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STATION HILL

GEOTECHNICAL AND GEOENVIRONMENTAL DESK STUDY

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EXECUTIVE SUMMARY

Scope			
Purpose of the Report	The purpose of this report is to highlight potential geotechnical and geo-environmental based hazards associated with the development site and to identify where further assessment may be required to inform a strategy addressing identified risks. The report and site surveys will allow recommendations to be made on potential foundation and substructure options for the redevelopment. This report also identifies the key design drivers, residual risks and areas which will be the focus of the next stage of the design.		
Proposed Development	The proposed development at the time of writing consists of the demolition of the existing buildings. With the subsequent construction of four residential (plots A,D,E,F) and two office buildings (plots B & C) varying from 8 to 32 storeys.		
Site Information			
Grid Reference	471370, 173710	Approx. Area (ha)	3.15
Current Site Description	The site is located in central Reading, bounded by Friars Street to the south, Greyfriars Street to the west, Reading train station and Station Hill road to the north, along with Thames Tower immediately adjacent to the site in the northeast. A number of commercial outlets bordering the site in the south west and south east along Friar Street represent the southern boundary of the site. The Site itself is bisected by Garrard Street splitting the site into a northern and southern section. The northern section hosts a multi-storey car park that is still in use, Xafinity House, and a Temporary Events space which occupies the area of the recently demolished Retail Parade, Western Tower, and former Bingo Hall and Bus Station. The southern section of the site hosts the now disused Telecoms House and the Friars Walk Shopping Centre, being used as a Zombie experience setting.		
Site History	Historical maps date back to 1879, when the site was occupied by terraced housing, a Malt House, a Timber Yard, and a Coal Yard. The remaining northeast section of the site consisted of open fields and woodland. During the 1900s, the site became more developed with a large building constructed in the centre of the site by 1931. From the 1940s onward a factory is observed in the northwest corner of the site in 1957, with the large central building being labelled as a garage. A number of depositories and warehouses were then built on the site, with a carpark present by the 1960s. By the late 1960s a ballroom had been constructed on the western portion of the car park along with a bus station. A coal yard was present in the south of the Site, and Western Tower and its adjoining office block had been built along the northern boundary of the Site. The garage, houses and factory were eventually demolished sometime before 1980 to make way for a multi-storey car park in the centre, an office building in the west and Friar’s Walk Shopping Centre, which included a rooftop car park.		
Unexploded Ordnance	London and Greater London is renowned for heavy bombing during World War II and unexploded ordnance (UXO) may present a risk to construction projects. Given Reading’s proximity to London it may also be at greater risk. Unexploded ordnance often entered the ground unnoticed and at high velocity and are still buried beneath the surface. 1st Line Defence were commissioned by Ramboll to undertake a Preliminary Express UXO risk assessment and found there to be a “minimal” risk and recommended that no further research be carried out on the site.		
Services and Utilities	Several utility companies were contacted by the Project Manager (Cast). The information made available to Ramboll revealed that Friars Street, Garrard Street, and Greyfriars Road all host a high density of services. There are also a number of known services which cross		

	the site, including a Thames Water deep foul sewer, reportedly flowing west to east across the northern section of the site, with three smaller sewers branching off.
Environmental Setting	
Geology	The geology of the site comprises superficial deposits of Alluvium and the Taplow Gravel Formation, underlain by the Upper Chalk Formation, the upper layers of which comprise variable and significant thicknesses of Structureless Chalk. This information has been taken from borehole data from a previous site investigation completed by Waterman in 2014, and borehole records from nearby developments, in particular, the Thames Tower.
Groundwater	Groundwater was encountered in seven exploratory locations during the ST Consult intrusive investigation. Revealing shallow groundwater, within the Alluvium, Taplow Gravel Formation, and Upper Chalk Formation. At depths of between 2.7 mbgl and 5.3 mbgl, usually at or near the boundary of the Alluvium and Taplow Gravel Formation, or within the Structureless Chalk when they are absent. The groundwater monitoring indicated water levels between 2.15 mbgl and 2.75 mbgl, corresponding to 36.07m AOD and 36.44 AOD.Isolated perched groundwater bodies may also be present within parts of the Made Ground or Fill.
Hydrology	The nearest surface water feature is a drainage network 320m northwest of the site, associated with the railway line. Followed by the easterly flowing River Thames which, at its closest point, lies 420m northeast of the site. The river Kennet is located approximately 500m southeast of the Site and also flows in an easterly direction..
Hydrogeology	The Made Ground is classified as an Unproductive Strata, with the Environment Agency classifying the Alluvium and Taplow Gravel Formation as Secondary A Aquifers and finally the Upper Chalk Formation is classified as a Principle Aquifer. The Site is not located within a Source Protection Zone (I, II, III). There are 12 recorded groundwater abstractions within a 1km radius of the Site, the closest of which is located 0.16km to the southwest of the Site associated with a Primark and used as drinking and washing water.
Conclusions	
Foundation Recommendations	The foundation options which are deemed potentially feasible for the proposed structures at this stage are as follows: - shallow foundations comprising a raft founded on the Taplow Gravel Formation combined with potential ground improvements for the lower rise buildings; and/or - piled foundations founded within the lower part of the Upper Chalk Formation A raft foundation solution may be feasible for some of the smaller buildings located in the South Site. This solution can be used to spread column loading across a large ground area. The stiffness of the raft assists in limiting total and differential settlements for moderate column loads. Uplift due to water pressures on the underside of the raft should also be considered in both temporary and permanent cases . A fully piled solution is considered feasible for the larger buildings in the northern section of the development. These could be constructed by boring, driven cast-in-place piles or continuous flight auger (CFA) piles, although CFA piles are considered most suitable for the development, as they are relatively quiet and cause limited vibrations. This is dependent on the depth of the formation level and the depth of the rock head. Piles would

	be considered to be founded within the structured chalk of the Upper Chalk Formation, i.e. beneath the structureless chalk. Piled foundations offer the opportunity to construct any potential basement top down (i.e. build structure while excavating basement). Reinforcement cages and large plant are required on site and hence a piling mat is likely to be required. It should be noted that piles can produce pathways for the vertical downwards migration of contaminants, should they be identified, in the upper soils to important aquifers at lower levels.
Geotechnical Risk Assessment	The preliminary geotechnical risk assessment identified that previous ground investigations only cover the northern section of the site, and only one exploratory hole extended below the structureless chalk. The ground conditions in this report have been inferred from the available borehole records from surrounding buildings in particular Thames Tower. The main risks, particularly in the South Site, include the variable/unknown thickness of the Structureless Chalk across the site; the corresponding variable/unkown depth of the structured chalk; the thickness of Alluvium and Taplow Gravel Formation;the presence of buried services and obstructions (e.g. former foundations and/or retaining walls and Thames Water Assets); the unknown thickness, chemical composition and gas generation potential of Made Ground / Infill and Alluvium across the site.
Preliminary Contamination Risk Assessment	The preliminary contaminated land risk assessment has identified a number of sources of potential contamination, including current and former land uses at the site and in the surrounding area. The site has been previously occupied by a garage, car park, coal yard and bus station. The historical maps illustrate a garage located in the centre of the site with a car park and bus station constructed by the early 1960s. A coal yard was present to the south of the site. The historical data report from Envirocheck identified two potentially fuel related tanks on site. Whilst no tanks were identified during the site walkover (September 2018), residual contamination may be present. In addition, three electrical sub-stations were noted across the site during the site walkover, with unknown potential for release of PCBs. A review of the surrounding areas history highlighted industrial land use within 100m of the site. The Great Western Railway runs parallel to the site boundary 60m north, since before first maps in the late 1870s. Garages were situated 90m southwest and 50m southeast of the site by 1957. Engineering works were identified on the historical maps to the northwest and north of the site. Four electrical sub-stations were also identified within 80m of the site. Historical Building Plans Information has identified three underground fuel tanks and oil storage within 100m south of the site. As such there is the potential for ground contamination from off-site sources, which could migrate onto site as a result of groundwater migration. Based on a review of the historical and current uses of the site and the surrounding area, potential risks from potential contamination to both human health and controlled waters is considered likely to be Low/Moderate, dependent on which receptor or pathway is being considered. Potential risks from ground gas are assessed as High. It is recommended that an intrusive Ground Investigation is undertaken prior to redevelopment at the site, in order to properly characterise the ground and groundwater conditions at the site and identify any potential contamination. The findings of the Ground Investigation should be used to inform the design and construction of the proposed development and identify whether mitigation measures or remediation is required. Information on contamination is also likely to be required as part of the planning process for the future proposed development of the site.

Recommendations	
Scope of Work for Site Investigation	It is essential that further liaison with Thames Water’s and other utility owners technical experts is undertaken in order to attain as-built drawings and sections and an accurate location plan of their assets adjacent to and on the site. It is recommended that a phased ground investigation be carried out at the site, in order to:

- Undertake a full geotechnical and geo-environmental assessment of the site to facilitate design of the foundations and substructures for the proposed development. This should include a Ground Investigation and geotechnical design reports, in accordance with Eurocode 7. An intrusive Ground Investigation is recommended to be carried out at site in order to: - Target the anticipated location of principal existing foundations and delineate significant party wall foundations adjacent to, and bounding the site. It is likely that this investigation would be combined as a phased structural and environmental assessment. Details of ground investigation works and additional intrusive works will be determined at a later project stage. - Establish the underlying ground conditions across the site and geotechnical engineering design parameters for substructure (foundation and retaining wall) design – this should include in-situ and laboratory geotechnical testing; - Determine the presence and chemical composition of the Made Ground / Infill through targeted and representative soil sampling; - Determine the presence of any potential contamination in natural soils through targeted and representative soil sampling; - Undertake a Waste Assessment to determine the status of the soils to be removed as part of the construction works; - Characterise the underlying groundwater and ground gas regimes through sampling, monitoring well installation and the development of a monitoring program; - Prior to demolition, a pre-demolition asbestos survey should be completed (in accordance with HSG 264, 2012) and any residual ACMs removed for disposal at a suitable licensed facility; - Identifying extent of significant foundations for current developments on site prior to demolition works; - Qualitatively identify the risk of encountering significant subsurface obstructions such as historic foundations, potential archaeological findings or existing services; - Assess the need for stability assessments of adjacent third-party structures or assets.
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1. INTRODUCTION

1.1 Brief

Ramboll has been appointed by cRTKL to provide a Geotechnical and Geoenvironmental Desk Study for the Station Hill site, as part of the redevelopment. Both north and south sections of the site, as defined in Drawing 1, are covered in this report.

The purpose of this report is to highlight potential geotechnical and geoenvironmental based hazards associated with the development site and to identify where further assessment may be required to inform a strategy for addressing the identified risks. The report and existing site surveys allow preliminary recommendations to be made on potential foundation and substructure options for the redevelopment. This report also identifies the key design drivers, residual risks and areas which will be the focus of the next stage of the design.

1.2 Proposed Development

The proposed development currently comprises six plots, A-F. Plots A and D are situated north of Garrard Street and both comprise 15 storeys of proposed residential accommodation. Plots B and C are also situated north of Garrard Street and are to contain 19 and 30 storeys of office space. Plots E and F are located south of Garrard Street and both will host residential accommodation, with Plot F consisting of 12 storeys, and Plot E split over 12, 10, and 6 storeys.

1.3 Objectives

The objective of this Geotechnical and Geoenvironmental Desk Study is to collate and review available information regarding the existing site conditions and existing structures which may potentially have an impact on the development proposals and the geological succession and hydrogeological conditions beneath the site, in order to identify potentially significant geotechnical and geoenvironmental hazards and constraints to the proposed development. Moreover, the aim of this report is to make recommendations for further Ground Investigation and to describe options for substructure solutions for the Phase 1 development works. The report also defines the constraints at the site.

The objectives of this report are:

- To identify the existing ground based site conditions based on desktop research, site walkover surveys and through consultation with relevant authorities and stakeholders;
- To review the existing ground conditions based on information from the British Geological Survey (BGS), previous site investigation works and anticipated geology of relevance to the site, contamination source records on or adjacent to the site, and key obstructions, constraints and services;
- To assess potential foundation design constraints and outline preliminary substructure options; and
- To compile a Hazard Register detailing the identified ground based risks relevant to the proposed scheme, and ultimately a set of recommendations for future work shall be made based on the findings within this report.

1.4 Constraints and Limitations

The information within this report is based on data presented by the Landmark Information Group in their Envirocheck report and other resources such as the ST Consult 2014 ground investigation, and consultation

with relevant parties and statutory authorities. A summary of the consultation undertaken during the preparation of this report is presented in Section 3.

This report has been prepared for the exclusive use of cRTKL for the purpose of assisting them in evaluating the site in the context of the outlined development. This report should not be used in whole or in part by any third parties without the express permission of Ramboll in writing. Ramboll has endeavoured to assess the accuracy of all information provided during this Geotechnical and Geo-environmental Desktop Study. Ramboll cannot accept any liability for the accuracy or otherwise of any information derived from third party sources.

The preliminary substructure design options provided in this report relate to details of the proposed development at the time of writing. Any substantial changes to the proposed development may require a reassessment of the implications of the hazards identified.

2. EXISTING INFORMATION

Information provided by the Client and archive information that has been made accessible in relation to the site and proposed development is summarised in Table 2.1.

Table 2.1 - Documents Reviewed (see also References)

Title	Institution	Date
Geo-Environmental and Geotechnical Assessment	Waterman	September 2014
Factual Ground Investigation Report	ST Consult	May 2014
Ground Investigation Specification	Waterman	February 2014
Post Demolition Ground Investigation Specification	Waterman	July 2015
Preliminary Environmental Risk Assessment	Waterman	February 2013
Flood Risk Assessment	Waterman	March 2013
Written Scheme of Investigation (Archaeological)	Waterman	June 2017
Archaeological Evaluation and Watching Brief Report	Archaeological South-East	March 2016
Rights of Light Report	GIA	April 2017
Envirocheck Report	Landmark	February 2012
Utility Infrastructure Report	Hoare Lea	July 2014
Site Investigation Report (Thames Tower)	Concept	July 2012

2.1 Geological and Geotechnical Information

Available BGS records, in conjunction with site specific ground investigation data from ST Consult and data from the adjacent Thames Tower development, were consulted to identify the geology on site.

The following BGS records were reviewed:

- Reference the BGS map.
- Maybe also reference the Regional memoirs.
- Reference any relevant historical boreholes.

The ST Consult investigation comprised:

- 5 No cable percussive boreholes to a depth between 6.5m and 12.5m bgl.
- 2 No follow on rotary boreholes to depths of between 16 and 25m bgl.
- 1 No rotary Borehole to 30.2m bgl.
- 1 No flight auger borehole to 12m bgl.
- 2 No DPSH Probes.

The geotechnical factual report done for the site investigation of the neighbouring Thames Tower consisted of:

- 3 No Rotary Cored Boreholes to a maximum depth of 30.45m
- 2 No Windowless Sampling Boreholes to a maximum depth of 6.00m
- 3 No Observation Pits to a maximum depth of 3.45m
- 2 No Diamond Cored Holes
- Falling Head Tests

- Parallel Seismic Testing
- Geotechnical and Chemical Laboratory Testing

Geological Information from the Landmark Envirocheck report that was ordered as part of the Preliminary Environmental Risk Assessment has also been reviewed.

A summary of the findings of these sources are discussed in Section 3 with an assessment of the geotechnical implications and risks presented in Section 8.5.

2.2 Topographical Information

The study area is covered by Ordnance Survey (OS) maps at various scales and these illustrate the topography with contours.

Topographical information for the site is included in historical site surveys by XYZ Land Surveys covering the north section of the site. Utilities plans which include topographical information have also been reviewed which cover the majority of the south section of the site.

2.3 Hydrogeological Information

The Envirocheck report (2018) was reviewed for hydrogeological information. Further information on the hydrogeology of the site, including bedrock aquifer designation, has been obtained from the Flood Risk Assessment (2018) and also the EA website.

The key findings from these documents are discussed in Section 4.1 and Section 6.3.

2.4 Environmental Data

The Envirocheck report provides a range of mapping and geographical data for the UK; including information from public registers and other relevant records provided by the Environment Agency, British Geological Society, English Nature, Countryside Agency, Department of Environment, Transport and Regions, The National Radiological Protection Board and the local council. Key findings from the Envirocheck report are detailed within Section 5.1.

2.5 Historical Maps

Within the Envirocheck report (2018), a series of digital scans of original and reprinted maps dating back to the Country Series Maps published in 1879-1880 are available. The maps represent specific times and are therefore not a continuous record. A summary of the potential historical geotechnical and contaminative features surrounding the Station Hill site are summarised in Section 6.

2.6 Unexploded ordnance records

The Zetica website provides information on the unexploded ordnance risk across the UK. Information relating to Reading has been reviewed and a summary can be found in Section 6.3. A preliminary Express UXO risk assessment undertaken by 1st Line Defence classified the risk level as 'Minimal'.

2.7 Utilities

Hoare Lea was commissioned to produce a utility Infrastructure Report. The client has also provided information from the following:

- Energis
- Fibernet

- XYZ Land Surveys
- Kingston Infrastructure
- Ntl
- Scottish and Southern Energy plc
- Thames Water
- GallifordTry
- 40seven
- Peter Brett Associates

These have been reviewed and a summary can be found in Section 5.2. It should be noted that the report was completed in 2014, an additional asset search will be required in the future.

2.8 Previous Reports

A Geo-Environmental and Geotechnical Assessment and Preliminary Environmental Risk Assessment have previously been issued by Waterman. Additional information from archive and anecdotal findings / relevant excerpts for the proposed development and site area has been included within this report.

2.9 Archaeology

An Archaeological evaluation and Watching Brief has been completed by Archaeological South-East and a corresponding Written Scheme for Investigation done by Waterman. Archaeological artefacts may be of concern for excavations – significant finds have been made within the immediate area and further assessments may be required.

