KAB GEO-SOLUTIONS LTD

LAND TO THE WEST OF BLOXHAM ROAD
BANBURY
OXFORDSHIRE
OX16 9UN

PHASE I SITE APPRAISAL (DESK STUDY)

OCTOBER 2022

REPORT REF: 22021/10-22/001-1

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APPENDICES

EXECUTIVE SUMMARY – PHASE I SITE APPRAISAL

SITE SETTING & INFORMATION	**Site Location**	The site, which covers an area of approximately 3.6ha, is located on the south western fringes of the Market Town of Banbury, Oxfordshire. The site area is approximately 2.15km south west of Banbury town centre.
	Site Description - current land use	The site area is a roughly rectangular-shaped piece of open land formed by a single open field. The undeveloped site is largely surrounded by agricultural fields, although a new residential development is under construction on land to the north. The site includes a small wood and a track (concrete surface) close to the northern boundary. A wooden post and rail fence runs along the four sides of the field and is assumed to have been erected to retain livestock. The field is bordered by mature hedgerows and trees to the north, south and west as well as the southern portion of the eastern boundary. The site slopes gently down to the south east.
	Proposed Development	At this stage, the development proposals are to comprise residential development including gardens, landscaped areas and associated infrastructure.
	Site History	The earliest maps reviewed (1882) shows the site as a roughly rectangular shaped area of land, which is formed by a single field, with a layout similar to the present day. The field forms a part of a network of fields associated with Crouch Farm, which is 200m to the north west and reached via a track, which cuts across the northern portion of the site. The track runs from Bloxham Road, 80m to the east. No significant changes are shown for the site area, which has remained undeveloped, although the 1999 aerial photograph shows that the land between the track and the northern boundary is a small woodland.
DESK STUDY INFORMATION	**Geology**	The 1:50,000 British Geological Survey (BGS) Sheet 218 (Chipping Norton) shows that the area along the northern site boundary is directly underlain by solid geology of the Whitby Mudstone Formation - Mudstone, with the land to the south being underlain by solid geology of the Marlstone Rock Formation - Ferruginous Limestone and Ironstone.
	Coal Mining	The site is not in an area affected by coal mining or brine extraction.
	Hydrogeology	The solid strata directly underlying the northernmost portion of the site (Whitby Mudstone Formation) are classified as being Unproductive and the Marlstone Rock Formation, underlying the remaining portion of the site, is classified as a Secondary (A) Aquifer. The cohesive strata (clay) of the Whitby Mudstone and the Marlstone Rock Formations are likely to include a high percentage of fine-grained material and are likely to be unsuitable for soakaway drainage devices and restrict the downward migration of potential site contamination. There is one recorded groundwater abstraction license within 250m of the site area and is associated with Crouch Farm. The record is for groundwater extraction for General Farming and Domestic Use and is located 212m to the west. The site is not recorded to be within 250m of a Groundwater Source Protection Zone.
	Hydrology	The nearest surface water feature is 2m to the east of the site and appears to refer to a drainage ditch along the eastern boundary. Four OS Water Network Lines are also recorded within 250m of the site area. The nearest record refers to the drainage ditch.

