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Rev	Date	Amendment	Drawn	Chkd	Appd

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Client	Gascogne Estates				
Project Name	Salisbury Square, Hatfield				
Description	Site Location Plan				

Dimension	Size	Scale	Geolocation	Project ID	Drawing no.	Rev	File name
m	A4	1:25,000	523335,208671	1922048	11101	C01	1922048-HH-111-SS-D-C-11101-C01

**Figure 2 SITE LAYOUT PLAN**



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**LEGEND**

— Site boundary

**Note:**

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Client  
 Gascogne Estates

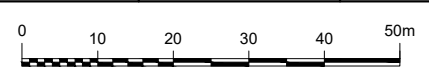
Project Name  
 Salisbury Square, Hatfield

Description  
 Site Layout Plan

Project ID	Drawing no.	Revision
1922048	11201	C01

File name  
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Dimensions	Scale	Size
m	1:1000	A3





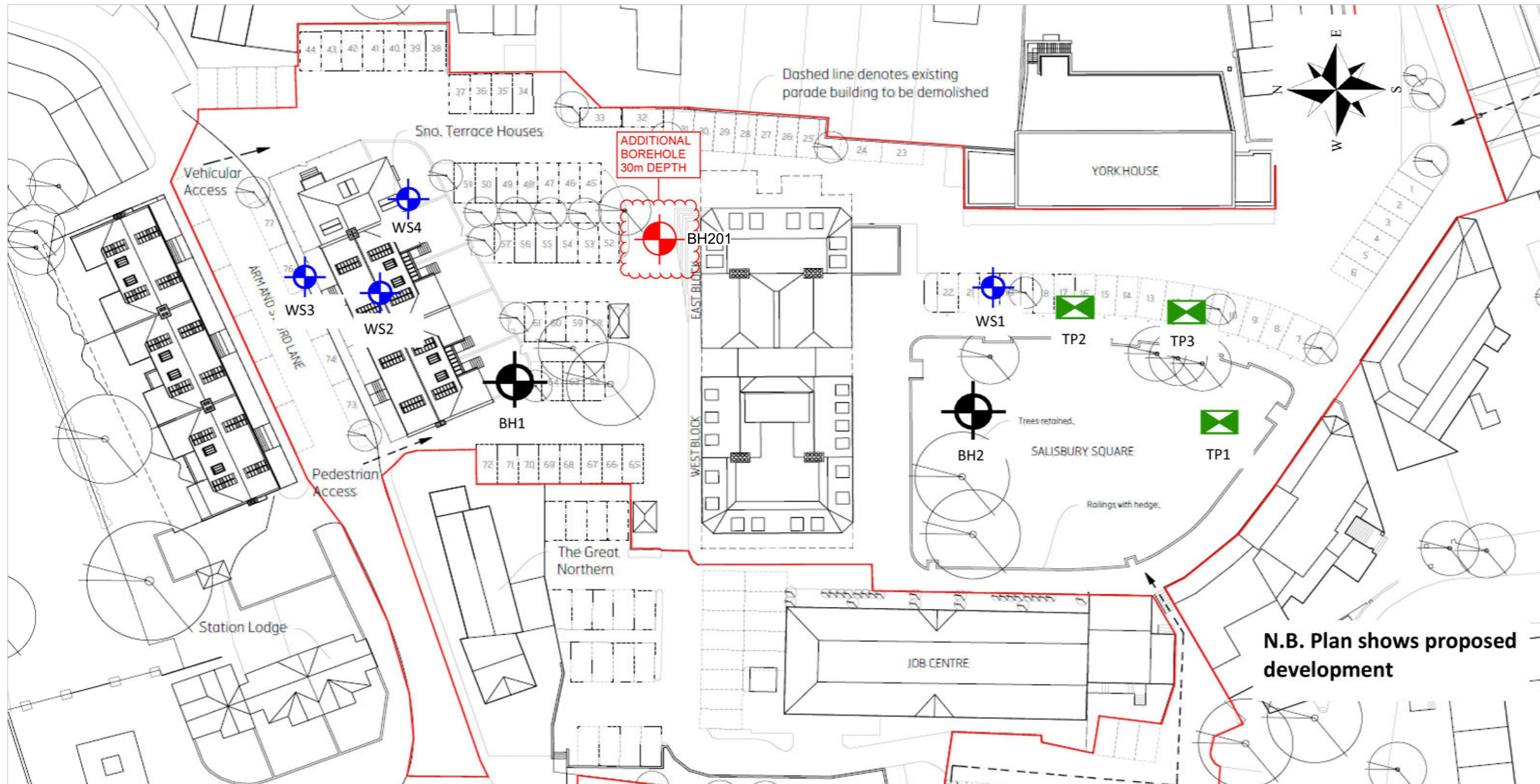
**Figure 3 EXPLORATORY HOLE LOCATION PLAN**



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**LEGEND**

- Site boundary
- Cable percussion boreholes (2011)
- Shallow window sampler boreholes (2011)
- Additional borehole
- Hand excavated trial pits (2011)



**N.B. Plan shows proposed development**

Note:

Base plan provided by Client/Brooks Murray Architects  
No. Ref: 789-PL-100

Rev	Date	Amendment	Drawn	Chkd	Appd
C02	29.06.23	Second Issue	LS	AC	AC
C01	22.06.23	First Issue	LS	AC	AC



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Client

Gascogne Estates

Project Name

Salisbury Square, Hatfield

Description

Exploration Location Plan: Additional Ground Investigation

Project ID	Drawing no.	Revision
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File name  
1922048-HH-222-SS-D-C-22201-C02

Dimensions	Scale	Size
m	NTS	A3

**PRELIMINARY REVISION  
TO BE REVISED**

# APPENDICES

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## Appendix A

### SERVICE CONSTRAINTS

---

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Gascoyne Holdings Ltd (the "Client") in accordance with the terms of a contract [RSK Environment Standard Terms and Conditions] between RSK and the Client, dated 2<sup>nd</sup> February 2023. The Services were performed by RSK with the reasonable skill and care ordinarily exercised by an environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the Client.
2. Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the Client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, persistent, bioaccumulative or toxic chemicals (including PFAS and related compounds) or other radioactive or hazardous materials, unless specifically identified in the Services.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of information, including documentation, obtained from third parties and from the Client on the history and usage of the site,

unless specifically identified in the Services or accreditation system (such as UKAS ISO 17020:2012 clause 7.1.6):

- a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.
- b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.
- c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services.