3. THIRD PARTY REPORTS

Waterman Ltd had undertaken a preliminary risk assessment as well as the geo-environmental and geotechnical assessment at the subject site. Ramboll has reviewed the following reports to better understand the possible sources, pathways and receptors for ground contamination assessment of the site;

- Preliminary Environmental Risk Assessment - Station Hill, Reading; Waterman Energy, Environment & Design Ltd, dated February 2013; and
- Geo-Environmental and Geotechnical Assessment – Station Hill, Reading; Waterman Energy, Environment & Design Ltd, dated September 2014

3.1 2013 Preliminary Environmental Risk Assessment

This report covers the north side of the site; the south side was largely inaccessible during the investigation in 2013. Appended **Drawing 1** illustrates the current site area boundary in relation to the extent of previous site investigation (North Side).

At the time of the report, the site was described as a largely derelict mixed-use city centre site with a disused shopping centre, high rise tower block, an active multi-storey car park, bus station, taxi rank and an office block. Historical maps indicated that the site uses previously included a coal yard, garage and car park in the centre portion of the site, a factory in the northwestern corner, a bus station in the western portion and a coal yard in the south. A tank was noted in the centre of the site in the later historical maps (1968-1984). After the 1980s, a multi-storey car park, an office building in the west and a shopping centre including a car park were constructed.

During a site walkover, potentially contaminative activities on site were identified by Waterman. These include run-down building fabrics (for asbestos containing materials) oil staining within the car park, waste food oil staining, presence of two tanks within Mecca Bingo and a switch room; and three electrical sub-stations.

The site as a whole was deemed to present a medium overall contamination risk due to the historic land uses, as well as the findings during the site walkover.

The report recommendations included a Phase II intrusive site investigation to be completed prior to the redevelopment works, targeting potential contaminants identified during the preliminary risk assessment. A ground gas monitoring survey was also recommended to provide sufficient data to allow environmental assessment of the site and determine areas which may require additional investigation and/or remediation.

3.2 2014 Geo-Environmental and Geotechnical Assessment

An intrusive geo-environmental investigation designed by Waterman Energy, Environment & Design was carried out following the preliminary risk assessment. Two areas were targeted for the investigation, known as the Temporary Events Space Area and the Outline Application Area (see Figure 7.1). Both were located in the northern part of the current site area.

The investigation comprised the drilling of five shell and auger boreholes, one rotary cored borehole, twenty-two window sample boreholes and seven trial pits. Four boreholes were installed with gas and groundwater monitoring wells. Selected soil and groundwater samples were submitted for laboratory analysis for contaminants associated with the historic and current land uses at the time of the investigation.

The investigation identified Made Ground up to the thickness of 3.75m beneath the site, made up of different soil types. The Made Ground was generally underlain by a layer of silty or sandy gravelly CLAY (Alluvium) between approximately 0.70m and 2.80m in thickness. This is generally underlain by the Taplow Gravel Formation comprised of sandy GRAVEL at 2.95 – 4.30m in depth, which is further underlain by Upper Chalk, which comprised an upper zone of structureless chalk, overlying structured chalk. Groundwater was encountered in seven exploratory holes at a range of depths from 2.70 - 5.30m bgl (below ground level). Ground water was usually encountered at the boundary of the Alluvium and Taplow Gravel Formation.

Comparison of soil analytical results against Generic Risk Assessment criteria in use at the time of the investigation identified potential risks to future commercial site users associated with metal contamination (principally lead, copper and zinc) and speciated PAHs (poly aromatic hydrocarbons) including benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(123-cd)pyrene and dibenz(ah)anthracene within the Made Ground. Comparison of natural ground against the relevant GAC indicated no exceedances of inorganic and organic contaminants. No consideration of residential site users was completed thus it should be noted that there may be additional risks to the residential receptors currently proposed.

Screening of selected samples for asbestos in both areas of investigation, identified eight samples (out of analysed twenty-three) containing chrysotile asbestos (in the form of free fibres and cement) and amosite (free fibres). Subsequent quantification analysis of asbestos soil gave the maximum value of 0.12% asbestos by weight of the total dried sample.

Four gas monitoring wells were installed, two in natural alluvium and river terrace gravels and two screening across both Made Ground and natural strata. Concentrations of carbon dioxide were recorded to a maximum 9.1%. Depleted oxygen levels were recorded in the wells with a minimum 5.2%. Carbon monoxide was recorded up to a maximum 8.0ppm, methane up to a maximum 0.4% and the flow rate maximum 2.2l/hr. A Gas Screening Value (GSV) was calculated using maximum flow, carbon dioxide and methane concentrations to provide a Characteristic Situation to assess if any ground gas protective measures are required. Based on the above data, the GSV yielded a Characteristic Situation 2 ("Low Risk") for the site which, in respect to the development proposals, requires low-level gas protective measures.

Comparison of groundwater analytical results against UK Drinking Water Standards, and if absent, against the Environmental Quality Standards identified potential risks to the controlled waters associated with elevated concentrations of ammoniacal nitrogen, benzo(a)pyrene and benzo(ghi)perylene.

Overall the results of the investigation suggest the ground contamination risks are generally low to medium with only limited concentrations of contaminants of concern identified in both soils and controlled waters. Any direct contact pathways between the contaminants and the human health receptors in the Made Ground are expected to be broken given the proposed end use of the site, which comprises of primarily hardstanding cover and soft landscaping areas with at least 450mm of certified clean inert soil cover.

In terms of controlled waters, marginal elevated concentrations of a few contaminants have been identified, however again given the proposed significant percentage of hardstanding and the low concentrations, the pollutant linkage between site soils and the underlying aquifer is not considered to be significant.

Recommendations for future development at the site included:

- Planters and/or capping layers with a minimum thickness of 450mm of clean imported soils are to be used for areas of vegetation, in areas of soft landscaping; and
- A post-demolition ground investigation should be undertaken to provide coverage in currently inaccessible areas; this should include additional environmental and geotechnical assessments.

The Waterman investigations were restricted in area compared to the current site boundary due in part to existing infrastructure. The data obtained is suitable for use to inform the current proposals but will require additional works in areas not previously investigated. The data will also require a reassessment in comparison to generic assessment criteria suitable for the currently proposed development.

4. THE SITE

Information presented in this section is based on observations made during a site walkover undertaken on 1st February 2018, 20th September 2018 and other available desk-based information.

4.1 Site Location

The site is located at National Grid Reference 471370, 173710 on Station Hill, directly to the south of the Reading Mainline Station in Reading town centre. The site occupies approximately 3.15 ha.

A site location plan has been presented as **Drawing 1** of this report, Appendix XXX.

The site is bounded to the north by Reading Mainline Station; to the east by Merchants Place road and a number of commercial use buildings; to the south by Friar Street and further commercial buildings; and to the west by Greyfriars Road. Building heights surrounding the site vary considerably from two and three storey buildings to the southeast to Thames Tower towards the northeast of the site which hosts fifteen storeys and is approximately 53m tall.

4.2 Site Setting

A site walkover was undertaken by Ramboll on the 7th August 2018 and 20th September 2018. A photographic record has been presented as **Appendix A** of this report, and the findings are summarised in **Table 4.1**.

Table 4.1 – A Summary of Walkover Observations (07/08/18) & (20/09/18)

Subject	Notes
Land Use	The North (or northern section of the site) Site has recently been transformed into a temporary events pace following the demolition of the retail parade and bus station. The northwest is occupied by Xafinity House which hosts six storeys of office space. The centre of the site is occupied by the NCP multi storey car park. The south of the site is occupied by the Friars Walk Shopping Centre, currently being used as a Zombie experience setting, and Telecoms House, which hosts retail outlets on the ground floor adjacent to Friar Street. The overlying 5 storeys of Telecoms House are now abandoned office space.
Topography	The ground elevation varies from approximately +41.6m in the west of the site to approximately +46.7m above ordnance datum (AOD)in the east of the site. Then from approximately +46.0mAOD in the north to approximately +45.7mAOD in the south. There is a notable rise along Friar Street with the southern basement level of Telecoms House being at ground level on the north side of the building. The demolished Bingo Hall and Bus Station area is also at a different elevations to surrounding areas, with Station Hill Road to the north gradually rising towards the

Subject	Notes
	east and the Temporary Event Space to the east being 2-3m higher. The ground elevation of the multi-storey car park, is also at a lower level than the road on its north side.
Ground Surface	The site is covered by a combination of concrete pavement slabs, brick pavement and asphalt. Any notable features on condition? The site of the former bingo hall and bus station is compacted ground fill.
Services	Surface drains are visible across the site beside roads as well as near building boundaries. In Particular drains were seen in Telecoms house likely feeding a sewer leading to the main Thames Water sewer running beneath the north section of the site. A number of other service manholes were visible accross the site. A Thames Water Main Sewer runs west to east across the north section of the site. With two smaller diameter sewers feeding into it from Garrard Street in the south and one from the north. A full buried services survey is to be commissioned by the project including CCTV of the existing drainage connections.
Site Boundaries	The Reading Mainline Station has recently been redeveloped and contains the creation of taxi rank directly adjacent to the northern boundary of the site. Friar street adjacent to the southern boundary of the site is a busy high street, with a number of bus stops occupying the section directly adjacent to the site.
Ground Contamination	No underground storage tanks (USTs) were reported by the site manager to be present at the site and no visual evidence of USTs was noted by Ramboll during the site inspection (such as unexplained manhole covers, vent pipes, fill points or signage). No above ground storage tanks (ASTs) were reported to be present at the site by the site manager and no visual evidence of current or former ASTs was observed by Ramboll during the site walkover (such as concrete plinths, marking or staining on areas of hardstanding). Three electricity sub-stations were observed to be present on site therefore the possibility of PCB containing oils cannot be ruled out. Responsibility of PCB oils would lie with the sub-station operators. No other potential PCB-containing equipment was observed by Ramboll during the site inspection. No waste is being generated on site as it is currently vacant. No activities with the potential for ground contamination were identified during the site walkover.
Other Observations	A taxi rank is present on Garrard Street. The site of Western Tower and Retail parade is now being used as a Temporary Events Space and is open to the public. The multi storey carpark is also still in use. The Friars Walk Shopping Centre is being

Subject	Notes
	used as a zombie experience and airsoft location. The section of the 1 st floor carpark that extended over Garrard Street has now been demolished.

5. CONSULTATION

The agencies, authorities, organisations and individuals which have been contacted and/or their records reviewed during the course of this study are listed in **Table 5.1**.

Table 5.1 - List of Parties Consulted During the Study and Details of Responses

Institution	Consultees	Responses
Envirocheck / Landmark	Envirocheck / Landmark Reports	Landmark was commissioned to collate statutory information pertaining to the site. The information obtained is presented in public registers and includes other relevant records provided by the Environment Agency, British Geological Survey, English Nature, Countryside Agency, Department of Environment, Transport and Regions, the Health Protection Agency and the Local Authority. Historical building records are also included within the Envirocheck report, further detailed in Section 5.1 and presented in Appendix B of this report. The information was collated by Landmark, with an Envirocheck report issued on the 7 th February 2018, included as Appendix B of this report.
Thames Water	General Enquiry	Hoare Lea are currently leading the early stakeholder engagement regarding the Thames Water assets running beneath the north section of the site. Highlighted to Thames Water was the proposed development proposal in order to understand whether a specific damage assessment was required for their assets. Prior to engagement, water utility plans were received from the prior Waterman investigation. As-built drawings and sections for the site and the surrounding area will be requested from Thames Water.
1 st Line Defence	Scott Mundy	1 st Line Defence was contacted to quote for a preliminary UXO risk assessment.

5.1 Envirocheck Reports

A summary of the environmental search information obtained from the Envirocheck report (ref. 179269911_1_1) is presented in Table 5.2. The data sheets provided within the reports are included in **Appendix B**. All distances quoted are from the site boundary.

Table 5.2 - Summary of Salient Information from the Envirocheck Database

Issue	Location	Information
Agency & Hydrological		

Issue	Location	Information
Groundwater Flooding Susceptibility	On Site	The site is located within a Flood Zone 1 and therefore has a low probability of flooding from rivers or sea (less than 1 in 1000 annual probability of river or sea flooding). The site resides in an area that has a very low to high flood risk from surface water, with the high risk zone noted in the centre of the site.
Licensed Discharge Consents	Two (2No.) within 500m Eight (8No.) within 1000m	No discharge consents are listed at the site, or within 250m of the site. The nearest active discharge consent is located 300m north-east of the site, for trade effluent which discharges into The Vastern Ditch. The permit was issued in December 1999.
Nearest Surface Water Feature	One (1No.) within 500m	The nearest surface water feature is a drainage network 320m northwest of the site, associated with the railway line.
Pollution Incidents to Controlled Water	One (1No.) on site. Five (5No.) within 250m.	One 'Category 3 – Minor' pollution incident to controlled waters is listed at the site. It had occurred in April 1993, and pollutant listed is 'Oils – Unknown'. The closest 'Category 2 – Significant Incident' was recorded 570m north-east of the site. It had occurred in March 1996, with 'Miscellaneous – Unknown' pollutant entering the controlled waters.
Substantiated Pollution Incident Register	One (1No.) within 500m. Two (2No.) within 1000m.	The closest substantiated pollution incidents are registered 450m southeast of the site. It has been classified as 'Category 2 – Significant Incident' for water impact and 'Category 4 – No Impact' for air and land impact. The incident is dated June 2005 and the pollutant is 'Oils – Diesel (Including Agricultural)'.
Groundwater Vulnerability	On Site	The nearest groundwater vulnerability information is noted to be on site with the following soil classification: Soils of High Leaching Potential (U) - Soil information for restored mineral workings and urban areas is based on fewer observations than elsewhere. A worst-case vulnerability classification (H) assumed, until proved otherwise.
Drift Deposits	None	No drift deposit information is noted for the site within the Envirocheck Report. However, BGS (British Geological Survey) geology online resources suggest that Alluvium is present at the site and Taplow Gravel Formation may be encountered underneath this.
Bedrock Aquifer Designations	On Site	The bedrock underlying the site is classified as Principal Aquifer.
Superficial Aquifer Designations	On Site	Superficial deposits underlying the site are classified as Secondary A Aquifer.
Incidents and Enforcements	Fifteen (15No.) within 1000m	One (1No.) Contaminated Land Entries & Notices is recorded 710m to the west of the site. No Enforcement Prohibition Notices are recorded at the site or within 1000m radius of the site. Two (2No.) Local Authority Pollution Prevention and Controls are recorded within 500m of the site, and further twelve (12No.) are recorded within 1000m of the site. The nearest is recorded 290m southeast of the site, at Sketchley Dry Cleaners; the permit application is not yet authorised.
Waste		
Local Authority Landfill Coverage	Two (2No.) within 1000m	No BGS recorded landfill sites, local authority recorded landfill sites or registered landfill sites are recorded at the site or within 1km of the site. Two recorded historical landfill sites are located within 1000m of the site, with the closest recorded 720m northwest of the site. It was in operation between December 1970 and December 1979, and deposited waste included commercial and household waste, and liquid sludge. A second historical landfill site is located 970m west of the site, which has been in operation between December 1950 and December 1959. The deposited waste included inert waste.

Issue	Location	Information
Potentially Infilled Land (Non-Water and Water)	One (1No.) on site. Four (4No.) within 500m Eleven (11No.) within 1000m	One (1No.) record of Potentially Infilled Land (Water) was recorded onsite, however, the use is unknown. It is located beneath Garrard Street Multi Storey Car Park. No Potentially Infilled Land (Non-Water) was recorded within 1000m of the site.
Geology		
Coal Mining Affected Area	None	The site is not located in an area that might be affected by coal mining.
Non-Coal Mining Areas of Great Britain	On Site	The site is classified as highly unlikely to be located on Non-Coal Mining Areas of Great Britain.
Potential for Collapsible Ground Stability Hazards	On Site	The site is located in an area where there is no hazard to very low hazard potential for being affected by collapsible ground stability.
Potential for Compressible Ground Stability Hazards	On Site	The site is located in an area where there is no recorded hazard of being affected by potential for compressible ground stability in the south. Moderate hazard potential has been identified to the southwest of the site.
Potential for Ground Dissolution Stability Hazards	On Site	The site is located in an area where there is very low hazard of being affected by potential for ground dissolution stability.
Potential for Landslide Ground Stability Hazards	On Site	The site is located in an area where there is a very low hazard potential for being affected by landslide ground stability.
Potential for Running Sand Ground Stability Hazards	On Site	The site is located in an area where there is a very low to low hazard potential for being affected by running sand ground stability.
Potential for Shrinking or Swelling Clay Ground Stability Hazards	On Site	The site is located in an area where there is a no hazard to very low hazard potential for being affected by shrinking or swelling clay ground stability.
Radon Potential - Radon Affected Areas	On Site	The site is located in a Lower Probability radon area (less than 1% of homes are estimated to be at or above the Action Level). The Envirocheck Report states no radon protective measures are necessary in the construction of new dwellings or extensions.
Industrial Land Use		
Contemporary Trade Directory Entries	Eleven (11No.) within 250m	There are no active records of contemporary trade directory entries at the site. The nearest active contemporary trade directory entry is recorded 66m southwest of the site for Everest Jewellery, classified as Jewellery Manufacturers & Repairers. Eleven (11No.) are located within 250m, 20No. within 251-500m and 80No. within 501-1000m of the site.
Fuel Station Entries	Five (5No.) within 1000m	There is no open fuel station on site or in the nearest 500m radius. The closest fuel station entry is located 680m northwest of the site and it is operated by BP.

Issue	Location	Information
Points of Interest - Commercial Services	Eleven (11No.) within 250m Twenty-seven (27No.) within 1000m	The closest commercial service point of interest is located 150m west of the subject site at 45 Caversham Road, occupied by the National Tyres and Autocare and Hiq Tyre Services. Further 92No. commercial service points of interest are located within 1000m.
Points of Interest - Manufacturing and Production	Three (3No.) within 250m Fifteen (15No.) within 500m.	The closest manufacturing and production point of interest is located 40m southeast of the site at 1a Merchants Place, occupied by Works (Industrial Features). Further 60No. manufacturing and production points of interest are located within 1000m of the site.
Points of Interest - Public Infrastructure	One (1No.) on site Eight (8No.) within 250m	Reading Rail Station is located 50m north-east of the site. Further 9No. points of interest are recorded within 500m; and 34No. within 1000m of the site.
Sensitive Land Use		
Marine Nature Reserves	None	None are located within 2000m of the subject site.
Nitrate Vulnerable Zones	On Site	A nitrate vulnerable zone of surface water is located on site (Thames Wallingford to Caversham NVZ).
Ramsar Sites	None	None are located within 2000m of the subject site.
Sites of Special Scientific Interest	None	None are located within 2000m of the subject site.
Special Areas of Conservation	None	None are located within 2000m of the subject site.
Special Protection Areas	None	None are located within 2000m of the subject site.