		No significant pollution incidents are recorded within 250m of the site. There are no recorded surface water abstraction licenses within 250m of the site.
	Flood Risk	The site area is within a Zone 1 Floodplain. Zone 2 and 3 Floodplains are recorded more than 500m to the south west of the site. The Envirocheck data indicates that there are no areas of the site susceptible to Surface Water Flooding. The nearest location is approximately 120m to the south east of the site. The BGS Groundwater Flooding Susceptibility data indicates that the area of the site underlain by the Marlstone Rock Formation (central and southern portion) has a "Limited Potential for Groundwater Flooding to Occur".
	Radon	The site is in an area recorded to require full radon protection measures as more than 30% of properties are estimated to be at or above the action level.
	Other issues	Potentially elevated arsenic concentrations within the shallow soils, associated with the Marlstone Rock Formation.
ASSESSMENT & CONCLUSIONS	**Preliminary Contamination Assessment**	**On-site** The following potential on-site sources have been identified from the desk study information: • Localised Made Ground, associated with the construction of the on-site track – the Made Ground is a potential source of metals, hydrocarbons (PAH/TPH) and ACMs. • Previous land use as agricultural land – potential for pesticide contamination and hydrocarbons (farm machinery). **Off-site** • Localised Made Ground, associated with the construction of nearby off-site buildings - the Made Ground is a potential source of metals, hydrocarbons (PAH/TPH) plus the ACM's As it is proposed to redevelop the site for a residential end-use, sampling, and chemical testing of near-surface soils across the entire site is likely to be required to meet the likely requirements of the Local Authority.
	Preliminary Geotechnical Assessment	At this stage based on the desk-based information available, it is considered that: • The ground conditions are likely to comprise variable weathered strata (clay/clayey sand) over solid strata associated with Whitby Mudstone Formation – mudstone and the Marlstone Rock Formation - Ferruginous Limestone and Ironstone. • The natural soils are likely to be suitable for the use of traditional trench, strip, or pad foundations. • Due to the presence of mixed strata, including potential shrinkable soils and the presence of trees, deepening of foundations following NHBC standards may be required locally. • Outside any areas of unsuitable strata (Made Ground and/or soft or loose materials), the use of ground-bearing slabs may be suitable; however, at this stage allowance should be made for the use of suspended floors. • KAB Ltd has reviewed a third-party soakaway test report for the adjacent development and the majority of the results were considered unsuitable for the design of soakaway devices.

	Soil Gases	No significant sources of ground gases have been identified and very low risk from ground gases (methane and carbon dioxide) has been identified. A gas monitoring programme across the site is required to confirm this assessment. Information provided in BRE:211 (2015) indicates that the site is in an area requiring full radon measures.

These tabulated pages are a summary of the site assessment and do not provide a definitive analysis. The Executive Summary should be read in conjunction with the main report (KAB Report Ref: 22021/10-22/001-1).

1.0 INTRODUCTION

1.1 Terms of Reference

KAB Geo-Solutions Limited (KAB Ltd) has been appointed by Barwood Development Securities Ltd T/A Barwood Land (Client) to undertake a Phase I Site Appraisal (desk study) for the proposed development at Bloxham Road, Banbury. The desk study investigation forms Phase I of a site appraisal and allows the setting of the site (geoenvironmental and geotechnical) to be determined. The findings of the study also assist in future decision-making by identifying potential ground engineering and contamination hazards that may require targeted investigation.

At this stage, the development proposals are for residential development and are likely to include garden areas, areas of soft landscaping and associated infrastructure.

The Client has not informed KAB Ltd of any significant development hazards but has provided a topographic survey for the proposed development site, which shows the current site boundaries and illustrates the extent of the development area (hereafter referred to as 'the site').

1.2 Objectives

The principal aims of the Phase I Site Appraisal (desk study) are as follows:

- Obtain information, from easily available sources, related to the soil and groundwater conditions within the area of the site.
- Determine the nature of the site and surrounding area including land uses (historic and current), underlying geology, hydrogeology, hydrology and geoenvironmental data.
- Determine the possible ground-related geotechnical and contamination hazards within the site boundaries that may have the potential to affect the proposed development.
- Provide preliminary development recommendations.
- Provide advice on further works required for the cost-effective reduction of risks to the development and procedures likely to satisfy regulators.

Whilst every effort has been made to pre-empt the likely requirements of the Local Authority and the Environment Agency, they are likely to have specific requirements that will need to be discussed and addressed at a later date.

The report has been prepared using only published information and information provided by the Client which was made available at the time of writing. No liability is extended to any information which has become available since this time. Third parties using information contained in this report do so at their own risk.

A detailed description of the methodology for undertaking a Phase I Site Appraisal is included in the General Appraisal Comments, presented in Appendix D.

KAB Ltd Standard Limitations of Reporting are provided in Appendix E of this report.

1.3 Information Sources

In addition to the general sources of information listed in Section 7, the following information, provided by the client, has been reviewed as part of the site assessment:

- The location of the site.
- A topographic survey showing the current site levels.

Client-supplied development layout plans are presented in Appendix A.