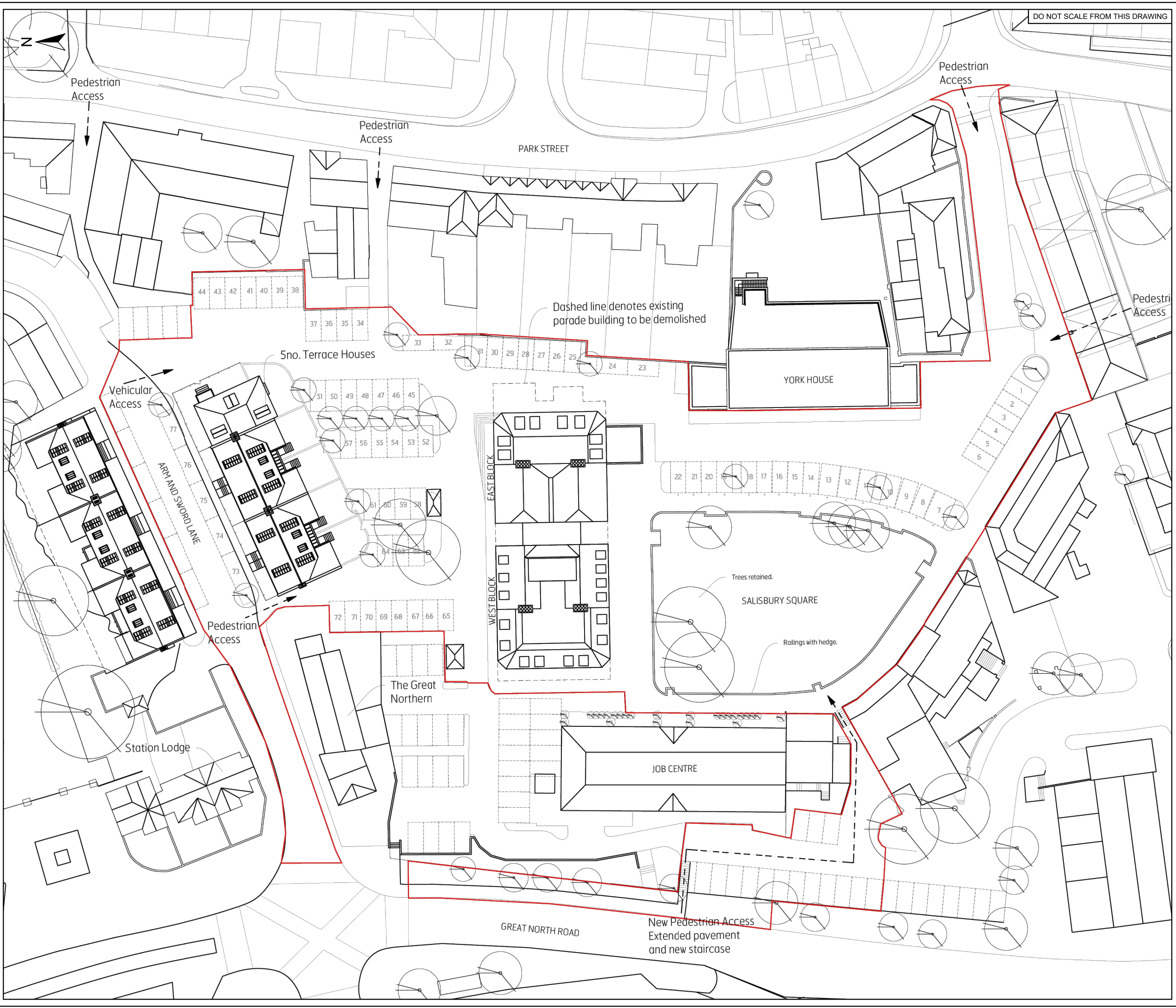
RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the Client and RSK.

8. The intrusive environmental site investigation aspects of the Services are a limited sampling of the site at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the properties of the materials adjacent and local conditions, together with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope between the client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.
10. The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.
11. Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works.
12. Unless stated otherwise, only preliminary geotechnical recommendations are presented in this report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed.



**Appendix B**  
**DEVELOPMENT DRAWINGS**

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**LEGEND**

— Site boundary

**Note:**

Base plan provided by Client/Brooks Murray Architects  
No. Ref: 789-PL-100

C01	22.06.23	First Issue	LS	AC	AC
Rev	Date	Amendment	Drawn	Chkd	Appd



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Client  
**Gascogne Estates**

Project Name  
**Salisbury Square, Hatfield**

Description  
**Development Plan**

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File name  
**1922048-HH-324-SS-D-C-32401-C01**

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m	NTS	A3

**Appendix C**  
**PREVIOUS REPORTS**

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Gascoyne Cecil Estates

Salisbury Square, Old Hatfield

Geotechnical and Geoenvironmental  
Report

Project no. 241882-01(00)

March 2011

Safeguarding  
your business  
environment

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Figure 3	SPT 'N' Values vs. Depth
Figure 4	Undrained Shear Strength vs. Depth

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GroundSure Report including Historical Maps (on CD)  
Correspondence with Statutory Authorities  
Welwyn Hatfield Borough Council 'Hatfield Chalk Mines' Map

**Appendix B Fieldwork Records**

Borehole Records (drive-in window sampler and cable-percussive)  
Trial Pit Records  
Gas/Water Monitoring Record Sheet

**Appendix C Geotechnical Laboratory Test Records**

Moisture Content and Plasticity Index of Soil  
Particle Size Distribution Results  
Triaxial Test Results  
Sulphate and pH Analysis Test Results

**Appendix D Chemical Laboratory Test Records**

Chemical Analysis of Soils including Sulphate and pH Analysis Test Results

**Appendix E CLEA Software Output Reports****Appendix F HAS-WASTE Assessment**

## DOCUMENT CONTROL

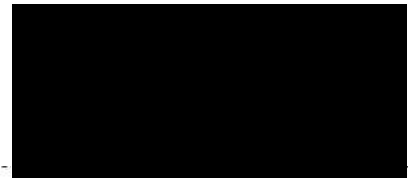
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Salisbury Square, Old Hatfield

The Client: Mr Anthony Downs  
Head of Building and Development  
Gascoyne Cecil Estates  
The Melon Ground  
4 Carters Row  
Hatfield Park Estate  
Hatfield  
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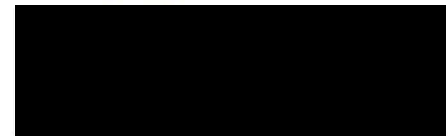
RSK STATS Geoconsult Ltd (RSK) has prepared this report in accordance with the instructions of JB Planning Associates Limited acting on behalf of Gascoyne Cecil Estates ("the Client") by letter reference PA/1040/sf, dated 14<sup>th</sup> December 2010 and under the terms of appointment for RSK. This report is confidential and non-assignable by the Client and RSK shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared and provided. Should the Client require to pass copies of the report to other parties for information, the whole of the report should be so copied, but no professional liability or warranty shall be extended to other parties by RSK in this connection without the explicit written agreement thereto by RSK.

Report Number	Status	Date of issue
241882-01(00)	FINAL	23 <sup>rd</sup> March 2011

Author and Project Manager Ben Coulston  
Senior Geoenvironmental Engineer



Technical Reviewer Jon Bailey  
Associate Director



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## 1. INTRODUCTION

### 1.1 Instructions

On the instructions of JB Planning Associates Limited, on behalf of Gascoyne Cecil Estates (the 'Client'), RSK STATS Geoconsult (RSK) has carried out a Phase 1 and 2 geotechnical and geoenvironmental investigation of the Salisbury Square area of Old Hatfield.

The project was commissioned in order to identify the potential for hazardous substances or conditions to exist on, at or near the site and therefore, via the development of a Conceptual Site Model (CSM), identify the necessity for and extent of mitigation measures to be employed in relation to the proposed improvement of Salisbury Square. There are four aspects to this improvement, as follows:

- Open up Salisbury Square by reinstating the original road through the heart of the Old Town which will reconnect the square to the surrounding streets and railway station;
- Form a new larger car park for local use providing 139 car parking spaces screened behind the new buildings;
- Some of the existing buildings are to be made more visually interesting by small architectural interventions such as enhancing the shop windows with traditional details and improved signage; and
- Provide better located accessible shops with residential accommodation. Open space is to be provided in the form of a town square off reinstated vehicular access.