The Historical Building Plans date back to 1885 and were produced as fire insurance plans; the production of these plans ceased in 1970.

Historical Building Plans Information identified three underground fuel tanks and a potential oil store 70m and 90m south of the site, respectively. Gas engine was identified 60m south of the site. Asbestos has been identified on the historical maps within 100m of the site, with the closest located 30m south of the site. There could still be a risk of asbestos being present on site and will need to be searched for. Paint Based Oils were identified to be located 100m south of the site.

Historical Tanks and Energy Facilities data has been obtained and the dataset identifies four electrical sub-station facilities within 100m of the site, with the nearest located 10m southwest of the site. Two potentially fuel related tanks have been identified on site and one within 100m of the site. These were identified on maps between 1957 – 1969 and were located to the east and south of the site. One further tank has been identified to the north of the site, on the 1969 map.

5.2 Services and Utilities

Several utilities companies were contacted by the Project Manager (Cast). Information regarding the services is included in **Appendix C**. Utilities interactions are to be addressed in detail by the project MEP design consultant and subsequently the main contractor.

Energis plans (dated 24/06/03) show cables running below Greyfriars Road and Garrard Street, with Flex points identified as being within the site boundaries.

Fibrenet plans (dated 18/06/03) show a duct running along the northern boundary down past Thames Tower and into Garrard street before heading down Merchants Place.

XYZ Land Surveys drawings (dated 06/03) also highlight that there are a large number of utilities running along the roads on the boarder of the site and under Garrard Street running through the middle of the site. There is also a number of utilities identified running through the site away from the roads.

A Kingston Infrastructure drawing (dated unknown) also shows a duct containing fibre optic cables running along Garrard Street.

As of 08/09/03 Ntl is known to have fibre optic cables running below Garrard Street.

Scottish and Southern Energy plans (dated 27/06/2003) also have electric/gas assets present on site in particular in the southern section of the site beneath Friars Walk Shopping Centre, and around the north, west and south edge of Thames Tower.

Thames Water plans (dated 25/06/03) also have a number of assets running around the site in particular a Main Sewer which runs west to east across the north section of the site.

Despite the evidence showing that the majority of services lie outside of the site boundary, it is recommended that utility scans are undertaken prior to any intrusive works at site to ascertain any potential risks underlying the development area from local utilities and connections.

6. SITE HISTORY

6.1 Introduction

The detailed history of the site and environment has been determined with reference to published literature and Ordnance Survey (OS) Maps dating from 1802 to 2018 obtained as part of the Envirocheck (ref. 37687984_1_1). Salient findings are summarised within **Table 6.1** below. Copies of the historical map data are contained within **Appendix B**.

Table 6.1 - Summary of Historical Mapping

Historical Map (Scale)	Site	Surrounding
Pre 1900's		
1802	Gardens and undeveloped land with drainage ditch.	Residential buildings on Friar Street to the south and open fields to the north.
1879 1899	By 1879, the southwest corner and southern boundary of the Site were occupied by terraced houses, with some larger houses and a timber yard located along the western boundary. A few additional houses were also situated on the east side and to the south of the Site. Livery stables were noted to be present in the northeast corner of the Site. A malt house and a coal yard were located in the central portion, with the remainder of the Site consisting of open fields and an area of woodland. The 1899 Ordnance Survey map indicates the presence of an irregular oval feature in the centre of the Site.	The Great Western railway , situated approximately 60m north, ran parallel to the Site's northern boundary. A gasworks company was located approximately 100m southeast and east of the Site and was no longer operational by 1879. By 1879 the Royal Horse and Carriageway Depository was constructed approximately 60m southeast of the Site. To the west of the Site, a cattle market is shown. A rifle factory was located approximately 12m northwest. A timber yard is present approximately 20m to the west. Two coal yards are located approximately 80m to the northwest and 80m to the southwest. A veterinary infirmary is present, adjacent to the western boundary. Roughly 60m to the east of the Site, near to the station, a railway terminus had been erected. A brewery is marked approximately 80m west. Garrard Street was constructed by 1879. 1899 maps indicate a public house approximately 50m to the west. In addition, a further timber yard had been established approximately 170m to the northwest.
1900's to 1940's		
1912 1931	The oval feature is no longer present by 1912. Additional buildings are located towards the centre of the Site. In 1931 a large building had been established in the centre of the Site. A separate building of unknown use was constructed on the east of the Site.	Further residential units, commercial facilities and trade units were constructed around the Site. Ordnance Survey maps indicate that by 1912 an iron works and iron foundry had been established approximately 280m northeast of the Site. The 1931 historical map indicates that a timber yard was operational on the Site of the former iron works . A paint works is situated adjacent the timber yard. A

Historical Map (Scale)	Site	Surrounding
		smithy is located adjacent to the southeastern boundary.
1940's to 1980's		
1957-1961 1962-1972 1968-1984 1980-1988 1979-1989 1986-1991 1993 1994	In 1957 a factory is shown in the northwest corner of the Site. The large building in the central part of the Site is shown to be a garage . Two depositories are also marked to the south which had turned into warehouses by the early 1960s. By the early 1960s the central, unused area of the Site was made into a car park . By the late 1960s a ballroom had been constructed on the western portion of the car park along with a bus station . A coal yard was present to the south of the Site. The Western Tower and its adjoining office block had been built along the northern boundary of the Site and a tank was located in the centre. The garage, houses and factory were eventually demolished sometime before 1980 to make way for a multi- storey car park in the centre, an office building in the west and Friar's Walk Shopping Centre to the south of the Site, including a roof top car park .	By 1957 a garage resided on the Site of the former paint works to the northeast. Garages are also situated approximately 90m, 110m and 125m southwest and 50m southeast of the Site. Medieval pottery was found adjacent to the northeast Site border. Warehouse complexes had established approximately 20m and 100m northwest of the Site. An engineering works was situated 115m northwest. An extensive works Site is marked roughly 150m north, whilst a smaller works unit was located approximately 220m east. An engineering works occupied the Site of the aforementioned paint works and a railway works occupied a portion of the extensive works site to the north. By the late 1960s a builders yard had been established approximately 60m west.
1980's to present		
	By 1986, the former ballroom was marked as a club. At present the former ballroom has been demolished as has the bus station and shopping arcade in the north of the site and replaced with a temporary events space.	By 1984 electrical substations were evident 75m east, 25m southeast, and 40m and 50m southwest.

*Potentially contaminative uses are shown in bold italics.

6.2 Cultural Heritage

6.2.1 Archaeology

An Archaeological evaluation and Watching Brief has been completed by Archaeological South-East and a corresponding Written Scheme for Investigation done by Waterman, for the excavation of a site-wide sprinkler and wet riser tank. Archaeological artefacts may be of concern for excavations – significant finds have been made within the immediate area and further assessments may be required. It is considered likely that an archaeological watching brief will be in place during the main/additional/ future site

investigation(s). It is anticipated that the site will be of high archaeological interest based on the presence previous finds in the immediate area. Archaeological experts may be required during the next stage of works to understand and highlight the potential risks on site prior to undertaking any intrusive works.

6.3 Unexploded Ordnance

London and Greater London is renowned for heavy bombing during World War II and unexploded ordnance (UXO) presents a risk to construction projects. Unexploded ordnance often entered the ground unnoticed and at high velocity and are still buried beneath the surface. They have the potential to penetrate to a depth of several meters and present significant safety risks to construction workers and surrounding properties. This is reflected in the number of UXO's found since the war, and it is accepted that a significant risk from UXO exists across the London area. On average, 10% of high explosive and 50% of incendiary bombs failed to explode. Due to Reading's proximity to London it may also be at risk.

As the site is located in Reading a considerable distance from central London, the risk of encountering UXO is lower.. However there were around 20 recorded raids on Reading during the war. The soft alluvial deposits present on site may also mean that the ordnance could penetrate the ground to greater depths. The online Zetica unexploded bomb risk maps give a "low" risk rating.

A preliminary UXO risk assessment undertaken by 1st Line Defence classified the risk level as 'minimal' therefore no further actions are recommended.

7. GROUND CONDITIONS

7.1 Geology

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

- Factual Ground Investigation Report, ST Consult, 2014
- Site Investigation Report, Concept, 2012
- Envirocheck Landmark report, 2018
- British Geological Society historical information

The ST Consult report detailed eight distinct types of made ground, overlying Alluvium. The Thames Tower report also identifies another type of made ground. The Alluvium then overlies Taplow Gravel Formation, which was split into a sand dominated member, a gravel dominated member, and mixed sand and gravel member. The Taplow Gravel Formation overlies the Upper Chalk, which was split into an upper layer of structureless chalk and a lower layer of very weak to weak medium dense structured chalk.

presents the location of the exploratory holes that formed the basis of the previous site investigation of the northern part of the site. Figure 7.2: Thames Tower Exploratory Hole Location Plan (Concept, 2012)Figure 7.2 shows the location of the exploratory holes for the Thames Tower investigationas well as the approximate location of the Thames Water Main sewer running beneath the site, shown in yellow.

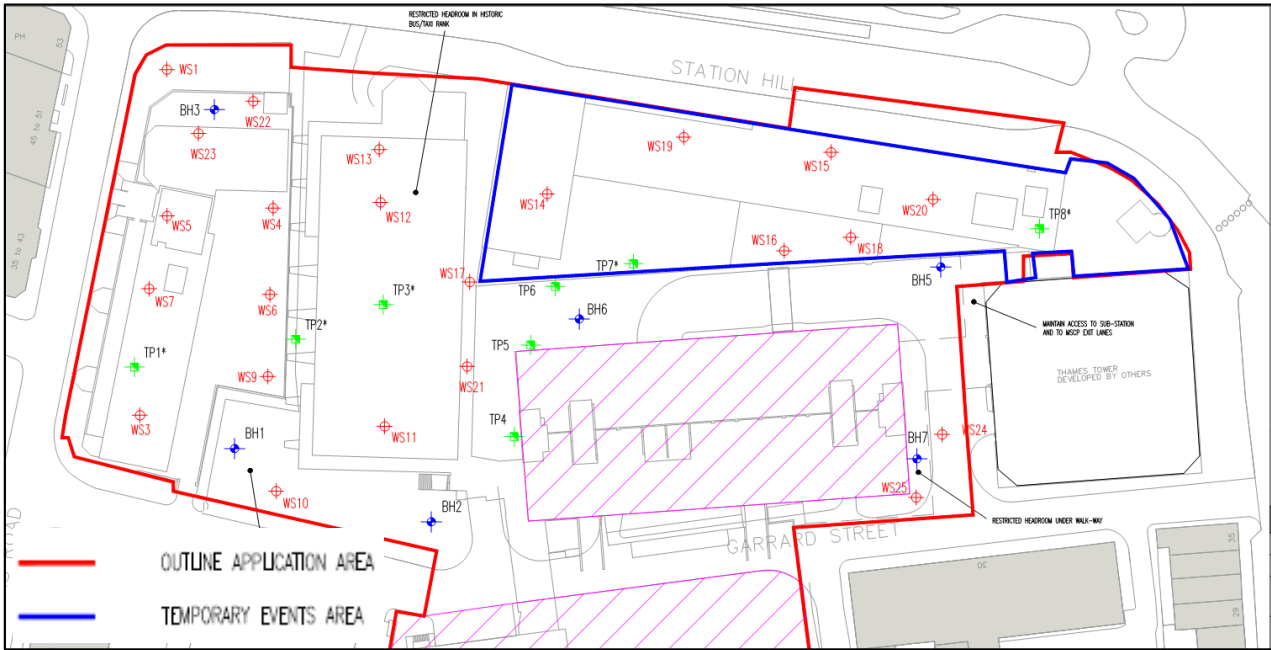


Figure 7.1: Previous site investigation Exploratory Hole Location Plan (ST Consultant, 2014)

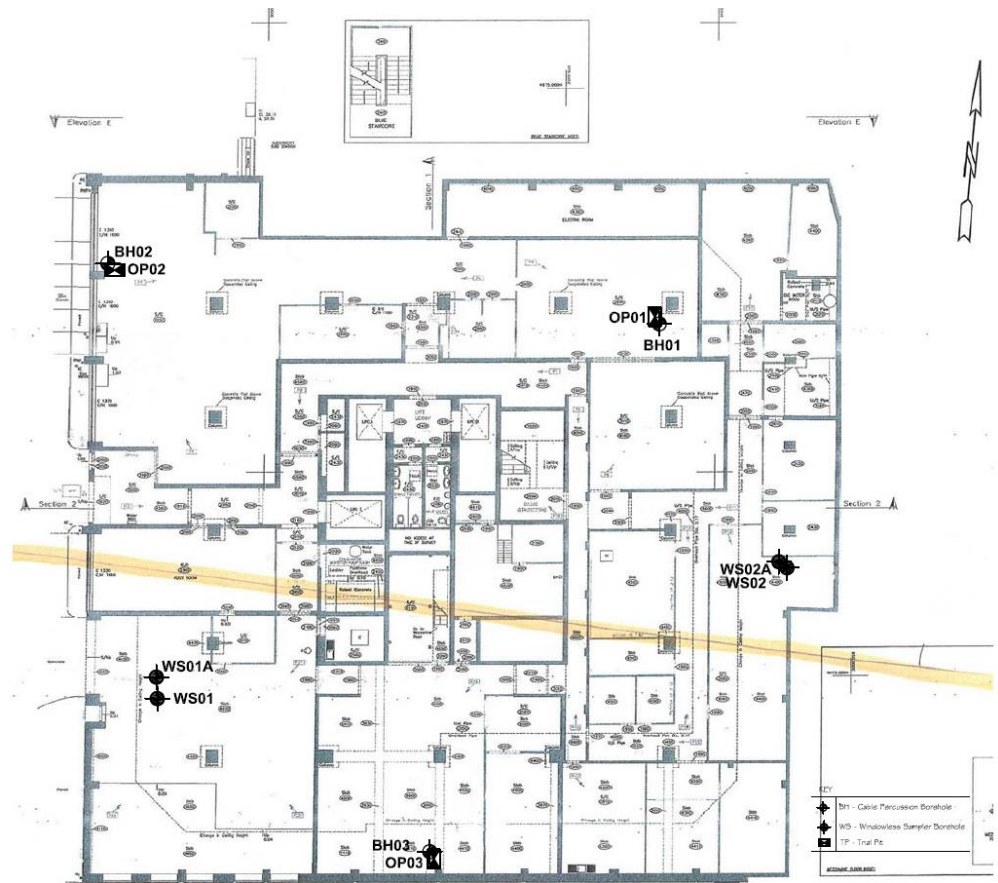


Figure 7.2: Thames Tower Exploratory Hole Location Plan (Concept, 2012)

Made Ground

Made Ground comprises a varying composition and can be split into 9 distinct types detailed in Table 7.1 below.

Table 7.1: Types of Made Ground Encountered in Exploratory Holes during the Waterman 2014 investigation

Soil Type	Depth of top of stratum (mbgl)	Thickness (m)	Typical description
Made Ground 1	0 – 0.02	0.04 – 0.45	Hardstanding – Reinforced concrete slab, Tarmac over concrete, Concrete paving slab
Made Ground 2	0	0.5	Dark brown slightly sandy silty TOPSOIL with abundant fine roots and fine to coarse flint gravel.
Made ground 3	0	0.02 – 0.05	Blacktop
Made Ground 4	0.04	0.11	Brown cemented SAND

Soil Type	Depth of top of stratum (mbgl)	Thickness (m)	Typical description
Made Ground 5	0.2	0.3	Subbase
Made Ground 6	0.10 – 0.25	0.2 – 1.57	Fine to coarse yellow brown to pinkish brown sand with coarse to cobble sized brick fragments and fine to coarse flint gravel.
Made Ground 7	0.75	1.05	Blackish grey sandy clayey gravel. Gravels comprise fine to cobble sized brick and concrete, ashy material and occasional organic material.
Made Ground 8	0.15 – 1.8	0.4 – 3.75	Firm orange brown to dark brown to black organic fine to medium sandy/ gravelly / silty clay with frequent fine rounded chalk gravel, fine to coarse brick and concrete fragments, black ashy fragments, slate, rare metal, charcoal, porcelain, clay pipe fragments and weathered chalk fragments.
Made ground 9	0.39 – 2.7	2.31	Soft, brown silty sandy gravelly clay. Sand is fine to coarse. Gravel is angular to rounded fine to coarse of concrete, brick, flint, slag and chalk and subangular to rounded cobbles and boulders of concrete.

7.1.1 Alluvium

The top of the Alluvium was encountered at between 1.5 and 3.1 mbgl with a thickness varying between 0.7 and 2.8m.

It is described as soft to firm, low to medium strength orange brown mottled greenish grey to black organic silty or sandy gravelly CLAY. Gravel is fine to medium of subrounded flint.

7.1.2 Taplow Gravel Formation

Three variations of the Taplow Gravel Formation were identified with one composed of predominantly sand, another gravel and a third one a mix, detailed in Table 7.2 below.

Table 7.2: Encountered Variations in the Taplow Gravel Formation Strata—observed during the Waterman 2014 Investigation

Soil Type	Depth of top of Stratum (mbgl)	Thickness (m)	Typical Description
Taplow gravel 1	3.0 – 6.5	0.7 – 3.0	Medium dense becoming loose, yellowish brown gravelly sometimes clayey or silty fine to coarse SAND. Gravels comprise fine to medium subrounded flint and rounded quartz.
Taplow gravel 2	3.2 – 4.4	0.6 – 1.8	Medium dense fine to coarse sandy GRAVEL. Gravel is fine to coarse subrounded flint and fine to medium rounded quartz.
Taplow gravel 3	2.95- 4.3	0.4 – 2.7	Medium dense orange brown to dark grey fine to coarse SAND and GRAVEL. Gravel comprises fine to coarse subrounded to subangular flint and fine to medium rounded quartz.

