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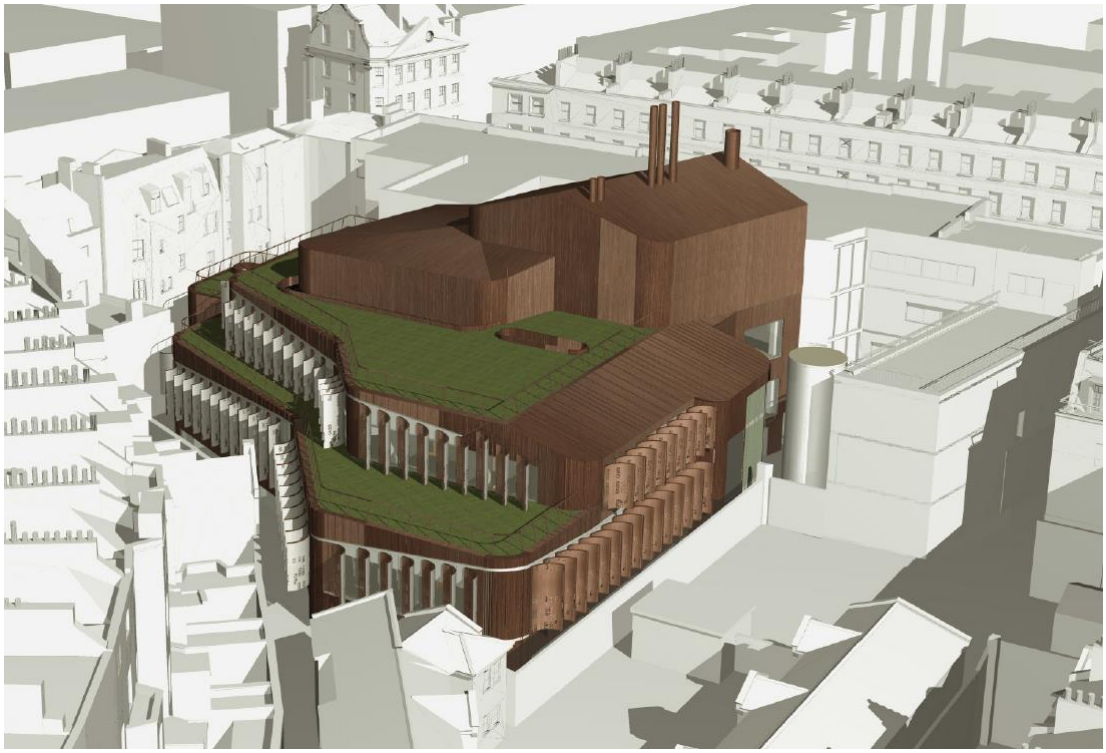

BASEMENT IMPACT ASSESSMENT REPORT

FOR

BLOOMSBURY RESEARCH INSTITUTE
LONDON SCHOOL OF HYGIENE + TROPICAL MEDICINE
UNIVERSITY COLLEGE LONDON
15–17 TAVISTOCK PLACE, LONDON, WC1H 9SH

4159
June 2015 Rev A

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CONTENTS

1. EXECUTIVE SUMMARY 3

2. INTRODUCTION 4

3. GROUND WATER 5

3.1 STAGE 1 – SCREENING 5

3.2 STAGE 2 – SCOPING 6

3.3 STAGE 3 – SITE INVESTIGATION AND STUDY 6

3.4 STAGE 4 – IMPACT ASSESSMENT 7

4. GROUND STABILITY 8

4.1. STAGE 1 – SCREENING 8

4.2. STAGE 2 – SCOPING 9

4.3. STAGE 3 – SITE INVESTIGATION AND STUDY 9

4.4. STAGE 4 – IMPACT ASSESSMENT 9

5. SURFACE FLOW AND FLOODING 10

5.1. STAGE 1 – SCREENING 10

6. BASEMENT CONSTRUCTION METHOD STATEMENT 11

APPENDIX A – FIGURES 14

APPENDIX B – PHOTOGRAPHS 23

APPENDIX C – OUTLINE STRUCTURAL & SURVEY DWG'S 28

LIST OF SURVEY DRAWINGS:
3746 – T_Rev. B - Topographic Survey
3476 – S- Sections

LIST OF STRUCTURAL DRAWINGS:
4159 – S.50_Rev. P1 – Level -2 Plan
4159 – S.51_Rev. P1 – Level -1 Plan
4159 – S.52_Rev. P1 – Level 0 Plan
4159 – S.57_Rev. P1 – Sections
4159 – S.22_Rev. P1 – Sequence of Works for Basement

1. EXECUTIVE SUMMARY

1.1 BRIEF

This report was prepared by Wilde Carter Clack Ltd. Consulting Engineers and complied by a Chartered Structural Engineer to accompany the Planning Application. It follows the approach laid out in Camden Planning Guidance "Basements and Lightwells" CPG4 (September 2013 edition) and demonstrates (in combination with other reports forming part of this application) that the proposed basement adheres in all respects to the requirements on Camden's development policies DPO policy DP27 on basements and lightwells.

1.2 PROJECT DESCRIPTION

The new development is on the site of the London School of Hygiene and Tropical Medicine (LSHTM) on the part of the site currently occupied by the old single storey steel framed building, used as ancillary cycle storage.

It is proposed to demolish the existing building and construct a new four storey building including a double level basement which is below the majority of the new footprint of the development.

1.3 SCREENING RESULTS

A screening exercise was carried out in accordance with the recommendations of CPG4 in respect of groundwater flow; land stability and surface flow/flooding. Reference was made to Camden Geological, Hydrogeological and Hydrological Study and other data resources.

With regards to ground water flow, the site is not in close proximity to any water surface features. Historically, a tributary of the River Fleet flowed in a generally easterly direction, roughly 100 m to the north of the site. The underlying soil is considered a secondary aquifer. It was noted that the basement construction will extend below the water table.

In respect to ground stability, the screening process highlighted that the development will increase the foundation depths relative to the neighbouring properties.
The site is located approximately 20 m to the east of the Piccadilly Line London Underground tunnel.

The area was not affected by the 1975 and 2002 floods, therefore a flood risk assessment is not required, however there is a need for a Storm Water Strategy for the site as whole.

1.4 SCOPING

A two stage soil investigation was carried out by Geotechnical and Environmental Associates – GEA – geotechnical specialists to determine detailed ground conditions, and assess the possible impact of the proposed development on the local hydrogeology and advice with respect to design of suitable foundations and retaining walls.
In order provide options for the discharge of rainfall, run-off from the proposed development consultations have been made with Thames Water Utilities Ltd.

