



Hydrock 

University of Warwick
Wellesbourne Campus
Phase 1 Desk Study

University of Warwick

Date:

Doc ref: 18736-HYD-XX-XX-GE-DS-1001

DOCUMENT CONTROL SHEET

Issued by	Hydrock Consultants Limited Hawthorn Park Holdenby Road Spratton Northampton NN6 8LD	Tel: 01604 842888 E-mail: northampton@hydrock.com www.hydrock.com
Client	University of Warwick	
Project name	University of Warwick Wellesbourne Campus	
Title	Phase 1 Desk Study	
BIM reference	18736-HYD-XX-XX-GE-DS-1001	
Project reference	C-18736-C	
Date		

Document Production Record		
Status and Revision	P2 S1	Name
Prepared by	Megan Adams MGeol FGS	
Checked by	Click here to enter name AND QUALIFICATIONS.	
Approved by	Paul Eastwood BSc MSc CGeol FGS CWEM RoGEP	

Document Revision Record			
Status	Revision	Date	Revision Details
S2	P1	[Publish Date]	

Hydrock Consultants Limited has prepared this report in accordance with the instructions of the above named client for their sole and specific use. Any third parties who use the information contained herein do so at their own risk.

CONTENTS

1.	INTRODUCTION.....	1
2.	PHASE 1 STUDY (DESK STUDY AND FIELD RECONNAISSANCE).....	3
3.	PRELIMINARY CONCEPTUAL SITE MODEL.....	23
4.	DESK STUDY CONCLUSIONS.....	26
5.	UNCERTAINTIES AND LIMITATIONS.....	28
6.	RECOMMENDATIONS FOR FURTHER WORK.....	29
7.	REFERENCES.....	31

Appendices

Appendix A	Drawings
Appendix B	Field Reconnaissance Photographs
Appendix C	Historical Ordnance Survey Maps
Appendix D	Desk Study Research Information
Appendix E	Preliminary Geotechnical Risk Register
Appendix F	Plausible Source-Pathway-Receptor Contaminant Linkages
Appendix G	Hydrock Methodologies

Tables

Table 2.1: Site referencing information	3
Table 2.2: Site description.....	4
Table 2.3: Site history review Area A (south west).....	6
Table 2.4: Non-specialist UXO screening (for the purposes of ground investigation).....	13
Table 2.5: Geology	13
Table 2.6: Aquifer system	15
Table 2.7: Groundwater abstractions	15
Table 2.8: Surface water features	16
Table 2.9: Surface water abstractions.....	16
Table 2.10: Regulatory information within 500m of the site	18
Table 2.11: Natural soil chemistry.....	21
Table 4.1: Possible Pollutant Linkages (for Risk Levels of Moderate or Greater)	27

Figures

Figure 2.1: Site location	3
Figure 2.2: Extract from the Ordnance Survey Map.....	3
Figure 2.3: Liquid nitrogen storage, east of the site.....	5
Figure 2.4: Gas cylinders in the east of the site.	5

Figure 2.5: Substation, one of at least three, centre of campus.	5
Figure 2.6: Chemical waste store in the west of the campus.	5
Figure 2.7: Superficial deposits.	14
Figure 2.8: Solid geology.	14

EXECUTIVE SUMMARY

<i>SITE INFORMATION AND SETTING</i>	
Objectives	The objective of the Phase 1 Desk Study is to formulate a Preliminary Conceptual Ground Model of the site to identify key geo-environmental and geotechnical risks to the proposed development.
Client	University of Warwick
Site name and location	University of Warwick, Wellesbourne Campus
Proposed development	Hydrock understands that the site is to be partially developed with series of academic and industrial structures related to innovative and automotive research.
<i>PHASE 1 (DESK STUDY AND SITE RECONNIASANCE)</i>	
Ground Model	<p>The site is currently a crop centre for the University of Warwick and is used to undertake research into sustainable agriculture, horticulture and food security. There are university buildings in the north east of the site and arable fields in the remainder of the site.</p> <p>The site is approximately 191 ha in area and generally undulating. The River Dene bisects the site in the south and forms a small valley where the site slopes down from the south and north. North of the River Dene the site also gently slopes from 46m OD in the east to 42m OD in the west. An unnamed small brook runs east to west within a ditch. In addition, there are a few depressions in the east of the site, south of the university campus, that lie 2m below the surrounding land, one was filled with water at time of site visit.</p> <p>There are substations on site, a liquid nitrogen storage area, above ground storage tanks, above ground pipes and gas cylinders (helium, hydrogen, oxygen and nitrogen). The current buildings appear to have used potentially asbestos containing building materials in their construction.</p> <p>There are several bridges over the unamend small brook with varying weight limits (5 to 20 tonnes). Irrigation systems appear to run across the majority of the surrounding fields with numerous standpipes for irrigation and manholes noted.</p> <p>The fields are a mixture of ploughed, cropped and grassed fields and an orchard. A reservoir is present in the central west of the site. There is an area in the centre of the site with various instruments, likely used for recording weather and atmospheric conditions.</p> <p>Access between the fields is well connected via various farm tracks.</p> <p>An overhead electricity cable runs east to west north of Dogkennel Lane and north towards the reservoir where it grounds. High pressure gas markers were noted in two locations suggesting a high-pressure gas main runs north north east to south south west along the south east of the site.</p> <p>The fields South of Dogkennel Lane were not accessed during the site walkover due to locked gates, however a track was observed running north to south and it is expected access will be readily available between fields.</p> <p>Review of historical Ordnance Survey data indicates:</p> <ul style="list-style-type: none"> • The site was open fields until between 1971 and 1975 with footpaths, bisected by the River Dene and a small road just north of the river. There is a gravel pit some 200m west of the eastern site boundary. • In 1941 the land directly south of the site was used for an Airfield during WW2, and now is used for light aircraft. • In the mid-1950s a sewage works was constructed directly south east of the site. • In the 1970s, the research centre and university building were constructed and the small gravel pit was infilled. • In the late 1980s the small pond in the centre of the site was turned into a small reservoir.

- Between 1971 and 1991, Charlote Quarry was active to the north west of the site with several gravel pits, after 1991, most were infilled or became lakes.
- Between 1995 and 1999 a number of industrial units were constructed to the south east of the site as the town of Wellesbourne becomes more commercial.

A non-specialist UXO assessment indicates moderate risk associated with the nearby Wellesbourne Airfield.

The geology at the site consists of River Terrace deposits between 2m and 4m deep, overlying Mercia Mudstone Group with Alluvium present along the banks of the River Dene. Localised Made Ground is likely to be present around structures comprising the university campus and research centre.

One small gravel pit was present in the north east of the site, it is assumed to be infilled after 1972 with unknown material and is currently a playing field north of the campus.

The superficial deposits comprise a Secondary A aquifer and the Mudstone is a Secondary B Aquifer. The site is not within a Source Protection Zone and there are 8 groundwater abstractions within 1km of the site.

The River Dene flows east to west across the south of the site, joining the River Avon some 800m to the west of the site.

ASSESSMENT AND CONCLUSIONS

<p>Preliminary Geotechnical Hazards</p>	<p>The following plausible geotechnical risks are identified.</p> <ul style="list-style-type: none"> • Variable localised Made Ground - settlement or differential settlement of foundations, floor slabs, roads and infrastructure elements. • Low strength, compressible ground – risk of shear failure and excessive settlement of foundations, roads and infrastructure elements. • Shrinkage/swelling of clay – settlement/heave of foundations, especially where located within the influence of trees and vegetation. • Running sands, loose Made Ground and shallow groundwater, leading to difficulty with excavation due to trench instability. • Earthworks – Low bearing capacity or settlement of new fill and impact on foundations, floor slabs, roads and infrastructure and construction plant. • Potential for unforeseen ground conditions and the risks associated with limited data. 												
<p>Preliminary Geo-environmental Conclusions</p>	<p>Based on historical and current land uses It is considered that it is unlikely that the site would be classified as Contaminated Land under Part 2A of the EPA 1990.</p> <p>The overall risk from land contamination at the site is considered to be low for the current development, as it is covered by hard standing or buildings (the Campus area) limiting the possibility of contact with the soils, as well as the risk of significant rainwater infiltration leading to leaching and due to the current land use of the site.</p> <p>The overall risk for a redeveloped site is assessed to be low, with some specific potentially high risks, but this would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation.</p> <table border="1" data-bbox="368 1653 1401 2016"> <thead> <tr> <th data-bbox="368 1653 890 1697">Source(s)</th> <th data-bbox="890 1653 1214 1697">◀ potential Impact on ▶</th> <th data-bbox="1214 1653 1401 1697">Receptor(s)</th> </tr> </thead> <tbody> <tr> <td data-bbox="368 1697 1161 1816">Metals, metalloids, PAH, petroleum hydrocarbons and asbestos in Made Ground below the site.</td> <td data-bbox="1161 1697 1214 1816"></td> <td data-bbox="1214 1697 1401 1816">Site users Neighbours Groundwater</td> </tr> <tr> <td data-bbox="368 1816 1161 1935">Hydrocarbon fuels, lubricants, chlorinated solvents and PCBs (sub-stations only) from the operation of the engineering works and electricity sub-station on the site.</td> <td data-bbox="1161 1816 1214 1935"></td> <td data-bbox="1214 1816 1401 1935">Site users Neighbours Buildings</td> </tr> <tr> <td data-bbox="368 1935 1161 2016">Contamination associated with sewage treatment works directly south east of the site.</td> <td data-bbox="1161 1935 1214 2016"></td> <td data-bbox="1214 1935 1401 2016">Site users Groundwater</td> </tr> </tbody> </table>	Source(s)	◀ potential Impact on ▶	Receptor(s)	Metals, metalloids, PAH, petroleum hydrocarbons and asbestos in Made Ground below the site.		Site users Neighbours Groundwater	Hydrocarbon fuels, lubricants, chlorinated solvents and PCBs (sub-stations only) from the operation of the engineering works and electricity sub-station on the site.		Site users Neighbours Buildings	Contamination associated with sewage treatment works directly south east of the site.		Site users Groundwater
Source(s)	◀ potential Impact on ▶	Receptor(s)											
Metals, metalloids, PAH, petroleum hydrocarbons and asbestos in Made Ground below the site.		Site users Neighbours Groundwater											
Hydrocarbon fuels, lubricants, chlorinated solvents and PCBs (sub-stations only) from the operation of the engineering works and electricity sub-station on the site.		Site users Neighbours Buildings											
Contamination associated with sewage treatment works directly south east of the site.		Site users Groundwater											

