REPORT

Deerfield's Farm

Land Quality Phase 1 Preliminary Risk Assessment

Client: Mr Nigel Morris

Reference: I&BPB7300R001D0.1
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Enhancing Society Together

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Executive Summary

Royal HaskoningDHV have been commissioned by Mr Nigel Morris to undertake a Phase 1 Land Quality Preliminary Risk Assessment (PRA) to support an application for outline planning permission for a potential housing development at Deerfield's Farm, Canal Lane, Banbury. The site is located at National Grid Reference 446520, 238280, approximately 3km south of the centre of Banbury.

The PRA is a desk-based study and forms the initial step in the assessment of potentially contaminated land. The objectives of the PRA are to identify, as far as reasonable possible any potential sources of contamination within or around the site which may represent an unacceptable risk to site users and/or controlled waters.

The site was undeveloped until it became part of Deerfield's Farm and now consists of agricultural land, farm buildings and farming equipment. The site is bordered by residential dwellings to the western boundary of the site and the Longford Park housing development to the north and east sides, where other residential dwellings are currently under construction.

Existing information indicates that the ground conditions comprise of soil over brown clay over limestone, over brown clay with limestone over siltstone. There is currently gravel and made ground (concrete) in some areas of the site. The bedrock unit is mostly designated as a Secondary A Aquifer and the Environment Agency have assigned a High groundwater vulnerability. The site is not located within a groundwater Source Protection Zone and there are no groundwater abstractions in the vicinity of the site. There are a number of surface water sources in the vicinity of the site including the Sor Brook 750m to the south of the site, the Oxford Canal 800m north-east of the site, and a river which flows into the River Cherwell 900m north-east of the site.

The PRA has identified a number of potential plausible pollutant linkages that could represent an unacceptable risk to construction workers, future residents and groundwater due the ground conditions. Whilst a number of potential contaminants of concern (PCOC) have been identified, the potential for asbestos and hydrocarbons in the soil/groundwater, and radon are of particular concern. Whilst there is the potential for other contaminants associated with agricultural use to have impacted the site through general site operations, it is considered that any residual chemicals would be unlikely to represent an unacceptable risk to site users or the environment.

Whilst these issues are unlikely to represent significant constraints to redevelopment of the site, it is likely that the local authority regulator will require some level of intrusive investigation to confirm soil and groundwater conditions. We would also recommend this as a prudent way forward, as failure to do so now can have major delays on construction and increased costs if contamination is found during redevelopment.

The PRA has also confirmed the site is located in an area where the radon potential is high. Note there is some uncertainty regarding the extent of the area designated as high, which should be clarified with the local authority. Therefore, as required by building regulations and associated guidance it is a requirement that all residential dwellings on this site are built with radon protective measures installed to mitigate the risk to residents.

1 Introduction

1.1 Background

Royal HaskoningDHV have been commissioned by Mr Nigel Morris to undertake a Phase 1 Land Quality Preliminary Risk Assessment (PRA) to support an application for outline planning permission for a potential housing development at Deerfield's Farm, Canal Lane, Banbury.

The proposed development will be on land to the rear of Deerfields Farm which is currently utilised as agricultural land. There are a number of storage buildings and farming equipment also present on the site.

1.2 Key Objectives

The objectives of the PRA are to identify, as far as reasonably possible at this stage of preliminary consideration of the proposed scheme, any potential sources of contamination within or around the site which may represent an unacceptable risk to site users and/or controlled waters.

1.3 Methodology

The PRA has been completed in general accordance with the recommended approach in Contaminated Land Report 11, (*DEFRA and Environment Agency. 2004. Model Procedures for the Management of Contaminated Land, R & D Publication CLR11*).

The PRA is a desk-based study and forms the initial step in the assessment of potentially contaminated land. It proceeds, if required, intrusive investigation, risk assessment, options appraisal, remedial design, implementation planning and completion reporting.

The main purpose of the PRA is to identify whether or not there are potentially unacceptable risks to human health or the environment posed by the site and the immediate surroundings, which warrant further investigation.