1.5 IMPACT ASSESSMENT

The basement impact assessment was prepared focusing on those issues raised during screening.

The investigation has indicated that the shallow gravel aquifer is not laterally extensive across the site and the location of the proposed basement is such that it is unlikely to affect the groundwater flow regime.

Significant ground water inflows during basement excavation would be avoided due to adoption of a secant pile wall - interlocking concrete male and female piles.
The stability of neighbouring properties and structures will be ensured at all times, through a suitable retention system. There is nothing unusual or exceptional in the proposed development or the findings of the investigation that give rise to any concerns with regard to stability over and above any development of this nature.

Contact will be made with London Underground Limited prior commencing any works to ensure that the proposed development will not affect any London Underground assets.

2. INTRODUCTION

Wilde Carter Clack has been appointed on behalf of University College London to prepare a Structural Basement Impact Assessment that addresses the specific key issues in DP27 as described in Camden Planning Guidance CPG4 (September 2013 edition) to support the Planning Application for subterranean development of Bloomsbury Research Institute.

This report has been prepared by Chartered Structural Engineer Tim Smith BSc(Eng) CEng MICE MIStructE and Structural Engineer Frank Bartal MEng, MIstructE.

2.1 EXISTING SITE

The proposed new development is on the site of the London School of Hygiene and Tropical Medicine (LSHTM) on the part of the site currently occupied by the old single storey steel framed building. Used as ancillary storage associated with the use of the main LS HTM buildings on site.

The site is enclosed on all sides with the main LSHTM building facing Tavistock place, a number of hotels at the back on Cartwright Gardens, a public house and other retailers on Marchmont Street and a car park on the west side. Access to the site is possible under two arched entrances through the LSHTM building and another limited headroom entrance adjacent to the public house.

For photos of the existing site refer to pictures 1-5 in Appendix B.

For survey drawings refer to survey drawings in Appendix C.

2.2 PROPOSAL

It is proposed to demolish the existing depot and construct a new four storey building including a double level basement which is below the majority of the new footprint of the development.

To minimize the potential impact on the surrounding structures the new basement is proposed to be retained by secant piled wall.

For preliminary 3D model of proposed structure refer to picture 6 in Appendix B.

For proposed basement schemes refer to structural drawings in Appendix C.

3. GROUND WATER

3.1 STAGE 1 – SCREENING

The impact of the proposed development on ground water flows is considered here as outlined in DP27 and Camden Planning Guidance CPG 4. The references are to the screening chart Figure 1 in CPG4.

Subterranean (groundwater) Screening Assessment

Question	Response for 15–17 Tavistock Place
1a. Is the site located directly above an aquifer?	*Yes. The site is underlain by Lynch Hill Gravel which is designated as a Secondary 'A' Aquifer by the Environment Agency, capable of supplying local water supplies and supporting small watercourses – Ref. to Figure (a) in Appendix A.*
1b. Will the proposed basement extend beneath the water table surface?	*Yes. Groundwater has been measured at depths of between 3.11 m and 5.59 m from within the made ground. The proposed basement formation level extends to a maximum depth of approximately 10 m (roughly 14 m OD) below existing ground level.*
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	*Yes. Historical maps indicate that the site lies approximately 100m south of a tributary of the River Fleet. The tributary is not present at the surface and is likely to have been culverted to form part of the local surface water sewer – Ref. to Figures (b) & (c) in Appendix A.*
3. Is the site within the catchment of the pond chains on Hampstead Heath?	*No. The site is outside the catchment of Hampstead Heath ponds.*
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	*No.*
5. As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	*No. The existing surface water drainage arrangements will not be materially changed, however there is a need for a Storm Water Strategy for the site as a whole.*
6. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than, the mean water level in any local pond or spring line?	*No. There are no local ponds or spring lines present within 100m of the site.*

The screening exercise has identified the following potential issues which should be assessed:

GW Q1a The site is located on a Secondary 'A' Aquifer.
GW Q1b The basement excavation is likely to extend beneath the water table.
GW Q2 The site is within 100 m of a former river.
GW Q5 Storm water discharges off site should be reduced by 50% using Sustainable Drainage Systems (SuDS).

3.2 STAGE 2 – SCOPING

With reference to the Camden Geological, Hydrogeological and Hydrological study, the potential impacts which will need to be considered will include:

- Whether the basement works will affect the groundwater flow regime and hence increase or decrease the groundwater level locally.
- Will the flow from watercourses or spring lines be diverted by the basement works
- Whether dewatering during basement construction can cause ground settlement

These potential impacts have been further assessed through the site investigation as detailed below.

3.3 STAGE 3 – SITE INVESTIGATION AND STUDY

In order to assess the potential impacts identified in the screening exercise of BIA ground investigation including ground water monitoring was carried out by Geotechnical and Environmental Associates - GEA.

3.3.1 Exploratory Work

Four cable percussion boreholes were advanced, to depths of between 20.45 m and 30.45 m. Standard Penetration Tests (SPTs) were carried out at regular intervals in the cable percussion boreholes to provide quantitative data on the strength of soils encountered.

In addition, ten window sampler boreholes were drilled to depths of between 0.40 m and 2.60 m to provide additional coverage of the site and five trial pits were manually excavated to depths of between 0.30 m and 1.40 m to investigate the existing foundations.

Groundwater monitoring standpipes were installed in three of the cable percussion boreholes to depths of 6.20 m, 6.30 m and 4.50 m, and have been monitored on a single occasion to date.

3.3.2 Ground Conditions

The investigation has encountered a significant thickness of made ground of depths between 1.60 – 4.30m overlying Lynch Hill Gravel to a depth 4.60 below the surface which was underlain by London Clay; the London Clay was underlain by the Lambeth Group, which was proved to the full depth of investigation.

Groundwater is present in the made ground at depths of between 0.8 m and 2.1 m. Minor inflows were recorded in the London Clay at depths of 9.65 m and approximately 18.0 m.
Subsequent monitoring has measured groundwater at depths of 3.11 m and 5.59 m; and no elevated concentrations of contaminants were measured in the samples tested.

3.3.3 Sustainable Drainage Systems (SuDS)

Rainwater harvesting systems are proposed to meet SuDS requirements. The new building is proposed with green roof system in combination with blue roof. By partnering a green roof with a blue roof system, the retention of stormwater in the green roof's layers, complements the detention of stormwater by the blue roof to provide valuable additional drainage capacity.

3.4 STAGE 4 – IMPACT ASSESSMENT

Groundwater monitoring has measured water at depths of between 3.11 m and 5.59 m from within the made ground or towards the base of the Lynch Hill Gravel. The proposed basement will therefore intercept the groundwater table, however it will only act as a partial barrier to groundwater flow as there is space between this and other neighbouring structures for groundwater to flow around the excavation. In any case groundwater flow is likely to be towards the south and given that the proposed basement will be to the north of the existing basement, it is highly unlikely to result in any significant changes to the groundwater flow regime in the vicinity of the site.