	Leachate from unknown landfilled waste on the western boundary of the site.	Site Users Groundwater
<i>FUTURE CONSIDERATIONS</i>		
Further work	<p>In order to confirm the actual risks to receptors and confirm the ground conditions with respect to potential geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken. This investigation will need to:</p> <ul style="list-style-type: none"> • determine the depth and distribution of Made Ground and natural strata across the site; • determine the soil strength/density profile beneath the site; • determine the depth/level of groundwater beneath the site; • determine the ground gas concentrations beneath the site; • determine CBRs to assist with pavement design; • assess trench stability, over break potential and ‘diggability’; • allow sampling for chemical and geotechnical laboratory testing; • allow soil classification to allow geotechnical characterisation and determine suitability for reuse of soils within earthworks; • obtain information in terms of Aggressive Chemical Environment for Concrete Class (ACEC Class). • Following investigation, assessment will be required to: <ul style="list-style-type: none"> • update the Ground Model; • update the Geotechnical Risk Register; • provide Geotechnical Design recommendations; • update the Conceptual Site Model (CSM), including identification of plausible pollution linkages; • undertake generic quantitative risk assessment of potential chemical contaminants to establish ‘suitability for use’ under the current planning regime; • discuss potential environmental liabilities associated with land contamination (soil, water and gas); and • provide outline mitigation recommendations to ensure the site is ‘suitable for use’. 	

This Executive Summary forms part of Hydrock Consultants Limited report number 18736-HYD-XX-XX-GE-DS-1001 and should not be used as a separate document.

1. INTRODUCTION

1.1 Terms of reference

In February 2021, Hydrock Consultants Limited (Hydrock) was commissioned by the University of Warwick (the Client) to undertake a desk study at University of Warwick Wellesbourne Campus.

The site is currently mainly agricultural fields with the University of Warwick Wellesbourne Campus in the north east of the site.

Hydrock understands that the site is to be partially developed with series of academic and industrial structures related to innovative and automotive research.

The works have been undertaken in accordance with Hydrock's proposal referenced (18736-E.001 dated 15th February 2021) and the Client's instructions to proceed (email dated 17th February).

1.2 Objectives

The objective of the Phase 1 Desk Study is to formulate a Preliminary Conceptual Ground Model of the site to identify key geo-environmental and geotechnical risks to the proposed development.

1.3 Scope

The scope of the Phase 1 Desk Study comprises:

- a field reconnaissance (walkover) to determine the nature of the site and its surroundings including current and former land uses, topography, geology and hydrology;
- acquisition and review of:
 - historical Ordnance Survey maps, to identify former potentially contaminative uses at the site and immediately surrounding it, and an assessment of the associated contamination risks;
 - a third party environmental database search to identify flooding warning areas, local landfills, pollution incidents, abstractions, environmental permits etc. which may have had the potential to have environmental impact on the site;
 - topographical, geological and hydrogeological maps;
 - British Geological Survey (BGS) archive records;
 - regional UXB risk maps;
- development of a preliminary Conceptual Site Model (CSM), including identification of potential pollution linkages;
- a qualitative assessment of any risks identified; and
- identification of plausible geotechnical hazards.

1.4 Regulatory context and guidance

The geo-environmental section of this report is written in broad agreement with BS 10175:2011+ A2:2017, the Land contamination risk management (LCRM)(Environment Agency 2020) and the AGS (2006) Good Practice Guidelines for Site Investigations. The methods used follow a risk-based approach, with the first stage being a Phase 1 desk study and field reconnaissance (this report), with the potential geo-environmental risk assessed qualitatively in future reports using the 'source-pathway-

receptor contaminant linkage' concept to assess risk as introduced in the Environmental Protection Act 1990 (EPA, 1990).

The geotechnical section of this report is undertaken in general accordance with BS EN 1997 (EC7). This report forms the Preliminary Sources Study Report (PSSR) as defined by DMRB HD22/08.

Where relevant the NHBC Standards (2021), have also been applied.

Remaining uncertainties and recommendations for further work are listed in Section 0 and Section 6.

Reference to the technical details of the approach and the methodologies adopted are provided in Appendix G.

2. PHASE 1 STUDY (DESK STUDY AND FIELD RECONNAISSANCE)

2.1 Data

A number of desk study sources have been used to assemble the following information. These are presented in Appendix D and include:

- Third party environmental database search (Envirocheck report);
- Historical Ordnance Survey mapping;
- BGS Archive Records; and,
- Zetica UXB Risk Maps (<https://zeticauxo.com/downloads-and-resources/risk-maps/>)

2.2 Site referencing

The site is referenced in Table 2.1 and the location is indicated in Figure 2.1 and Figure 2.2.

Table 2.1: Site referencing information

Item	Brief Description
Site name	University of Warwick Wellesbourne Campus
Site address	University of Warwick, Wellesbourne Campus, Wellesbourne, Warwick CV35 9EF.
Site location and grid reference	The site is located to the west of the A429, 6km east of Stratford upon Avon and 9km south of Warwick city centre. The National Grid Reference of the approximate centre of the site is 427040E, 256485N.



Figure 2.1: Site location



Figure 2.2: Extract from the Ordnance Survey Map.

A site location plan (Hydrock Drawing 18736-HYD-XX-ZZ-DR-GE-1000) is presented in Appendix A.

2.3 Site description and field reconnaissance survey

A field reconnaissance survey was undertaken on 3rd March 2021 to visually assess potential geotechnical hazards, contaminant sources and receptors. The weather during the field reconnaissance survey was dry. Access was prevented to the southern fields by locked gates, however the area was viewed from nearby public rights of way.

A basic site description is presented in Table 2.2 and selected photographs are presented in Figure 2.3 to Figure 2.6. Additional photographs are presented in Appendix B.

Table 2.2: Site description

Item	Brief Description
Site access	Via A429 (for site area north of Dogkennel Lane) and Dogkennel Lane for site area south of Dogkennel Lane.
Site area	The site is irregular in shape and has an area of approximately 191 ha.
Elevation, topography and any geomorphic features	In general, the site is undulating. The River Dene bisects the site in the south and forms a small valley where the site slopes down from the south and north, both from 46m OD towards the River which lies at 40m OD. North of the River Dene the site also gently slopes from 46m OD in the east to 42m OD in the west. An unnamed small brook runs east to west within a ditch. In addition, there are a few depressions in the east of the site, south of the university campus, that lie 2m below the surrounding land, one was filled with water at the time of the site visit.
Present land use	The site is currently a crop centre for the University of Warwick and is used to undertake research into sustainable agriculture, horticulture and food security. As such, there are university buildings in the north east of the site and arable fields in the remainder of the site. The buildings comprise multistorey and single storey offices/labs, greenhouses, industrial/infrastructure housing units and associated services and infrastructure. In particular there are substations on site, a liquid nitrogen storage area, above ground storage tanks (it is unclear what they were storing), above ground pipes and gas cylinders (helium, hydrogen, oxygen and nitrogen). Several of the greenhouses (as seen on Google maps) have been removed and replaced with car parking. To the north of the university buildings there are residential properties (The Crescent), a school and football pitch. The buildings to the north west of the campus area appeared older, with suspected asbestos roofing, and were being used for agricultural purposes, e.g., storage of farm equipment. There is a pond to the west of these older buildings. There are several bridges over the unnamed small brook with varying weight limits (5 to 20 tonnes). The majority of the surrounding fields appear to have an irrigation system with numerous standpipes for irrigation and manholes noted running east to west across the site. There was a mixture of ploughed, cropped and grassed fields and an orchard. A reservoir is present in the central west of the site. There is an area in the centre of the site with various instruments, likely used for recording weather and atmospheric conditions. An overhead electricity cable runs east to west north of Dogkennel Lane and north towards the reservoir where it grounds. High pressure gas markers were noted in two locations suggesting a high pressure gas main runs north east to south west along the south east of the site (to be confirmed by service plans). Access between the fields north of Dogkennel Lane was facilitated by a track running north to south in the centre of the site and open field entrances which were numerous. The fields South of Dogkennel Lane were not accessed during the site walkover due to locked gates, however a track was observed running north to south and it is expected access will be readily available between fields.
Vegetation	The field boundaries comprised well established hedges with sporadic to frequent mature trees and fencing around the site boundary. Mature trees line the unnamed small brook and around the pond in the north of the site. Around the campus there were sporadic