The following desk-based information sources have been reviewed:

- Envirocheck Report (Ref. 159030877_1_1) compromising historical maps, environmental sensitivity data and regulatory records – presented in Appendix 3;
- British Geological Survey (BGS) on line geology viewer;
- UK Radon Website (Public Health England)[1];
- Environment Agency interactive mapping ('What's in your Backyard' website[2]); and
- Publicly available aerial imagery (Google Earth[3]).

1.4 Report Format

The remainder of this report comprises the following principal sections:

- Section 2 – Site Location;
- Section 3 – Environmental Setting;
- Section 4 – Regulatory Information;
- Section 5 – Preliminary Conceptual Site Model and Qualitative Assessment; and

[1] *Public Health England, 2018 http://www.ukradon.org/*
[2] *http://maps.environment-agency.gov.uk/wiyby/*
[3] *https://earth.google.com/web*

- Section 6 – Conclusions and Recommendations.

2 Site Location and Description

The site is located at National Grid Reference 446520, 238280 at Deerfield's Farm, Canal Lane, Bodicote, within an area of predominantly residential development approximately 3km south of the centre of Banbury, and to the east of the A4260. The site is bordered by residential dwellings to the western boundary of the site, and Longford Park borders the north and east of the site where other residential dwellings are currently under construction. Canal Lane borders the south of the site and across the road there is another housing development and a field associated with Deerfield's Farm.

The site extends to around 1.06 hectares of agricultural land and is generally level with hedges and trees along the western boundary. The south-western half of the site is mainly covered in gravel with some areas of concrete, there are three large buildings which are used for storing machinery. Three containers and one trailer are also present in this area. Next to the most southern of the three buildings is a specialist bunded plastic tank for diesel storage, installed approximately twelve months ago. There is an area to the north-west which is designated for storing farming equipment. There are woodpiles and areas of rubble adjacent to the northern extent of the buildings in the southwest. The eastern area of the site is grassland, and there is an area designated for the storage of hay bales and silage bales to the south of this. There are two smaller buildings to the south-east of the site with an area of concrete between them.

2.1 Historical Information

A review of historical maps contained within the Envirocheck report has been undertaken to identify potentially contaminative land-uses. Key on-site and off-site features are identified in **Table 2-1** and **Table 2-2**, respectively.

Table 2-1 Historical Information (On-Site)

Map Dates	On-site Features
1882	Undeveloped, agricultural land
1900 - 1955	No significant change
1993	Residential dwelling and storage building to the south of site
1999	Farm storage building

Table 2-2 Historical Information (Off-site)

Map Dates	Off-site Features	Distance	Direction
1885-1887	New College Farm	600m	East
	Paddock Farm	650m	South-west
	Bodicote Grounds Farm	700m	North
	Grange Farm	850m	North
	Sandhill farm	1km	East
	Pound	600m	West
	Malthouse	500m	South-west
	Malthouse	700m	South-west
1900	Allotments	100m	South-east
1923	Allotments	750m	South-west

	Allotments	800m	West
	Sewage works	1.1km	South
1955	No significant change		
1977	College Farm (building)	350m	South
	Garage	250m	North-west
	Town Furlong Farm	750m	Southwest
	Cotefield Farm	800m	South
	Allotment gardens	1km	South
1993	Tipper's Farm	250m	Northwest
1999	Beerfield's Farm	<50m	South

3 Environmental Setting

3.1 Ground Conditions

Information on geological conditions at the site has been collated from the British Geological Survey (BGS) datasets including 1:50,000 scale geological mapping. The anticipated geological sequence, as shown on the BGS online viewer, is outlined in **Table 3-1** below.

Table 3-1 Geology

Stratum	Unit	Description
Superficial Deposits	None recorded	N/A
Bedrock	Marlstone Rock Formation – Ferruginous Limestone and Ironstone (northern area of site).	Sandy, shell-fragmental and ooidal ferruginous limestone interbedded with ferruginous calcareous sandstone, and generally subordinate ferruginous mudstone beds.
	Whitby Mudstone Formation – Mudstone (south-eastern area of the site)	Medium and dark grey fossiliferous mudstone and siltstone.