2.0 PHASE I SITE APPRAISAL (DESK STUDY)

2.1 Site Location

The site is located on the western side of Bloxham Road, on the south western fringes of the Market Town of Banbury, Oxfordshire. The site area is approximately 2.15km to the south west of Banbury town centre. The site is centred with National Grid reference 443880, 238690 and covers a total area of approximately 3.6ha. A site location plan (KAB Drawing 001) is presented in Appendix A.

2.2 Site Description

The site area is a roughly rectangular-shaped piece of open land formed by a single open field. The site, which is currently undeveloped, is largely surrounded by agricultural fields, although a new residential development is under construction on land to the north. A metal farm building, associated with the nearby farm (Crouch Farm), is located immediately adjacent to the western boundary. A drainage pond, linked to the adjacent development, is located in the field to the east.

The site includes a small wood and access track (concrete surface) close to the northern boundary. The track runs from Bloxham Road in the east to Crouch Farm in the north west and is separated from the main field by a wooden post and rail fence, which runs along the four sides of the field. The fence appears to be in good repair and is assumed to have been erected for the control of livestock. The field is bordered by mature hedgerows and trees to the north, south and west as well as the southern portion of the eastern boundary. The topographic survey provided by the Client, indicates that the site slopes gently down to the south east, from a level of 135.94m AOD in the north western corner to a level of 133.00m AOD in the south eastern corner.

The Site Photographs (KAB Drawing 003, 003A to 003M) are presented in Appendix A.

Significant Features identified from Google Mapping/Site Walkover:
• The site is agricultural land – potential for pesticide and petroleum hydrocarbon contamination (TPH/PAH) – from farm machinery. The risk is considered likely to be very low (pesticides), locally very low (hydrocarbons). • Development adjacent to the site boundaries (e.g., current development to the north) – potential Made Ground including localised contamination including metals, ACMs, and hydrocarbons (PAH/TPH). The risk is considered to be very low (localised). • Hedgerows and mature trees along site boundaries and localised within the site – potential for deeper foundations if clay strata are present.

2.3 Site History

A useful insight into the development of a site and potential hazards within the surrounding area can be obtained by a review of the Historical Ordnance Survey (OS). The extracts of the historic OS maps reviewed as part of this appraisal are provided in Appendix C.

The earliest maps reviewed (1882) show the site as a roughly rectangular-shaped area of land, which is formed by a single field, with a layout similar to the present day. The field forms a part of the network

of fields associated with Crouch Farm. Bloxham Road is shown 80m to the east of the site. A track, which connects to Bloxham Road, cuts across the northern portion of the site and runs to Crouch Farm, which is shown 200m to the north west. The 1967-1973 OS map shows a cattle grid at the western end of this track and suggests the land has been primarily used for livestock rather than arable crops. The 1999 aerial photograph shows that the small strip of land between the track and the northern boundary is a small woodland. No significant changes are shown for the site area, which has remained undeveloped.

The area surrounding the site (within a 250m radius) has included the potentially contaminative former land uses/receptors listed in Table 2.1:

Table 2.1: Principal Historical Off-Site Features

OS Map Date Range(s)	Principal Off-Site Features (Nearest Land Parcel)	Direction/Approx. Distance – nearest point (m)
1882, 1885-7, 1900	Road - Bloxham Road, Unnamed Road Buildings – Crouch Farm and a Lodge Pond	E (80), N (230) NW (200), S (230) N (<5)
1922-3, 1938, 1938-51, 1967-73, 1971-84, 1984-90, 1993, 1999, 2006	A new road is shown adjacent to the Lodge (labelled as Wykham Park Lodge in 2006) Buildings – labelled as present-day Crouch Cottages by 1967-73	S (230) E (190)
2021	The new residential development is shown to the north	NE (75)
2022	**No** further significant changes are shown in the surrounding area, although the map shows the development to the north has extended westwards.	NE (50)

It is considered unlikely that the off-site features pose a significant risk to the proposed end-users of the site, due to the nature of the features and the distance to the development area. Localised contamination may be present and can be targeted during a ground investigation.

It should be noted, however, that a considerable period of time may have elapsed between successive Ordnance Survey map editions and further land uses may have occurred in the intervening years which are not shown. In these circumstances, whilst we have tried to ascertain the complete record of the site history, the possibility that other significant land uses may have taken place cannot be discounted.