Item	Brief Description
	mature trees with areas of more dense woodland located around the school and residential area and southeast of the buildings.
General site sensitivity	The site is within a generally rural to the east north and west. Wellesbourne is south east of the site and there is the Wellesbourne Mountford Airfield and commercial units to the south. To the west of the site is the National Trust Charlecote Park.
Site boundaries and surrounding land	The site boundaries are lined by hedges, fences and sporadic trees. The northern boundary comprises a drainage ditch. Detail boundaries. Surround land is mainly agricultural.



Figure 2.3: Liquid nitrogen storage, east of the site.



Figure 2.4: Gas cylinders in the east of the site.



Figure 2.5: Substation, one of at least three, centre of campus.



Figure 2.6: Chemical waste store in the west of the campus.

2.4 Site history

A study of historical Ordnance Survey maps (Appendix C) has been undertaken to identify any former land uses at the site and surrounding areas which may have geotechnical or geo-environmental implications for the proposed development. Due to the size of the site, it has been split up into four sections as shown in Figure 2.67. The key findings are summarised in Table 2.3 – 2.6.

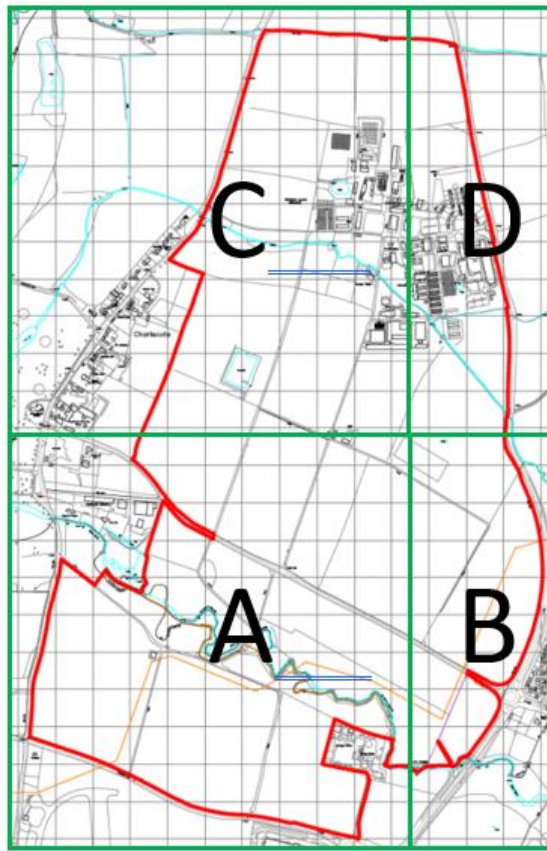


Figure 2.7: Plan of site showing Areas A-D.

Table 2.3: Site history review Area A (south west)

Reference	Key Features on Site	Key Features off Site
Warwickshire 1884 – 1886 1:10,560	The site is open fields with footpaths. The site is bisected by the River Dene and a small road just north of the river. A drain also runs parallel to the river.	Roads bound the site to the west and south of the site. The wider area is farmland with Charlote Park and gardens to the west.
Warwickshire 1884 – 1886 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1886 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1886 - 1887 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1905 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1906 1:10,560	No noticeable changes	No noticeable changes
Warwickshire	No noticeable changes	No noticeable changes

Reference	Key Features on Site	Key Features off Site
1938 1:2,500		
Ordnance Survey Plan 1955 1:10,000	No noticeable changes	Airfield directly south of the site and a sewage treatment works outside the south east corner of the site.
Ordnance Survey Plan 1966 1:2,500	No noticeable changes	No noticeable changes
Ordnance Survey Plan 1966 - 1968 1:2,500	No noticeable changes	No noticeable changes
Ordnance Survey Plan 1966 - 1972 1:2,500	No noticeable changes	No noticeable changes
Ordnance Survey Plan 1971 – 1975 1:10,000	No noticeable changes	No noticeable changes
Ordnance Survey Plan 1974 1:2,500	No noticeable changes	No noticeable changes
Additional SIMs 1980 1:2,500	No noticeable changes	No noticeable changes
Additional SIMs 1980 - 1989 1:2,500	No noticeable changes	No noticeable changes
Additional SIMs 1989 1:2,500	Small track is now present on site to access a small farm building in the south west of the site.	A small pond is now present just outside the western boundary, north of the River Dene.
Additional SIMs 1990 1:2,500	No noticeable changes	Roundabout is now present 100m to the southwest as Wellesbourne becomes more residential.
Ordnance Survey Plan 1991 – 1995 1:10,000	No noticeable changes	No noticeable changes
Large-Scale National Grid Data 1992	No noticeable changes	No noticeable changes

Reference	Key Features on Site	Key Features off Site
1:2,500		
Large-Scale National Grid Data 1994 1:2,500	No noticeable changes	No noticeable changes
10k Raster Map 1999 1:10,000	No noticeable changes	No noticeable changes
Aerial Photograph 1999	No noticeable changes	Industrial estate is now present 400m south east of the site.
10k Raster Map 2006 1:10,000	No noticeable changes	No noticeable changes
VectorMap Local 2020 1:10,000	No noticeable changes	Depot id now present 10m south of the site.

Table 2.4: Site history review Area B (south east)

Reference	Key Features on Site	Key Features off Site
Warwickshire 1886 1:10,560	The site is open fields with footpaths. The site is bisected by the River Dene and a small road just north of the river. There is a small pond close to the eastern boundary.	The wider area is farmland with the small village of Wellesbourne Hastings lies to the east of the site. There is a gas works 900m east of the site.
Warwickshire 1886 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1886 - 1887 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1905 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1906 1:10,560	No noticeable changes	No noticeable changes
Warwickshire 1938 1:2,500	No noticeable changes	No noticeable changes
Ordnance Survey Plan 1955 1:10,000	No noticeable changes	No noticeable changes.

Reference	Key Features on Site	Key Features off Site
Ordnance Survey Plan 1966 1:2,500	No noticeable changes	More residential houses are now present in Wellesbourne.
Ordnance Survey Plan 1966 - 1972 1:2,500	No noticeable changes	No noticeable changes
Supply of Unpublished Survey Information 1973 1:2,500	No noticeable changes	No noticeable changes
Ordnance Survey Plan 1974 1:2,500	No noticeable changes	No noticeable changes
Ordnance Survey Plan 1974 – 1975 1:10,000	No noticeable changes	The gas works is now gone and the town is now more residential. An industrial estate is now present 600m south east of the site.
Additional SIMs 1980 1:2,500	No noticeable changes	No noticeable changes
Additional SIMs 1980 - 1987 1:2,500	There is a second small pond 30m from the eastern site boundary	No noticeable changes
Additional SIMs 1990 1:2,500	No noticeable changes	Roundabout is now present directly east of the site, and a road built up on an embankment, with a bridge over the River Dene is now present along the eastern boundary of the site.
Ordnance Survey Plan 1991 – 1995 1:10,000	No noticeable changes	More residential houses are now present further south.
Large-Scale National Grid Data 1992 1:2,500	No noticeable changes	No noticeable changes
Large-Scale National Grid Data 1994 1:2,500	No noticeable changes	No noticeable changes

Reference	Key Features on Site	Key Features off Site
10k Raster Map 1999 1:10,000	No noticeable changes	No noticeable changes
Aerial Photograph 1999	No noticeable changes	More residential houses to the north of Wellesbourne, along the eastern site boundary.
10k Raster Map 2006 1:10,000	No noticeable changes	No noticeable changes
VectorMap Local 2020 1:10,000	No noticeable changes	More residential houses are now present further south.