Royal HaskoningDHV are not aware or any previous site investigation at the site.

Historical boreholes records were also accessed via the British Geological Survey (BGS) online viewer. A borehole located on the north-west of the site indicated the following ground conditions.

Table 3-2 BGS Borehole Log Summary

Borehole	Depth (m bgl)	Description
SP43NE15 (0m north-west of site)	0-0.18	Soil
	0.18-0.86	Brown clay
	0.86-4.04	Limestone
	4.04-5.64	Brown clay with limestone bands
	5.64-5.944	Siltstone

3.1.1 Mining and Mineral Extraction

The site is located in an area that might not be affected by coal mining.

There are no British Geological Survey (BGS) recorded mineral extraction sites either on site or in the vicinity.

3.1.2 Radon Gas

The presence of radon gas is assessed in the UK according to the number of homes likely to be above the Action Level (200 Bq m-3). Under building regulations the requirement for protection measures (described in BRE, 2015) in the construction of new buildings, conversions or extensions is dependent on Radon Potential[1].

According to the Envirocheck report, BGS data indicate that the northern area of the site is located within a higher probability radon area, with 10-30% of homes estimated to be at or above the Action Level. This means that full radon protective measures are necessary in the construction of new dwellings or extensions. However, the eastern area of the site is in a lower probability radon area, with less than 1% of the homes estimated to be at or above the Action Level, and no radon protective measures are necessary. However, on the UK Radon Map[1], the site is shown to be fully within the higher probability radon area.

3.2 Hydrogeology and Groundwater Vulnerability

The northern and western area of the site is classified as a Secondary A Aquifer. Secondary A aquifers are defined by the Environment Agency as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. There is a small area to the south-east of the site which is designated as unproductive strata.

The Environment Agency online portal indicates the northern area of the site has been assigned a high groundwater vulnerability risk. This designation indicates that the soil is easily able to transmit pollution to groundwater, which is characterised by high leaching soils and the absence of low permeability superficial deposits.

Based on the topography the local groundwater flow is likely to be towards the south east.

3.2.1 Groundwater Abstractions

There are no licenced groundwater abstractions on site or within 250m of the site.

There is one groundwater abstraction 725m south of the site for agricultural vegetable washing. There are two groundwater abstractions between 1 – 2km of the site. There is one 1452m north-east of the site, and one 1625m south-west of the site, both for general farming and domestic use.

3.2.2 Groundwater Source Protection Zones

Groundwater Source Protection Zones (SPZs) are defined around abstraction boreholes used for potable water supply, to delineate the area where release of a contaminant into the aquifer could impact on the abstraction[4]. There are no SPZs within the vicinity of the site.

3.3 Hydrology

There are no water features within the site boundary. However, the Oxford canal is approximately 800m north-east of the site and flows south, and there is a river which runs parallel to this around 100m to the north-east of the canal and flows south into the River Cherwell. A small length of inland river also runs around 50m south-west of the canal. Around 750m south of the site is the Sor Brook which flows south. This is shown in the river network map supplied with the Envirocheck report, Appendix 3.

[4] The Inner Zone (Zone 1) is the most sensitive and certain potentially hazardous activities are restricted in this area. Outside this are the Outer Zone (Zone 2) and the Total Catchment (Zone 3), which indicates the recharge area that contributes to that water supply. The Environment Agency has published SPZs for public water supplies and other significant sources. For potable abstractions without published SPZs there is a default Inner Zone of 50 m radius and, (for sources providing more than 2,000m3) an Outer Zone of 250 m radius.

3.3.1 Surface Water Abstractions

There are no surface water abstractions within the site boundary or within 1km of the site. However, there are three between 1-2km of the site, including one potable public water supply 1,216m south-west of the site, abstracted from the Sor Brook at Bodicote Pumping Station.