### 1.2 Project Brief

The project was carried out to an agreed brief as set out in RSK's proposal letter of 27<sup>th</sup> September 2010.

The work undertaken included the following tasks:

(i) *Desk Study*

- The history of development and industry on the site, including a study of archival Ordnance Survey mapping and other sources of historical information as appropriate, e.g. local archives, trade directories and planning records.
- A study of local geology, hydrogeology and surface water setting.
- The identification of potential geological hazards, including radon and solution features that are known to be present in the Hatfield area.
- A review of relevant environmental data held by appropriate statutory authorities, e.g. the local Environmental Health Department and the Environment Agency, obtained in the form of a GroundSure Report and, where appropriate, through direct contact.
- A site reconnaissance survey.
- Liaison where possible with current/previous owners/occupiers of the site.
- A preliminary conceptual model of contamination on the site identifying possible pollutant linkages.

(ii) *Site Investigation*

- Forming of exploratory holes at locations to be finalised during the desk study and site reconnaissance.
- Sinking of two light cable percussive boreholes to provisionally 15m depths.
- One day of drive-in window sampler boreholes to provisionally 3m depths.
- 3No shallow hand pits in the proposed ground level car parking area (currently soft landscaping) to collect samples for contamination testing.
- Associated sampling and on site testing, including three in situ CBR determinations using the clegg hammer apparatus and the use of a photo-ionisation detector (PID) to screen for the presence of volatile organic compounds.

During the investigation, it was considered prudent to install ground gas monitoring wells owing to the thickness of fill material in certain areas of the site. As such, three monitoring wells were installed, and an allowance made for 2 no. monitoring visits after the fieldwork to provide an initial assessment of development requirements.

### 1.3 Standards

The project was designed generally to meet the objectives of a Preliminary (Phase 1) Investigation and an Exploratory Investigation, as defined by BS 10175:2001 "Code of Practice for the Investigation of Potentially Contaminated Sites". Exploratory Investigations usually involve only limited intrusive/analytical work in which relatively few samples are collected for contamination identification/confirmation purposes. They play a role in establishing the potential for short-term exposure or other immediate risks to health and the environment, and they are used to generate initial gas, vapour and water quality data.

The intrusive aspects of the investigation were generally carried out following guidance given in BS 5930:1999 - Code of Practice for Site Investigations.

This report adopts the technical approach presented in Contaminated Land Report 11 "Model Procedures for the Management of Land Contamination" (Environment Agency 2004) for applying a risk management process when dealing with land affected by contamination.

### 1.4 Limitations

This report should be considered in the light of any changes in legislation, statutory requirement or industry practices that may have occurred subsequent to the date of issue.

The "vicinity" of the site for the purposes of this report, is defined as locations situated within an approximate 250m radius of the site, although certain sources of contamination and / or sensitive targets further than 250m may also have been considered.

The opinions and recommendations expressed in this report are based on the ground conditions encountered during the site work, the results of field and laboratory testing and interpretation between exploratory holes. The material encountered and samples obtained represent only a small proportion of the materials present on-site, therefore other conditions are likely to prevail at the site which have not been revealed by this investigation.

The environmental reconnaissance survey consisted of a general external inspection of the site aimed at identifying any obvious signs of potential sources of ground contamination. A detailed internal inspection of the buildings was outside the brief for the study.

As an Exploratory Investigation, the results may not provide sufficient data to make detailed estimates of the quantities involved in any remediation work, if required.

The results of RSK laboratory tests are covered by UKAS accreditation, but opinions and interpretations expressed in the report and on the site work records are outside the scope of this accreditation. Where laboratory testing has been carried out at a sub-contractor laboratory, this laboratory is an approved sub-contractor in accordance with the requirements of the RSK quality management system and is UKAS accredited for the relevant range of tests undertaken.

## 2. SITE DETAILS

### 2.1 Description and Geographic Setting

The site is located at National Grid reference 523321<sup>E</sup> 208687<sup>N</sup>, as shown on **Figure 1**.

The site covers approximately 0.9 hectares and comprises ground-level car parking within the northern portion of the site and Salisbury Square with surrounding retail and commercial units in the south. The parade of shops separating the car park to the north from Salisbury Square to the south includes a launderette, two takeaway food outlets, a newsagent and an insurance brokers. A plan of the site is shown on **Figure 2**. The area around the site contains a mixture of both commercial and residential elements, as detailed below:

<b>To the North:</b>	A new mixed commercial and residential development at Dunhams Courtyard is located immediately to the north of the eastern part of the site. This site is partly bisected by a viaduct, which provides access to Hatfield House and Hatfield Park to the east. Commercial and recreational land-use occupies the majority of the land further to the north. The River Lea runs west-to-east some 1.2km beyond the northern site boundary.
<b>To the East:</b>	A mixture of retail, commercial and residential properties are located immediately beyond the eastern site boundary in 'Old Hatfield'. Hatfield park is situated some 200 to 250m to the northeast and east of the site. A large pond is located in Hatfield House some 500m to the east of the site. Furthermore, a number of field drains are located within the grounds themselves. An office building FORMS THE SOUTHERN PART OF THE EASTERN SITE BOUNDARY.
<b>To the South:</b>	A number of retail and office units are located along the southern site boundary. An electricity sub station is located some 46m to the south of the site. The land further to the south occupies a mixture of retail, commercial and residential units, forming part of Old Hatfield.
<b>To the West:</b>	Great North Road (A1000) runs north-to-south immediately adjacent to the western site boundary. Hatfield railway station lies some 50m further to the west with the associated railway lines running parallel to the western site boundary immediately beyond. A number of industrial units are located immediately beyond the railway tracks to the west some 100 to 150m from the site, including unspecified 'works', factories and car servicing and repairs.

### 2.2 Reconnaissance Survey

The site was visited on 13<sup>th</sup> January 2011. The aim of the survey was to identify the range of potentially contaminative activities carried out on the site and in the immediate vicinity, and any obvious potential sources of ground contamination.

The characteristics of the site observed during the site reconnaissance visit and obtained from current Ordnance Survey maps are summarised in **Table 2.1**.

**Table 2.1 – Site description**

Feature	Description
<b><i>Physical characteristics</i></b>	
Area of site	Approximately 0.9 hectares.
Ground levels	The site generally slopes to the south with the most steeply sloping land within the car park area in the northern portion of the site.