Table 2.5: Site history review Area C (north west)

Reference	Key Features on Site	Key Features off Site
Warwickshire 1886 1:10,560	The site is open fields with footpaths. There are 2 small ponds and a cottage farm on site. The site is bisected by a small brook.	The wider area is farmland with the small village of Charlcote directly to the west of the site and the River Avon lies some 800m to the west.
Warwickshire 1886 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1886 - 1887 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1905 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1906 1:10,560	No noticeable changes	No noticeable changes
Warwickshire 1922 - 1926 1:10,560	No noticeable changes	No noticeable changes
Warwickshire 1925 1:2,500	No noticeable changes	No noticeable changes
Ordnance Survey Plan 1955 1:10,000	No noticeable changes	No noticeable changes.
Ordnance Survey Plan 1968 - 1972 1:2,500	No noticeable changes	No noticeable changes

Reference	Key Features on Site	Key Features off Site
Ordnance Survey Plan 1971 – 1975 1:10,000	Research station is now present in the north west of the site, with associated sewage works to the south.	Charlcote Quarry is now present some 250m to the north west of site and a pumping station is also present 400m to the north.
Ordnance Survey Plan 1972 1:2,500	No noticeable changes	No noticeable changes
Additional SIMs 1979 - 1989 1:2,500	No noticeable changes	No noticeable changes
Additional SIMs 1987 - 1989 1:2,500	The pond further south is now a reservoir.	No noticeable changes
Ordnance Survey Plan 1991 1:10,000	No noticeable changes	Charlcote Quarry is now infilled, with one pit now a lake.
Large-Scale National Grid Data 1992 1:2,500	No noticeable changes	No noticeable changes
10k Raster Map 1999 1:10,000	No noticeable changes	No noticeable changes
Aerial Photograph 1999	No noticeable changes	No noticeable changes
10k Raster Map 2006 1:10,000	No noticeable changes	No noticeable changes
VectorMap Local 2020 1:10,000	No noticeable changes	No noticeable changes

Table 2.6: Site history review Area D (north east)

Reference	Key Features on Site	Key Features off Site
Warwickshire 1886 1:10,560	The site is open fields with footpaths. There is a small gravel pit some 200m west of the eastern site boundary.	The wider area is farmland with three old stone pits 800m north east of the site.
Warwickshire 1886	No noticeable changes	No noticeable changes

Reference	Key Features on Site	Key Features off Site
1:2,500		
Warwickshire 1886 - 1887 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1905 1:2,500	No noticeable changes	No noticeable changes
Warwickshire 1906 1:10,560	No noticeable changes	No noticeable changes
Warwickshire 1925 1:2,500	No noticeable changes	No noticeable changes
Ordnance Survey Plan 1955 1:10,000	No noticeable changes	The old stone pits are now infilled.
Ordnance Survey Plan 1972 1:2,500	Gravel pit on site is now infilled and Research institution is now present on site.	No noticeable changes
Supply of Unpublished Survey Information 1973 1:2,500	No noticeable changes	No noticeable changes
Ordnance Survey Plan 1975 1:2,500	No noticeable changes	No noticeable changes
Additional SIMs 1987 1:2,500	No noticeable changes	No noticeable changes
Additional SIMs 1991 1:2,500	No noticeable changes	No noticeable changes
Large-Scale National Grid Data 1992 1:2,500	No noticeable changes	No noticeable changes
Large-Scale National Grid Data 1994	No noticeable changes	No noticeable changes

Reference	Key Features on Site	Key Features off Site
1:2,500		
10k Raster Map 1999 1:10,000	No noticeable changes	No noticeable changes
Aerial Photograph 1999	No noticeable changes	No noticeable changes
10k Raster Map 2006 1:10,000	No noticeable changes	No noticeable changes
VectorMap Local 2020 1:10,000	No noticeable changes	No noticeable changes

2.5 Unexploded ordnance (UXO)

In general accordance with CIRIA Report C681 (Stone et al 2009) a non-specialist UXO screening exercise has been undertaken for the purposes of ground investigation and is presented in Table 2.4 .

Table 2.4: Non-specialist UXO screening (for the purposes of ground investigation)

Data	Comment	Further Assessment Required
Site History	Wellesbourne Mountford Airfield lies directly south of the site. Commissioned in 1941 for use during WWII.	Yes
Post War Development	No visible post-war damage on OS mapping	No
Geology Type	The ground conditions comprise a River Terrace Deposits and Alluvium over Mercia Mudstone. There is the potential that UXO, if present, would remain undetected.	Yes
Surface Cover during WWI	The surface cover during WWII comprised open fields. There is the potential that UXO, if present, would remain undetected.	Yes
Indicator of Aerial Delivered UXO	Screening against the regional bomb risk map (Warwickshire) Appendix D indicates the site to be in an area where the bomb risk is low.	No

The non-specialist UXO screening exercise has indicated that whilst the regional risk map showed low risk in this area, Wellesbourne Mountford Airfield was active and bombed several times during WWII. A detailed specialist UXO risk assessment in accordance with CIRIA Report C681 is recommended.

2.6 Geology

The general geology of the site area is shown on the 1:10,000 British Geological Survey (BGS) map extract reproduced as part of the Envirocheck report and is summarised in Table 2.5. Extracts from the map are shown in Figure 2.7 and Figure 2.8.

Table 2.5: Geology

Ref. for Figures	Location	Stratigraphic Name	Description
Superficial Deposits (Figure 2.7)			
RTD	On site	River Terrace Deposits	Sand and Gravel
ALV	On site	Alluvium	Clay, Silt, Sand and Gravel
Solid Geology (Figure 2.8)			
MMG	On site.	Mercia Mudstone Group	Dominantly red or greenish grey mudstones and siltstones. Thin beds of gypsum and sandstones.

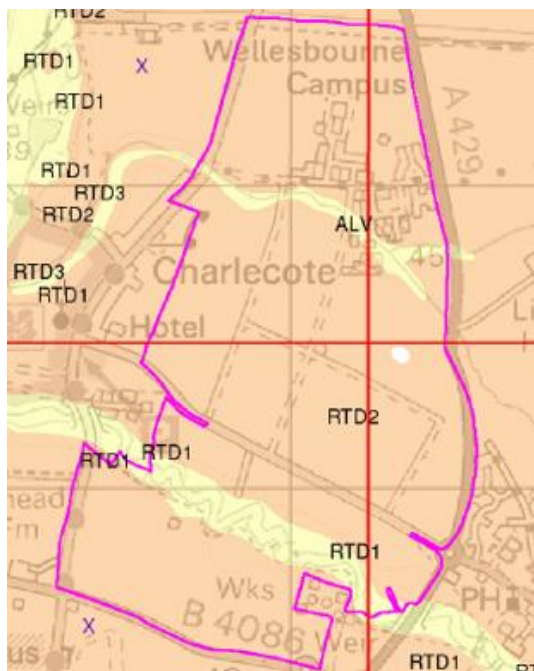


Figure 2.7: Superficial deposits.

(Reproduced with permission from Envirocheck)

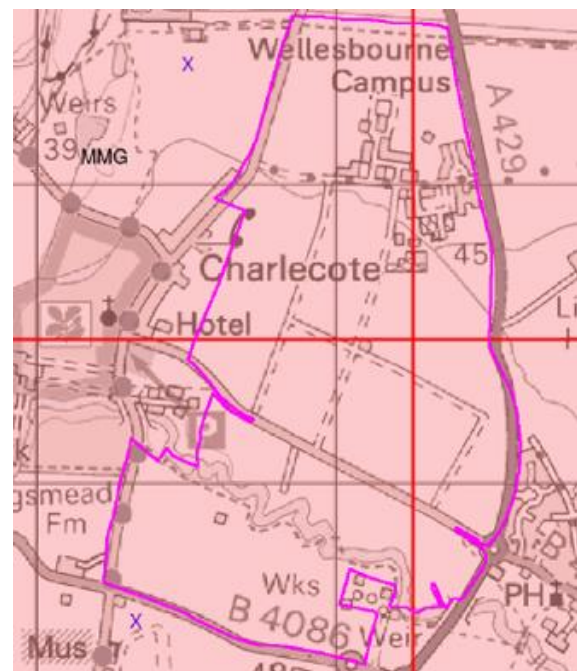


Figure 2.8: Solid geology.

(Reproduced with permission from Envirocheck)

A number of borehole logs from the BGS archive have been reviewed. Selected records are summarised below:

- SP25NE138, located in the north of the site (NGR 427105E, 257491N), drilled to a depth of 4.50m and recorded:
 - Topsoil from ground level and 0.50m below ground level (bgl);
 - Orange brown very clayey sand between 0.50m and 2.0m bgl (probable River Terrace Deposits);
 - Orange brown clayey sandy coarse grained rounded gravel between 2.0m and 2.50m bgl (probable River Terrace Deposits);
 - Clayey coarse grained rounded gravel between 2.50m and 3.20m bgl (probable River Terrace Deposits); and
 - Firm red brown friable sandy weathered marl between 3.20m and 4.50m bgl (probable Mercia Mudstone Group).
- SP25NE174, located in the south west of the site (NGR426780E, 256440N), drilled to a depth of 180.14m and recorded:

- Topsoil from ground level to 0.45m bgl;
- Gravel from 0.45m to 1.80m bgl (probable River Terrace Deposits);
- Variable marls from 1.80m to 145m bgl (probable Mercia Mudstone Group); and
- Variable sandstones and marls from 145m to 181.14m bgl.