3.4 Sensitive Land Use

The site is within the Cherwell (Ray to Thames) and Woodeaton Brook nitrate vulnerable zone (NVZ). There is one environmentally sensitive area, the Upper Thames Tributaries, which is 834m north-east of the site. There are no other sensitive land use areas within the vicinity of the scheme.

4 Regulatory Information

Regulatory information relating to potentially contaminative activities in the vicinity of the site has been summarised in **Table 4-1.** Further details are provided in the Envirocheck Report (Ref. 159030877_1_1) enclosed in Appendix 3.

Table 4-1 Regulatory Information

Environmental Records	On-site	0-250m	Description
Discharge Consents	0	0	One discharge consent 484m south of the site for sewage discharges (pumping station). Five discharge consents between 500-1km from the site which include sewage discharges from pumping stations and final/ treated effluent.
Pollution Incidents to controlled waters	0	0	Two pollution incidents between 500-1km from the site: - One category 2 significant incident occurred for a general pollutant 524m south of the site; and - One category 3 minor incident for unknown oils 728m south of the site.
Substantiated Pollution Incidents	0	0	None within 1km of the site.
Registered landfill, historic landfill or other waste disposal sites	0	0	None within 1km of the site.
Licensed waste management facilities (transfer, treatment and disposal sites)	0	0	None within 1km of the site.
Integrated Pollution Prevention and Control authorisations	0	0	None within 1km of the site.
Local Authority Pollution Prevention and Control authorisations	0	1	One authorisation 233m north-west of the site for a petrol filling station for Local Authority Air Pollution Control. One authorisation (revoked) 289m north-west of the site for waste oil burners (less than 0.4MW net rated thermal input).
Hazardous substances consents and handling notifications	0	0	None within 1km of the site.
Prosecutions relating to Authorised Processes	0	0	None within 1km of the site.
Prosecutions Incidents to Controlled Waters	0	0	One incident 397m west of the site which involved disposing unleaded fuel into a storm drain which then entered the River Cherwell.
Licensed radioactive substances	0	0	None within 1km of the site.
Fuel sites	0	1	One petrol station 233m north-west of the site. One fuel station (obsolete) 725m north-west of the site.

Environmental Records	On-site	0-250m	Description
Contemporary Trade Directory records (active and former)	0	6	Six contemporary trade directory entries between 0-250m of the site including: - Furniture - repairing and restoring (active), 139m south-west; - Crane hire, sales and service (inactive), 183m west; - Refrigerators and freezers - servicing and repairs (inactive), 211m south-west; and - Petrol filling stations (active), 233m north-west. There are 26 entries between 250m-1km of the site, including a car dealers (active), 280m north-west of the site.

5 Preliminary Conceptual Site Model and Qualitative Assessment

Current guidance recommends that a Conceptual Site Model (CSM) is formulated based on the information available. As more information becomes available the conceptual model may be updated. The CSM is limited at this stage to the identification and assessment of potential sources, potential receptors, and the anticipated pathways to those receptors, identified as a result of desk-based research.

For contamination within soil or water to pose a risk, a feasible pollutant linkage must be established. A pollutant linkage consists of three parts:

- A source of contamination in or on the land;
- A viable pathway by which the contaminant is able to cause harm (or which presents a significant possibility of such harm being caused); and
- A receptor which is sensitive to impact from the contamination.

Where all three of these are present, a feasible pollutant linkage exists.

5.1 Potential Sources

Potential on-site sources of contamination are presented in **Table 5-1**.

Table 5-1 Potential on-site sources of contamination

Potential Source	Potential Contaminants of Concern (PCOC)
Potential for fertilisers, pesticides and herbicides.	Fertilisers (including nitrogen, phosphorous, potassium), pesticides, herbicides.
Made ground (concrete).	Asbestos is commonly identified in made ground deposits, particularly where localised building refurbishment has occurred and material has been buried/ used in farm tracks. Other contaminants such as polycyclic aromatic hydrocarbons are also frequently recorded.
Agricultural vehicles and equipment on site. It is possible that the underlying soils could be impacted as a result of leaks and spillages.	Predominantly hydrocarbons.
Above ground diesel storage tank (bunded).	Diesel.
Silage storage area.	Silage run off.
Bedrock.	Radon (naturally occurring).