Feature	Description
Depressions in the ground surface	No large depressions were noted, however, it was noted that a number of paving slabs had been slightly displaced to the south of the centrally-located shopping parade. It was noted that this could be due to root action of the mature deciduous tree within the landscaped area to the south of this location.
Waterlogged or marshy ground	None observed.
Surface water	An existing culverted watercourse runs across the southern portion of the site. The exact location and orientation is shown on the WSP Drawing No. 1458-D-001, 'Outline Foul Water and Surface Water Drainage Proposals', which is also included as part of the overall submission.
Trees and hedges	The majority of the northern portion of the site is covered by hardstanding (concrete), with sections of the car park separated by hedges and a small number of trees. Two large landscaped areas are located in the central part of Salisbury Square which comprises two grassed areas with a number of plants, deciduous trees and two coniferous trees.
Existing buildings on site	Salisbury parade is located in the central portion of the site. These four separate buildings include 7 units of deck-access maisonette residential flats located above shops. This divides Salisbury Square from the car park area to the north. The Hatfield Arms public house (to be retained) is located in the northwest corner of the site. A number of buildings are located on the eastern and western site boundaries, including a number of vacant units.
Basements on site	It is assumed that the historic buildings within the Salisbury Square area of the site had basements. However, there was no evidence of backfilled basements at the time of the site reconnaissance survey.
External hardstanding	With the exception of the raised area of soft landscaping in the centre of Salisbury Square, the majority of the site is covered by hardstanding in the form of bituminous hardstanding, pre-cast concrete slabs, and concrete paving slabs.
Retaining walls and adjacent buildings on or close to site boundary	A number of buildings form the site boundary, particularly within the Salisbury Square area in the southern part of the site. With the exception of the marginally raised landscaped area supported by a brick-faced wall within Salisbury Square, no retaining walls were identified.
Made ground, earthworks and quarrying	None observed, however, the history of development and associated phases of construction and demolition suggest that the site is underlain by made ground.
Potentially unstable slopes on or close to site	None observed.
Buried services present	There are a number of manhole covers on site, furthermore, plans provided by the client detail a number of utilities beneath the site (both active and redundant).
<b><i>Environmental characteristics</i></b>	
Tank storage and dispensing facilities	None observed.

Feature	Description
Potentially hazardous materials storage and use	None observed.
Asbestos-containing materials	No obvious asbestos construction materials were observed but a detailed survey of the buildings would be required to confirm the presence or otherwise of asbestos-containing materials.
Waste storage	Waste from the offices/retail units is stored in wheely bins.
Electricity sub-stations	There is an existing sub-station located within the eastern portion of the site.
Evidence of possible land contamination on site	None observed.
Potential off-site sources of ground contamination	The railway land and light industrial premises to the west of the site are the most significant potential off-site sources of contamination. However, it is noted that a number of these premises are not topographically up-gradient and the current activities are not considered to pose a significant risk to the subject site.

No potentially significant ground contamination issues associated with the current activities on and in the vicinity of the site were identified during the site reconnaissance survey. Hydrocarbon contamination in the form of leaks and spills from parked cars could be a potential source, however, no significant surface staining was noted that the time of the site investigation.

## 2.3 Information from Environmental Searches

### 2.3.1 Environmental Database Report and Environment Agency (EA) information

Details on the presence of industries with pollution-related licences, landfill sites and pollution incidents have been obtained via an environmental database report and from a search of information publicly available on the EA website. A copy of the environmental database report is included in **Appendix A**. Salient information from these sources is as follows:

- There are no records of landfill sites (former or current) within 250m of the site (i.e. within the Planning Consultation Zone). Furthermore, there are no records of landfills within a 0.5km radius of the site.
- There are records of no records of facilities currently operating under an Integrated Pollution Prevention and Control (IPPC) authorisation within 250m of the site.
- There are no records of facilities currently operating under a Local Authority Pollution Prevention and Control (LAPPC) authorisation within 250m of the site.
- There are no records of pollution incidents attributable to the site and no records of prosecution or enforcement action against the site with respect to environmental issues.
- There are thirty sites recorded on the industrial data sheet within the environmental database report. These include:
  - Electricity Sub Stations;
  - Railway Station;
  - Engineering Services;

- Manufacture of concrete products;
- Vehicle Repairs and Servicing;
- Metalworkers (or Blacksmiths); and
- A number of Engineering Services and Unspecified Works (such as factory units)

### 2.3.2 *Local Authority Environmental Health Department Information*

The Environmental Health Department (EHD) of Welwyn Hatfield Borough Council has no records of contamination in connection with the site. However, the report notes the possibility for potential contamination issues associated with the historical legacy of the site, specifically in relation to the use of part of the site as Hatfield Brewery from approximately 1800 to 1920.

A copy of the EHD's response is included in **Appendix A**.

### 2.3.3 *Local Authority Planning Department Information*

Planning records held by Welwyn Hatfield Borough Council predominantly relate to the change of use of a number of the buildings surrounding Salisbury Square itself, rather than detail on the actual site area. Readily available records date back to 1989, from which point the majority of the alterations relate to the buildings surrounding Salisbury Square. The records indicate the majority of applications granted relate to the conversion of the residential properties to flats, and change in retail use of the surrounding shops.

### 3. DEVELOPMENT HISTORY

#### 3.1 Sources of Information

The history of the site's land-use and development from Victorian times onwards has been researched from:

- Early Ordnance Survey (OS) maps;
- Pre-Ordnance Survey (County Series) maps;
- Information from the Local Planning Authority (see Section 2.3.3); and
- Historical Photography, including Aerial Photography (provided by JB Planning Associates Limited).

Copies of OS and County Series maps are included in the environmental database report in **Appendix A**. Reference to historical maps provides invaluable information regarding the land use history of the site, but historical evidence may be incomplete for the period pre-dating the first edition and between successive maps.

The development history of the site and surrounding area from the above sources is summarised below.

#### 3.2 Summary of Development History

##### 3.2.1 *The Site*

The earliest available map edition of 1879 indicates that the southern portion of the site formed part of Hatfield Brewery with small areas of soft landscaping / courtyards located adjacent to the central part of the eastern site boundary and to the extreme north. A Public House was located in the north-western portion of the site at this time, in a similar location to the present day. Great North Road encroached onto the site, along the western site boundary. A street referred to as 'Arm and Sword Yard' provided access across the site between Great North Road to the east and Park Road to the west, leading to a number of terraced residential properties in the northern portion of the site. The majority of the northern portion of the site appeared to be occupied by residential land-use at this time, with the exception of a large factory/warehouse-type building located in the north-eastern corner.

The configuration and general land-use across the site seemed to remain largely unchanged with the exception of the slight relocation of the Public House to the east up until the early 1920's. At this point, the construction of a Public Hall in the centre of the site coincided with the closure Hatfield Brewery, although a number of the buildings remained in place in the southern part of the site. A bank was also located in the far southeast corner at this stage.

By the late 1930's to 1950's, a large proportion of the site had been redeveloped. The larger buildings in the south, previously associated with the brewery, had been demolished and replaced with a number of smaller units. Furthermore, the terraced properties and warehouse-type building in the north of the site had been demolished and a number of smaller buildings had been constructed. This redevelopment was utilised as an unspecified 'Works', occupying a large proportion of the site with the exception of the Public House in the north-west and 'Viaduct Villas' in the north-east. Great North Road had been retained, running approximately north-to-south along the western site boundary.

The buildings formerly located in the central portion of the site had been demolished by the late 1960's, leaving an area of open space. The electricity sub station located within the northern part of the eastern site boundary had been constructed by this time. By the mid-1970's, Great North Road had been re-routed beyond the western site boundary and the site



had been redeveloped to a similar layout as that of the current day, with car parking and the Hatfield Arms Public House in the North, Salisbury Parade in the centre, and Salisbury Square to the south. A minor road had been replaced by car parking for Black Horse House (off-site) in the north-west corner by the mid-1990's.