2.7 Groundwater system

2.7.1 Aquifer designations

Based on the inferred geological sequence presented in Section 2.6 and the Environment Agency's interactive aquifer designation map, the aquifer system presented in Table 2.6 applies.

Table 2.6: Aquifer system

Stratum	Aquifer Designation	Hydraulic Characteristics
River Terrace Deposits	Secondary A Aquifer	Dominated by high permeability sand and gravel.
Mercia Mudstone Group	Secondary B Aquifer	Dominated by low permeability and low porosity clay/silt, which is interbedded with moderate to high permeability layers of sandstone.

2.7.2 Groundwater abstraction

There are 8 active licensed groundwater abstractions within 1000m of the site. They are listed in Table 2.7.

Table 2.7: Groundwater abstractions

Location Relative to Site	Purpose of Abstraction
On Site	Agricultural, University of Warwick, general farming & domestic
On Site	Agricultural, University of Warwick, spray irrigation
On Site	Agricultural, Horticultural Research Unit, general farming & domestic
On Site	Agricultural, Horticultural Research Unit, spray irrigation
442m north	Potable, Severn Trent Water Limited, Borehole C
445m north	Potable, Severn Trent Water Limited, Borehole D
650m east	Agricultural, Messrs T Barber & Son, general farming & domestic
780m west	Potable, Severn Trent Water Limited, Borehole A

2.7.3 Groundwater source protection zones and groundwater vulnerability

The site is not within a groundwater Source Protection Zone (SPZ)

2.7.4 Groundwater quality

The groundwater body beneath the site (Warwickshire Avon – Secondary Mudrocks) is currently (2016 Cycle 2) classified under the Water Framework Directive as 'good'.

2.7.5 Groundwater levels, recharge, and flow

Shallow groundwater is likely to be present within the River Terrace Deposits, with a deeper groundwater body within permeable horizons of the Mercia Mudstone Group. The presence of the low permeability clay is likely to inhibit vertical connection between these two potential groundwater bodies.

Available BGS borehole data recorded groundwater at 3.9m bgl (41.6m OD) for a borehole in the north of the site and at 8.0m, 20m and 31m bgl for a borehole in the south west of the site.

Groundwater below the site is likely to drain towards the River Dene, that cuts across the south of the site and the River Avon, which lies some 800m to the west of the site.

2.8 Surface Water System

2.8.1 Hydrology and drainage

The surface water features in the vicinity of the site are listed in Table 2.8.

Table 2.8: Surface water features

Feature	Location Relative to Site
River Dene	Runs east west through the south of the site, joining the River Avon
Drainage Ditch	Along the northern site boundary, joining the river Avon
Small brook	Runs east west across the site, just south of the University campus, joining the River Avon
Small pond	In the central north of the site
Small reservoir (80m x 50m)	Centre of the site
River Avon	800m west of site

2.8.2 Surface water abstractions and discharges

There are four active licensed surface water abstractions within 1km of the site. They are listed in Table 2.9.

Table 2.9: Surface water abstractions

Location Relative to Site	Purpose of Abstraction
450m west of site	Agricultural, J M Meir, spray irrigation - storage
680m west of site	Agricultural, J L Lampitt, spray irrigation - storage
720m west of site	Agricultural, J L Lampitt, spray irrigation
740m west of site	Agricultural, J L Lampitt, spray irrigation

2.8.3 Surface water quality

Reference to the Environment Agency website shows the site is located in the River Severn District, but is separated into specific river water bodies.

The north of the site lies within the catchment of the Avon (Wark) Conf R Leam to Tramway Br, Stratford. The current (2019 Cycle 2) overall status under the Water Framework is 'moderate'. The water body is currently 'moderate' due to poor phosphate levels and failure on priority hazardous substances such as Mercury, Polybrominated diphenyl ethers (PBDE) and Perfluorooctane sulphonate (PFOS). The objective is for phosphate levels to be 'good' by 2021 and overall water body to be 'good' by 2027.

The south of the site lies within the catchment of the Dene – Butlers Marston to conf R Avon. The current (2019 Cycle 2) overall status under the Water Framework is 'moderate'. The water body is currently 'moderate' due to poor phosphate levels and failure on priority hazardous substances such as Mercury and PBDE. The objective is for overall water body to be 'good' by 2027.

Though the site is split into two river catchments, the outflow of the Dene is into the Avon some 800m to the west of the site.

2.8.4 Surface water flooding

The desk study information indicates the majority of the site is in Flood Zone 1 (with a low probability of flooding from rivers) with a small portion of the site, along the small brook running across the north of the site lying within Flood Zone 2 (with a medium/moderate probability of flooding from rivers).

No further consideration of flood risk is undertaken in this report. A specialist flood risk report will be completed and issued by Hydrock separately to this report.

2.9 Mining or mineral extraction

The environmental database report indicates that sand and gravel quarrying has been undertaken in the wider area and in the north east of the site.

The on site gravel pit can be dated back to 1886, and was infilled by 1972, as shown on the historic maps, however it is unknown what material was used to backfill. The location of the gravel pit is currently under playing fields north of the Campus as shown in Figure 2.9 below.

The off site mining however is dated to 1972, Charlote Gravel Pit. All mining in the area has now ceased.



Figure 2.9: Site Feature Plan, showing location of Historical Gravel Pit and unknown Landfill, drawing extracted from University of Warwick Drawing Ref: 20XXX-UOW-0001-DR-A-0001

2.10 (Reproduced with permission from Envirocheck)Waste management

There is one historic land fill site recorded within 250m of the site. It is located off Charlecote Road on the western site boundary; however, the Environmental Database Report supplies no further information on the site as shown in Figure 2.9 above.

2.11 Regulatory consultation

Information in the Envirocheck Report (Appendix D), relating to various regulatory controls has been reviewed, with a summary presented below in Table 2.10.

Table 2.10: Regulatory information within 500m of the site

Regulatory Data	Distance from Site	Details	Potential Risk	Comment
Discharge Consents	On site	Severn Trent Water Limited Trade & Sewage discharges – process effluent – Water Company Discharged into River Dene.	Yes	From Waste Water Treatment Works directly to the south east of the site. Listed as 8 entries in Envirocheck report.
	On site	Severn Trent Water Limited Trade discharges – process effluent – Water Company Discharged into River Dene.		From Waste Water Treatment Works directly to the south east of the site. Listed

Regulatory Data	Distance from Site	Details	Potential Risk	Comment
				as 2 entries in Envirocheck report.
	On site/south east site boundary	Severn Trent Water Limited Sewage discharges – Water Company Discharged into River Dene.		From Waste Water Treatment Works directly to the south east of the site. Listed as 10 entries in Envirocheck report.
	On site/south east site boundary	Severn Trent Water Limited Discharge of other matter – Crude Effluent Discharged into River Dene.		From Waste Water Treatment Works directly to the south east of the site. Listed as 8 entries in Envirocheck report.
	150m west	Charlescote Garden Centre Sewage Discharges – Final/Treated Effluent Discharges into Land/Soakaway	No	Due its location in relation to the site.
	208m north west	Domestic Property Sewage Discharges – Final/Treated Effluent Discharges into Land/Soakaway		
Local Authority Pollution Prevention and Controls	287m south east	Authorised Petrol filling station	Yes	As the hydrogeological gradient and direction is not known.
Pollution Incidents	On site	August 1997, chemical detergent into watercourse, Category 3 – minor incident	Yes	Due to Category 3 classification of the incident.
	On site	September 1996, Sewage into watercourse, Category 3 – minor incident		
	On site	July 1998, Miscellaneous – Natural into watercourse, Category 3 – minor incident		
	108m west	February 1997, Kerosene fuel oil into watercourse, Category 3 – minor incident	No	Pollution incident occurred west of the site into a watercourse that flows east west.
	111m west	October 1995, Chlorinated water into watercourse, Category 3 – minor incident		
	412m south	March 1999, Oils into watercourse, Category 3 – minor incident	No	Due to its distance from the site