The nearest surface water feature is Regent's Canal, located approximately 900 m to the north of the site and groundwater from beneath the site generally drains towards the south. Historically a tributary of the River Fleet flowed in a generally easterly direction, roughly 100 m to the north of the site. The tributary is not present at the surface and is likely to have been culverted in the late 19th Century.

The screening identified a number of potential impacts. The desk study and site investigation information has been used below to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The table below summarizes the previously identified potential impacts and the additional information that is now available from the site investigation in consideration of each impact.

Potential Impact	Site Investigation Conclusions
Site is underlain by Secondary 'A' Aquifer and the basement is likely to extend into the underlying aquifer.	*The Lynch Hill Gravel Secondary Aquifer is not laterally extensive across the site. Groundwater has been measured at depths of between 3.11 m and 5.59 m. The proposed basement extends to a depth of approximately 10 m and will therefore intercept the groundwater table and toe into the London Clay. However it will only act as a partial barrier to groundwater flow as there is space between this and other neighbouring structures for groundwater to flow around it.*
The site lies with 100 m of a former watercourse.	*The basement will extend beneath the water table surface, however, due to the location of the proposed basement in relation to the existing basement and direction of groundwater flow it is highly unlikely to cause any significant change in the groundwater flow regime.*

4. GROUND STABILITY

4.1 STAGE 1 – SCREENING

The impact of the proposed development on land stability is considered here as outlined in DP27 and Camden Planning Guidance CPG 4. The references are to the screening chart Figure 2 in CPG4.

Land Stability Screening Assessment

Question	Response for 15–17 Tavistock Place
1. Does the existing site include slopes, natural or manmade, greater than 7°?	*No. The site is in level.*
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	*No.*
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	*No.*
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	*No.*
5. Is the London Clay the shallowest strata at the site?	*No. Refer to 3.3.2*
6. Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained?	*No.*
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	*No.*
8. Is the site within 100 m of a watercourse or potential spring line?	*Yes. Historical maps indicate that the site lies approximately 100m south of a tributary of the River Fleet. The tributary is not present at the surface and is likely to have been culverted to form part of the local surface water sewer network.*
9. Is the site within an area of previously worked ground?	*No.*
10. Is the site within an aquifer?	*Yes. The site is underlain by Lynch Hill Gravel which is designated a Secondary 'A' Aquifer by the Environment Agency, capable of supporting baseflow to watercourses.*
11. Is the site within 50 m of Hampstead Heath ponds?	*No.*
12. Is the site within 5 m of a highway or pedestrian right of way?	*Yes. The site fronts onto Tavistock Place to the southeast.*
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	*Yes. The proposed development will increase foundation depths to a maximum depth of about 10.0 m (roughly 14 m OD).*
14. Is the site over (or within the exclusion zone of) any tunnels, eg railway lines?	*Possibly. The site is located approximately 20 m to the east of the Piccadilly Line London Underground tunnel.*

The above assessment has identified the following potential issues that need to be assessed:

GS Q8 The site is within 100 m of a former stream.
GS Q10 The site is underlain by a Secondary 'A' Aquifer – Ref. to Figure (a) in App. A
GS Q12 The site is within 5 m of a public highway, although the proposed development will be in excess of 5 m from the highway.
GS Q13 The development will increase the foundation depths relative to the neighbouring properties to a relatively significant extent.
GS Q14 The site is located approximately 20 m to the east of the Piccadilly Line London Underground tunnel – Ref. to Figure (d) in Appendix A.

4.2 STAGE 2 – SCOPING

With reference to the Camden Geological, Hydrogeological and Hydrological study Appendix F3, the potential impacts which will need to be considered will include:

- Excavation of a basement may result in structural damage to the road or footway.
- Excavation may lead to structural damage to neighbouring properties if there is a significant differential depth between adjacent properties
- Excavation of a basement may result in structural damage to London Underground Assets.

These potential impacts have been further assessed through the site investigation as detailed below.

4.3 STAGE 3 – SITE INVESTIGATION AND STUDY

In order to assess the potential impacts identified in the screening exercise of BIA ground investigation was carried out by Geotechnical and Environmental Associates - GEA.

The made ground extends to depths of between 1.60 m and 4.30 m and generally comprises brown silty clayey gravelly sand with occasional brick fragments, burnt coal and ash. Within the former depot, a second layer of concrete was encountered from a depth of about 0.4 m to 0.7 m, most likely to represent a former floor slab. The Lynch Hill Gravel generally comprises medium dense orange-brown and brown sandy fine to coarse sub-angular to sub-rounded flint gravel and extends to a depth of 4.60 m. London Clay initially comprises firm brown mottled grey silty sandy clay to depths of 3.70 m and 4.80 m. Firm becoming stiff grey silty clay extends to depths of between 19.00 m and 25.45 m and is underlain by stiff becoming very stiff grey sandy clay proved to a depth of 20.45 m and 25.45 m. the Lambeth Group was only encountered in Borehole No 4, it comprises stiff brown mottled reddish brown and greenish brown silty sandy clay and extends to the maximum depth investigated of 30.45 m.

4.4 STAGE 4 – IMPACT ASSESSMENT

Elements of the basement design were considered in more detail following the findings of GEA's site investigation report as summarized below.

4.4.1 Heave Effects

Formation level of the proposed double basement will be in the London Clay.
The excavation of the basement will result in an approximate unloading of roughly 180 kN/m2, which will result in an elastic heave and long term swelling of the London Clay. The effects of the longer term swelling movement within London Clay will be mitigated by application of compressible base layer between formation level and base slab. The base slab will be suspended on secant pile wall around the perimeter of basement and internal piles.

4.4.2 Hydrostatic Forces

Hydrostatic forces will act on the basement due to the level of the water table. The hydrostatic uplift force will be resisted by a combination of the self-weight of the structure and the tension capacity of all perimeter and internal piles, such that any upward movement of the completed structure will be minimal.

4.4.3 Ground Stability

Various forms of basement construction were considered during the feasibility design of the project. To minimize the potential impact on the surrounding structures a concrete piled or diaphragm walling were considered more closely. The restricted site access eliminated the use of a diaphragm walling rig so piled solutions were more closely analyzed. Both contiguous piled walling and 'secant' piled walls were considered. The water table is above the bottom of the basement which meant that secant walling was chosen as the preferred basement wall construction.
(A secant piled wall comprises interlocking concrete male and female piles. A line of female piles are installed initially such that male piles can be installed between them to interlock so that they form a continuous wall).