### 3.2.2 *The Surrounding Area*

By the mid to late 1800s, Hatfield Railway Station and associated running lines had been constructed 60m to the west of the site. Immediately south of Hatfield Station was a large residential property referred to as 'The Cottage'. Undeveloped land occupied the area to the west of the railway lines during the 1870's, slowly becoming occupied with terraces of residential properties through to the latter part of the 19<sup>th</sup> Century. Hatfield Brewery extended from the site itself to the southwest and two Smithys' located some 100m and 120m beyond, respectively. A relatively small Gas Works was located further southwest, some 180m from the site, immediately west of the railway lines. Old Hatfield had been developed by this time and extended to the south and east of the site comprising a mixture of residential and commercial elements. The viaduct had been constructed by this time some 20m to the north of the site, providing access to Hatfield Park and Hatfield House to the east. The land further to the north was largely undeveloped with open fields/allotments and occasional isolated dwellings. A small pond (Reed Pond), some 50m in length was located some 180m to the southwest.

The general configuration of Old Hatfield itself appeared to remain relatively unchanged into the early 20<sup>th</sup> Century. The premises associated with Hatfield Brewery to the immediate southwest had been partially demolished by the early 1920's. A Fire Station is also marked in the Batterdale area on the map labelled 1922, some 110m to the southwest of the site. The majority of the alterations to the surrounding land into the mid-20<sup>th</sup> Century involved the continued expansion of residential land-use to the west of the railway lands and the assumed residential development of the Batterdale area to the immediate southwest of the site.

The emphasis on light industrial land-use increased into the early 1960's. Namely, unspecified 'Works' located 40m northwest, 120m south and 90m southwest (two), a garage immediately east of the eastern (south) site boundary, 120m south and 130m south, a factory 70m southwest and a builders yard beyond the railway lines around 160m southwest. A depot had also replaced the former gas works, around 180m to the southwest.

By the late 1960's, the residential and light industrial elements in the Batterdale area to the southwest had almost entirely been replaced by landscaping surrounding the St Teresa's Church area. This coincided with vast residential development beyond the viaduct to the north of the site. The residential dwellings immediately beyond the railway lines to the west of the site had also been demolished by this time and replaced by a Woodwork Factory, Printing Works, and a Tool Factory at distances of 150m northwest, 120m west and 170m southwest, respectively. The light industrial development in this particular area continued into the 1980's with additional units including Engineering Works (120m west), Heating and Ventilation Works (130m west), Meat Processing Works (130m west) and a Depot (140m southwest). The former 'Works' 40m to the northwest of the site had been demolished and replaced by a depot at this point. Furthermore, the Batterdale area had also been redeveloped with residential and commercial premises by this time. The most significant change during this period, however, was the re-routing of Great North Road to the west of the site.

The surrounding area remained largely unchanged up until the current time, with the exception of an alteration in the light industrial use of the units to the west of the railway lines to comprise units associated with Medical Equipment Supplies and Pharmaceuticals, Precision Engineers and Concrete Products.

## 4. GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

### 4.1 Geology

#### 4.1.1 General Characteristics

The published 1:50,000 scale geological map of the area (Sheet No 239 'Hertford') indicates that the site is underlain by deposits of Glacial Gravels over the White Chalk Subgroup. According to the map referred to above, the site is very close (generally within 100m) to an outcrop of Boulder Clay, both to the west and south of the site. Furthermore, the land some 150m to the east/southeast is characterised by the absence of Quaternary Deposits.

BGS borehole logs have also been obtained from the site vicinity, specifically from the site at Hatfield Station to the west. These logs indicate a sequence of Glacial Deposits comprising Glacial Gravels and Boulder Clay to a depth of approximately 17m bgl, overlying the White Chalk Subgroup to the terminal depth of the borehole at 122m bgl. Groundwater was initially encountered within the chalk at approximately 27m bgl.

On the basis of the published geological maps of the area, the full succession of natural strata in the vicinity of the site is likely to comprise:

**Table 4.1 – Conjectural Geological Succession beneath the Site**

Geological Unit	Brief Description	Anticipated Thickness
<b>Superficial Soils/Drift</b>		
<i>Boulder Clay</i> (possibly in western and/or southern portion of site)	Sandy clay with flint and chalk	5 to 10m
Glacial Gravels	Sand and gravels containing rounded bunter pebbles	10 to 15m
<b>Solid Geology Deposits</b>		
White Chalk Subgroup	Soft white chalk with flints	>30m

The existing topography and history of development of the site suggests that, in addition to these natural strata, made ground is likely to be present beneath the site.

#### 4.1.2 Chalk-related Subsidence Risk

In view of the prevailing ground conditions, with Chalk at shallow depth beneath the site, it is normal practice to consider the potential risk of ground subsidence related to the possible presence of swallow holes and other natural chalk solution features or man-made cavities.

Based on the Edmund's risk assessment model for natural dissolution features referred to in CIRIA Report C574 (2002), the site falls into the 'very low anticipated subsidence risk' category. With reference to Edmund's database of known natural and man-made chalk solution features there is a single natural solution feature within 500m of the study site, associated with a subsidence doline, some 239m to the west / northwest of the site.

#### 4.1.3 Radon

The environmental database report indicates that the site is not located within an 'Affected Area' as defined by the Health Protection Agency (HPA) and therefore the risk of significant

ingress of Radon into structures on-site is considered to be low. This indicates that less than 1% of the homes are above the action level.

## 4.2 Hydrogeology

### 4.2.1 General Characteristics

Based on the published geological map referred to above, the hydrogeology of the site is likely to be characterised by the presence of a deep aquifer within the White Chalk Subgroup. Any cohesive Glacial Deposits overlying the White Chalk Subgroup are likely to act as an aquitard.

The anticipated depth to the water table in the White Chalk Subgroup, i.e. the thickness of the unsaturated zone, is in the order of 25 to 30m below ground level. However, perched groundwater may be present above any particularly cohesive lenses within the Glacial Deposits. The regional direction of groundwater flow is to the northeast.

### 4.2.2 Vulnerability of Groundwater Resources

The White Chalk Subgroup beneath the site classified by the Environment Agency (EA) as a Principal Aquifer (as indicated on the Environment Agency Groundwater Vulnerability Map of the area, Sheet No. 39 'West London'. Furthermore, the Glacial Gravels have been classified as a Secondary (A) Aquifer. The Principal Aquifer has been classified with a High (Urban) Vulnerability rating. Soil information for urban areas is less reliable and based on fewer observations than in rural areas. The worst case (i.e. high leaching potential) is therefore assumed until proved otherwise.

The potential presence of low permeability Boulder Clay at relatively shallow depths beneath the site, whilst restricting downwards migration, may increase the potential for lateral migration of shallow groundwater (and therefore mobile contamination, if present).

### 4.2.3 Licensed Groundwater Abstraction

The environmental database report indicates that there are no current licensed groundwater abstractions within a 1km radius of the site.

The Environmental Health Department of Welwyn Hatfield Council has reported that there no public water supplies within a 2km radius of the site.

In terms of aquifer protection, the EA generally adopts a three-fold classification of Source Protection Zones for public supply abstraction wells.

- *Zone I* - or 'Inner Protection Zone' is located immediately adjacent to the groundwater source and is based on a 50-day travel time. It is designed to protect against the effects of human activity and biological/chemical contaminants that may have an immediate effect on the source.
- *Zone II* - or 'Outer Protection Zone' is defined by a 400-day travel time to the source. The travel time is designed to provide delay and attenuation of slowly degrading pollutants.
- *Zone III* - or 'Total Catchment' is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.

Information obtained from the environmental database report indicates that the site lies within Zone 3 (Total Catchment) of the groundwater Source Protection Zone.