Several current and historical activities undertaken within 1km of the site also have the potential to release contaminants into the ground, which may have subsequently migrated to the site in groundwater. These are identified in **Table 5-2.**

Table 5-2 Potential off-site sources of ground contamination

Potential Source	Potential Contaminants of Concern (PCOC)
Petrol filling station, car dealers. (Garage on site since 1977)	Petroleum spirit (VOCs, SVOCs, PAHs), petrol additives (tetramethyl-lead, tetraethyl-lead, methyl tertiary butyl ether) and diesel.
Historical sewage works	Metals, metalloids and their compounds, inorganic ions, organics, micro-organisms, treatment chemicals, hazardous gas generation potential in buried sludge and asbestos.

5.2 Qualitative Risk Assessment

The qualitative assessment considers the PCOC, site setting, and site use, to establish whether a feasible pollutant linkage is likely to exist. If a feasible pollutant linkage is identified this is then assessed to determine whether it could represent an unacceptable risk to human health or controlled waters. The Preliminary CSM and Qualitative Assessment is presented in **Table 5-3.**

Table 5-3 Preliminary Conceptual Site Model and Qualitative Risk Assessment

Source	Pathway	Receptor	Qualitative Assessment
Potential on-site sources of soil and groundwater contamination	Dermal contact, ingestion, inhalation	Construction/ maintenance workers	Based on the information currently available PCOC may be present in the soils and groundwater at concentrations that exceed current guideline values and may therefore represent potential unacceptable risks to construction/ maintenance workers. Of particular concern is the potential for asbestos and hydrocarbons in the soil from local disposal and potential spillages. However, it is likely that short term risks associated with construction/ maintenance could be managed through the use of personal protective equipment and appropriate working practices.
	Dermal contact, ingestion, inhalation	Site users (residents)	As noted above PCOC may be present in the soils and groundwater at concentrations that exceed current guideline values and may therefore represent potential unacceptable risks to future residents, particularly in landscaped areas or as result of the migration of volatile contaminants (if present) into buildings.
	Contaminant migration via leaching and groundwater transport	Oxford Canal, Sor Brook and river which runs into the River Cherwell; Secondary A aquifer	Over half of the site (northern area) is located upon a Secondary A aquifer, with a high groundwater vulnerability classification, which means the soil is easily able to transmit pollution to groundwater. The site is not located within a source protection zone and there are no groundwater abstractions utilised for potable supply within 1km of the site, although there is one 1.2km south-west of the site. The Oxford Canal is 800m northeast of the site, and there are a number of other surface water courses in the vicinity of the site. Of particular concern is the potential for historical spillages of hydrocarbons as a result of ongoing leaks from the storage tank/ catastrophic failure of tank integrity, which could have impacted shallow groundwater. However, given the likely limited volumes of hydrocarbons stored on-site and the absence of potable abstractions in the vicinity of the site, and the distance to surface water receptors the risk to off-site receptors is likely to be low.
	Physical transport by surface runoff or due to erosion	Surface waters	During construction there is a risk of runoff from exposed contaminated soils which could transport contaminated sediments or dissolved contaminants to surface waters, however, due to the distance from any surface water body (the nearest being the Sor Brook 750m south and the Oxford Canal 800m to the north-east) this can be scoped out for further assessment.
Potential off-site sources of groundwater contamination	Groundwater migration	Construction workers, site operatives and site users (residents)	OS mapping indicates the site is at a similar level to that of the petrol filling station, 233m north-west of the site, and topography slopes towards the Oxford Canal, therefore it is possible that any contamination associated with the petrol station could migrate in groundwater beneath the site. However, the Envirocheck report does not record any pollution incidents associated with the petrol station site or enforcement action therefore the risk is considered to be low. There was however, a prosecution relating to the release of unleaded fuel to a storm drain 397m west of the site which then entered the River Cherwell, however it is unlikely that this would have an impact on the site. There is no potential pathway from the historical sewage works site, as this would likely flow south to the Sor Brook, rather than towards the site, therefore this pollutant linkage has been scoped out for further assessment.