Preliminary discussions were held with piling specialists to ensure that a suitable piling rig that was capable of installing the required piles, could gain access to the site. A pile diameter of 900mm was therefore designed for the appropriate loadings and a suitable piling rig sourced.

4.4.4 Ground Movement

The design of the piles is such that as well as carrying vertical load they can carry horizontal loads in both the temporary and permanent condition.
Depending on piling specialist design temporary propping may be required at the top of capping beam.
During the works, precise monitoring of targets will record the movement of adjoining walls and buildings. Inclinometers will also be installed within the piles. This will enable actual ground movements to be compared with the predictions, and mitigation measures enacted if required.

4.4.5 Other Potential Impacts

The screening identified a number of potential impacts. The desk study and site investigation information has been used below to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The table below summarizes the previously identified potential impacts and the additional information that is now available from the site investigation in consideration of each impact.

Potential Impact	Site Investigation Conclusions
The site is within 5 m of a public highway.	*The basement is proposed to be excavated in the north of the site and it will therefore be in excess of 5 m from a public highway. In any case the retention system will ensure the stability of the excavation and neighbouring structures at all times.*
The development will increase the foundation depths relative to the neighbouring properties to a relatively sianificant extent.	*The retention system will ensure the stability of the excavation and neighbouring properties at all times.*
The site is located approximately 20 m to the east of the Piccadilly Line London Underground tunnel.	*Contact will be made with London Underground Limited prior to demolition or structural works to ensure that the proposed development will not affect any London Underground assets.*

5. SURFACE FLOW AND FLOODING

5.1 STAGE 1 – SCREENING

The impact of the proposed development on the surface water environment and whether a flood risk assessment is required is considered here as outlined in Camden Planning Guidance CPG 4. The references are to the screening chart figure 3 in CPG4.

Surface Flow and Flooding Screening Assessment

Question	Response for 15–17 Tavistock Place
1. Is the site within the catchment of the pond chains on Hampstead Heath?	*No. With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead Heath.*
2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	*Yes. Rainwater harvesting systems are proposed to meet SuDS requirements. The new building is proposed with green roof system in combination with blue roof – rainwater harvesting system.*
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	*No.*
4. Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?	*No. All surface water for the site will be contained within the site boundaries; hence there will be no change from the development on the quantity or quality of surface water being received by adjoining sites*
5. Will the proposed basement result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses?	*No. The surface water quality will not be affected by the development, as in the permanent condition collected surface water will be generally be from roofs, or hard landscaping.*
6. Is the site in an area known to be at risk from surface water flooding such as South Hampstead, West Hampstead, Gospel Oak and Kings Cross, or is it at risk of flooding because the proposed basement is below the static water level of a nearby surface water feature?	*No. The site is not on one of the streets noted within the Camden Planning Guidance CPG 4 as a street "at risk of surface water flooding" (refer Figure (e) in Appendix A)*

The above assessment has not identified any potential issues that need to be assessed.

6. BASEMENT CONSTRUCTION METHOD STATEMENT

The following provides an outline Method Statement for the construction of the basement. This will be developed and finalized by the appointed Contractor, once the detailed design is complete.
The following sequence to be read in conjunction with drawing No. 4159/S.22_P1 in Appendix C:

6.1. Prior to works commencing, schedules of condition will be carried out to the adjoining properties as part of the Party Wall process.

6.2. A monitoring regime will be agreed including precise monitoring of targets affixed to adjoining structures. Initial readings will be taken prior to works commencing, and then at agreed intervals going forward. The monitoring readings will be compared with 'trigger levels' at which further investigations or mitigation measures will be implemented.

6.3. The works will commence with demolition of the depot at ground level.

6.4. Existing ground bearing slab to be broken out locally to allow for excavation and installation of piles and capping beam. Excavation to be propped at all times.

6.5. It is proposed that the piles for the secant wall are constructed from the existing ground level through capping beam formers to improve alignment and minimize pile position tolerances. The constraints of the proposed piling rig means that the piles cannot be constructed any closer than 1.2m from the centre of then pile to the nearest wall or boundary.

6.6. When the perimeter piling works are complete, reinforced concrete capping beams will be cast to tie the heads of the male/female secant piles.

6.7. To prevent any significant horizontal deflection of the piled secant wall horizontal propping may be installed at the top of the wall – T.B.C. by piling specialist.

6.8. A detailed construction sequence with propping design will be produced before work commences.

6.9. Excavation may proceed to the formation level. Due to the secant piles, no significant water inflows are anticipated during the excavation. However it may be that some ground water remains within the basement box following pile installation. This will be collected in temporary sumps and pumped.

6.10. On completion of the excavation to basement slab formation level install internal piles.

6.11. Once internal piles are in place excavate for capping beams. Prop internal surface of excavations where necessary.

6.12. Formation level to be blinded and compressible material installed on top to eliminate potential heave effects from the clay strata.

6.13. Reinforcement of the internal piles to be bent to suit formwork and dowels to be installed into secant piles to tie together the base structure with the piled wall around the perimeter.

6.14. Pile cap and base slab reinforcement to be installed and cast. This will be designed to resist potential hydrostatic forces.

6.15. Works will then proceed with the construction of the walls, columns and the slabs at levels above.

6.16. On completion of the permanent slab at level 0 the temporary props can be removed.

6.17. The works can then proceed with the construction of the superstructure.

Alternative methods of construction have been considered including 'top – down' construction. When the Contractor joins the team this will inevitably be re-visited but if the construction is changed to 'top – down' it does have the advantage that the perimeter walls are restrained by the permeant structure and the need for temporary propping significantly reduced.