Regulatory Data	Distance from Site	Details	Potential Risk	Comment
	452m south	October 1995, Miscellaneous – Natural into pond/lake, Category 3 – minor incident		
	463m south	August 1995, miscellaneous – natural into watercourse, Category 3 – minor incident		
	467m south	March 1999, oils, Category 3 – minor incident		
	474m south	September 1995, Sewage Category 3 – minor incident		
	497m south	June 1999, Miscellaneous into watercourse, Category 3 – minor incident		
Trade Directory Entries	On site	Inactive Food colouring & additive manufacturer	Yes	Due to its proximity to the site.
	On site	Inactive Garage Services	Yes	Due to its location on site.
	76m south	Inactive PVC-U Products – Manufacturers and suppliers	No	Due to the small volumes of potential contaminants.
	76m south	Inactive Door Manufacturers - joinery	No	
	76m south	Active Freight forwarders	No	
	82m east	Active Domestic appliance servicing	No	
	200m south	Active Aviation Engineers	No	
	200m south	Inactive Airport	Yes	Due to its proximity to the site and large volumes of potential contaminants
	228m south east	Inactive Domestic cleaning service	No	Due to the small volumes of potential contaminants.
	230m south	Inactive Distribution centre	Yes	Due to its proximity to the site and large volumes of potential contaminants
	287m south east	Inactive Car Dealers	No	Due to the small volumes of potential contaminants.
	325m east	Inactive Chemical engineers	No	

Regulatory Data	Distance from Site	Details	Potential Risk	Comment
	350m south east	Active Car body repairs & dealers	No	Due to the small volumes of potential contaminants.
	405m south east	Active Ventilator systems	No	
	416m south east	Inactive Road haulage service	No	
	430m south	Active Airfield	Yes	Due to the large volumes of potential contaminants
	450m south east	Active Car Garage Services	No	Due to the small volumes of potential contaminants.
	460m south east	Inactive Car Garage	No	
Fuel Station Entries	287m south east	Active Petrol Station & Garage Services	Yes	As the hydrogeological gradient and direction is not known.
Control of major accident hazards sites (COMAH)	N/a	No entries on notification of installations handling hazardous substances were recorded within 500m of the site.	No	-
Registered radioactive substances	On site	University of Warwick For the keeping, use and disposal of radioactive waste	Yes	Due to its proximity to site.
	On site	University of Warwick Horticultural research	Yes	Due to its proximity to site.
Notification of installations handling hazardous substances	N/A	No entries on notification of installations handling hazardous substances were recorded within 500m of the site.	No	-

2.12 Natural soil chemistry

Information contained within the environmental data report (Appendix D) gives indicative natural concentration values (estimated) for the natural soils at the site for a selection of Contaminants of Potential Concern (CoPC). These have been reproduced in Table 2.11.

Table 2.11: Natural soil chemistry

Element	Arsenic	Cadmium	Chromium	Lead	Nickel
Concentration (mg/kg)	<15	<1.8	40 - 60	<100	15 - 30

2.13 Radon

The radon risk is covered in the environmental data report. This indicates that the site is not in a Radon Affected Area and no radon protection measures are required in new structures.

3. PRELIMINARY CONCEPTUAL SITE MODEL

3.1 Ground model

The preliminary ground model is presented in Section 2 which forms the understanding of the ground conditions that inform the preliminary geotechnical hazard assessment (Section 3.2) and the preliminary geo-environmental exposure model (Section 3.3).

3.2 Geotechnical hazard identification

The preliminary geotechnical hazard identification has been undertaken in accordance with the general requirements of ICE/DETR Document 'Managing Geotechnical Risk' and the HE documents HD 41/15 and HD 22/08.

The following section sets out the identified geotechnical hazards and the development elements potentially affected (see Table E.1 in Appendix E for further detail).

3.2.1 *Plausible geotechnical hazards*

Plausible geotechnical hazards identified at the site are:

- Uncontrolled Made Ground (variable strength and compressibility).
- Soft / loose compressible ground (low strength and high settlement potential).
- Shrink swell of the clay fraction of soils under the influence of vegetation.
- Variable lateral and vertical changes in ground conditions.
- Attack of buried concrete by aggressive ground conditions.
- High groundwater.
- Changing groundwater conditions.
- Risk from erosion or flooding.
- Earthworks – poor bearing capacity of new fill.
- Earthworks – unsuitability of site won material to be reused as fill.

3.2.2 *Potential development elements affected*

Development elements affected by potential geotechnical Hazards are:

- Buildings – foundations.
- Buildings – floor Slabs
- Roads and pavements.
- Services.
- Soft landscaping.
- Construction staff, vehicles and plant operators.
- Concrete below ground.
- Earthworks control, inability to place and compact fill.
- Insufficient fill to complete earthworks.

Health and safety risks to site Contractors and maintenance workers have not been assessed during these works and will need to be considered separately during design.

The above plausible geotechnical hazards and development elements affected will need to be carried forward for investigation and assessment.

3.3 Geo-environmental exposure model

The preliminary exposure model is based on information presented in Section 2 and is used for geo-environmental hazard identification and establishing potential contaminant linkages based on the contaminant-pathway-receptor approach.

A pollutant linkage requires all the elements (S-P-R) to be present. If only one or two are present, there is likely to be no linkage and further assessment is not required.

3.3.1 *Potential contaminants*

For the purpose of this assessment the potential contaminants have been separated according to whether they are likely to have originated from on-site or off-site sources.

Potential on-site sources of contamination

- S 1. Localised Made Ground below the site e.g., there is a man-made bund in the north east of the site (metals, metalloids and PAH).
- S 2. Contamination from sewage works present in the central north of the site.
- S 3. Landfilled waste including household, commercial and industrial, asbestos, animal processing wastes and pharmaceutical products from the small landfill on the southwestern boundary of the site, indicated in the environmental database report.
- S 4. Localised hydrocarbon fuels, lubricants and solvents from the operation of farming machinery on the site including leakage from USTs, the pipework between tanks and pumps, and general spillage, together with uncontrolled disposal and spillage from waste receptacles.
- S 5. Localised PCBs and oils from transformers in the electricity sub-stations on site.
- S 6. Naturally occurring elevated concentrations of metals within soils.
- S 7. Buildings (asbestos).
- S 8. Point sources of pollution identified on site e.g., over ground tanks, chemical waste store and numerous air conditioning units.
- S 9. Pesticides and herbicides associated with agriculture.

Potential off-site sources of contamination

- S 10. Leachate from unknown landfilled waste on the western site boundary
- S 11. Hydrocarbon fuels, lubricants and solvents from the operation of Wellesbourne & Mountford Airfield directly south of the site.
- S 12. Sewage treatment works directly south east of the site.

3.3.2 *Potential pathways*

The following potential pathways have been identified.

- P 1. Humans: ingestion, skin contact, inhalation of dust and outdoor air.
- P 2. Buildings: direct contact with substances deleterious to building materials.
- P 3. Buildings: methane ingress via permeable soils and/or construction gaps.
- P 4. Buildings: VOC and petroleum hydrocarbon vapour ingress via permeable soils and/or construction gaps.
- P 5. Plant life: root uptake.
- P 6. Underlying groundwater: migration of contaminant via leachate dispersion through the unsaturated zone in the River Terrace Deposits.
- P 7. Underlying groundwater: migration of contaminant into the Mercia Mudstone.
- P 8. Surface water: overland flow.
- P 9. Surface water: drainage discharge.
- P 10. Surface water: base flow from groundwater

3.3.3 *Potential receptors*

The following potential receptors in relation to the proposed land use have been identified.

- R 1. Humans (neighbours, site end users).
- R 2. Development end use (buildings, utilities and landscaping).
- R 3. Groundwater: Secondary A aquifer status of the River Terrace Deposits.
- R 4. Surface water: on-site drainage ditches, ponds and rivers.

An assessment of the Source-Pathway-Receptor linkages has been undertaken and is presented in Appendix F (Table F.2) and the conclusions of the assessment are discussed in Section 4. A Conceptual Site Model is presented in Appendix A (Ref: 18736-HYD-XX-XX-DR-GE-1001)

Health and safety risks to site Contractors and maintenance workers have not been assessed during these works and will need to be considered separately.

4. DESK STUDY CONCLUSIONS

4.1 Geotechnical conclusions

The following plausible geotechnical risks are identified.

- Variable Made Ground - settlement or differential settlement of foundations, floor slabs, roads and infrastructure elements.
- Low strength, compressible ground – risk of shear failure and excessive settlement of foundations, roads and infrastructure elements.
- Shrinkage/swelling of clay – settlement/heave of foundations, especially where located within the influence of trees and vegetation.
- Running sands, loose Made Ground and shallow groundwater, leading to difficulty with excavation due to trench instability.
- Earthworks – Low bearing capacity or settlement of new fill and impact on foundations, floor slabs, roads and infrastructure and construction plant.
- Potential for unforeseen ground conditions and the risks associated with limited data.

These plausible risks require further investigation and assessment (see Section 6).

4.2 Geo-environmental conclusions

Based on historical and current land uses and in accordance with the processes set out in Appendix G:

- It is considered that it is unlikely that the site would be classified as Contaminated Land under Part 2A of the EPA 1990.
- The overall risk from land contamination at the site is considered to be low for the current development, as it is covered by hard standing or buildings (the Campus area) limiting the possibility of contact with the soils, as well as the risk of significant rainwater infiltration leading to leaching and due to the current land use of the site.
- The overall risk for a redeveloped site is assessed to be low, with some localised specific potentially high risks, but this would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation.