7.1.3 Upper Chalk Formation

The Upper Chalk is split into a structureless chalk layer encountered at between 3.6mbgl and 9.5mbgl with a thickness of 8.7m. It is described as fine to coarse, weak to moderately strong subangular CHALK gravel with abundant coarse to cobble sized flint gravel. Beneath this, structured chalk was encountered at 15.2mbgl in BH1 with an unproved depth to at least 30.2 mbgl. It is typically described as very weak to weak, medium density, white CHALK, with fractures extremely to closely spaced. A Ciria Grade of B5 - B4 at 15.2m, improving to B3-B2 from 24 mbgl, was recorded.

7.2 Hydrogeology/Groundwater

The Made Ground is classified as an Unproductive Strata, with the Environment Agency classifying the Alluvium as a Secondary A Aquifer. The Taplow Gravel Formation is classified as a Secondary A Aquifer and finally the Upper Chalk Formation is classified as a Principle Aquifer. A principal aquifer is a layer of rock or drift deposits that have high intergranular permeability, meaning they usually provide a high level of water storage.

Groundwater was encountered in seven exploratory locations during the ST Consult intrusive investigation, revealing shallow groundwater, associated with the Secondary A aquifers within the Alluvium, Taplow Gravel Formation, and Principle aquifer Upper Chalk Formation. Recorded waterstrike depths during drilling varied between 2.7 mbgl and 5.3mbgl in WS12 (Made Ground), WS13 (Alluvium), BH1 (Alluvium/Taplow Gravel), BH2 (Upper Chalk), BH3 (Taplow Gravel), BH5 (Alluvium/Taplow Gravels), and BH6 (Alluvium/ Taplow Gravels). The Thames Tower investigation had a water strike in WS01A at 3.7m in the Alluvium.

The groundwater levels for both investigation have been summarized in Table 7.3 below. Showing that the groundwater monitoring indicated water levels between 2.15 mbgl and 3.18 mbgl, corresponding to 35.64m AOD and 36.44 AOD.

Taking into consideration the presence of the Made Ground and potential Fill on-site, isolated perched groundwater bodies could be present. Perched water bodies are not necessarily representative of the underlying groundwater regime. It is imperative that a site-specific Site Investigation is undertaken to identify the groundwater regime and across the site.

The Site is not located within a Source Protection Zone (I, II, III), signifying that surface water could be discharged to ground without causing a risk of contamination. There are 12 recorded groundwater abstractions within a 1km radius of the Site, the closest of which is located 0.16km to the southwest of the Site. The abstraction from a single point is licensed to Primark stores that utilize the water for drinking cooking, sanitary and washing (small garden) purposes (Waterman, 2013). The abstraction stratum is not specified but is likely to be from the Chalk.

Table 7.3: Summary of groundwater monitoring results from previous investigations

Waterman, 2014													
Exploratory Hole	Strata	Depth to base of well (m)						Water level (m)					
		12/5	16/5	22/5	30/5	16/6	30/6	12/5	16/5	22/5	30/5	16/6	30/6
WS3	AL, TG	4.9	4.91	4.92	4.92	4.92	4.92	2.28	2.31	2.3	2.22	2.2	2.34
WS12	MG, AL, TG	4.95	4.97	4.96	4.96	4.96	4.96	2.7	2.73	2.72	2.64	2.6	2.75
WS20	MG, AL, TG	4.95	4.87	4.86	4.85	4.85	4.85	2.38	2.41	2.39	2.32	2.3	2.44
WS22	MG, AL, TG	3.9	3.85	3.88	3.87	3.87	3.87	2.23	2.26	2.28	2.16	2.1	2.32
Thames Tower, 2012													
	Strata	Depth	Water level			Strata	Depth	Water level					
			14/06	21/06	05/07			14/06	21/06	05/07			
BH01	AL, TG	9.5	2.82	2.66	2.62	SC	15.0	2.34	3.06	2.80			
BH02	AL	9.5	3.06	3.08	3.16	SC	15.0	3.06	3.09	3.15			
BH03	MG, SC	5.0	2.88	2.94	3.07	SC	20.0	3.03	3.10	3.18			
WS01A	MG, AL	5	2.91	3.00	3.05								
WS02A	MG	2.2	Dry	Dry	Dry								

NB: MG= Made Ground, AL = Alluvium, TG = Taplow Gravel Formation, SC = Upper Chalk Formation (Structureless), CH= Upper Chalk Formation

7.3 Hydrology

The nearest surface water feature is a drainage network 320m northwest of the site, associated with the railway line. The closest point of the River Thames, flowing in an easterly direction, is approximately 420m northeast of the Site. The river Kennet is located approximately 500m southeast of the Site and also flows in an easterly direction.

A Flood Risk Assessment was undertaken by Waterman in 2013, it found the following: The Environment Agency mapping shows the site to be located within Flood Zone 1, and is therefore classified as being at a low risk of tidal and fluvial flooding. The flood risk from pluvial, groundwater and artificial sources has been assessed and found to be low. The current development proposals indicate that over 25% of the site will comprise living roofs, which will reduce the impermeable area of the site and the rate of surface run off. It is anticipated that further attenuation will also be provided by underground storage tanks to ensure that the rate of water run off will not increase over the lifetime of the development.

8. PRELIMINARY SCHEME DESIGN OPTIONS

8.1 Site Overview

The findings of this report indicate that the site is underlain by Made Ground, Alluvium, Taplow Gravels, and Chalk to depth. It should be noted that the chalk comprises a ctructureless chalk layer of variable thickness overlying structured chalk.

Based on the limited extent of historical boreholes and site specific boreholes, there is limited knowledge of the nature and presence of the chalk to depth in the South Site. There is also limited knowledge on the the presence and nature of historic foundations throughout the site. There is also a known basement on site and another potential basement structure within the Plot E area. These will be considered during the phased Site Investigation, design, demolition and construction processes.

It should be noted that the current layout of the site pre-demolition may pose access and plant restrictions. In addition, the northern part of the site is to remain open to the public during the site investigation phase, therefore the phased Site Investigation works developed should consider the least intrusive or disturbing methods.

8.2 Development Proposal

To facilitate the demolition, excavation and construction for the proposed development it is anticipated that liaison will be required with residents, appropriate stakeholders and asset holders adjacent to the site, and highways specialists in order to allow for permanent site access routes.

8.3 Foundations

Possible foundation options may comprise shallow pad or strip footings, raft foundations or deep piled foundations. The selection of these options is influenced by a number of factors relating to the ground conditions and proposed development. These are generally associated with the ability of the ground to support the loads applied by the building above and to the sensitivity of the building to ground movement. **Table 8.1** relates the influences of the various factors on foundation options.

Table 8.1 - Suitability of foundation solutions based on structural options

Item	Influence	Pad or strip footings	Raft foundation	Piled foundation
i	The geology below the site is believed to comprise Made Ground, Alluvium, Taplow Gravel, and underlain by Chalk.	Given the anticipated building loading associated to the proposed development scheme and the uncertainty of the depth and continuity of the Structureless Chalk, as well as the strength characteristics of the Taplow Gravel and Alluvium, it is unlikely shallow foundations will be possible. Ground improvement methods could be employed for some of the lower elevation buildings.	A raft foundation may be suitable to be founded on the Taplow Gravel for some of the plots, depending on the geotechnical ground properties and the proposed building loadings. A raft foundation option may be suitable if completed in association with ground improvements, and depending on the site specific ground conditions. Ground improvement techniques will be used that best minimise the potential for ground water contamination by eliminating where possible, any potential contaminant pathways.	Piled foundations will be suitable to be founded on the anticipated geology. There is likely to be man made obstructions present however in the form of historic foundations. Flint in the chalk beds may also pose an obstruction to piling.
ii	The column grid at foundation level has an impact on the column loads – larger spans result in increased column loads.	Suitable for regular grid subject to magnitude of load and performance requirements of structure. Close spaced grid may result in pads becoming close together and effectively becoming a raft. Pad or strip footings are unlikely to be viable given the anticipated column loads.	Suitable for variable grid subject to magnitude of load and settlement criteria. May become inefficient for large spans.	A piled solution will be suitable for anticipated column loads and may comprise single or multiple pile groups.
iii	Stability cores for the building are often the most heavily loaded area of the structure.	Large pads suitable for cores subject to magnitude of load, overturning and settlement criteria. Pad or strip footings are unlikely to be economic given the anticipated loads and depths of excavations that may be required.	Suitable for cores subject to magnitude of load, overturning and settlement criteria. A raft foundation may be suitable given anticipated column loads depending on site specific ground conditions. This may require local thickening.	Suitable for cores with pile caps. Tensile loads can be supported by piles.
iv	Selection of construction materials affects foundations loads.	Construction materials which increase foundation loads would lead to increasing sized foundations, which may become inefficient at large loads. Live loading characteristics affecting foundation loads and the geometry of shallow foundations. The height of structure (no. of floors) also	Increasing foundation loads require increasing depth of raft and heavier reinforcement, which may become inefficient at large column spans.	Suitable for variable column loads. May require pile groups to support heavier loads. Using a ground bearing floor slab if founded below the Alluvium. A suspended floor slabs is recommended due to the low CBR value of the natural subgrade, the presence of
v	Live loading characteristics of the proposed building use affects foundation loads.			
vi	Height of structure affects foundation loads.			

		affects foundation loads. A suspended floor slabs is recommended due to the low CBR value of the natural subgrade, the presence of organic alluvium in places and the depth and variability of the made ground.		organic alluvium in places and the depth and variability of the made ground.
vii	Sensitivity of the building to foundation movement either due to sensitivity of the structure to differential settlement between foundations or sensitivity of equipment used inside the building.	An ineffective solution to mitigate the risk of differential settlement posed by the laterally and horizontally variable ground conditions. May result in settlement of the foundations and potential for differential settlement where column loads vary across the site. We could incorporate this into the design of the pads however. This may then result in them becoming uneconomical or challenging to construct due to obstructions, with foundations merging in some areas. Ground improvement would be an additional operation and cost, that may bring additional environmental risks.	Suitable for variable column loads and limits differential settlement but subject to column spacing. It would also be possible to incorporate piles under heavily loaded sections, stone columns, or localised thickening of the raft to limit the amount of differential movement.	Suitable for most column loads and layouts and pile design relatively flexible to enable limiting movement to acceptable levels.
viii	Drainage and waterproofing requirements for the proposed development.	Waterproofing can potentially be applied around pad footings. Uplift may need to be considered depending on the relative levels of the groundwater level and founding level.	Waterproofing can be applied below raft foundation. Uplift may need to be considered depending on the relative levels of the groundwater level and founding level.	Waterproofing below floor slab will require penetrations for connections to piles. Uplift may need to be considered depending on the relative levels of the groundwater level and founding level.
ix	Location of the proposed development in relation to adjacent structures and infrastructure.	Ground movement caused by new building loads may affect adjacent buildings but can generally be designed and controlled. The location of underground assets in particular the Thames Water main sewer would have to be considered and incorporated into the design.	Ground movement caused by building loads may affect adjacent buildings but can generally be designed and controlled. The location of underground assets in particular the Thames Water main sewer would have to be considered and incorporated into the design.	Ground movement is generally limited due to the transfer of load to depth within the piles. The location of underground assets in particular the Thames Water main sewer would have to be considered and incorporated into the design.
x	Environmental influences.	Excavation and disposal of material would be required for pad foundations and hence programme and cost considerations must be accounted for. Ground gas protection measures are likely to be required.	Additional excavation and disposal of increased volumes of material may be required for raft foundation compared to other options and hence programme and cost considerations must be accounted for. Ground gas protection measures are likely to be required.	Bored piling methods generate arisings equivalent to the volume of the pile bore and can produce a pathway for contamination to underlying strata. Limited excavation for pile caps may also be required. Ground gas protection measures are likely to be required.
xi	Economic influences.	Reinforcement quantities required and hence programme considerations must be accounted for. Depth or extent of excavation may become uneconomic for larger loads.	Redundancies in the raft design. Local thickening / heave protection may be necessary.	Requires mobilisation of a specialist piling contractor to undertake the work. Expected to require a piling platform. Some piling techniques may require temporary or permanent pile sleeves through unstable material.
xii	Obstructions	Existing foundations have been identified, and will likely remain in the ground as obstructions. Leading to an impact on the proposed foundation programme and cost. Thames water assets are also preent on site and will need to be spanned.	Existing foundations have been identified, and will likely remain in the ground as obstructions. Leading to an impact on the proposed foundation programme and cost. Thames water assets are also preent on site and will need to be spanned.	Existing foundations have been identified, and will likely remain in the ground as obstructions. Leading to an impact on the proposed foundation programme and cost. Thames water assets are also preent on site and will need to be spanned.

8.4 Foundation Recommendations

The foundation options are dependent upon the magnitude of the load, the application and location of the load over the proposed structure, the deformational tolerances of the structure and the findings of the site specific ground conditions confirming the geological and hydrogeological ground conditions.

The available ground condition information is largely inadequate to produce reliable geotechnical parameters for the purpose of preliminary design. A scope of works for additional Ground Investigation to be undertaken has been recommended and is discussed in Section 11.

The proposed Development will comprise the development of two office buildings consisting of 21 and 32 storeys and four residential buildings ranging between 30 and 8 storeys. Based on current proposals, localised excavation may be required in the south west section of the site. The existing retaining wall is to be retained to provide temporary support, with a new retaining wall cast in-situ against the existing one. The feasibility of the proposed foundation options will be assessed further after a detailed Site Investigation has been undertaken, however, the most feasible foundation options anticipated for the proposed structures at this stage are as follows:

- shallow foundations comprising a raft founded on Taplow Gravel Formation combined with ground improvements for the lower rise buildings; or/and
- piled foundations founded within the Upper Chalk.

8.4.1 Raft Foundation

A raft foundation solution may be feasible, for the lower rise buildings if associated with possible ground improvements. This solution can be used to spread column loading across a large ground area. The stiffness of the raft assists in limiting total and differential settlements for moderate column loads. If a raft solution is used, careful consideration of the founding level of the raft in relation to both a suitably stiff founding layer, beneath the Made Ground, and the site specific water table will also be required. Since the raft may be founded below the water table dewatering may be required during construction. Uplift due to water pressures on the underside of the raft should also be considered in both temporary and permanent cases using an active drainage system. If the raft is founded below the water table, tension piles may be required/incorporated below the raft to combat any significant uplift and heave pressures.

8.4.2 Piled Foundations

Based on the known ground conditions from the historic investigations and understanding of the proposed structure, a fully piled solution is considered feasible for all the proposed buildings. These could be constructed by boring, driven cast-in-place piles, driven pre-formed piles or continuous flight auger (CFA) piles, although CFA piles are considered most suitable for the development, which are relatively quiet and vibration free. This would pose significant advantages compared to other piling methods due to the proximity of adjacent assets such as the Thames Water assets. Piles would be founded within the Chalk. The economical aspects of this foundation option include the requirement of mobilisation of a specialist piling contractor to undertake the work; this specialist contractor can also undertake retaining wall installation if a secant or contiguous wall is considered.

A piled solution is suitable for large column loads and may comprise single piles under columns or multiple piles in groups. Piled foundations are suitable for cores with pile caps. Piles are suitable for supporting tensile loads, variable column loads and limiting movement to acceptable levels where differential settlements cannot be controlled sufficiently by shallow foundations.

Construction of piled foundations from the existing ground level may require cutting down of piles. Waterproofing below the basement floor slab will require penetrations for connections to piles. Reinforcement cages and large plant are required on site and hence a piling mat is likely to be required.

It should be noted that piles can produce pathways for the vertical downwards migration of contaminants, should they be identified, in the upper soils to important aquifers at lower levels.

8.4.3 Retaining wall

The current proposals require a retaining wall to be constructed in the south west section of the site. It is to be cast against the current retaining wall which will provide temporary support. As such there is only one option for retaining wall available, cast in situ.

8.5 Geotechnical Hazards

8.5.1 Unknown Ground Conditions

Although information about the anticipated ground conditions at the site has been presented in this report, site specific ground conditions for the site are largely unknown, as are the engineering parameters of the strata, particularly at depth. Therefore, recommendations about the foundations and substructures for the development and analysis of potential hazards are of a preliminary nature. It should be noted that as only BH1 from the previous investigation reached below the Structureless Chalk its depth across the site is unknown and may vary significantly, especially as it was observed to be significantly lower beneath the adjacent Thames Tower.

The nature and extent of the existing/historic foundations is known for the Friars Walk Shopping Centre, NCP Car Park, and Western Tower, however are unknown for Xafinity House, Retail Parade, Telecoms House, and the former Bingo Hall/Bus Station.

8.5.2 Groundwater

The geology beneath the site comprises superficial deposits of Alluvium and Taplow Gravels overlying bedrock in the form of the Upper Chalk. The Alluvium and Taplow Gravels are classified as a highly porous and permeable rock, acting as Secondary aquifers with the Chalk beds being the Principal Aquifer.

Natural groundwater conditions from the available site investigation data indicate the groundwater is anticipated to be approximately 2.15m-2.75mbgl. Really need to relate this to the water bearing strata – Secondary and Principle aquifers would suggest separate aquifers, rather than hydraulic continuity existing between the Alluvium/Taplow and the Chalk.

With the presence of Made Ground, areas of known Fill and potential Fill on-site, isolated perched groundwater bodies could be present. There is an absence of groundwater data available for sections of the site in particular the southern section, therefore it is recommended to undertake site specific investigations and groundwater monitoring to characterise the groundwater regime for detailed design. In order to provide efficient design of such measures, additional pumping trials may be required as the scheme develops.

The presence of groundwater impacts the bearing capacity and settlement response of the ground through time. The groundwater level will therefore need to be considered during substructure and possible retaining wall design. Long-term groundwater monitoring to capture seasonal variations in groundwater levels should mitigate the risk of, for example, foundations being designed for unrepresentative low groundwater levels that may be encountered during periods of low rainfall or in summer months.

Care will need to be taken when drilling/piling into aquifers to avoid contamination.

Groundwater controls may need to be put into place during construction, and health and safety mitigation measures implemented.

8.5.3 Aggressive Ground Conditions

There is potential for contamination from The Great Western Railway that runs parallel to the site boundary 60m north since before first maps in the late 1870's. Garages that were situated 90m southwest and 50m southeast of the site by 1957. Engineering works were also identified on the historical maps to the north-west and north of the site. Four electrical sub-stations were also identified within 80m of the site.