Ground gases and vapours	Gas generation and transport	Construction workers, Future site users	Geological mapping does not record the presence of made ground deposits on-site, and there is no evidence of quarrying and backfilling. Given the historical use of the site it is unlikely that there would significant deposits of gas-generating materials, therefore this pollutant linkage has been scoped out for further assessment. According to the Envirocheck report, the northern and western area of the site is located within a higher probability radon area, with 10-30% of homes estimated to be at or above the Action Level. Whereas the UK Radon online map[1] showed the whole site to be within the higher probability radon area. Therefore, full protective measures must be taken against radon entering the buildings.

6 Conclusions/ Recommendations

The key objective of the Preliminary Risk Assessment (PRA) was to develop a Preliminary Conceptual Site Model (PCSM) to aid in the identification of any potential pollutant linkages and potential unacceptable risks to sensitive receptors associated with the proposed redevelopment.

The PRA has identified a number of potential plausible pollutant linkages that could represent an unacceptable risk to sensitive receptors. Key receptors are likely to be construction workers, future residents and groundwater.

Whilst a number of PCOC have been identified, the potential for asbestos and hydrocarbons in the soil/groundwater, and radon are of particular concern. Whilst there is the potential for other contaminants associated with agricultural use to have impacted the site through general site operations, it is considered that any residual chemicals would be unlikely to represent an unacceptable risk to site users or the environment.

It is not uncommon and, historically was normal practice for demolition material containing asbestos fragments to be buried on-site or used in farm tracks during on-site redevelopment works. Where hydrocarbons have been stored on-site it is also not uncommon to encounter localised soil and groundwater contamination as a result of poor site practices/ failure of tank integrity.

Whilst these issues are unlikely to represent significant constraints to redevelopment of the site, it is likely that the local authority regulator will require some level of intrusive investigation to confirm soil and groundwater conditions. We would also recommend this as a prudent way forward, as failure to do so now can have major delays on construction and increased costs if contamination is found during redevelopment.

Intrusive investigation would comprise the recovery of soil and groundwater samples via a borehole investigation targeted at key locations e.g. fuel storage area. On completion of the intrusive investigation and receipt of laboratory results, a generic quantitative risk assessment should be undertaken utilising the findings of the intrusive works and laboratory analysis to establish if potential unacceptable risks to sensitive receptors are present at the site. The assessment should be undertaken in line with current guidance.

The PRA has also confirmed the site is located in an area where the radon potential is high. Note there is some uncertainty regarding the extent of the area designated as high, which should be clarified with the local authority. Therefore, as required by building regulations and associated guidance it is a requirement that all residential dwellings on this site are built with radon protective measures installed to mitigate the risk to residents.

Appendix

1 Limitations

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Limitations

The direct assessments and judgements given in this report are limited by both the finite data on which they are based and the proposed works to which they are addressed. The acquisition of data is constrained by both physical and economic factors and, by definition, is subject to limitations. Conditions at the site will change over time due to natural variations and may be affected by human activities.

This document has been prepared for the titled project and should not be relied upon or used for any other project. Royal HaskoningDHV accepts no responsibility or liability for the consequences of this document being used for a purpose other than that purpose for which it was commissioned. The assessments and judgements contained herein should not be relied upon as legal opinion.

The findings and opinions are relevant to the dates of the information reviewed and should not be relied upon to represent conditions at later dates. The opinions included herein are based on the information obtained from the assessments undertaken in the study area and from the experience of the reviewers.

This Phase I Land Quality Assessment has utilised a variety of publicly available data sources such as the Environment Agency, Landmark Group, historical maps and the British Geological Survey. Therefore, the study is limited by the age and limitations inherent in the data described.

Appendix

2 Site Location Plan

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revision
Mr N Morris
Land at Deerfields Farm
Canal Lane
Banbury
Site Layout
Option 2
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Appendix

3 Envirocheck Report

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