The possible pollutant linkages (for risk levels of moderate or greater) on an unremediated redeveloped site, as determined by the desk study and walk-over, are summarised in Table 4.1:

Table 4.1: Possible Pollutant Linkages (for Risk Levels of Moderate or Greater)

Source(s)	◀ potential Impact on ▶	Receptor(s)
Localised metals, metalloids, PAH, petroleum hydrocarbons and asbestos in Made Ground below the developed part of site.		Site users Neighbours Groundwater
Localised hydrocarbon fuels, lubricants, chlorinated solvents and PCBs (sub-stations only) from the operation of the engineering works and electricity sub-station on the site.		Site users Neighbours Buildings
Localised contamination associated with sewage treatment works directly south east of the site.		Site Users Groundwater
Leachate from unknown landfilled waste on the western boundary of the site.		Site Users Groundwater

These possible pollutant linkages require further investigation and assessment (see Section 6).

5. UNCERTAINTIES AND LIMITATIONS

5.1 Site-specific comments

Access was to a number of fields in the south of site was not possible due to locked gates. The operational aspects of the existing University Campus are excluded as are any aspects regarding the on site reservoir Any previous report regarding ground conditions of the existing structure have not been made available at this stage ,but if any come to light we would be pleased to have a brief overview.

5.2 General comments

Hydrock Consultants Limited (Hydrock) has prepared this report in accordance with the instructions of University of Warwick (the Client), by email dated 17th February 2021 under the terms of appointment for Hydrock. Hydrock 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.

This report details the findings of work carried out in March 2021. The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, not all potential environmental constraints or liabilities associated with the site may have been revealed.

Information provided by third parties has been used in good faith and is taken at face value. However, Hydrock cannot guarantee its accuracy or completeness.

Where any existing report prepared by others are provided by the Client, it is assumed that these have been either commissioned by the Client, or can be assigned to the Client, and can be relied upon by Hydrock. Should this not be the case Hydrock should be informed immediately as additional work may be required. Hydrock is not responsible for any factual errors or omissions in the supplied data, or for the opinions and recommendations of others. It is possible that the conditions described may have since changed through natural processes or recent activities.

The work has been carried out in general accordance with recognised best practice. The various methodologies used are referenced in Appendix G.

Where the phrase 'suitable for use' is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Hydrock.

Unless otherwise stated, no assessment has been made for the presence of radioactive substances or unexploded ordnance.

The non-specialist UXO screening has been undertaken for the purposes of site investigation only (i.e. low risk activity in accordance with CIRIA Report C681). Further assessment should be undertaken with regards to the WW2 airfield that lies directly south of the site and other higher risk activities e.g. construction.

Please note that notwithstanding any site observations concerning the presence or otherwise of archaeological sites, asbestos-containing materials or invasive vegetative species, this report does not constitute a formal survey of these potential hazards and specialist advice should be sought.

Whilst the preliminary risk assessment process has identified potential risks to construction workers, consideration of occupational health and safety issues is beyond the scope of this report.

Any site boundary line depicted on plans does not imply legal ownership of land.

6. RECOMMENDATIONS FOR FURTHER WORK

6.1 Ground investigation objectives

In order to confirm the actual risks to receptors and confirm the ground conditions with respect to potential geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken. This investigation will need to be linked to the proposed development layout. Although the future location of proposed structures is beyond the specific scope of this report it is considered that there are various localised areas of the site which may be subject to land contamination aspects, however much of the site is likely to be natural uncontaminated materials. From a geotechnical view point it may be preferable to avoid areas of made ground, and alluvium, developing upon natural River Terrace Deposits. Should demolition and decommissioning of the existing structures be proposed an investigation of those specific higher risk areas should be undertaken.

Any investigation would need to:

- determine the depth and distribution of localised Made Ground and natural strata across the site;
- determine the soil strength/density profile beneath the site;
- determine the depth/level of groundwater beneath the site;
- determine the ground gas concentrations beneath the site;
- determine CBRs to assist with pavement design;
- assess trench stability, over break potential and 'diggability';
- allow sampling for chemical and geotechnical laboratory testing;
- allow soil classification to allow geotechnical characterisation and determine suitability for reuse of soils within earthworks;
- obtain information in terms of Aggressive Chemical Environment for Concrete Class (ACEC Class).

Following investigation, assessment will be required to:

- update the Ground Model;
- update the Geotechnical Risk Register;
- provide Geotechnical Design recommendations;
- update the Conceptual Site Model (CSM), including identification of plausible pollution linkages;
- undertake generic quantitative risk assessment of potential chemical contaminants to establish 'suitability for use' under the current planning regime;
- discuss potential environmental liabilities associated with land contamination (soil, water and gas); and
- provide outline mitigation recommendations to ensure the site is 'suitable for use'.

6.2 Proposed scope and rationale for investigation works

Based on the current data, site investigation is proposed to comprise:

- the excavation of trial pits to allow collection of samples for geotechnical and chemical analysis, to assess trench stability, over break potential and 'diggability' and allow soil infiltration rate testing to be undertaken;

- dynamic sampling to allow collection of samples for geotechnical and chemical analysis of shallow soils, and allow *in situ* testing (SPTs) to be undertaken to determine the strength of the clay and assess density of the sands and gravel, and allow the installation of gas and groundwater monitoring wells;
- cable percussive boreholes to allow collection of samples for geotechnical and chemical analysis of deeper soils, and allow *In situ* testing (SPTs) to be undertaken to determine the strength of the clay at depth and allow the installation of gas and groundwater monitoring wells;
- gas and groundwater monitoring installations to allow gas concentrations and groundwater levels to be monitored;
- geotechnical testing of soils and rock; and
- contamination analyses of soil and groundwater.

Access to the site will be restricted not only by the existing buildings and infrastructure, but by the fact that it is still occupied. Therefore, a phased investigation may be required.

7. REFERENCES

- ASSOCIATION OF GROUND INVESTIGATION SPECIALISTS. 2006. Guidelines for Good Practice in Site Investigation. Issue 2. AGS, Beckenham.
- BRITISH STANDARDS INSTITUTION. 2004. Eurocode 7 – Geotechnical design - Part 1: General rules. BS EN 1997-1. Incorporating Corrigendum No.1. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2007. Eurocode 7 – Geotechnical design - Part 2: Geotechnical investigation and testing. BS EN 1997-2. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2011. Code of Practice for Investigation of Potentially Contaminated sites. BS 10175 Incorporating Amendment No. 2:2017. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2015. Code of practice for ground investigations. BS 5930. BSI, London.
- CLAYTON, C. R. I. 2001. Managing Geotechnical Risk. Improving productivity in UK building and construction. Thomas Telford, London.
- DCLG. March 2012. National Planning Policy Framework. DCLG, London.
- ENVIRONMENT AGENCY. Land contamination risk management (LCRM)2020 . The Environment Agency.
- THE HIGHWAYS AGENCY. 2008. Design Manual for Roads and Bridges. Volume 4, Geotechnics and Drainage. Section 1 Earthworks, Part 2, Managing Geotechnical Risk. HD 22/08
- THE HIGHWAYS AGENCY. 2015. Design Manual, Road and Bridges: Volume 4, Geotechnics and Drainage; Section 1, Earthworks; Part 3, HD 41/15, Maintenance of highway geotechnical assets. HD 41/15.
- MILES, J. C. H., APPLETON, J. D., REES, D. M., GREEN, B. M. R., ADLAM. K. A. M. and MYRES. A. H. 2007. Indicative Atlas of Radon in England and Wales. Health Protection Agency and British Geological Survey. Report HPA-RPD-033.
- MINISTRY OF HOUSING, COMMUNITIES and LOCAL GOVERNMENT (MHCLG). Internet published Planning practice guidance <https://www.gov.uk/government/collections/planning-practice-guidance>. MHCLG. London
- NHBC. 2021. NHBC Standards. NHBC, Milton Keynes.
- RAWLINS, B. G., McGRATH, S. P., SCHEIB, A. J., CAVE, N., LISTER, T. R., INGHAM, M., GOWING, C. and CARTER, S. 2012 .The advanced geochemical atlas of England and Wales. British Geological Survey, Keyworth.
- SCIVYER, C. 2015. Radon: Guidance on protective measures for new buildings. Building Research Establishment Report BR 211. BRE, Garston.
- STONE, K., MURRAY, A., COOKE, S., FORAN, J. and GOODERHAM, L. 2009. Unexploded ordnance (UXO), a guide to the construction industry. CIRIA Report C681. Contaminated Land: Applications in Real Environments, London.
- WATER UK HBF. January 2014. Contaminated Land Assessment Guidance. Water UK and the Home Builders Federation.