Potential contaminants that may be present as a result of the historic industrial land use in the surrounding area has the potential to migrate onto site.

There is also potential for contamination to be present in Made Ground at the site, with ash, brick rubble and metal fragments encountered. Ramboll have assumed that there is potential for contamination within the ground and groundwater which may create aggressive conditions for concrete. An assessment of the potential contamination and natural chemistry of all strata will therefore need to be carried out, with concrete designed accordingly.

8.5.4 Obstructions

- Foundations and Substructures

There is likely to be foundations from the historic/current buildings present on site, the extent and nature of which are not completely .

Obstructions to future works such as excavations and pile construction if they are not correctly identified during the ground investigation works, and consequently not removed during demolition and excavation works. Re-use of the existing foundations may be possible once a survey has been completed to ascertain their length and hence bearing capacity.

- Services

A high density of services is known to exist in and around the site beneath Greyfriars Road, Garrard Street, and Friar Street although their exact location is currently unknown. Local service connections and other local services such as CCTV, fibre-optic etc. may also exist throughout the site. Services into the site will need to be disconnected as the phased development takes place. There is also the possibility of unknown buried services beneath the site which could present an obstruction to Site Investigation and future intrusive works, while also presents a health and safety risk to site workers.

There is a 1250mm diameter brick foul sewer running west to east beneath the northern section of the site, at a depth of approximately 4 mbgl, with three 225mm diameter sewers branching off, as seen in Figure 8.1 below. Further liaison with Thames Water including the provision of as-built drawings and sections will provide more conclusive certainty of the location details of their tunnel. Protection zones associated with Thames Water tunnel asset may limit the location, proximity and construction methods of foundation and retaining wall structures. Pre- and Post- construction condition surveys may be required, along with monitoring and inspections during the course of the site development. Impact Assessments may also be required by Thames Water to demonstrate the effect of demolition and construction activities associated with the proposed development.

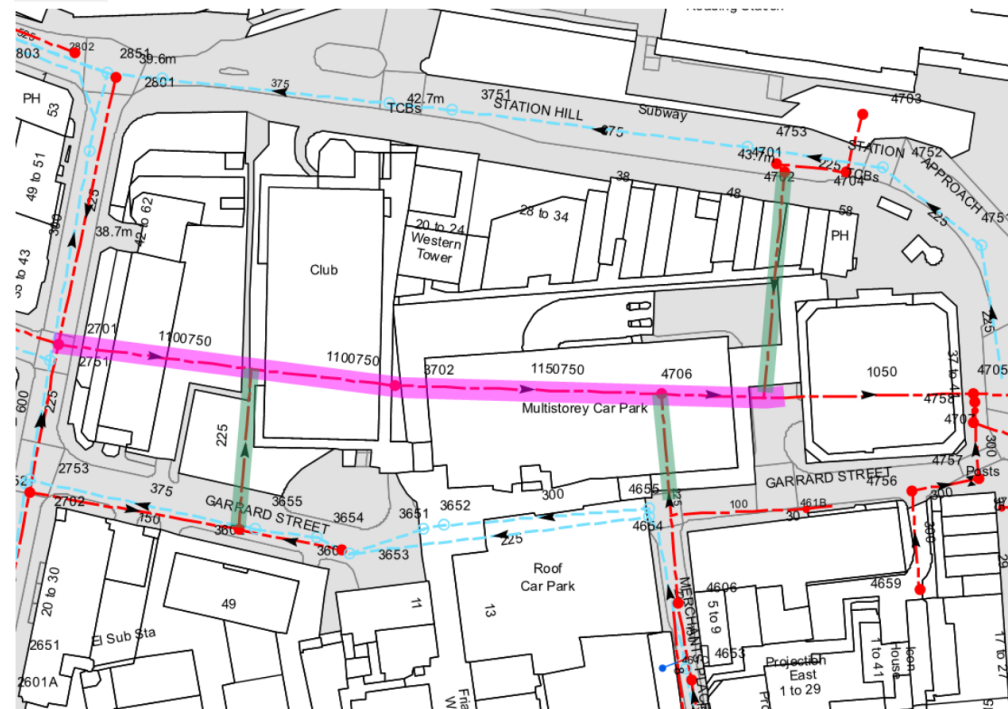


Figure 8.1: Map of Thames Water Sewer, Hoare Lea Thames Water Note

8.6 Further Works

A full geotechnical assessment of the site should be carried out in order to facilitate design of the substructures for the proposed developments. This should include a ground investigation and geotechnical design reports, in accordance with Eurocode 7.

The ground investigation should be targeted to the anticipated location of foundations and assess shallow and deep ground conditions. It should include in-situ and laboratory geotechnical testing and ground gas and groundwater monitoring. It is likely that this investigation would be combined with a structural, environmental and archaeological assessment. Details of ground investigation works and additional intrusive works will be determined at a later project stage.

A full search of existing buildings drawings is going to be undertaken in order to gather informations on the existing foundations. A separate site investigation is recommended after demolition, to assess the nature and extent of the existing foundation present on site and confirm the details of existing information.

9. PRELIMINARY CONTAMINATION ASSESSMENT

9.1 Framework for the Assessment of Contamination

Environmental risks are assessed within the risk management framework established in Part IIA of the Environmental Protection Act (EPA) 1990 (HMSO, 1990), which provides a statutory definition of contaminated land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that:

- a) Significant harm is being caused or there is a significant possibility of such harm being caused;
- b) Pollution of controlled water is being, or is likely to be caused; or
- c) Risk from contamination is assessed by consideration of possible linkages between contaminant sources and potential receptors which could be harmed or polluted.

The key aspect of the framework is the development of a Conceptual Site Model (CSM) which illustrates the spatial interaction between the potential sources and receptors on site.

The information presented in the previous sections of this report were collated and evaluated to develop a preliminary CSM to assess ground contamination issues at the site.

For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- A source, i.e., a substance that is capable of causing pollution or harm;
- A receptor, i.e., something which could be adversely affected by the contaminant; and
- A pathway, i.e., a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

Potential sources, pathways and receptors are identified in the sections below and the risks associated with possible pollutant linkages outlined.

9.2 Potential Contamination Sources

The main sources of potential contamination that have been identified at the site, or in the vicinity of the site are summarised in **Table 9.1**.

Table 9.1 - Potential Sources Contamination

Source	Detail and Potential Contaminants of Concern
Onsite Sources	
Made Ground (Ground contamination)	Made Ground with elevated inorganic and organic contaminants following the site investigation (Waterman, 2014), in particular those mentioned in section 3.2. Visual and olfactory contaminative impacts have been identified during the site investigation, including hydrocarbon staining and strong odour. Made Ground has been identified with ash, brick and

Source	Detail and Potential Contaminants of Concern
	concrete rubble and rare scrap metal fragments. Asbestos has been identified across the site. Inaccessible areas of the site have been largely uncharacterised and may have a high likelihood of contaminative impacts. A potentially infilled pond has been identified on site within the Envirocheck report, beneath Garrard Street MSCP. Potential contaminants: heavy metals, Total Petroleum Hydrocarbons (TPH), Poly Aromatic Hydrocarbons (PAHs), Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), phenols, chlorides, sulphate, sulphides, Asbestos Containing Material (ACM).
Historical and current site use (including garages, bus station, multi-storey car park) (Ground and groundwater contamination)	The site has been previously occupied by a garage, car park, coal yard and bus station. The historical maps illustrate a garage located in the centre of the site with a car park and bus station constructed by the early 1960's. A coal yard was present to the south of the site. Potential contaminants: heavy metals, Total Petroleum Hydrocarbons (TPH), Poly Aromatic Hydrocarbons (PAHs), Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), phenols, chlorides, sulphate, sulphides, Asbestos Containing Material (ACM), MTBE.
Electricity Sub-Stations (ground and groundwater contamination)	Three electrical sub-stations have been noted during a site walkover (Waterman, 2013) with unknown potential for release of PCBs. Potential contaminants: heavy metals, Polychlorinated Biphenyl (PCBs), Total Petroleum Hydrocarbons (TPH), Poly Aromatic Hydrocarbons (PAH), Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs) and Asbestos Containing Material (ACM).
Ground gas and vapours contamination	Generation potential primarily associated with unknown composition of Made Ground and natural ground within the areas where site investigation access was restricted. Elevated concentrations of carbon dioxide (CO2) and methane (CH4) and depleted concentrations of oxygen (O2).
Fuel tanks (ground contamination)	The historical data report from Envirocheck identified two potentially fuel related tanks on site, on the 1969 historic map. Whilst no tanks were identified onsite during the site walkover (September 2018), residual contamination may be present. Potential contaminants: heavy metals, Total Petroleum Hydrocarbons (TPH), Poly Aromatic Hydrocarbons (PAHs).
Offsite Sources	
Historic and current industrial land use (including garages, engineering works, railway and electrical sub-stations)	A review of the surrounding areas history highlighted industrial land use within 100m of the site. The Great Western Railway runs parallel to the site boundary 60m north since before first maps in the late 1870s. Garages were situated 90m southwest and 50m southeast of the site by 1957. Engineering works were identified on the historical maps to the northwest and north of the site. Four electrical sub-stations were also identified within 80m of the site.

Source	Detail and Potential Contaminants of Concern
(Ground contamination)	Potential contaminants that may be present beneath the site as a result of the historic industrial land use in the surrounding area have the potential to migrate onto site. Potential contaminants: heavy metals, Total Petroleum Hydrocarbons (TPH), Poly Aromatic Hydrocarbons (PAH), Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), Asbestos Containing Material (ACM), phenols, solvents and Polychlorinated Biphenyl (PCBs).
Fuel tanks (ground contamination)	Historical Building Plans Information has identified three underground fuel tanks and oil storage within 100m south of the site. Potential contaminants: heavy metals, Total Petroleum Hydrocarbons (TPH), Poly Aromatic Hydrocarbons (PAHs).
Ground Gases (Made Ground and natural strata)	Generation potential primarily associated with unknown composition of Made Ground in the surrounding area of the site. Elevated concentrations of carbon dioxide (CO₂) and methane (CH₄) and depleted concentrations of oxygen (O₂).

All potential off-site sources and contemporary trade directories 500m or more from the site have been omitted from further assessment based upon the proximity of the source to the subject site, the nature of the various potential sources and the absence of any reportable environmental incidents

9.3 Potential receptors

The site-specific receptors that could potentially be affected by contamination hazards are summarised in **Table 9.2**.

Table 9.2 - Potential Receptors

Receptor	Details
Future Site Users	The current buildings and structures on site are to be demolished, with high rising residential and office buildings to replace these.
Construction Site Workers	Any workers coming into contact with ground, or material impacted by any contamination.
Adjacent Site Users	The site is situated in an area of residential and commercial/industrial land use. Reading railway station is located to the northeast, residential housing to the west, Friar Street to the south; and hotel and office buildings to the east of the site.
Controlled Waters	The BGS maps reviewed indicate the geology surrounding the site to comprise superficial deposits of Alluvium, Taplow Gravel (River Terrace Deposits) and Seaford Chalk Formation at depth.

	The superficial River Terrace Deposits (Taplow Gravels) are classified by the Environment Agency as a Secondary A Aquifer. The bedrock of the Seaford Chalk Formation is classified as a Principal Aquifer. According to the Environment Agency sources, the site does not lie within a Source Protection Zone (SPZ). Six groundwater abstractions are located within 1000m of the site; the nearest of these is held by Primark Stores Limited abstracted from a single point located 137m southwest of the subject site, for potable water supply. The nearest surface water abstraction is located 476m south of the site, held by Oracle Shopping Centre Ltd. The water is used for lake and pond throughflow.
Buildings and Structures	Infrastructure and construction materials associated with the future development, including building foundations and potable water supply pipes.
Flora	Areas of soft landscaping may potentially be included within the final design plans for the proposed development.

9.4 Potential Pathways

If contamination is encountered, to reach the receptor there has to be a viable pathway for the contaminant. The site-specific pathways identified during this preliminary appraisal are summarised in **Table 9.3**.

Table 9.3 - Potential Pathways

Receptor	Pathway	Comments
Human Health (Future site users, construction workers and adjacent site users)	Direct contact: Dermal, Ingestion, Inhalation	Construction workers have the potential to come in direct contact with soil during site enabling works and construction activities. The use of Personal Protection Equipment (PPE) would mitigate the exposure to residual contaminants. Construction activities also have the potential to generate dust particulates which therefore presents an inhalation risk to construction workers and adjacent site users. The proposed development includes construction of office space and residential accommodation (Section 1.2). Therefore, future site users are unlikely to come into contact with contaminated soils on the basis that the site will be covered in hardstanding. If considered, soft landscaping areas within the proposed development could present a potential pathway that could impact future site users. If soft landscaping areas are limited to above ground planters, the potential for future

Receptor	Pathway	Comments
		site users to be exposed to contamination in site soils would be limited.
	Accumulation of hazardous vapours, ground gases and dust generation	Future site users and construction workers have the potential to be affected by elevated concentrations of hazardous ground gases (CO₂ & CH₄) and depleted O₂ and also volatile organic compounds which may be present in the ground. Gases may migrate accumulate in internal spaces within the proposed development structure. The use of PPE and Respiratory Protection Equipment (RPE) would mitigate the exposure of Construction Workers to harmful ground gases during the construction phase. Construction workers and adjacent site users may be affected though dust ingestion and inhalation during construction work.
	Vertical migration of soil impacts to the Secondary A and Principal Aquifers	Leachable contaminants have the potential to impact controlled waters via vertical and lateral migration. The majority of the site is currently covered by hardstanding with limited areas of soft landscaping, as such infiltration is likely to be limited. Where hardstanding is present, the potential for infiltration and leaching will remain limited, however potential contamination within these areas could impact groundwater onsite via lateral migration. The site is underlain by Taplow Gravels; the highly permeable nature of this formation may facilitate the vertical migration of contamination into the impermeable Seaford Chalk.
	Lateral migration to surface water	River Thames is situated 460m northeast and River Kennet is situated 550m southeast of the site. Due to presence of groundwater at shallow depths and presence of permeable superficial deposits (Taplow gravels) underlying the site, there is potential pathway by

Receptor	Pathway	Comments
		which the contaminants may laterally migrate to the surface water.
Buildings and Structures	Damage to building materials or services through direct contact with contaminants, contaminant migration	Aggressive ground conditions and hydrocarbons, sulphates and other contaminants which may be present in the ground have the potential to affect subsurface construction materials (in particular water supply pipes, where applicable, and buried concrete). Hazardous ground gases and vapours may also have the potential to migrate and build up in in buildings and confined spaces.
Flora	Plant uptake	Areas of soft landscaping may potentially be included within the final development plans; however it is likely that these areas will be limited.

9.5 Qualitative Risk Assessment

Potential pollutant linkages are identified using the source-pathway-receptor framework detailed above. An assessment of the potential significance of each linkage is then made by consideration of the likely magnitude and mobility of the source, the sensitivity of the receptor and nature of the migration/exposure pathways.

This qualitative hazard assessment has been undertaken in accordance with NHBC and Environment Agency, 2008. Further details of legislative Context are presented in **Appendix E**, including risk categories and the assessment methodology.

An assessment of the likelihood of the risk being realised and the magnitude of potential risk is presented below to give an estimation of the significance of each potential pollutant linkage identified. The assessment is undertaken based on the end use proposed.

9.6 Pollutant Linkages

Table 9.4 forms an assessment of the significance of potential pollutant linkages associated with the site.

Table 9.4 - Preliminary Conceptual Site Model

Source	Pathway	Receptor	Potential Severity	Probability	Level of Risk
Made Ground (Ground contamination)	Dermal contact, ingestion and inhalation of	Future site users	Medium	Low	Moderate/Low
		Construction workers	Medium	Likely	Moderate*

Source	Pathway	Receptor	Potential Severity	Probability	Level of Risk
	dusts and vapours	Adjacent site users	Medium	Unlikely	Low
	Inhalation of free fibres (ACMs)	Future site users	Severe	Unlikely	Moderate/Low
		Construction workers	Severe	Likely	High*
		Adjacent site users (during enabling works / construction)	Severe	Low	Moderate
	Leaching and migration via groundwater	Secondary A and Principal Aquifers	Medium	Likely	Moderate
		River Thames and River Kennet	Medium	Unlikely	Low
	Direct Contact	Construction Materials	Medium	Likely	Moderate
	Ground Contamination from Current and Historical Site Use	Dermal Contact, Ingestion and Inhalation of dusts/soils	Future site users	Medium	Unlikely
Construction workers			Medium	Likely	Moderate*
Adjacent site users			Medium	Unlikely	Low
Inhalation of vapours		Future site users	Medium	Low	Moderate / Low
		Construction workers	Medium	Likely	Moderate*
		Adjacent site users	Medium	Unlikely	Low

Source	Pathway	Receptor	Potential Severity	Probability	Level of Risk
	Leaching and Migration via groundwater	Secondary A and Principal Aquifers	Medium	Likely	Moderate
		River Thames and River Kennet	Medium	Unlikely	Low
	Direct Contact	Construction Materials	Medium	Low	Moderate / Low
Fuel tanks (ground contamination)	Dermal contact, ingestion and inhalation of dusts/soils	Construction workers	Severe	Low	Moderate*
		Future site users	Medium	Low	Moderate / Low
		Adjacent site users	Medium	Unlikely	Low
	Leaching and Migration via groundwater	Secondary A and Principal Aquifers	Medium	Likely	Moderate
		River Thames and River Kennet	Medium	Unlikely	Low
	Direct Contact	Construction Materials	Medium	Low	Low/moderate
Off-site Ground Contamination from Historical/Current Industrial Sources (Leaching and migration of contaminants from infilled land, Made Ground and historical/current industrial sources such as garages, engineering works, car park)	Dermal contact, Ingestion and Inhalation	Future site users	Medium	Unlikely	Low
		Construction workers	Medium	Likely	Moderate *
	Direct Contact	Construction Materials	Medium	Low	Moderate / Low*

Source	Pathway	Receptor	Potential Severity	Probability	Level of Risk
Electricity Stations	Dermal contact	Future site users	Medium	Unlikely	Low
		Construction workers	Medium	Low	Moderate / Low *
	Leaching and Migration via groundwater	Secondary and Principal Aquifers	Medium	Low	Moderate / Low
		River Thames and River Kennet	Medium	Unlikely	Low
	Direct Contact	Construction Materials	Medium	Unlikely	Low
Ground Gases (onsite and offsite sources)	Ground gas migration and inhalation	Future site users	Severe	Likely	High
		Construction Workers	Severe	Likely	High*

Notes:

Assessment completed assuming site in current condition. Should site levels be altered during development, a reassessment would be required.