APPENDIX A

FIGURES

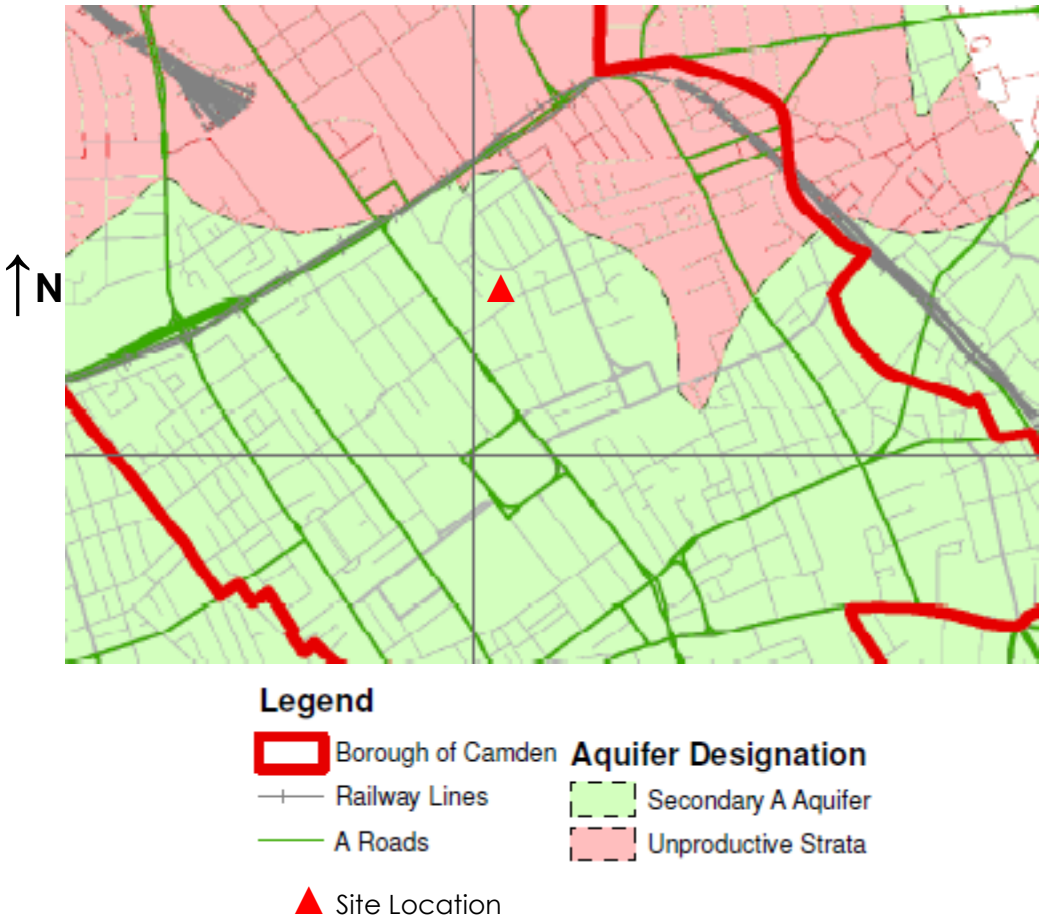
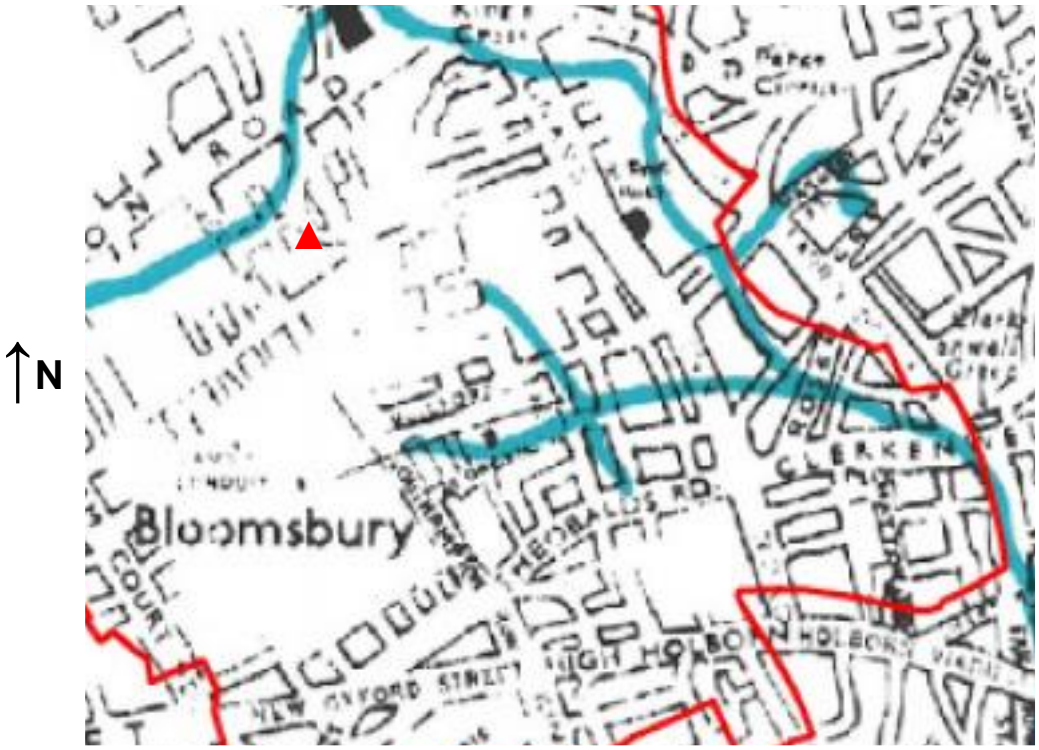


Figure (a)
Aquifer Designation Map
(Extract from Fig. 8 of Camden Geological, Hydrogeological and Hydrological Study)



Legend

~ Watercourses

▲ Site Location

Figure (b)
Watercourses
(Extract from Fig. 11 of Camden Geological, Hydrogeological and Hydrological Study)