## 4.3 Hydrology

### 4.3.1 Nearest Watercourse

There are no ponds, streams or drainage ditches on or adjacent to the site. The nearest identified surface watercourse / feature to the site (with the exception of small ponds and drainage ditches within Hatfield Park to the east) is the River Lea located approximately 1.2km to the north of the site. It should be noted that the environmental database also makes reference to an extended culvert which runs approximately southwest-to-northeast, marginally encroaching across the site boundary in the extreme northwest corner. This minor culverted channel appears to flow northwards and opens some 380m to the north of the site before eventually flowing into the River Lea.

The base flow of the River Lea is likely to be recharged by groundwater in north by both the shallow and deep aquifer in the site area. A linkage between the river and any ground or groundwater contamination beneath the site may therefore exist, however, the culvert is assumed to be in an isolated channel and therefore is not considered to present an additional pathway between the site and the River Lea.

### 4.3.2 Site Drainage

It is assumed that the existing surface water drainage is discharged into a combined sewerage system. However, we have not received any evidence to support this assumption.

### 4.3.3 Preliminary Flood Risk Assessment

The indicative floodplain map for the area, published by the EA, shows that the site does not lie within a floodplain. This report is not intended to replace a full hydrological study and it is recommended that additional specialist studies be conducted to confirm flood risks at the site.

## 4.4 Mining and Quarrying

Evidence has been sought to identify any mining, quarrying and landfilling operations, past and present which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- Environmental database report;
- Records held by Local Authority (Hatfield Chalk Mines Map) / Environment Agency;
- Old Ordnance Survey maps and plans (see Section 3); and
- Geological maps (see Section 4.1).

The environmental database report indicates that the site is located in an area where the likelihood of chalk mining is unlikely (some small scale mining may have occurred, but restricted in extent). Furthermore, a map of potential local chalk mines produced by Welwyn Hatfield Borough Council confirms that no known historic chalk mining occurred beneath the site itself. However, a small chalk former chalk mine is noted on the same map, some 50m to the northeast of the site (referred to as Area 25-Hill House). The Hatfield Chalk Mines map produced by Welwyn Hatfield Borough Council is included in **Appendix A**.

## 4.5 Landfilling and Land Reclamation

Evidence has been sought to identify any landfilling or land reclamation operations, past and present which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- Environmental database report;

- Records held by Local Authority / Environment Agency;
- Old Ordnance Survey maps and plans (see Section 3); and
- Geological maps (see Section 4.1).

With reference to the above data there are no recorded licensed landfills (current or historic) within a 250m radius of the site. However, with reference to the historical data there have clearly been some phases of construction and demolition on the site and therefore the presence of made ground should not be overlooked.

## 5. PRELIMINARY CONCEPTUAL SITE MODEL

### 5.1 Introduction

A CSM is a simplified written and/or visual/schematic description of the environmental conditions on a site and the surrounding area. It is developed from the individual components of the investigation at each stage to provide a depiction of likely contaminants, pathways and receptors, and highlights key areas of uncertainty.

Fundamental to the CSM is the principle of pollutant linkages, i.e. a source of contamination, a migration pathway and a receptor at risk from that contamination must all be present for a pollutant linkage to be complete. This approach is now accepted best practice in the industry but it does not take into account less scientific factors such as perceived risk, which frequently has a significant influence on land values, particularly when dealing with brownfield sites with a history of contamination. In these circumstances, the perceived risk may significantly exceed the actual levels of risk involved, particularly when residential development is considered.

The site is considered for the proposed future end use, which is understood to be a mixed commercial and residential development with surrounding areas of hardstanding and soft landscaping, and a basement car park facility.

The preliminary CSM presented below is based on the findings of the Preliminary (Phase 1) investigation and therefore contains elements of conjecture and hypothesis. The exploratory investigation reported upon herein was designed to test those hypotheses and acquire data on the actual ground conditions beneath the site, enabling the CSM to be further refined.

In the following sections, the individual components of all identified possible pollutant linkages are assessed using the information identified during the course of the Preliminary (Phase 1) investigation described above.

### 5.2 Sources of Contamination

The study has identified a number of potentially contaminative land uses (current and historic) on and in the vicinity of the site. These are summarised in **Table 5.1** below, together with the identified contaminants of concern typically associated with those land uses (from Environment Agency R&D Publication 66, Industrial Profiles and other sources including the walkover survey).

**Table 5.1 – Potential Sources and Types of Contamination**

Potential Sources	Contaminants of Concern
<b>On-site Historical</b>	
Hatfield Brewery (c. 1800 to 1920).	Potentially petroleum hydrocarbons / fuel oils, Polycyclic aromatic hydrocarbons (PAHs), Asbestos
Warehouse-type building in north of site (c. late 1800's to 1930's).	Petroleum hydrocarbons, PAH, Asbestos
Works – (c. 1940's to c. 1970's).	Petroleum hydrocarbons, PAH, Asbestos, hydrocarbons
<b>On-site Present Day</b>	
Electricity Sub Station	Polychlorinated Biphenyls
Launderette	No current potential sources have been identified associated with this small unit,

Potential Sources	Contaminants of Concern
	however, potentially organic solvents if dry cleaning practices also operate.
Car Parking in the northern portion of the site	Petroleum hydrocarbons
Existing retail, office and fast-food units	No current potential sources have been identified.
Made Ground (i.e. fill material).	Unknown fill material (but potentially including heavy metals, ash, clinker, sulfates, polycyclic aromatic hydrocarbons (PAHs), asbestos etc.).
<b>Off-site</b>	
Garage (assumed automotive), immediately east of site	Fuel oils, lubricating oils, PAHs.
Various industrial land uses including: Smithy, 100m SW and 120m SW (c. late 1800's to 1920s), Gas Works, 180m SW (c. late 1800's to 1920's), unspecified 'works', 40m NW, 120m S, 90m SW (1960's to 1990's), Woodworks Factory, 150m NW, Printing Works, 120m W, Tool Factory 170m SW (c. late 1960's to late 1990's), Heating and Ventilation Works (c1980's to 2000's).	Fuel oils, lubricating oils, heavy metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), solvents and other common industrial contaminants.
Railway, 60m west of site (c. 1800s-present)	Fuel oils, lubricating oils, heavy metals, polycyclic aromatic hydrocarbons (PAHs), PCBs, ash, sulfate, herbicides and asbestos.

The principle source of contamination associated with the historic activities across the site relate to the former use as Hatfield Brewery and 'Works', particularly in the southern portion of the site. These former land-uses also had the potential to impact upon the made ground that is likely to be present across the site. Furthermore, there is the potential for any former basements to be infilled with potentially contaminated material. The potential for the existing site operations to have a contaminative threat to the site is considered to be low owing to the widespread cover of hardstanding and generally low risk land-use.

In terms of off-site sources, the industrial activities to the west of the site (both former and current), including the railway line, have the most potential to be a contaminative threat to the site. However, the distance from the site and general topography of the surrounding area suggest that the potentially most contaminative surrounding land-uses are unlikely to impact the subject site directly.

### 5.3 Receptors at Risk

The risk assessment identifies potential receptors within the following four categories:

- i. end users of the site who may have acute exposure to sources of contamination on a regular and predictable basis;
- ii. controlled waters, being defined as all surface water, groundwater or perched water;
- iii. building structures and services placed in or on the ground;

- iv. other targets such as the “environment”, including any flora and fauna on or near the site and construction and maintenance workers who will have chronic but potentially higher levels of exposure than end users.