*The risks to construction workers and site operatives will be reduced to Low on the assumption that the contractor will deal with all risk to construction workers, based on the hazards identified within this report and revised according to ground conditions encountered during any on-site activities. The Contractor will be responsible for site Health and Safety and will manage the risk through control of suitable Health and Safety measures including provision of PPE, appropriate site infrastructure, education of the workforce and inductions for all site staff and visitors.

10. HAZARD REGISTER

The risk register contained in Table 10.10.1 is based on a review of documentary evidence concerning the site setting, the ground conditions beneath the site and the historical structures. A number of general and particular hazards to the proposed development have been identified and collated into a register for the site which provides a focus for actions required to mitigate the effects of each item at the earliest stage in the design development. The risks reported are limited to the information available at the time of preparation. The list is not exhaustive and further development of this risk register may be required as further information becomes available.

Table 10.10.1 - Risk Register for Station Hill.

Subject	Hazard	Potential Consequence	Mitigation Measures
Geology			
Ground Conditions	Unkown/ variable thickness of the Made Ground / Infill across the site, especially in the southern section, due to limited site specific exploratory holes. Composition and geotechnical properties of the Made Ground and Taplow Gravels can be variable limiting passive resistance at shallow depths, this would require more extensive temporary works during construction. The presence of Alluvium on site is variable. A comprehensive ground investigation covering the whole site has not been undertaken and therefore site-specific ground conditions and geotechnical design parameters are not fully understood.	Made Ground / Infill, Alluvium, and Structureless Chalk, are unlikely to be suitable as a founding stratum due to variable properties. Over conservative or unsafe foundation and substructure design. Excessive and / or differential settlement. Delays due to unforeseen ground conditions; cost and programme implications. Removal and replacement with engineered fill or ground improvement options may be required to ensure bearing capacity and settlement performance requirements. Such options would also require environmental assessment and there may be increased costs associated with such options.	Undertake a project specific ground investigation to characterise ground conditions for detailed design. The results shall be used for system selection and concept design of the substructure and potential ground improvement works, and update the recommendations for the mitigation and management of ground based risks within this register.
Aggressive Ground Conditions	Ground chemistry and its aggressivity to buried structural materials have not been sufficiently characterised. Potential sulphate bearing minerals. Potential presence of asbestos fragments and organic soils can lead to aggressive conditions. Made Ground could be a source of heavy metals, inorganics, asbestos, phenols, petroleum, hydrocarbons, ground gases etc.	Long term exposure resulting in deterioration of concrete strength, leading to unsafe design and additional maintenance costs. Vertical migration through the weathered soils. Programming and cost implications and excavation complications.	
Ground Gas	Ground gases can be generated from any organic material present in the Made Ground / Infill material or Alluvium on or adjacent to the site. Ground gases can be generated from off-site sources and migrate onto the site through permeable strata. If present, Alluvium can produce ground gas such as Methane and Carbon Dioxied.	Accumulation in confined internal spaces. Potentail for toxic or explosive atmospheres. Risk of inhalation of potentially poisonous gas by construction workers and/or future users of the site. Ground gas/ vapour protection measures may be required.	Undertake an appropriate ground investigation with the installation of ground gas monitoring wells, followed by a period of ground gas monitoring to obtain data to inform the ground gas risk assessment for the site. In the event that ground gas protection measures are required, incorporate the measures into the substructure design of the scheme.
Compressibility	Alluvium generally has a high volume change potential under compression, and can lead to negative skin friction values affecting pile capacity. The extent and depth of the Alluvium is known to be highly variable in the northern section of the site and unknown for the southern section.	Unsafe substructure design and failure of foundations. Differential settlement response across the site. In addition to foundations and substructures, there are also implications for external paving and hard-landscaping features and buried services. Delays due to unforeseen ground conditions; cost and programme implications.	Ground Investigation will establish the parameters of the Alluvium that could contribute to compressibility, such as its depth and volume change potential. An assessment of proposed excavations and associated ground movements will be carried out to assess the impact of the proposed development works, including how these may impact on neighbouring structures and assets. Foundation design to be carried out by taking into account these features if present. The wider implications on the development proposals should consider this.
Hydrology and Hydrogeology			

Subject	Hazard	Potential Consequence	Mitigation Measures
Groundwater	Shallow and perched groundwater potential on site within the Made Ground / Infill. Historic BGS boreholes surrounding the site provide some evidence of perched groundwater. What about the Secondary and Primary aquifers?	Ingress into excavations for foundations or to remove pre-existing and / or existing building foundations could allow contaminated stagnant groundwater migration and infiltration.	Undertake a project specific ground investigation to characterise groundwater regime for detailed design.
		Health and safety impact on site operatives.	Consult a dewatering specialist to design a practical maximum dewatering depth in the temporary case.
		Impact of potential dewatering / groundwater control measures of adjacent structures / services.	Consult the receiving authority if necessary to dewater and dispose of groundwater to a foul sewer to determine if any pre-treatment is required prior to discharge and whether a discharge license is required.
		Programming and cost implications and potential environmental liability.	
		Reduction in the effective unit weight of the ground due to saturation reduces lateral confining pressures, and hence reduces bearing capacity and increases settlements.Uplift pressures may act on shallow foundations and sub-structures. Potential for excessive movement from dewatering schemes. Water ingress into basement areas.	The site investigation will include groundwater monitoring installations in order to better understand and model the groundwater conditions. The groundwater level, including seasonal variations will be considered during substructure design. Undertake early liaison with stakeholders and undertake impact assessments to understand the implications of changing groundwater conditions due to temporary groundwater control measures that may be required to facilitate construction. Adjacent structures and key underground utilities to be monitored for excessive movements and appropriate measures in place to monitor groundwater levels.
		Water entering pile bores can reduce the strength and adhesion of the cohesive strata, negatively influencing pile capacity.	A method of piling will be selected that minimises the potential for groundwater contamination. By using continuous flight auger (CFA) piles, it should be possible to prevent groundwater from the Made Ground / Infill and Taplow Gravels entering the bore.
	The chemistry and aggressivity of the groundwater has not been determined.	Potential use of deep piled foundations or retaining walls may provide a preferential pathway for any underlying contaminants (if any), into the Principle Aquifer.	Undertake a project specific ground investigation to characterise groundwater chemistry across the whole site for detailed design.
		Damage to sub-surface structural materials.	Design of sub-surface construction materials to account for groundwater chemistry. A Foundation / Piling Works Risk Assessment will ensure that appropriate measures are put in place to protect the aquifers beneath the site.
Flood Risk	The site is located within a Flood Zone 1 and therefore has a low probability of flooding from rivers (less than 1 in 1000 annual probability of river or sea flooding). The risk of flooding from pluvial, groundwater, and artificial sources has been assessed as being low.	May pose risk of flooding to the property. This may result in damage to property, loss of use, risk to site users, affect layout, FFL, uses and cost of the scheme.	A flood risk assessment has previously been completed to investigate the risks and consider the need to incorporate appropriate mitigation measures into the proposed scheme. The assessment concluded the site was at a low risk of flooding.
Surface Water Drainage	Potentially need to reduce runoff rates compared to the existing situation.	Provide strategies for surface runoff attenuation.	Consider drainage implications early in the design process, undertake consultation with lead local flood authority (LLFA) to agree discharge rates.
Ground Contamination	Ground contamination may be present at the site as a result of onsite historic land uses such as Garages, Bus Station, Coal Yard, Factory, Car Park, Timber Yard and Tanks.	Potential risk to human health, controlled waters and other receptors.	Undertake an intrusive Ground Investigation with soils and groundwater chemical analysis to characterise potential contamination at the site.
	Ground contamination could also be present as a result of the composition of the Made Ground or infilled ground at the site. During the site investigation carried out by Waterman (2014), some elevated concentrations of inorganic and organic contaminants were identified. The assessment only considered potential future commercial end use not the more sensitive residential use now proposed however, and only covered north side of the current study site.	Programming and cost implications. Potential environmental liability. Possible cost and programme implications, increased disposal costs if material is contaminated. Damage to structural materials. Where ground contamination is present care must be taken to ensure that the potential foundation works do not create significant pathways for the vertical downwards migration of contaminants in the upper soils to the Superficial Secondary A Aquifer (River Terrace	Undertake a screening and risk assessment in order to identify how risks should be managed as part of the proposed development. Undertaken a preliminary waste assessment to characterise the soils that will be taken for offsite disposal.

Subject	Hazard	Potential Consequence	Mitigation Measures
	Potential migration of off-site contamination present as a result of historical and current industrial land use onto site, via groundwater migration. Potential contaminants in groundwater due to leaching and migration, with the potential for vertical migration into underlying Superficial Secondary A and Principal Aquifers.	Deposits) and the Principal Bedrock Aquifers at depth (Thanet Sands and Chalk Group Formation).	
Waste Management	Should materials require off-site disposal they will be subject to waste management regulations e.g. duty of care regulations.	Offsite disposal will be subject to waste management regulation. Cost and programme implications. Increased disposal cost if material is contaminated.	Minimise offsite disposal by optimising cut and fill, subject to suitable testing, and liaising with the client for the potential to store excess spoil on various sections of the site. Ensure contamination testing is undertaken at an early stage. Samples should be collected and tested for waste classification purposes. Depending on the receiving facility, materials destined for landfill disposal may need to meet Waste Acceptance Criteria. Prepare Site Waste Management Plan for the new scheme if required.
Unexploded Ordnance	Reading is known to have been bombed during WWII and unexploded bombs may still exist on or near the site. Being close to the train station the site may have been a target.	Risk of explosion and risk to site workers during site investigation work and construction. Risk to future occupants of the site, the general public and structures within the vicinity of the site. Health and safety implications during construction and final usage.	There is a low risk of encountering unexploded ordnance within underlying strata as understood from the Zetica website. A specialist consultant (1st Line Defence) has been commissioned to carry out a desk based UXO assessment of the site prior to the site based intrusive works. No further recommendations were suggested.
Asbestos	Asbestos (chrysotile and amosite) has been identified within the Made Ground during the ground investigation by Waterman (2014). These were found as free fibres as well as cement; and the quantification analysis gave a maximum asbestos concentration of 0.12% of weight from total soil sample. It is considered likely that there will be additional asbestos impacts across the areas of the site not yet investigated.	Health and safety implications. Potential programme and cost implications due to removal. Increased disposal costs if soils contain asbestos.	Screen Made Ground / Infill samples taken during the ground investigation for asbestos for contamination testing. Appropriately qualified personnel / consultants should be commissioned to assess the risk of asbestos on site prior to any demolition or intrusive works.
Obstructions			
Historic Foundations and Existing Retaining Walls	Foundations associated with the current and historical buildings may remain in-situ within the ground. The site is known to have undergone a number of developments, the extent of historic foundations is not known exactly. It is also unknown whether historic basements on the site have been infilled and whether the foundations are still present.	Obstructions to future development and intrusive ground works; concrete slab and paving stones present at depth. Delays due to unforeseen ground conditions; cost and programme implications. Excessive dust and noise upon removal of the concrete slabs and potential limited hours of work. Existing foundations may have to be removed, which is an expensive, time-consuming, and energy-intensive activity. Reduction of the strength of the soil and capacity of newly-constructed foundations – may require an appropriate founding fill adding to cost implications. Underpinning works / temporary propping works may be required to allow the required excavation – potential programme and cost implications.	Obtain available information about former structures on the site. An investigation has been planned to assess the presence and extent of underground obstructions that may impact future works. The investigation works are to determine the type and nature of existing foundations and retaining walls on site. Potential structural grid and pile layout alterations to avoid clashes with existing substructure. Undertaken additional targeted investigation following demolition of existing structures. Assessment of potential re-use of onsite building foundations, namely for the retained structures.
Underground Services	A relatively high density of services are located beneath Greyfriars Road and Friars Street bordering the site and Garrard Street within the site boundaries. An existing Thames Water main sewer also runs beneath the north section of the site that could be affected by	Liability through damage – greatest effects could be experienced during demolition, excavation and development construction.	Obtain all existing service drawings for the site; undertake further liaison utilities companies requesting location drawings.

Subject	Hazard	Potential Consequence	Mitigation Measures
	the proposed development works and where restrictions or easements may apply Services are known to be present beneath the site and site boundary however the extents are unknown. Local services and service connections may exist.	Planning conditions may be imposed. Restrictions or approvals on foundation and sub-structure options may be required. Disturbing underground services whose locations are not precisely known during the ground investigation or construction works. Removal / re-routing of services above those anticipated creating cost and programme implications. Health and safety risk.	Potential to carry out a preliminary condition survey, CCTV survey and / or line-and-level survey of Thames Water asset. Preliminary consultations to be undertaken with Thames Water; the impact of the development on the Thames Water asset to be assessed. Further consultation will be required to coordinate with Thames Water with regards to programme during design development. Guidance on piling techniques and protection zones should be adhered to in relation to subterranean assets. Piling layouts should be agreed with stakeholders to ensure they are satisfied with the suggested spacing. Commission service clearance and mapping (e.g. GPR survey etc.) of the site for potential and / or residual services that may have been left undetected. Any development within the vicinity of the services may be subject to asset protection constraints and liable for damage caused and hence engaging with the service providers may be required in case services are detected through undertaking CAT scans and other survey techniques. Early liaison should be initiated with service providers to discuss the requirements for any necessary diversions. Plans of existing building drawings showing service details e.g. entries, connections and local services should be obtained and reviewed in order to inform the development strategy.
Adjacent Sensitive Structures	The proposed development may have an adverse impact on the adjacent structures and substructures, their foundations and services due to ground movements and vibrations associated with the redevelopment works.	Liability through damage. Programming and cost implications. Planning conditions may be imposed.	Obtain as-built drawings for the substructure of the adjacent buildings and undertake a project specific Site Investigation to inform assessments of any identified sensitive existing structures. Early engagement and liaison with relevant stakeholders. Differential settlements between any retained elements on site and new structures must be controlled through design and monitoring of the retained or adjacent structures may be required.
Site Surrounds and Other Hazards			
Site Access	The main entrance to the site is likely to be via Station Hill for the northern section with egress via Garrard Street, while for the southern section entry will be via Garrard Street and egress also via Garrard Street.	Programming and cost implications and potential environmental liability. Planning conditions and restrictions on access times may be imposed. Health and safety risk. Conflicts with neighbours due to potential road closures or induced traffic delays; this will require negotiation with local stakeholders. Potential damage to roads and pavements depending on site machinery required and volume of site vehicles expected. Increased pollution.	The entrance must be examined by potential contractors to ascertain whether plant can access this space safely. Liaison with the asset holders will be required in the future in order to negotiate safe and more logistically appropriate access routes into site. Streamline the preliminary ground investigation works in order to reduce time on site.
Traffic	Site is surrounded by busy pedestrian and traffic routes, which will be utilised by site staff and trucks/plant.	Health and safety risk. Conflicts with neighbours due to potential road closures or induced traffic delays; this will require negotiation with local stakeholders. Potential damage to roads and pavements depending on site machinery required and volume of site vehicles expected. Increased pollution.	Contractor to be required to produce a traffic management plan for the operations, with goal of producing as little disruption as practically possible. Early engagement and liaison with relevant stakeholders.

Subject	Hazard	Potential Consequence	Mitigation Measures
Underground Structures	Basements are known to exist to the north of Thames Tower within the Site boundaries. As well as in the southwest section of the site adjacent to Telecoms house.	Obstruction to exploratory holes during site investigation.	Depending on finalised construction levels encountered basements/tanks will either be excavated or in filled.
		Programming and cost implications.	
	The Envirocheck Report indicated that there are two potential tanks in the E section of the site and one known tank in the NW section of the Site.	Affect pile installation and reduce bearing capacity.	
		Health and safety risk.	

11. CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

This Desktop Site Appraisal Report was prepared for the proposed development in order to highlight potential geotechnical and geo-environmental ground-based risks associated with the development and to provide a strategy for addressing those identified.

The preliminary contaminated land risk assessment identified the potential for ground contamination at the site. Historic and current uses of the land may lead to potential soil and groundwater contamination at the site. The site has been previously occupied by a garage, car park, coal yard and bus station. The historical maps illustrate a garage located in the centre of the site with a car park and bus station constructed by the early 1960s. A coal yard was present to the south of the site. The historical data report from Envirocheck identified two potentially fuel related tanks on site. Whilst no tanks were identified during the site walkover (September 2018), residual contamination may be present. In addition, three electrical sub-stations were noted across the site during the site walkover, with unknown potential for release of PCBs.

A review of the surrounding area’s history highlighted industrial land use within 100m of the site. The Great Western Railway runs parallel to the site boundary 60m north, since before first maps in the late 1870s. Garages were situated 90m southwest and 50m southeast of the site by 1957. Engineering works were identified on the historical maps to the northwest and north of the site. Four electrical sub-stations were also identified within 80m of the site. Historical Building Plans Information has identified three underground fuel tanks and oil storage within 100m south of the site. As such there is the potential for ground contamination from off-site sources, which could migrate onto site as a result of groundwater migration.

The Waterman investigaiton of accessible areas in 2014 identified low-moderate ground contamination risks. There is also potential for residual contamination to exist in the shallow soils and groundwater at the site which may have resulted from leaks and spills in areas not investigated previously (the south side of the site, which was inaccessible during the ground investigation in 2014). There is also potential for ground gas generation and accumulation, associated with unknown composition of Made and Natural Ground beneath the buildings on site.

Risks from potential contamination at the site which may present risk to both human health and controlled waters is considered likely to be **Low/Moderate**, dependent on which receptor or pathway is being considered. Potential risks from ground gas are assessed as **High**.