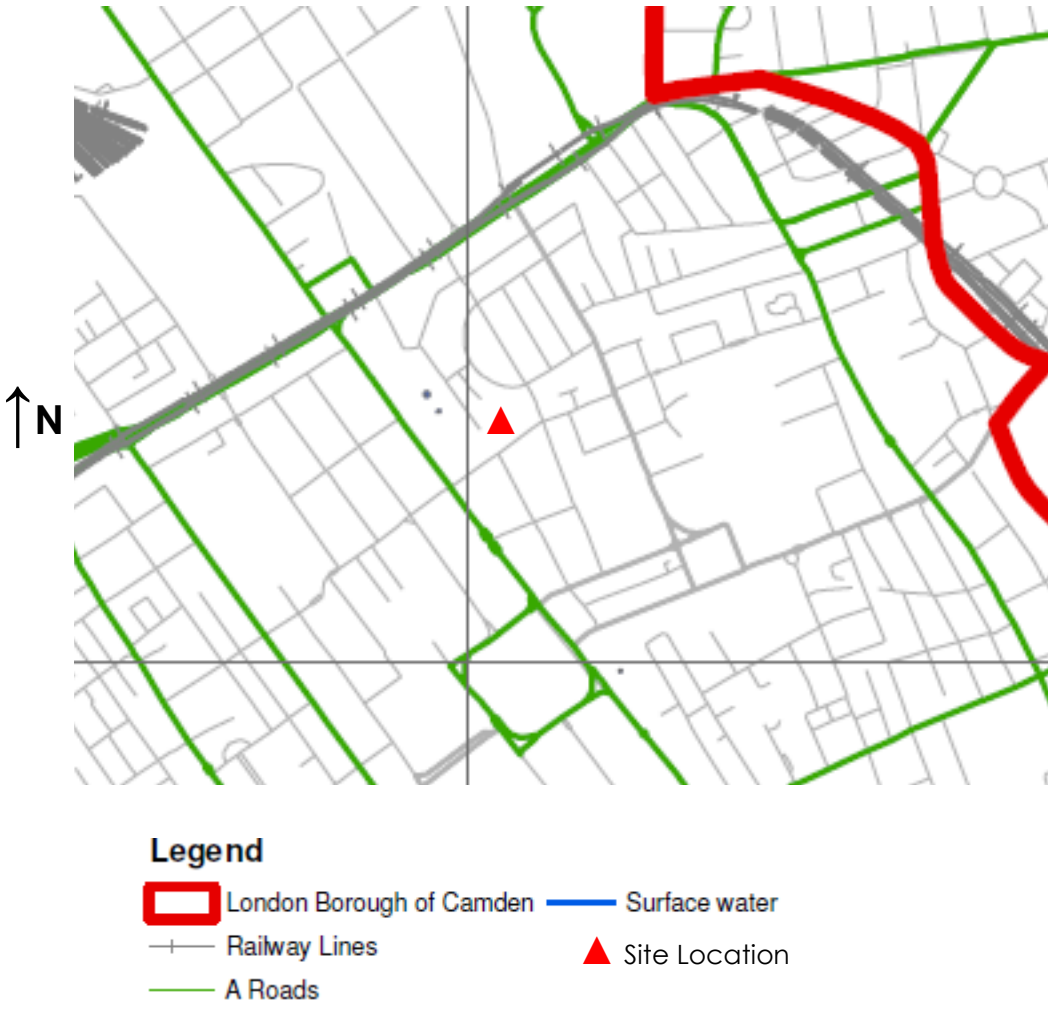


Figure (c)
Aquifer Designation Map
(Extract from Fig. 12 of Camden Geological, Hydrogeological and Hydrological Study)

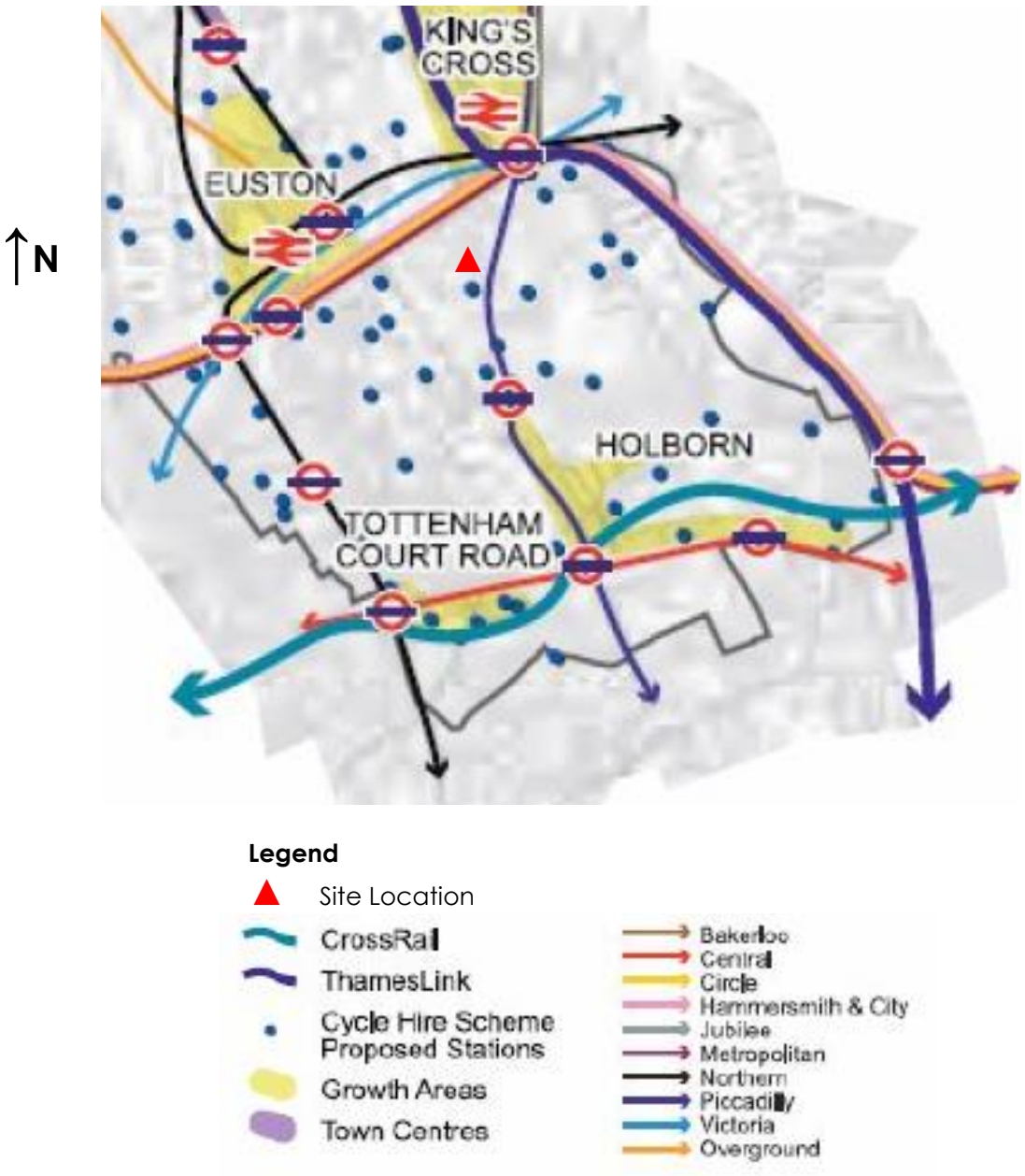
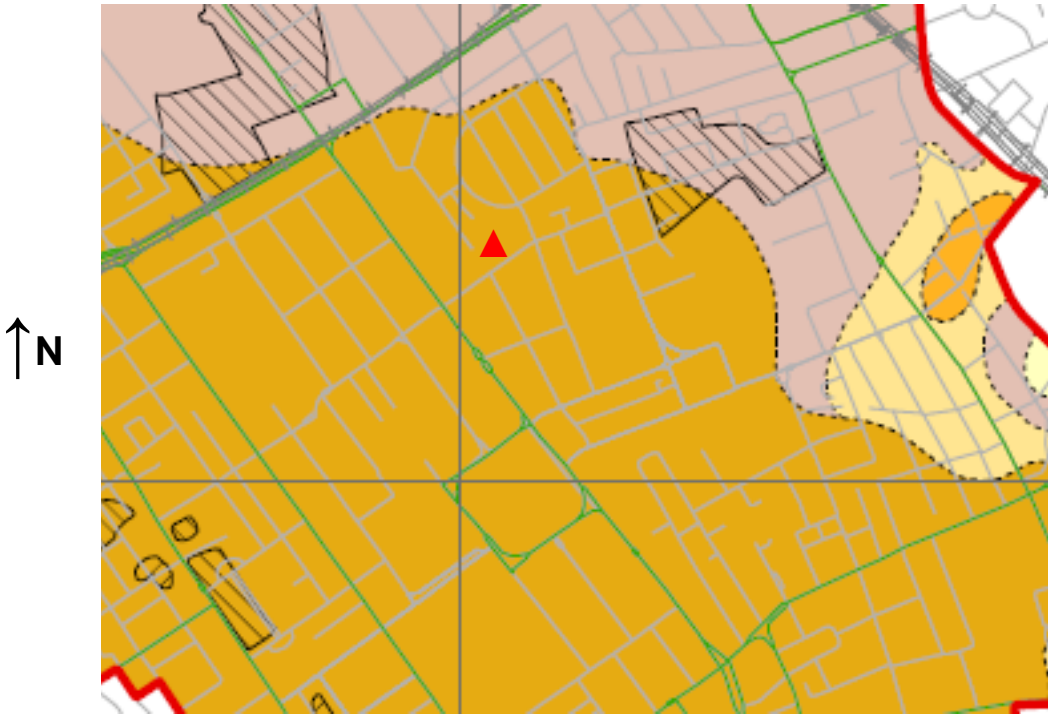


