sewer.

In addition regular inspection and maintenance of the private sewer network will be carried out to ensure the site drainage operates as intended.

5.0 IMPACT ON UNDERGROUND STRUCTURES

The nearest Railway is located nominally 80m from the West boundary of the site. As stated above the railway is in a cutting at a level significantly lower that the site. There will be no impact on the railway infrastructure as a consequence of the proposed development. There are no Underground Lines in the area and HBPW LLP is unaware of any other tunnels or infrastructure located near the proposed development.

5.1 Buried Services

An existing High Voltage cable currently runs through the middle of the site. Prior to commencement of construction of the basement it is proposed to divert the cable to a position next to the South boundary of the site.

6.0 PROPOSED SUBSTRUCTURE AND BASEMENT

It is intended to demolish and remove the existing structure from the site prior to commencing with the construction of the development.

The proposals for the basement construction are shown on drawings included in Appendix C and described below:

6.1 SUB-STRUCTURE

It is proposed to adopt a secant bored pile wall construction to form the basement perimeter walls. The piles are to be 600mm diameter and the inside face will be lined with reinforced concrete. The overall thickness of the wall is 750mm. It is proposed that the centreline of the piled wall is set 1m inside the site boundary line, so that construction activity is contained within the confines of the site.

The secant piled wall will be constructed with a capping beam which will in turn support the superstructure and podium slab. Reinforced concrete columns will support the podium/transfer slab at ground floor level within the basement void. The capping beam and podium slab will act to prop the perimeter secant piles in the permanent condition. In the temporary condition the secant piles have been designed to act as cantilevers negating the need for temporary propping.

A 350mm thick reinforced concrete slab is proposed to form the new basement slab level. The slab is designed as a raft, and in the permanent condition is expected to transfer loads from the structure to the bearing stratum below. Slab thickenings will be provided under column locations to spread the applied pressure due to localised load increases.

Ground water level for the purpose of design of the walls and basement slab has been assumed to be present at 1m below ground level. This is nominally 2m higher than recorded in the Phase 2 Ground Investigation. The walls and base slab have been designed (in addition to lateral earth pressure from retained material and surcharge loading) to accommodate the hydrostatic pressures generated both laterally and vertically as a result of a raised water level.

The basement wall adjacent to the High Street will provide support to the carriageway and footway. Agreement with the Local Highway Authority and Structures team will be sought as part of the detailed design with regards to obtaining Technical Approval in accordance with the procedure set out in Design Manual for Roads and Bridges (DMRB) document BD02/05.

6.2 BOUNDARY WALL

It is intended to retain the boundary wall running along the south boundary of the site. The wall divides the site from the terrace of properties comprising Building C in Figure 4. The wall is nominally 2m high and constructed in masonry. Stability of the wall during the construction of the basement will be provided by temporary propping and underpinning where necessary.

6.3 TREES SURROUNDING THE SITE

With the exception of Bushy Park located 50m to the east of the site, there are few trees in the locality of the site, reference is made to the Aboricultural Survey undertaken by Advanced Arboriculture which highlights three trees (T9, T10 and T11) located on the approach road St Clare Business Park from Holly Road, and one tree (T8) close to the north west boundary of the development. Tree references T9, T10 and T11 are located approximately 20m from the south west corner of the site boundary while tree reference T8 is described in the Aboricultural Survey as being small and having ‘negligible future potential’.

None of those present are deemed to have any effect on foundation design or be adversely affected by the proposed development. Trees to be provided as part of the new development

landscape design will be planted in suitably sized planters formed in the ground floor podium/transfer slab.

6.4 LAND STABILITY

The site is relatively flat, based on the information available land stability is not considered to be an issue.

7.0 TEMPORARY WORKS PROPOSALS

The following gives an overview to the envisaged construction sequence for the basement. A fully detailed temporary works design will be produced in conjunction with the Contractor prior to construction.

The following sequence is proposed:-

1. Demolition and removal of existing buildings.
2. Installation of secant piled wall.
3. Nominal excavation to enable pile capping beam to be constructed.
4. Construction of reinforced capping beam.
5. Mass excavation of the basement areas down to formation level. Secant piled wall is designed to act as cantilever without the need for temporary propping for stability.
6. Construction of basement slab and foundations.
7. Construction of reinforced concrete wall lining, after this stage the basement will be watertight.
8. Construction of reinforced concrete columns.
9. Construction of ground floor podium/transfer slab.

During excavation works and until stage 7 is complete it is likely that dewatering of groundwater will be required. Permission from Thames Water will be sought with regard to disposal.

8.0 MOVEMENT MONITORING AND POTENTIAL MOVEMENT TO BOUNDARY WALL

Due to the presence of neighbouring properties it is proposed to undertake movement monitoring during the basement construction. This will involve placing reflective targets onto the side of the adjacent properties, onto to which a surveyor can locate the target position in X, Y and Z co-ordinate as construction progresses. It is proposed that monitoring of adjacent properties commences in advance of the start of construction in order to establish a reliable base datum.

A monitoring regime is to be developed prior to construction to establish frequency of surveying intervals and to determine and agree acceptable trigger limits of movement to protect neighbouring properties.

In addition reflective targets will be placed on the side of the newly constructed capping beam in order to record movement during construction. The temporary and permanent works will be designed to limit eventual movement to acceptable limits.

Ciria report C580 ‘Embedded Retaining Walls – guidance for economic design’, outlines an approach to assessing potential damage to buildings near excavations. It is proposed to adopt this approach during the basement construction activity,

At this stage of the design it is anticipated the category of movement expected is between 1 and 2 based on Table 2.5 from C580.

Table 2.5 *Classification of visible damage to walls (after Burland et al, 1977, Boscardin and Cording, 1989; and Burland, 2001)*

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

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 9 – extract from C580)

At this stage it is proposed to monitor only buildings C, D, E and F as shown in Figure 4 although this may change following completion of detailed design.

9.0 SUPERSTRUCTURE

It is not intended to describe the superstructure in any specific detail as part of this report. However, for completeness it is proposed to construct the superstructure using a reinforced concrete frame with in-situ flat reinforced concrete slabs with a combination of exposed and rendered masonry external walls.

Appendix A

Borehole logs