The preliminary geotechnical risk assessment identified that there are a number of existing exploratory hole records directly relevant to the site from a previous site investigation by ST Consult, as well as limited records from nearby buildings. Shallow ground conditions for the northern section are known to a reasonable degree however ground conditions below the structureless chalk are only known for one borehole on site. The ground conditions in the southern section of the site are known to a far lesser degree and can only be inferred from data from the northern section of the site. The main risks include the variability in thickness, distribution and geotechnical characteristics of the Made Ground, Alluvium, Taplow Gravel Formation and structureless chalk across the site, as well as the presence of underground services and buried structures/obstructions on site.

11.2 Recommendations

A full geotechnical and geo-environmental assessment of the site should be carried out in order to facilitate design of the substructures for the proposed development and assess, and mitigate where possible, the hazards currently identified. This should include a Ground Investigation and geotechnical

design reports, in accordance with Eurocode 7. An intrusive Ground Investigation is recommended to be carried out at site in order to:

- Target the anticipated location of principal foundations, and delineate significant party wall foundations adjacent to and bounding the site, and assess shallow and deep ground conditions. It is likely that this investigation would be combined as a phased structural and environmental assessment. Details of ground investigation works and additional intrusive works will be determined at a later project stage.
- Establish the underlying ground conditions across the South Site as well as the ground conditions at depth for the North Site and derive appropriate geotechnical engineering design parameters for substructure (foundation and retaining wall) design – this should include in-situ and laboratory geotechnical testing;
- Determine the presence and chemical composition of the Made Ground / Infill and natural soils through targeted and representative soil sampling;
- Undertake a Waste Assessment to determine the status of the soils to be removed as part of the construction works;
- Characterise the underlying groundwater and ground gas regimes through sampling and the development of a monitoring program;
- Prior to demolition, a pre-demolition asbestos survey should be completed (in accordance with HSG 264, 2012) and any residual ACMs removed for disposal at a suitable licensed facility;
- Identifying extent of significant foundations for current developments on site prior to demolition works;
- Identify near-surface utilities;
- Assess the scale and dimensions of significant subsurface obstructions such as historic foundations, potential archaeological findings or existing services; and
- Assess the need for stability assessments of adjacent third-party structures or assets.

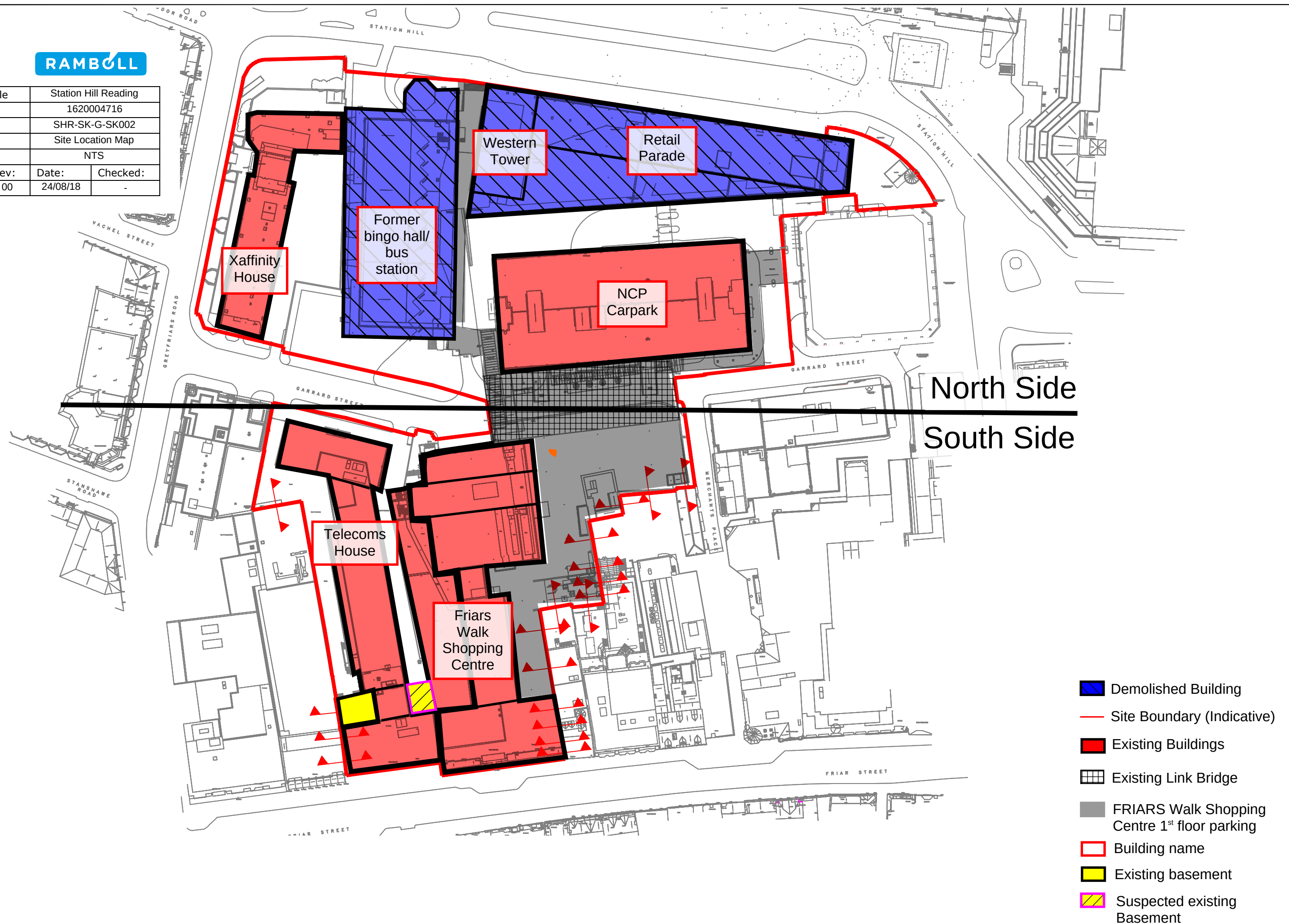
Other considerations:

- A material management plan / waste classification assessment should be undertaken if waste material is proposed to be taken off site;
- A Piling Risk Assessment may be required to accompany any piling works;
- Early liaison with Thames Water will be carried out in order to understand their requirements for surveying their asset locations, the level of ground movement impact assessments required, the movements acceptance criteria and the need for any monitoring of their assets during demolition, excavation and construction. Early involvement will be essential to mitigate against programme delays.

DRAWINGS

Drawing 1: Site Location Plan including Site Red Line Boundary

Project Title	Station Hill Reading		
Project N°	1620004716		
Sketch N°	SHR-SK-G-SK002		
Title	Site Location Map		
Scale	NTS		
Eng:	Rev:	Date:	Checked:
MT	00	24/08/18	-



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- NHBC and Environment Agency 2008. Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D Publication 66: 2008
- Zetica Unexploded Ordnance (UXO) Risk Map.

APPENDIX A

SITE WALKOVER PHOTOGRAPHIC RECORD



Photo 1: View from Reading Train Station looking south at NCP carpark and Temporary Events Space



Photo 2: View Looking east down Garrard Street



Photo 3: View Looking at carpark beneath Xaffinity House



Photo 4: View Looking east down Garrard Street



Photo 5: View Looking north onto Garrard Street, with the site of the former Bingo Hall/ bus Station opposite.



Photo 6: View Looking north towards Garrard Street with Telecoms House on the right.



Photo 7: View Looking south, towards Friar Street with Friars walk Shopping Centre on the left/ centre and Telecoms house to the right



Photo 8: Inside Telecoms House



Photo 9: Inside Friars Walk Shopping Centre



Photo 10: Inside Friars Walk Shopping Centre



Photo 10: View looking south down Merchants Place from Garrard Street.



Photo 11: View looking north at private carpark not within site boundaries, to the south east of the Site.



Photo 12: View looking south from roof of Friars Walk Shopping Centre at private carpark mentioned in Photo 11.



Photo 13: View looking south at entrance to site of the former Bingo Hall/ Bus Station.



Photo 14: View looking north with Xaffinity House on the left, on the site of the former Bingo Hall/ Bus Station.



Photo 15: View looking east towards the Temporary Events Space. Showing difference in ground level. (Base of wooden fence represents ground level on the Temporary Events Space.)



Photo 16: View looking north towards Station Hill Road. Showing rise in topography towards the east.



Photo 17: View looking north towards Reading Train Station, showing the Temporary Events Space.

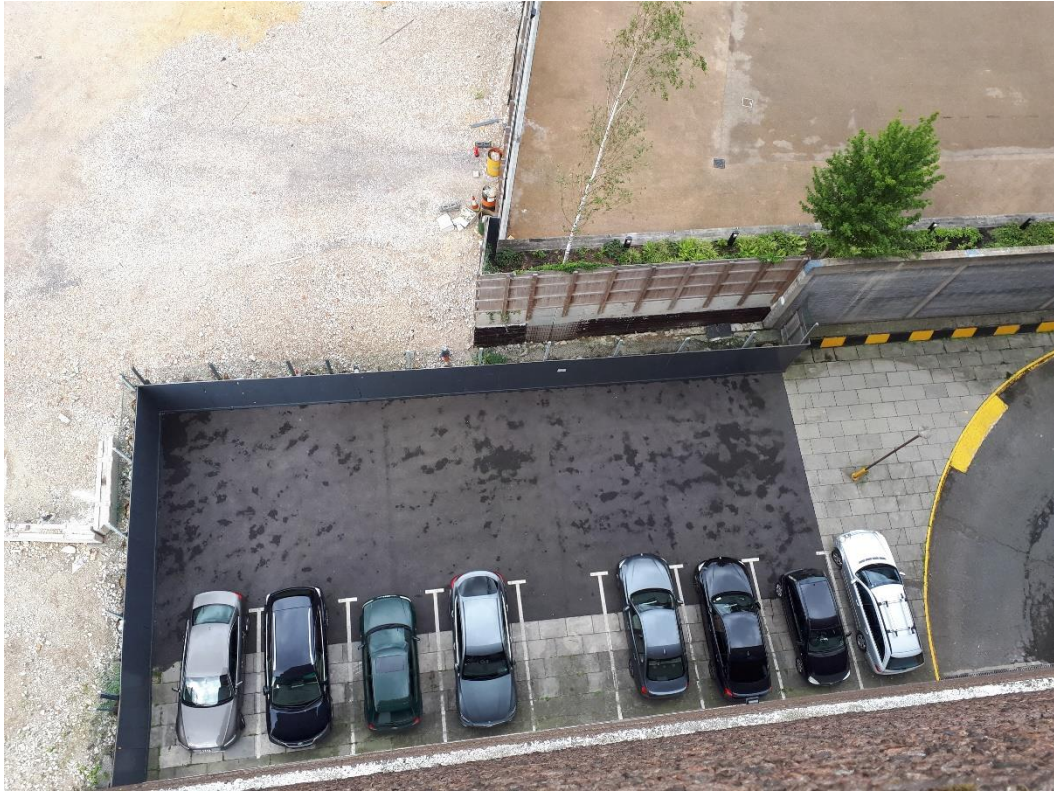


Photo 18: View looking north from the top of the NCP Carpark. Looking at car parking behind the Temporary Events Space.



Photo 19: View looking west at raised bedding area on the south side of the Temporary Events Space.

APPENDIX B
ENVIROCHECK REPORT AND HISTORIC MAPS

Envirocheck[®] Report:

Historical Data Report Datasheet

Order Details:

Order Number:

179269911_1_1

Customer Reference:

1620004716

National Grid Reference:

471370, 173710

Slice:

A

Site Area (Ha):

3.15

Search Buffer (m):

1000

Site Details:

Flat 2, Garrard House

30

Garrard Street

READING

RG1 1NR

Client Details:

Miss H Quinn

Ramboll UK Ltd

240 Blackfriars Road

London

SE1 8NW

Report Section	Page Number
Summary	-
Historical Building Plans Information	1
Historical Land Use Information	5
Historical Tanks and Energy Facilities	10
Historical Map List	11
Useful Contacts and Further Information	13

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination. For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.

In the attached datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

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Report Version v53.0

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m
Historical Building Plans Information					
Areas Cleared Due To Enemy Action					
Above Ground Fuel Tanks (100m)				n/a	n/a
Asbestos (100m)	pg 1		56	n/a	n/a
Benzene/Benzole/Naphtha, Naphthalene/Kerosene (100m)				n/a	n/a
Electricity Generation (100m)				n/a	n/a
Electricity Sub-Station (100m)				n/a	n/a
Gas Industry (100m)				n/a	n/a
Gas Storage (100m)				n/a	n/a
Gas Use (100m)	pg 3		1	n/a	n/a
Oil Industry (100m)				n/a	n/a
Oil Storage (100m)	pg 3		3	n/a	n/a
Oil Use (100m)				n/a	n/a
Paint based Oils (100m)	pg 3		2	n/a	n/a
Paraffin (100m)				n/a	n/a
Petrol and Diesel Industry (100m)				n/a	n/a
Petrol and Diesel Storage (100m)				n/a	n/a
Petrol and Diesel Use (100m)				n/a	n/a
Potential Fuel Gas (100m)				n/a	n/a
Potential Fuel Oil (100m)				n/a	n/a
Potential Fuel Use (100m)				n/a	n/a
Potential Petrol and Diesel (100m)				n/a	n/a
Potential Tanks (100m)				n/a	n/a
Potentially Fuel-related Tanks (100m)				n/a	n/a
Underground Fuel Tanks (100m)	pg 3		3	n/a	n/a
Historical Land Use Information					
Former Marshes	pg 5				1
Historical Flood Liabilities	pg 5			1	5
Potentially Contaminative Industrial Uses (Past Land Use)	pg 5	1	9	15	43
Potentially Infilled Land (Non-Water)	pg 8				2
Potentially Infilled Land (Water)	pg 8	1		4	9

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m
Historical Tanks and Energy Facilities					
Electrical Sub Station Facilities (100m)	pg 10		4	n/a	n/a
Electricity Industry Facilities (100m)				n/a	n/a
Gas Industry Facilities (100m)				n/a	n/a
Gas Monitoring Facilities (100m)				n/a	n/a
Miscellaneous Power Facilities (100m)				n/a	n/a
Oil Industry Facilities (100m)				n/a	n/a
Petroleum Storage Facilities (100m)				n/a	n/a
Potential Tanks (100m)	pg 10	2	1	n/a	n/a
Tanks (100m)	pg 10	1		n/a	n/a

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
1	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SW (S)	27	1	471307 173551
1	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SW (S)	33	1	471352 173548
1	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SW (S)	34	1	471352 173548
1	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SW (S)	34	1	471352 173548
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (SE)	44	1	471435 173559
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (SE)	44	1	471435 173558
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (SE)	44	1	471435 173557
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (S)	50	1	471406 173538
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (S)	50	1	471406 173538
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (S)	51	1	471405 173537
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (S)	55	1	471409 173533
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (S)	56	1	471406 173533
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (S)	56	1	471408 173533
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (S)	56	1	471406 173532
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (S)	56	1	471408 173533
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (S)	56	1	471406 173532
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (S)	57	1	471406 173532
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (S)	63	1	471434 173533
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (S)	64	1	471399 173523
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (S)	64	1	471407 173524
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (S)	64	1	471407 173524

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (S)	65	1	471396 173522
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (S)	65	1	471396 173522
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (S)	66	1	471411 173522
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (SE)	66	1	471448 173540
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (SE)	66	1	471450 173541
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (S)	66	1	471411 173522
2	Asbestos Map Text: ASB Clad Plan Name: 099_008_1953_geo1	A13SE (S)	68	1	471413 173521
2	Asbestos Map Text: ASB Clad Plan Name: 099_008_1958_geo1	A13SE (S)	68	1	471413 173521
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (S)	80	1	471428 173512
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (S)	80	1	471428 173512
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (S)	81	1	471428 173512
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (S)	85	1	471428 173507
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (S)	85	1	471428 173507
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (S)	85	1	471428 173507
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (S)	90	1	471404 173497
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (S)	91	1	471405 173497
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (S)	91	1	471405 173497
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (S)	96	1	471452 173506
2	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SE (SE)	98	1	471458 173507
2	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SE (SE)	99	1	471458 173506
2	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SE (SE)	100	1	471458 173506

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
3	Asbestos Map Text: ASB Plan Name: 099_006_1958_geo1	A13NE (E)	47	1	471535 173735
3	Asbestos Map Text: ASB Plan Name: 099_006_1958_geo1	A13NE (E)	53	1	471542 173736
3	Asbestos Map Text: ASB Plan Name: 099_006_1958_geo1	A13NE (E)	65	1	471552 173729
4	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SW (S)	49	1	471306 173528
4	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SW (SW)	50	1	471291 173532
4	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SW (SW)	70	1	471277 173517
4	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SW (SW)	71	1	471276 173516
4	Asbestos Map Text: ASB Plan Name: 099_008_1958_geo1	A13SW (S)	87	1	471301 173491
5	Asbestos Map Text: ASB Plan Name: 099_006_1958_geo1	A13SE (E)	76	1	471517 173665
5	Asbestos Map Text: ASB Plan Name: 099_006_1958_geo1	A13SE (E)	91	1	471535 173666
6	Asbestos Map Text: ASB Plan Name: 099_006_1958_geo1	A13NE (NE)	81	1	471566 173796
6	Asbestos Map Text: ASB CI Plan Name: 099_006_1958_geo1	A13NE (NE)	83	1	471566 173800
7	Asbestos Map Text: ASB Plan Name: 099_008_1951_geo1	A13SW (S)	95	1	471326 173483
7	Asbestos Map Text: ASB Plan Name: 099_008_1953_geo1	A13SW (S)	100	1	471334 173479
8	Gas Use Map Text: Gas Eng Plan Name: 099_008_1895_geo1	A13SW (S)	63	1	471344 173518
9	Oil Storage Map Text: Oil Store Plan Name: 099_008_1951_geo1	A13SE (S)	88	1	471429 173504
9	Oil Storage Map Text: Oil Store Plan Name: 099_008_1953_geo1	A13SE (S)	88	1	471429 173504
9	Oil Storage Map Text: Oil Store Plan Name: 099_008_1958_geo1	A13SE (S)	88	1	471429 173504
10	Paint based Oils Map Text: Oil & Color Plan Name: 099_008_1895_geo1	A13SE (S)	100	1	471431 173493
10	Paint based Oils Map Text: Oil & Color Plan Name: 099_008_1951_geo1	A13SE (S)	100	1	471431 173493
11	Underground Fuel Tanks Map Text: Sunk Petrol Tank Plan Name: 099_008_1951_geo1	A13SW (S)	70	1	471305 173507