The hazards identified are summarised in the table below:

Significant Features identified on OS Maps:
• Potential historic agricultural land (livestock farming) – potential for hydrocarbons (farm machinery) within the shallow site soils. • Construction of the adjacent buildings (including new development), access track – potential for localised Made Ground, which is a potential source of contamination including metals, hydrocarbons (TPH, PAH) and ACMs. • Made Ground – any Made Ground is a potential source of ground gases, and the risk is considered very low.

2.4 Geology

The 1:50,000 British Geological Survey (BGS) Sheet 218 (Chipping Norton) shows that the area along the northern site boundary is directly underlain by solid geology of the Whitby Mudstone Formation - Mudstone, with the land to the south being underlain by solid geology of the Marlstone Rock Formation - Ferruginous Limestone and Ironstone (a potential source of elevated arsenic). The nearest recorded superficial deposits are the Alluvium, approximately 1.3m to the west.

Nominal dip information is shown for the solid strata beneath the site, however, dip markers shown on the BGS Sheet for the region suggest that the solid strata are sub-horizontal.

The site is not indicated to be directly affected by faulting; the nearest indicated fault is approximately 1.25km to the north west of the site.

No BGS exploratory hole records are available for the site or within 250m of the site.

Significant Features identified from geological data:
• Shallow variable strata (granular/cohesive strata) – deepening of foundations where shrinkable clay/trees present OR so to ensure that foundations sit in a single strata type with similar geotechnical properties OR reinforced foundations. • Marlstone Rock Formation – potential for high arsenic levels within shallow soils (confirmed by the Environmental Data, which indicates concentrations >120mg/kg).

2.5 Coal Mining and Mineral Extraction

The site is recorded to be more than 1km from an area affected by coal mining activity and non-coal mineral extraction. In addition, there are no BGS Recorded Mineral Sites within 250m of the site area. The nearest recorded location is Crouch Hill, Broughton, Banbury, 348m to the north east.

The Envirocheck data indicates that there are no records for Potentially Infilled Land (water or non-water) within 250m of the site. The nearest record entry is for a backfilled former body of water approximately 384m to the south.

Potential Mining and Mineral Extraction Hazards:
• None recorded.

2.6 Natural Ground Hazards

The Envirocheck data includes hazard ratings for natural geotechnical ground hazards (e.g., Landslides, Ground Dissolution). The potential hazards are generally classified as being negligible to very low. However, where the ground hazards are considered to be low or higher, these are recorded in the table below:

Potential Natural Ground Hazards:
• Shrinking or Swelling Clay Ground Stability Hazards – Recorded to be Low Risk.

2.7 Hydrogeology

No detailed information regarding the depths of groundwater is available for the site area. However, groundwater levels are likely to be subject to seasonal variations.

The strata directly underlying the northernmost portion of the site (Whitby Mudstone Formation) are classified as being Unproductive Strata, with the Marlstone Rock Formation underlying the remaining portion of the site classified as a Secondary (A) Aquifer. The cohesive strata (clay) of the Whitby Mudstone and the Marlstone Rock Formations are likely to include a high percentage of fine-grained material and restrict the downward migration of potential site contamination. Accordingly, as the site has largely remained undeveloped agricultural land, unless significant contamination is encountered during the ground investigation phase, the risk to the aquifer is generally considered very low to negligible.

There is one recorded groundwater abstraction license within 250m of the site area. The location, which is 212m to the west of the site, is associated with Crouch Farm and recorded as being for General Farming and Domestic Use.

The site is not recorded to be within 250m of a Groundwater Source Protection Zone.

Significant Features identified from hydrogeological data:
• Secondary (A) Aquifer (Solid Strata) - potential receptor for site-derived contamination but due to the lack of site development and a high % of fines the risk is considered very low to negligible (unless significant contamination is encountered on site).

2.8 Hydrology and Flooding

The nearest recorded surface water feature to the site is 2m to the east of the site and appears to refer to a drainage ditch along the eastern boundary. Four OS Water Network Lines are also recorded within 250m of the site area. The nearest record refers to the drainage ditch along the site boundary and the remaining three entries appear to be similar (disconnected) drainage ditches to the north, east and south west.