Appendix A

Drawings

Appendix B

Field Reconnaissance Photographs

Appendix C

Historical Ordnance Survey Maps

Appendix D

Desk Study Research Information

Envirocheck

Database Report

Zetica UXB Risk Maps

Appendix E

Preliminary Geotechnical Risk Register

Geotechnical Hazard Identification – Desk Study Stage

Potential geotechnical hazards have been assessed in accordance with the general requirements of ICE/DETR Document 'Managing Geotechnical Risk' and the HE documents HD 41/15 and HD 22/08. The following pages set out the identified geotechnical risks and hazards which are associated with the proposed development and establish the approach which is to be taken to manage the risks including the geotechnical input and analysis.

Table E.1 is a preliminary assessment of possible geotechnical hazards at the site at Desk Study stage. This information is used to assist with site investigation design.

Table E.1: Possible geotechnical hazards

Hazard	Comment	Hazard status based on desk study	
		Could be present and / or affect site (i.e. Plausible)	Unlikely to be present and/or affect site
Uncontrolled Made Ground (variable strength and compressibility).		✓	-
Soft / loose compressible ground (low strength and high settlement potential).		✓	-
Shrink swell of the clay fraction of soils under the influence of vegetation.		✓	-
Variable lateral and vertical changes in ground conditions.		✓	-
Elevated sulfates present in the soils.		✓	-
Adverse chemical ground conditions, (e.g. expansive slag).		-	✓
Obstructions.		-	✓
Existing below ground structures to remain		✓	-
High groundwater.		✓	-
Changing groundwater conditions.		✓	-
Risk from erosion.		-	✓
Risk from flooding.		✓	-
Running sands and / or loose Made Ground, leading to difficulty with excavation and collapse of side walls.		✓	-
Slope stability issues – general slopes.		-	✓
Slope stability issues – retaining walls.		-	✓
Earthworks – settlement (due to placement of fill on soft / loose ground).		✓	-
Earthworks – poor bearing capacity of new fill.		✓	-
Earthworks – unsuitability of site won material to be reused as fill.		✓	-
Solution features in Chalk.		-	✓
Cavities in the Superficial Deposits due to solution features.		-	✓

Hazard	Comment	Hazard status based on desk study	
		Could be present and / or affect site (i.e. Plausible)	Unlikely to be present and/or affect site
Dissolution (associated with “wet rock head”).		-	✓
Brine extraction.		-	✓
Mining.		-	✓
Cambered ground with gulls possibly present.		-	✓
Relict Slip Surfaces.		-	✓
Solifluction.		-	✓
Problematic soils (silts and rewetting etc.).		✓	-

Appendix F

Plausible Source-Pathway-Receptor Contaminant Linkages

Summary of Potential Contaminant Linkages

Table F.2 lists the plausible contaminant linkages which have been identified. These are considered as potentially unacceptable risks in line with guidelines published in CLR 11 and additional risk assessment is required.

Source – Pathway – Receptor Linkages have been assessed in general accordance with guidance in CIRIA Report C552 (Rudland et al 2001) but with the addition of a ‘no linkage’ category (See Table F.1). More details are given in the relevant Hydrock methodology, referenced in Appendix G, including descriptions of typical examples of probability and consequences.

It should be noted that whilst the risk assessment process undertaken in this report may identify potential risks to site demolition and redevelopment workers, consideration of occupational health and safety issues is beyond the scope of this report and need to be considered separately in the Construction Phase Health and Safety Plan.

Table F.1: Consequence versus probability assessment.

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Low risk	Very low risk
	Low Likelihood	Moderate risk	Low risk	Low risk	Very low risk
	Unlikely	Low risk	Very low risk	Very low risk	Very low risk
	No Linkage	No risk			

Table F.2: Exposure model – preliminary risk assessment of source-pathway-receptor contaminant linkages

Sources	Possible Pathways	Receptors	Probability	Consequence	Risk Level	Comments	
Made Ground below the site (metals, metalloids and PAH).	Ingestion, inhalation or direct contact.	Site users.	Likely	Medium	Moderate	There is potential for Made Ground below certain areas of the site, to be confirmed by ground investigation, with the potential for metals, metalloids and PAH at levels in excess of the GAC.	Contact with these materials is likely in gardens and areas of Public Open Space. Mitigation measures will be required to break the S-P-R linkage.
	Inhalation of fugitive dust.	Neighbours.	Low likelihood	Medium	Low		The risk of significant generation of dust is likely only during site development process and can therefore be controlled.
	Leaching through unsaturated zone.	Groundwater and possible abstractors.	Likely	Medium	Moderate	There is a stream on site, the River Dene on site and a drainage ditch on the northern boundary. In addition, there is a pond on site and a reservoir. The site generally slopes north east to south west and towards the River Dene from both sides forming a valley. If contaminants are proven to be present on site during the ground investigation it's possible for there to be a pathway into the surface water features and groundwater on site.	
	Surface run-off.	Aquatic ecosystems.	Likely	Medium	Moderate		
	Base flow from contaminated groundwater.	Surface water and possible abstractors.	Likely	Medium	Moderate		
Asbestos	Inhalation of fugitive dust.	Site users.	Likely	Severe	Very High	There is potential Made Ground below the site, potentially containing ACM and/or asbestos fibres in the soil. One piece of asbestos cement was observed during the site walkover in the south west area of the campus. The campus was erected	Contact with these materials is likely in gardens and areas of Public Open Space. Mitigation measures will be required to break the S-P-R linkage.
		Neighbours.	Low likelihood	Severe	Moderate		The risk of significant generation of dust is likely only during site development process and can therefore be controlled.

Sources	Possible Pathways	Receptors	Probability	Consequence	Risk Level	Comments
						<p>in 1972, therefore the possibility of ACM being used is high. Potential asbestos roofing was also observed on site.</p> <p>Suppression should be included in control measures. There is ACM present on site, so works to be undertaken in accordance with CAR 2012.</p>
Hydrocarbon fuels, lubricants and solvents from the operation of farming machinery on the site.	Ingestion, inhalation or direct contact.	Site users.	Likely to High likelihood	Medium	Moderate to High	Contact with these materials is possible/likely in gardens and areas of Public Open Space.
	Vapours.	Neighbours.	Low likelihood	Medium	Low	The site is located in a largely rural area.
	Inhalation of fugitive dust.	Neighbours.	Low likelihood	Medium	Low	The risk of significant generation of dust is likely only during site development and can therefore be controlled. Suppression should be included in control measures.
	Leaching through unsaturated zone.	Groundwater and possible abstractors.	Likely	Medium	High	The groundwater below the site is a Secondary A Aquifer.
	Direct contact	Water supply pipes.		Medium	High	-
Contamination from sewage works on site.	Ingestion, inhalation or direct contact.	Site users.	Low Likelihood	Medium	Low	Possible leakage from pipes and general spillages.
	Inhalation of fugitive dust.		Likely		High	
	Leaching through	Groundwater and possible abstractors.				

Sources	Possible Pathways	Receptors	Probability	Consequence	Risk Level	Comments
	unsaturated zone.					
Leachate associated with the unknown landfilled waste on the western boundary of the site.	Leaching through unsaturated zone.	Groundwater and possible abstractors.	Low likelihood	Medium	Low	No visible signs noted during the walkover, Ground investigation to confirm.
PCBs and oils from transformers in electricity sub-stations on site.	Ingestion, inhalation or direct contact.	Groundwater and possible abstractors.	Likely	Severe	High	Due to the amount of sub stations present on site.
		Water supply pipes				
Point sources of pollution identifies on site e.g. over ground tanks & chemical waste store.	Surface run-off.	Groundwater and possible abstractors.	Low likelihood	Low	Low	Areas where storage tanks are present are mainly covered by hard standing or buildings (the Campus area) limiting the possibility of contact with the soils.
	Leaching through unsaturated zone.					
	Ingestion, inhalation or direct contact.	Site users.				
	Vapours.	Neighbours				
Hydrocarbon fuels, lubricants and solvents from the operation of Wellesbourne &	Ingestion, inhalation or direct contact.	Site users.	Likely	Severe	Moderate	Due to the proximity to the site. The River Dene is down gradient from the Airfield creating a possible migration path (Dependent on ground conditions).
	Vapours.	Neighbours				

Sources	Possible Pathways	Receptors	Probability	Consequence	Risk Level	Comments
Mountford Airfield directly south of the site.	Leaching through unsaturated zone.	Groundwater and possible abstractors.				
Contamination from sewage works directly south east of the site.	Ingestion, inhalation or direct contact.	Site users.	Low	Low	Low	Due to the sewage plant being off site and the end use of the site.
	Inhalation of fugitive dust.	Site users.	Low			
	Leaching through unsaturated zone.	Groundwater and possible abstractors.	High	Severe	Moderate	Several Category 3 Minor incidents reported.

Appendix G

Hydrock Methodologies

This report has utilised Hydrock Desk Study Template V12.1.

This appendix provides additional background information on certain approaches and methods used by Hydrock Consultants Limited in the preparation of this report.

The following Hydrock Methodologies apply to this report. These are not included, but are available on request by quoting the methodology reference, revision and date.

Reference	Name	Revision	Date
001	Desk Study	001	30/07/2018