Historical Building Plans Information

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
11	Underground Fuel Tanks Map Text: Sunk Petrol Tank Plan Name: 099_008_1958_geo1	A13SW (S)	70	1	471305 173507
11	Underground Fuel Tanks Map Text: Sunk Petrol Tank Plan Name: 099_008_1953_geo1	A13SW (S)	71	1	471306 173507

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
12	Former Marshes Use: Former Marsh Date of Mapping: 1962	A12NW (W)	910	1	470374 173867
13	Historical Flood Liabilities Use: Area liable to flood Date of Mapping: 1883	A13NE (NE)	295	1	471677 174002
14	Historical Flood Liabilities Use: Area liable to flood Date of Mapping: 1900	A19SW (NE)	609	1	471792 174305
15	Historical Flood Liabilities Use: Area liable to flood Date of Mapping: 1883	A12NW (W)	846	1	470445 173911
16	Historical Flood Liabilities Use: Area liable to flood Date of Mapping: 1900	A17NW (NW)	895	1	470640 174430
17	Historical Flood Liabilities Use: Area liable to flood Date of Mapping: 1883	A15NW (E)	954	1	472430 173927
18	Historical Flood Liabilities Use: Area liable to flood Date of Mapping: 1900	A20SW (E)	993	1	472420 174118
19	Potentially Contaminative Industrial Uses (Past Land Use) Use: Road haulage Date of Mapping: 1995	A13NW (W)	0	1	471347 173712
20	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1883 - 1992	A13NE (N)	8	1	471384 173814
21	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1883 - 1995	A13NE (E)	25	1	471518 173752
22	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1883 - 1995	A13NE (N)	72	1	471397 173879
23	Potentially Contaminative Industrial Uses (Past Land Use) Use: Transport manufacturing and repair Date of Mapping: 1883 - 1931	A13NW (N)	140	1	471367 173950
24	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1962	A13NE (N)	148	1	471398 173952
25	Potentially Contaminative Industrial Uses (Past Land Use) Use: Animal slaughtering & basic processing of meat [other than poultry] Date of Mapping: 1883	A13NW (NW)	154	1	471151 173884
26	Potentially Contaminative Industrial Uses (Past Land Use) Use: Sawmilling, planing & impregnation [i.e. treatment of timber] Date of Mapping: 1883	A13NW (NW)	158	1	471233 173958
27	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1883 - 1995	A13NE (E)	212	1	471700 173797
28	Potentially Contaminative Industrial Uses (Past Land Use) Use: Sawmilling, planing & impregnation [i.e. treatment of timber] Date of Mapping: 1913	A13NW (NW)	240	1	471109 173972
29	Potentially Contaminative Industrial Uses (Past Land Use) Use: Metal casting/foundries Date of Mapping: 1900 - 1913	A13NE (NE)	276	1	471652 173998
30	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1883 - 1995	A12NE (NW)	285	1	471028 173932
31	Potentially Contaminative Industrial Uses (Past Land Use) Use: Road haulage Date of Mapping: 1995	A14NW (E)	307	1	471787 173847
32	Potentially Contaminative Industrial Uses (Past Land Use) Use: Road haulage Date of Mapping: 1913 - 1995	A12NE (W)	341	1	470942 173826

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
33	Potentially Contaminative Industrial Uses (Past Land Use) Use: Electricity production & distribution [inc large transformers] Date of Mapping: 1900 - 1914	A18SE (NE)	346	1	471561 174125
34	Potentially Contaminative Industrial Uses (Past Land Use) Use: Road haulage Date of Mapping: 1995	A18SE (NE)	356	1	471574 174132
35	Potentially Contaminative Industrial Uses (Past Land Use) Use: Sawmilling, planing & impregnation [i.e. treatment of timber] Date of Mapping: 1914 - 1932	A18SE (N)	371	1	471394 174175
36	Potentially Contaminative Industrial Uses (Past Land Use) Use: Printing: miscellaneous exc. newspapers Date of Mapping: 1914 - 1932	A17SE (NW)	375	1	470997 174048
37	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1962	A18SW (N)	378	1	471245 174184
38	Potentially Contaminative Industrial Uses (Past Land Use) Use: Gas manufacture & distribution Date of Mapping: 1883 - 1913	A8NE (S)	388	1	471563 173234
39	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1962	A17SE (NW)	388	1	470987 174057
40	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1995	A17SE (NW)	389	1	470986 174057
41	Potentially Contaminative Industrial Uses (Past Land Use) Use: Brewing & malting Date of Mapping: 1913 - 1931	A8NE (S)	392	1	471563 173231
42	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1962 - 1995	A12NE (NW)	422	1	470922 174025
43	Potentially Contaminative Industrial Uses (Past Land Use) Use: Road haulage Date of Mapping: 1995	A8NE (SE)	455	1	471687 173228
44	Potentially Contaminative Industrial Uses (Past Land Use) Use: Transport support & cargo handling Date of Mapping: 1883	A8NE (S)	503	1	471472 173090
45	Potentially Contaminative Industrial Uses (Past Land Use) Use: Sawmilling, planing & impregnation [i.e. treatment of timber] Date of Mapping: 1883 - 1931	A14SW (SE)	520	1	471929 173473
46	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1962	A17SE (NW)	521	1	471007 174250
47	Potentially Contaminative Industrial Uses (Past Land Use) Use: Hospitals Date of Mapping: 1900	A8NE (S)	545	1	471470 173048
48	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1913 - 1931	A8NW (S)	547	1	471325 173030
49	Potentially Contaminative Industrial Uses (Past Land Use) Use: Military Land Date of Mapping: 1883	A8NE (SE)	558	1	471674 173100
50	Potentially Contaminative Industrial Uses (Past Land Use) Use: Sawmilling, planing & impregnation [i.e. treatment of timber] Date of Mapping: 1882	A18NW (N)	568	1	471196 174370
51	Potentially Contaminative Industrial Uses (Past Land Use) Use: Transport support & cargo handling Date of Mapping: 1913 - 1995	A9NW (SE)	572	1	471914 173331
51	Potentially Contaminative Industrial Uses (Past Land Use) Use: Transport support & cargo handling Date of Mapping: 1913 - 1931	A9NW (SE)	606	1	471933 173294
52	Potentially Contaminative Industrial Uses (Past Land Use) Use: Food processing - major Date of Mapping: 1883 - 1931	A14SW (E)	573	1	472055 173648

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
53	Potentially Contaminative Industrial Uses (Past Land Use) Use: Transport support & cargo handling Date of Mapping: 1883	A8SE (S)	607	1	471383 172974
54	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1913 - 1962	A8SW (S)	609	1	471345 172969
55	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1932 - 1962	A17SE (NW)	614	1	470751 174110
56	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1962 - 1995	A14SE (E)	615	1	472098 173645
57	Potentially Contaminative Industrial Uses (Past Land Use) Use: Machinery: engines, building and general industrial [manufacture] Date of Mapping: 1932	A18NE (N)	649	1	471537 174440
58	Potentially Contaminative Industrial Uses (Past Land Use) Use: Sawmilling, planing & impregnation [i.e. treatment of timber] Date of Mapping: 1914 - 1932	A18NE (N)	651	1	471594 174433
59	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1913 - 1962	A8SW (S)	653	1	471329 172923
60	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1962	A18NE (N)	665	1	471532 174458
61	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1962 - 1995	A18NE (N)	665	1	471631 174438
62	Potentially Contaminative Industrial Uses (Past Land Use) Use: Road haulage Date of Mapping: 1995	A17SW (NW)	679	1	470671 174100
63	Potentially Contaminative Industrial Uses (Past Land Use) Use: Metal casting/foundries Date of Mapping: 1883 - 1931	A9SW (SE)	698	1	471731 172972
64	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1962	A8SE (SE)	705	1	471707 172952
65	Potentially Contaminative Industrial Uses (Past Land Use) Use: Cemetery or Graveyard Date of Mapping: 1883	A8SE (S)	710	1	471580 172901
66	Potentially Contaminative Industrial Uses (Past Land Use) Use: Laundries & dry cleaning Date of Mapping: 1900 - 1932	A19NW (NE)	724	1	471889 174380
67	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1995	A17SW (NW)	726	1	470691 174227
68	Potentially Contaminative Industrial Uses (Past Land Use) Use: Food processing - major Date of Mapping: 1913	A9NW (SE)	734	1	471936 173084
69	Potentially Contaminative Industrial Uses (Past Land Use) Use: Metal casting/foundries Date of Mapping: 1883	A8SE (S)	735	1	471429 172851
70	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1883 - 1995	A14NE (E)	740	1	472230 173801
71	Potentially Contaminative Industrial Uses (Past Land Use) Use: Pipelines [transport via] Date of Mapping: 1995	A12NW (W)	783	1	470503 173872
72	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1962	A17SW (NW)	824	1	470526 174128
73	Potentially Contaminative Industrial Uses (Past Land Use) Use: Gas manufacture & distribution Date of Mapping: 1883 - 1931	A14SE (E)	867	1	472292 173419

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
74	Potentially Contaminative Industrial Uses (Past Land Use) Use: Paper packaging products [manufacture] Date of Mapping: 1882	A18NW (N)	868	1	471218 174674
75	Potentially Contaminative Industrial Uses (Past Land Use) Use: Road haulage Date of Mapping: 1995	A12NW (W)	869	1	470429 173959
76	Potentially Contaminative Industrial Uses (Past Land Use) Use: Sawmilling, planing & impregnation [i.e. treatment of timber] Date of Mapping: 1883	A8SW (S)	887	1	471363 172691
77	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1882 - 1992	A17SW (W)	895	1	470419 174037
78	Potentially Contaminative Industrial Uses (Past Land Use) Use: Road haulage Date of Mapping: 1995	A11SE (W)	902	1	470368 173678
79	Potentially Contaminative Industrial Uses (Past Land Use) Use: Quarrying of sand & clay, operation of sand & gravel pits Date of Mapping: 1883	A7NW (SW)	927	1	470543 173061
80	Potentially Contaminative Industrial Uses (Past Land Use) Use: Clay bricks & tiles [manufacture] Date of Mapping: 1883	A3NE (S)	946	1	471560 172655
81	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1995	A9SW (S)	948	1	471760 172710
82	Potentially Contaminative Industrial Uses (Past Land Use) Use: Railways Date of Mapping: 1883 - 1992	A11SE (W)	954	1	470318 173647
83	Potentially Contaminative Industrial Uses (Past Land Use) Use: Tableware & other ceramics [manufacture] Date of Mapping: 1883	A3NW (S)	971	1	471077 172635
84	Potentially Contaminative Industrial Uses (Past Land Use) Use: Factory or works - use not specified Date of Mapping: 1995	A3NW (S)	983	1	471360 172595
85	Potentially Contaminative Industrial Uses (Past Land Use) Use: Sewage Date of Mapping: 1900 - 1931	A15SW (E)	996	1	472457 173508
86	Potentially Infilled Land (Non-Water) Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1995	A7NW (SW)	927	1	470543 173061
87	Potentially Infilled Land (Non-Water) Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1995	A3NE (S)	946	1	471560 172655
88	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1995	A13NW (N)	0	1	471370 173714
89	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1900	A8NE (SE)	458	1	471685 173227
90	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1931	A14NW (NE)	460	1	471901 173975
91	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1962	A8NE (S)	474	1	471585 173151
92	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1900	A8NE (SE)	499	1	471647 173153
93	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1932	A17SE (NW)	543	1	470889 174179
94	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1932	A17SE (NW)	609	1	470985 174338

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
95	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1962	A12NW (W)	702	1	470580 173838
96	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1883	A8SW (S)	781	1	471230 172800
97	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1900	A8SW (S)	810	1	471315 172767
98	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1932	A17NE (NW)	836	1	470855 174526
99	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1883	A8SW (S)	855	1	471234 172726
100	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1932	A17NE (NW)	903	1	470774 174553
101	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1883	A3NW (S)	946	1	471230 172634

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
102	Electrical Sub Station Facilities Scale of Mapping: 1:1,250 Date of Mapping: 1969 - 1986	A13SW (SW)	11	1	471280 173663
103	Electrical Sub Station Facilities Scale of Mapping: 1:1,250 Date of Mapping: 1969 - 1986	A13SW (SW)	47	1	471297 173533
104	Electrical Sub Station Facilities Scale of Mapping: 1:1,250 Date of Mapping: 1986	A13SE (S)	60	1	471382 173526
105	Electrical Sub Station Facilities Scale of Mapping: 1:1,250 Date of Mapping: 1969 - 1986	A13SE (SE)	83	1	471452 173522
106	Potential Tanks Scale of Mapping: 1:1,250 Date of Mapping: 1957 - 1969	A13NE (E)	0	1	471423 173719
107	Potential Tanks Scale of Mapping: 1:1,250 Date of Mapping: 1957 - 1969	A13SE (S)	0	1	471401 173605
108	Potential Tanks Scale of Mapping: 1:1,250 Date of Mapping: 1971	A13NE (E)	59	1	471549 173768
109	Tanks Scale of Mapping: 1:1,250 Date of Mapping: 1969	A13NW (N)	0	1	471360 173738

The following plans have been analysed for Historical Building Plans Information:

Plan Name:	Town:	Published Date:	Last Pasted Date:
099_006_1895_geo1	Reading	1895	1895
099_006_1958_geo1	Reading	1895	1958
099_008_1895_geo1	Reading	1895	1895
099_008_1951_geo1	Reading	1895	1951
099_008_1953_geo1	Reading	1953	1953
099_008_1958_geo1	Reading	1953	1958
099_007_1895_geo1	Reading	1895	1895
099_007_1958_geo1	Reading	1895	1958
099_009_1895_geo1	Reading	1895	1895
099_009_1947_geo1	Reading	1947	1947

The following mapping has been analysed for Historical Land Use Information:

1:10,560	Mapsheet	Published Date
Oxfordshire	056_00	1882
Berkshire	037_00	1883
Berkshire	029_SE	1900
Berkshire	029_SW	1900
Berkshire	037_NE	1900
Berkshire	037_NW	1900
Oxfordshire	056_SE	1900
Oxfordshire	056_SW	1900
Oxfordshire	058_NE	1900
Berkshire	037_NE	1913
Oxfordshire	058_NE	1913
Berkshire	029_SE	1914
Berkshire	029_SW	1914
Berkshire	037_NW	1914
Oxfordshire	056_SE	1914
Oxfordshire	056_SW	1914
Berkshire	037_NE	1931
Berkshire	029_SE	1932
Berkshire	037_NW	1932
Berkshire	029_SW	1938
Oxfordshire	056_SW	1938
Ordnance Survey Plan	SU77NW	1961
Ordnance Survey Plan	SU77SW	1962
1:10,000	Mapsheet	Published Date
Ordnance Survey Plan	SU77NW	1991
Ordnance Survey Plan	SU77SW	1995

The following mapping has been analysed for Historical Tanks and Energy Facilities:

1:2,500	Mapsheets	Published Date
Ordnance Survey Plan	SU7174	1957
1:1,250	Mapsheets	Published Date
Ordnance Survey Plan	SU7173NE	1957
Ordnance Survey Plan	SU7173NW	1957
Ordnance Survey Plan	SU7173SE	1957
Ordnance Survey Plan	SU7173SW	1957
Ordnance Survey Plan	SU7174SE	1957
Ordnance Survey Plan	SU7174SW	1957
Ordnance Survey Plan	SU7173NE	1962
Ordnance Survey Plan	SU7173NW	1962
Ordnance Survey Plan	SU7173SE	1962
Ordnance Survey Plan	SU7173SW	1962
Ordnance Survey Plan	SU7173SE	1968
Ordnance Survey Plan	SU7173NW	1969
Ordnance Survey Plan	SU7173SW	1970
Ordnance Survey Plan	SU7173NE	1971
Ordnance Survey Plan	SU7174SW	1971
Ordnance Survey Plan	SU7174SE	1972
Ordnance Survey Plan	SU7173SW	1980
Ordnance Survey Plan	SU7174SW	1984
Ordnance Survey Plan	SU7173NE	1986
Ordnance Survey Plan	SU7173NW	1986
Ordnance Survey Plan	SU7173SE	1988

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Historical Building Plans Information

This data set contains potentially contaminative features such as asbestos, petrol, oil and tanks captured from Historical Building Plans. The Historical Building Plans were produced by the London-based firm Charles E. Goad Ltd. as fire insurance plans, dating back to 1885. The firm ceased production of fire insurance plans in 1970. Most of the important towns and cities of the British Isles are covered. Historical Building Plans are usually at the scales of 1:480 (1 inch to 40 feet) for the British Isles. They were updated every 5-6 years by means of revision sheets designed to be pasted on to the original plans.

It should be noted that Historical Building Plans are only available for certain major towns and cities and in some cases there may only be partial coverage of the search area. It cannot therefore be assumed that the absence of responses under the Historical Building Plans section of this report indicates that no hazards exist. Please check the Historical Building Plans Map List table in the Historical Map List section of this report to establish if Historical Building Plans are available for this search area.

Historical Land Use Information

Landmark's Historical Land Use Data is the result of combined analysis of historical map data captured at 1:10,560 and 1:10,000. A unique comprehensive database of Historic Land Use from the 1840's to 1996 it includes 67 different types of potentially contaminated past industrial land use. This entailed analysing over 60,000 maps and is drawn from at least four, and up to six historical map editions. In addition a seventh layer was also created, known as the land use layer, containing areas of infilled land which are plotted via comparison between two or more map editions.

Historical Tanks and Energy Facilities

In addition to HLU, additional analysis uncovered some of the most dangerous sources of contamination (past and present tanks, petrol storage, oil, gas, electricity, miscellaneous facilities). This data set covers over 390,000 Historical Tanks and Energy facilities in Great Britain and was captured from post war 1:2500 and 1:1250 Ordnance Survey historical mapping covering a period from 1943 to 1996.