Table 5.2 below lists the main sensitive targets within these categories as follows:

**Table 5.2 – Receptors at Risk**

Category	Details of receptor
Current/End users	As detailed within the CLEA Model, this comprises a 0-6 year old female child with respect to the proposed residential end use.  The above is considered the most sensitive receptor in view of the mixed residential and commercial end-use of the site.
Controlled waters	From the desk study/walkover information these generally comprise the groundwater beneath the site (Secondary A Aquifer and the Principal Aquifer and the River Lea (low risk) some 1.2km to the north.
Buildings/services	Buried concrete and other construction material within the ground including water supply pipes etc. The building(s) (and their occupants) may also be susceptible to gas ingress.
Other targets	Short term occupation by construction workers and long term but intermittent visits by maintenance workers.  Vegetation and other ecological receptors may be present in the form of localised areas of soft landscaping.

#### 5.4 Pathways for Migration

Based on the proposed end use of the site and the anticipated ground conditions at and in the vicinity of the site, the contaminant pathways identified within Table 5.3 are considered potentially to be present.

**Table 5.3 – Pathways for Migration**

Category	Details of pathway
End users	Pathways relevant to the end user are identified in the CLEA Model as ingestion, inhalation of soil / dust particulates or contaminant vapours, dermal contact (absorption through skin), and consumption of garden vegetables and fruit.
Controlled waters	Mobile/leachable contaminants will generally migrate vertically downward through the granular Glacial Deposits until meeting the water table after which free/dissolved phases would be expected to migrate towards the River Lea located 1.2km to the north.  The potential presence of low permeability cohesive Glacial Deposits (in the form of Boulder Clay) may restrict the downward migration and promote lateral migration of contaminants.
Buildings/services	Buried concrete and services will be susceptible to attack via contact with aggressive/contaminated ground, especially if mobile groundwater is present.  Pathways for gas migration are considered to exist through the granular Glacial Deposits between the site and the source of any potential ground gas.
Other targets	Pathways towards construction and maintenance workers will relate to acute exposure and as such are outside the scope of chronic risk



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Category	Details of pathway
	assessment methodologies. Vegetation and other ecological targets may be affected by contact with contaminated soils via plant uptake routes.

## 5.5 Preliminary CSM

Based on the assumptions above, a preliminary CSM of pollutant linkages on the site has been developed from the above information and is presented as **Table 5.4**

The CSM includes a qualitative estimation of risk for each pollutant linkage, based on a comparison of the consequence of the event against the probability of its occurrence, in line with the risk classification methodology presented in CIRIA Report C552 (2001).

**Table 5.4 – Preliminary Conceptual Model of Pollutant Linkages**

Sources Potentially Present	Pathways	Receptors	Qualitative Assessment of Risk
Car park in northern portion of the site <b>(Points)</b>	Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Ingestion of contaminated soil, dust, liquid Inhalation of contaminated dust and vapours/gases Contact with contaminated ground/liquid	Controlled waters Human health (future site users) Human health (construction workers) Building materials	<b>Negligible / Low</b>
Made Ground across site (may include heavy metals, PAH, sulphate, asbestos, etc.) <b>(Diffuse)</b>	Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Ingestion of contaminated soil, dust, liquid Inhalation of contaminated dust and vapours/gases Contact with contaminated ground/liquid	Controlled waters Human health (future site users) Human health (construction workers) Building materials	<b>Low / Moderate</b>
Ground gas resultant from: • On-site made ground <b>(Diffuse)</b>	Inhalation of vapours/gases Ingress into building structures	Human health (future site users) Human health (construction workers) Building/structures	<b>Low*</b>
Former light industrial use of the site – Hatfield Brewery and Unspecified Works. <b>(Point / Diffuse)</b>	Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Dermal contact with contaminated soil/water/liquid	Controlled waters Human health (construction workers) Building materials	<b>Moderate*</b>

Sources Potentially Present	Pathways	Receptors	Qualitative Assessment of Risk
Electricity substations <b>(Point)</b>	Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Ingestion of contaminated soil, dust, liquid	Human health (future site users) Human health (construction workers) Controlled waters Building materials	<b>Low*</b>
Railway Land (off-site) <b>(Diffuse)</b>	Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Surface run-off (although unlikely due to distance)	Human health (construction workers)	<b>Low</b> – unlikely to affect controlled waters beneath the site owing to the direction of groundwater flow.
Various off-site sources including light industrial / manufacturing (former and current) <b>(Diffuse)</b>	Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Surface run-off (although unlikely due to distance)	Human health (construction workers)	<b>Low</b> - unlikely to affect controlled waters beneath the site owing to the direction of groundwater flow.

\* Based on information pertained from the previous Site Investigation Report

To summarise, the preliminary CSM has identified evidence of possible ground contamination on the site, possible pathways for contamination to migrate and sensitive receptors potentially at risk. Plausible pollutant linkages are therefore deemed to exist.

## 6. GROUND INVESTIGATION

### 6.1 Site Work

#### 6.1.1 Rationale

The purpose of the intrusive investigation is to aid confirmation of the ground conditions and potential pollutant linkages identified within the Preliminary CSM. The techniques adopted for the investigation have been chosen considering the anticipated ground conditions and the proposed development.

With respect to ground contamination issues, the investigation was designed to target specific potential sources identified within the Preliminary CSM, and also to provide targeted and non-targeted coverage across the site in relation to the proposed redevelopment.

#### 6.1.2 Scope of Works

The site work was carried out between 2<sup>nd</sup> and 4<sup>th</sup> February 2011, and comprised the activities summarised in **Table 6.1**, below, which includes a justification for each exploratory hole location. The investigation and the soil descriptions were carried out in general accordance with BS5930:1999 - Code of Practice for Site Investigations. The exploratory hole logs and other site work records are presented in **Appendix B**.

**Table 6.1 – Summary of Ground Investigation Activities**

Investigation Type	Number	Designation	Rationale
Boreholes - by light cable percussive methods	2	BH1 to BH2	To prove the geological succession beneath the site, obtain geotechnical data and to determine the contamination status of the shallow soils in relation to the proposed redevelopment, to install ground gas monitoring wells.
Boreholes – by drive-in-sampler methods	3	WS1 to WS3	To prove the geological succession, obtain geotechnical data, to determine the contamination status of the ground and install additional dual purpose groundwater and gas monitoring wells. These exploratory holes were located in the area proposed for the construction of residential dwellings (north of the site)
Boreholes – by drive-in-sampler methods	1	WS4	To prove the geological succession, obtain geotechnical data and to determine the contamination status of the ground.
Monitoring well installations	3	WS2, WS4, BH2	Ground gas and groundwater monitoring installations
Trial Pits - excavated by hand	3	TP1 to TP3	To accurately log the upper strata in areas proposed for car parking as part of the proposed

Investigation Type	Number	Designation	Rationale
			redevelopment, provide in-situ CBR determinations and determine the contamination status of the shallow soils.
PID screening of samples	All*	N/A	Detection of volatile organic compounds
Water level monitoring in shallow installations	3	WS2, WS4, BH2	Measurement of depth to groundwater
Ground gas monitoring in monitoring well installations	3	WS2, WS4, BH2	Measurement of ground gas emission rates

\* All shallow samples of made ground and natural underlying soils tested.