Figure (d)
Map of Underground Infrastructure
(Extract from Fig. 18 of Camden Geological, Hydrogeological and Hydrological Study)



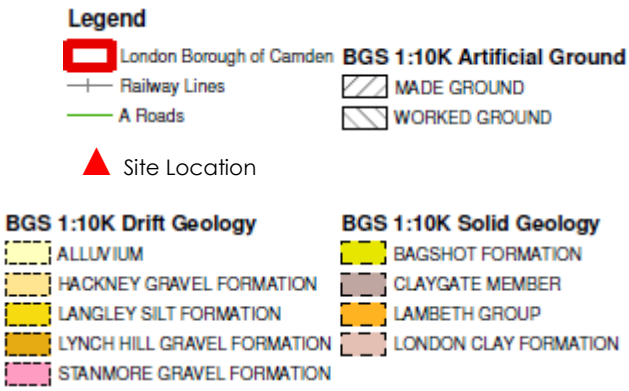


Figure (e)
Geological Map
(Extract from Fig. 4 of Camden Geological, Hydrogeological and Hydrological Study)

N

Legend

Site Location

Flooded Streets 2002

Flooded Streets 1975

Areas with the potential to be at risk of surface water flooding

Figure (f)
Flood Map
(Extract from Fig. 15 of Camden Geological, Hydrogeological and Hydrological Study)

Figure (g)
Areas at Risk of Flooding from Rivers or Sea
(Extract from Environment Agency flood map)

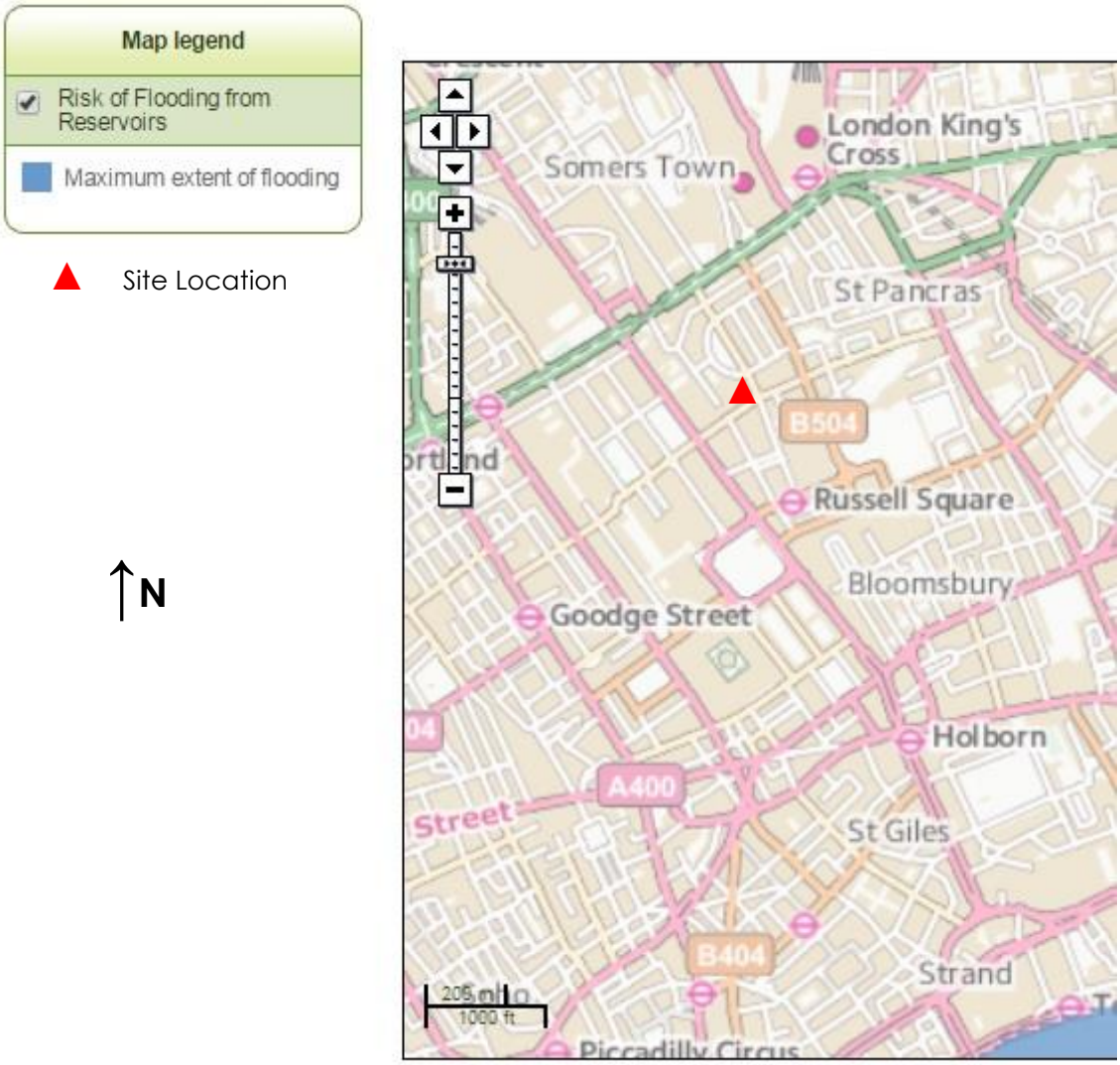
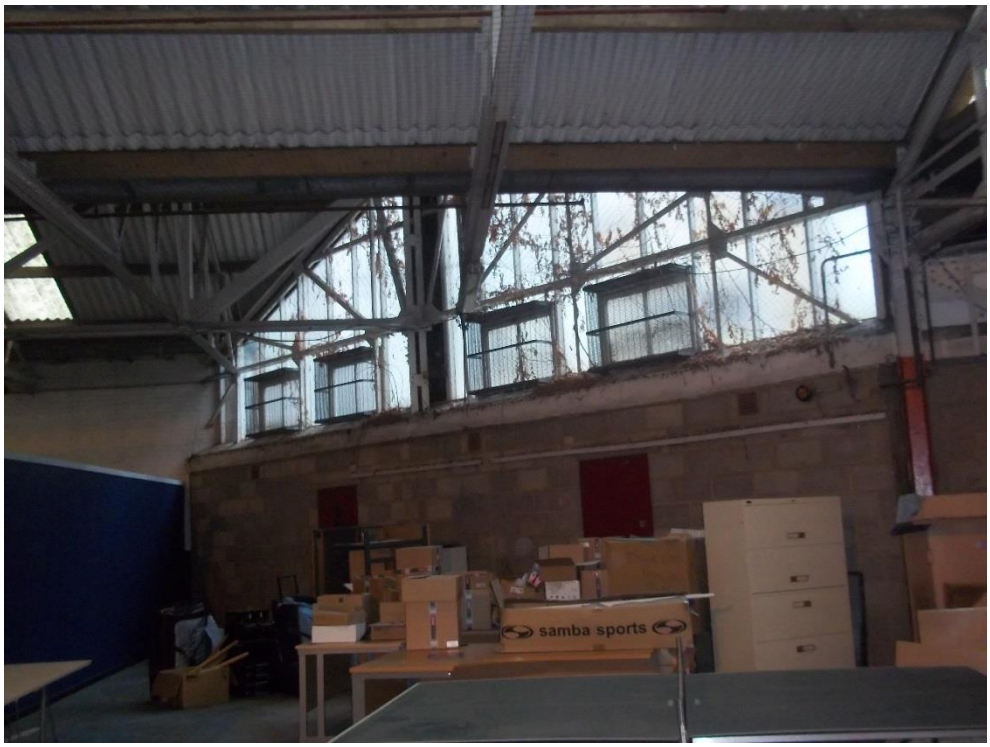