The site area is within a Zone 1 Floodplain. Zone 2 and 3 Floodplains are recorded more than 500m to the south west of the site. Accordingly, the risk of flooding (Rivers or Sea) is likely to be very low.

The Envirocheck data indicates that there are no areas of the site susceptible to Surface Water Flooding. The nearest location is approximately 120m to the south east of the site and the risk varies from low to high risk.

The BGS Groundwater Flooding Susceptibility data indicates that the majority of the central and southern area of the site, underlain by the Marlstone Rock Formation, is reported as having a "Limited Potential for Groundwater Flooding to Occur".

No significant pollution incidents, which may affect the site, are recorded within 250m of the site area and there are no recorded surface water abstraction licenses within 250m of the site. The nearest reported surface water abstraction is 876m to the south east and is for General Agriculture/Spray irrigation and Storage.

Significant Features identified from hydrological data:
• The BGS Groundwater Flooding Susceptibility data indicates that the majority of the central and southern area of the site has a "Limited Potential for Groundwater Flooding to Occur". *As the site is >1ha a flood risk assessment is required and has possibly been completed.

2.10 Environmental Data

Information on potentially significant environmental issues and controls at the site and surrounding area may be held on public records by regulatory authorities. This information is sourced directly from the regulatory authorities and from the Envirocheck database (The main concern is considered to be significant features within a 250m radius of the site). A copy of the Envirocheck Report is enclosed in Appendix B. A summary of the significant environmental issues and controls in the Envirocheck database are summarised below:

- There are no current or historical landfill sites recorded within 250m of the site.
- There are four Discharge Consents within 250m of the site. They all appear to refer to the same property owned by Mr T.J. Veres, 188m to the north east and refer to the discharge of sewage (Final/Treated Effluent).
- There are no Contemporary Trade Directory Entries or Points of Interest Entries (Commercial Services/ Manufacturing and Production or Public Infrastructure) within 250m of the site. The location is for photographic services but is no longer active. The nearest active entry is for a Domestic Cleaning Service, 457m to the north west.
- There are no Fuel Station Entries within 250m of the site.
- There are no significant pollution incidents within 250m of the site.
- The site is recorded to be within a Nitrate Vulnerable Zone.
- Zetica Unexploded Bomb Risk Map indicates that the site is at low risk. A Zetica – regional unexploded bomb risk map (www.zetica.com) is presented in Appendix B.

Significant Features identified from Environmental data:
• No significant features have been identified that could impact the site. • The site is within a Nitrate Vulnerable Zone.

2.11 Archaeology

Archaeological information has not been sought as part of this desk study and has not been identified as an issue by the Client. Archaeological investigations occasionally reveal ground-related problems, not recorded on the earliest OS maps that can cause foundation and contamination hazards.

Archaeological Hazards:
• None known.

2.12 Radon

Residential End-use

The site has been assessed following the guidelines in 'Radon: guidance on protective measures for new dwellings' (BR211 2015). The site is recorded to be within an area where full radon protection measures are required.

The property is in a Higher probability radon area where more than 30% of homes are estimated to be at or above the Action Level.

Radon Hazards:
• The Envirocheck Report indicates that **full radon** protection measures are required.

2.13 Contaminants of Concern

In addition to the general contaminants listed in Appendix D, the following site-specific potential contaminants have been identified:

- Asbestos (ACMs): associated with the existing farm track.
- Pesticides and hydrocarbons (PAH/TPH): associated with farming activities within the site area.

2.14 Summary of Potential Hazards (General/Geotechnical)

Potential geotechnical/general hazards have been identified in earlier sections and are summarised below.

Potential Hazard	Potential Consequence	Action
Live services to supply existing buildings (including Crouch Farm)	Danger to personnel	Locate before Ground Investigation/Disconnect and possible diversion
Variable strata (granular/cohesive)	Deepened Foundations/Reinforced Foundations	Ground Investigation
Trees	Deepened foundations - if shrinkable clay strata present	Ground Investigation

3.0 PHASE I CONCEPTUAL MODEL

The conceptual model has been drafted based on the current relevant guidance. The principles of the guidance are set out in Appendix D.