The investigation points were located approximately by reference to physical features present on the site at the time of investigation. The ground levels at the exploratory locations have not been measured.

## 6.2 Laboratory Testing

### 6.2.1 Introduction

A programme of geotechnical and chemical laboratory testing, scheduled by RSK and as detailed below, was carried out on selected samples taken from various strata. The laboratory results are presented in **Appendices C and D**, respectively.

### 6.2.2 Geotechnical Testing

The programme of geotechnical tests undertaken on samples obtained from the intrusive investigation is presented in **Table 6.2**, the main purpose of which was to accurately classify the natural soils beneath the site. Where appropriate, testing was undertaken in accordance with BS 1377:1990 Method of Tests for Soils for Civil Engineering Purposes within RSK's UKAS accredited laboratory.

Tests carried out in order to classify the concrete class required on site have been undertaken following the procedures within BRE SD1:2005 by a UKAS accredited laboratory (Structural Soils).

**Table 6.2 – Summary of Geotechnical Testing Programme**

Strata	Tests undertaken	No of Tests
Made Ground	Moisture Content	1
	Plasticity Index	1
	pH and water soluble sulfate	5
Boulder Clay	Moisture Content	5
	Plasticity Index	3
	Undrained Triaxial Compression Test	2
	pH and water soluble sulfate	2
Glacial Deposits (Granular)	Particle Size Distribution	2
	pH and water soluble sulfate	2

### 6.2.3 Chemical Testing

The programme of chemical tests was undertaken on samples obtained from the intrusive investigation as presented in **Table 6.3**. The scope of the testing undertaken is based on the findings of the Phase 1 study discussed above and includes the Contaminants of Concern listed within the Preliminary CSM. Additional tests may also have been specified as a consequence of observations made from the exploratory holes during the investigation.

The testing was carried out to assess the levels of contamination within the made ground and natural soils encountered on the site with regard to identified receptors as detailed within the Conceptual Model. Testing was undertaken by a UKAS accredited laboratory (Envirolab). MCERTS accredited test methods were specified where applicable.

**Table 6.3 – Summary of Chemical Testing Programme**

Strata	Tests undertaken	No of Tests
Made Ground	Heavy Metals Suite – As, Cd, tCr, Pb, Hg, Se, wsB, Cu, Ni, Zn, pH	14
	Speciated PAH	11
	TPHCWG (Speciated TPH)	2
	Total TPH	4
	Polychlorinated Biphenyls	1
	Phenols – Total monohydric	6
	Fibre Screen	11
	Total Organic Carbon (TOC)	4
Glacial Deposits (Granular)	Heavy Metals Suite – As, Cd, tCr, Pb, Hg, Se, wsB, Cu, Ni, Zn, pH	2
	Speciated PAH	2

## 7. PHYSICAL GROUND CONDITIONS

### 7.1 Findings of Ground Investigation

#### 7.1.1 General Succession of Strata

The exploratory holes revealed that the site is underlain by a variable thickness of made ground overlying an interbedded sequence of granular and cohesive Glacial Deposits comprising Boulder Clay and Glacial Gravels. The White Chalk Subgroup was not encountered within the terminal depth of the investigation. This generally appears to confirm the stratigraphical succession described within the Preliminary CSM. For the purpose of discussion, the ground conditions are summarised in **Table 7.1** below.

**Table 7.1 – General Succession of Strata Encountered**

Strata	Exploratory Holes Encountered	Depth to top of stratum m.bgl	Thickness (m)
Made Ground	All	0.00	1.8 to 4.9
Granular Glacial Deposits (shallow)	BH1, BH2, WS2, WS3, WS4	1.8 to 4.9	0.50 to 3.0
Boulder Clay	BH1, BH2, WS1, WS2, WS3, WS4	2.7 to 5.6	6.5 to 7.9 (thickness proven in BH1 and BH2 only)
Granular Glacial Deposits (deep)	BH1, BH2	11.8 to 13.5	Proven to 14.5m bgl

#### 7.1.2 Made Ground

The exploratory holes encountered a variable thickness of made ground across the site ranging from 1.8m in the northern portion of the site to 4.9m in the southern portion of the site (within the Salisbury Square area).

In general terms, the made ground in the northern portion of the site (with the exception of BH1) comprised granular made ground deposits comprising an initial granular layer (sub-base) with variable proportions of flint and concrete overlying clayey gravelly sand with flint and brick. Decomposing organic matter was noted within the sandy deposits in WS3 at 1.6m depth.

The made ground soils in the remaining exploratory locations (generally to the south of the site, except BH1) predominantly comprised a sandy gravelly clay with variable proportions of flint, brick, concrete and occasional ash and clinker-rich soils. Locally, fragments of bitumen (TP2), chalk (TP3) and ceramics (WS1). Occasional lenses of decomposing organic matter were noted within the cohesive made ground deposits between 0.9 and 1.9m depth within WS1.

Visual/olfactory evidence of contamination was encountered in the form of ash and clinker within the made ground soils at a number of locations. On-site PID screening of disturbed samples indicated concentrations of volatile organic compounds (VOCs) at <5ppm, indicating the absence of VOCs within the samples.

Roots were generally noted in the shallow made ground soils within the exploratory holes in the areas of soft landscaping within Salisbury Square. However, it is noted that the mature deciduous trees would extend to a greater depth. Roots were also noted within the made

ground soils beneath the current car parking area to the north to 0.45m depth in WS1, at 1.6m depth in WS3, and to 1.25m depth in WS4

The measured and inferred soil parameters for the stratum are listed in **Table 7.2** below.

**Table 7.2 – Summary of Soil Parameters for Made Ground**

Soil Parameters	Range	Results
Liquid Limit (%)	36*	Appendix B
Plastic Limit (%)	17*	Appendix B
Plastic Index (%)	17*	Appendix B
Modified Plasticity Index (%)	11.39*	-
Plasticity Term	Intermediate*	Appendix B
Volume Change Potential (NHBC)	Low*	-
Moisture Content (%)	22*	-
Modified Moisture Content (%)	33*	-
SPT 'N' Values	8 - 47	Figure 3

\* Cohesive made ground soils

### 7.1.3 Glacial Gravels (*Granular Glacial Deposits*)

The granular Glacial Deposits were encountered both above and below the Boulder Clay. The shallow granular deposits were encountered in all exploratory locations with the exception of the hand-excavated trial pits and WS1. The hand-excavated trial pits did not extend into natural soils and granular soils were absent above the Boulder Clay in WS2.

The shallow granular deposits generally comprised a very loose to medium dense brown/orange silty sand with variable proportions of flint gravel.

The deeper granular deposits were encountered directly below the Boulder Clay deposits in exploratory holes BH1 and BH2 and comprised a very dense slightly clayey (BH1 only) sandy gravel.

Visual/olfactory evidence of contamination was not encountered within the granular glacial deposits. On-site PID screening of disturbed samples indicated the absence of VOCs within the samples.

The measured and inferred soil parameters for the stratum are listed in **Table 7.4** below.

**Table 7.4 – Summary of Soil Parameters for Granular Glacial Deposits**

Soil Parameters	Range	Results
SPT 'N' Values*	4 - 17	Figure 3
SPT 'N' Values	90 – 105**	Figure 3
Density Term*	Very Loose to Medium Dense	
Density Term	Very Dense	

\*Shallow granular deposits (encountered above the Boulder Clay)