Figure (h)
Areas at Risk of Flooding from Reservoirs
(Extract from Environment Agency flood map)

APPENDIX B

PHOTOGRAPHS



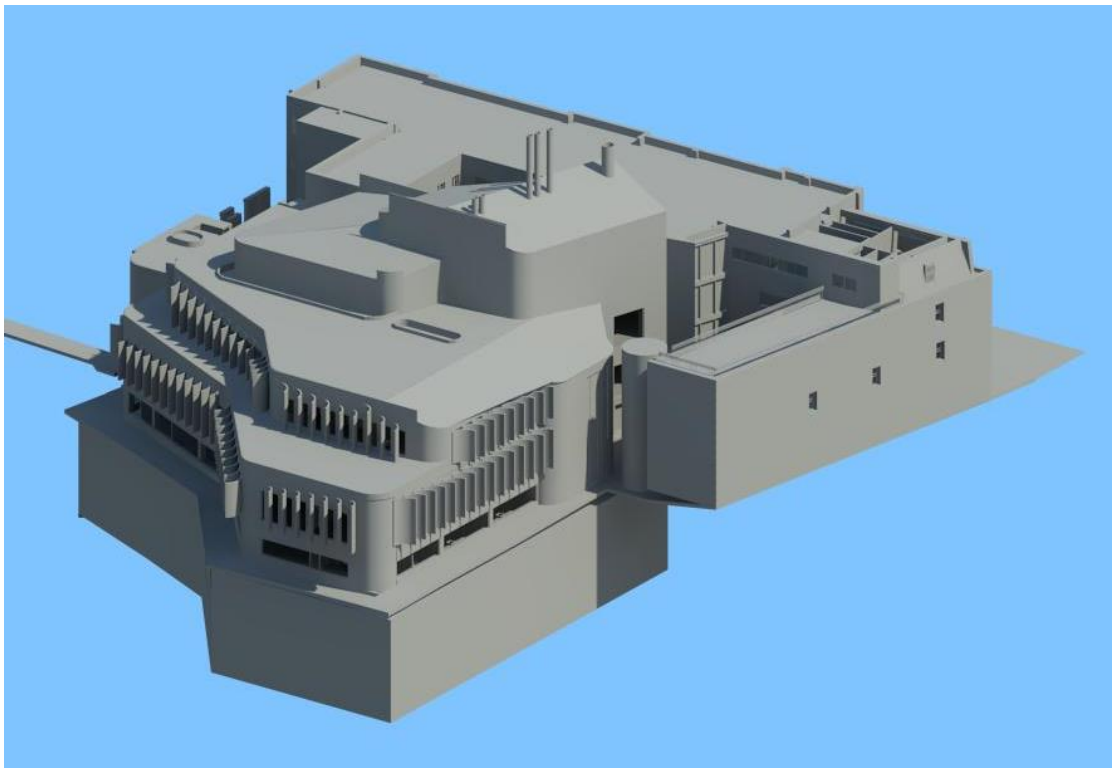
Picture 1 – Existing Depot

Picture 2 – Depot from courtyard

Picture 3
- London School of Hygiene and Tropical Medicine (LSHTM) from courtyard

Picture 4 – Depot and courtyard

Picture 5
– Roof of Depot and the back of surrounding properties at Cartwright Gardens



Picture 6 – Preliminary 3D model of the proposed development

APPENDIX C

OUTLINE STRUCTURAL & SURVEY DRAWINGS

List of Survey Drawings:

3746 – T_Rev. B - Topographic Survey
3476 – S- Sections

List of Structural Drawings:

4159 – S.50_Rev. P1 – Level -2 Plan
4159 – S.51_Rev. P1 – Level -1 Plan
4159 – S.52_Rev. P1 – Level 0 Plan
4159 – S.57_Rev. P1 – Sections
4159 – S.22_Rev. P1 – Sequence of Works for Basement