3.1 Preliminary Ground Model

The site comprises a roughly rectangular-shaped piece of open land formed by a single open field. The previously undeveloped site is largely surrounded by agricultural fields, with new residential development to the north. A metal farm building, associated with the nearby farm (Crouch Farm), is located immediately adjacent to the western boundary. A drainage feature (pond) linked to the adjacent development, is located in the field to the east. The current development proposals are for residential development including garden areas, landscaped open space and associated infrastructure.

The site area comprises a single field with a small wood and a track (concrete surface) close to the northern boundary. The track runs from Bloxham Road in the east to Crouch Farm in the north west and is separated from the main field by a wooden post and rail fence, which runs along the four sides of the field. The field is bordered by mature hedgerows and trees to the north south and west as well as the southern portion of the eastern boundary. The topographic survey provided by the Client indicates that the site slopes gently down to the south east.

Given the current and former uses (agricultural) of the site, the risk of significant contamination being present is considered generally very low to negligible, with a very low risk for pesticides. The construction of the track and nearby buildings are considered to be localised, very low-risk sources of contamination including metals, ACMs, and hydrocarbons (TPH, PAH).

Based on the BGS Sheet, the Whitby Mudstone Formation underlies the northern portion of the site, and the Marlstone Rock Formation - Ferruginous Limestone and Ironstone underlies the central and southern portion of the site. The Marlstone Rock Formation is known to form shallow soils with elevated concentrations of arsenic (naturally occurring) and further assessment is likely to be required to confirm this. Due to the recorded underlying strata, there is also a potential for the natural strata underlying the site to be locally variable and comprise both cohesive and granular and/or rock material.

The Whitby Mudstone strata are classified as being Unproductive Strata with the Marlstone Rock Formation classified as being a Secondary (A) Aquifer and the site is not within 250m of a Groundwater Source Protection Zone.

The Phase I Conceptual Site Model, which highlights pollutant linkages and potential solutions, is illustrated on the following page.

3.2 Phase I Conceptual Site Model

HUMAN HEALTH			
Source	**Pathway**	**Receptor**	**Solution**
Land use (agriculture) – pesticides (very *low risk*), metals, non-metals, hydrocarbons (TPH/PAH) (*very low to negligible risk*) Localised Made Ground from the construction of the site track and adjacent development (offsite) including metals, non-metals, hydrocarbons (TPH/PAH) and ACMs (very *low to negligible risk*)	Outdoor inhalation of soil dust, the ingestion of contaminated soil and soil dust, and dermal contact with contaminated soil and soil dust, ingestion of vegetables that have taken up contamination and contaminated soil attached to vegetables	End users and construction workers	Soil capping or removal of contaminated soils
No significant sources of ground gas identified - localised Made Ground and backfill ponds in the local area (*very low risk*)	Inhalation	End users High-risk end-use - residential	A gas monitoring program to confirm the level of risk

CONTROLLED WATERS			
Land use (agriculture) – pesticides (very *low risk*), metals, non-metals, hydrocarbons (TPH/PAH) (*very low to negligible risk*) Localised Made Ground from the construction of the site track and adjacent development (offsite) including metals, non-metals, hydrocarbons (TPH/PAH) and ACMs (very *low to negligible risk*)	Leaching of contaminants and vertical migration to the groundwater The high % of fines (low infiltration rates) will restrict the pathway (*Very low risk*) The risk is considered very low unless significant contamination encountered	Secondary (A) Aquifer	Nominal leachate testing and assessment during Phase II Intrusive Investigation works

CONSTRUCTION MATERIALS			
Land use (agriculture) – pesticides (very *low risk*), metals, non-metals, hydrocarbons (TPH/PAH) (*very low to negligible risk*) Localised Made Ground from the construction of the site track and adjacent development (offsite) including metals, non-metals, hydrocarbons (TPH/PAH) and ACMs (very *low to negligible risk*)	Migration of contamination through leaks and joints, degradation of pipe materials	Water pipes	Upgraded water pipes/clean backfill material
Potentially elevated sulphate and/or acidic ground conditions	Direct contact	Buried concrete	Appropriate concrete specification - Standard concrete is likely to be suitable, subject to testing