Land Science

DELSPRIDE, KENT STREET, COWFOLD, WEST SUSSEX, RH13 8BB

PHASE I GEO-ENVIRONMENTAL INVESTIGATION

MR AND MRS BRYANT

24TH MARCH 2022

LS6213

Site:	**DELSPRIDE, KENT STREET, COWFOLD, WEST SUSSEX, RH13 8BB**
Title:	**PHASE I GEO-ENVIRONMENTAL INVESTIGATION**
Project:	**RESIDENTIAL DEVELOPMENT**
Client:	**MR AND MRS BRYANT**
Surveyor:	**DOUGLAS JP EDWARDS**
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1.0 INTRODUCTION

1.1 General

Land Science was instructed to undertake a Phase I Geo-Environmental Investigation in relation to the proposed redevelopment at Delspride, Kent Street, Cowfold, West Sussex, RH13 8BB. The location is shown on Figure 1, which is centred at grid reference TQ 23555 21680.

1.2 Client

The Clients for this appointment were Mr and Mrs Bryant, through their surveyor Douglas JP Edwards. This report may only be used by this named client and their directly appointed project team for the purposes set out in the report conditions. It was understood that the Client already owned the property, and that this investigation was not a pre-purchase appraisal.

1.3 Area Under Investigation

The area under investigation comprised a disused chicken house, with a lean to along the southern edge, and associated wire racking inside. The layout is indicated on Figure 2, and a walkover survey is presented in section 3.0. The area was approximately 0.07 hectares.

1.4 Form of Development

The proposed development was understood to comprise the conversion of the existing chicken house into two residential units with associated garden space. The outer structure of the existing building was to be retained, a Sika render applied to the walls and floors, and new walls and floors constructed within. Figure 3 illustrates the layout of the proposed redevelopment. The findings of this report may be not valid if the proposed development is altered.

1.5 Previous Investigations

Land Science was not aware of any previous desk studies or ground investigation(s) undertaken on this site and for this scheme.

1.6 Scope of Work

The work carried out is described in detail in following sections but in summary included:

- A desk study (incorporating a walkover survey, review of historical land uses and a review of an Envirocheck data report).

The site walkover was conducted on the 24th of February 2022, under the supervision of Land Science.

1.7 Geo-Environmental Objectives

A preliminary phase I assessment was carried out, to identify potential sources of contamination, to develop a preliminary Conceptual Site Model (CSM) and to form the basis of a Preliminary risk Assessment (PRA). The report was required to assess risks associated with end users, the proposed redevelopment, adjacent land uses, and the wider environment, in the context of the planning regime. It was understood this report would support a future planning application.

2.0 STANDARDS AND REFERENCES

2.1 Standards

Where practicable, the investigation was undertaken in accordance with the following primary standards and guidance:

- Land Contamination Risk Management (LCRM) Environment Agency 2020
- BS10175:2011+A1:2013, Investigation of Potentially Contaminated Sites.
- National Planning Policy Framework, July 2018.
- Building Regulations Approved Document C: Site preparation and resistance to contaminants and moisture, HM Government, July 2013.
- NHBC Standards Chapter 4.1: Land Quality - Managing Ground Conditions, 2019.

Other technical sources have been cited in respect of specific aspects of the investigation, as referenced throughout the text.

2.2 References

A number of technical references have been referred to in the preparation of this document, including:

- Radon: Guidance on protective measures for new buildings, BRE Report BR 211, 2015 2ND edition
- Groundwater protection: Principles and practice (GP3) August 2013 Version 1.1

3.0 DESK STUDY (CONCEPTUAL SITE MODEL)

3.1 General

A desk study was carried out to inform the preliminary conceptual understanding of the site and its setting, and to identify potential aspects of concern, in the context of the stated report objectives.

3.2 Walkover Survey

A walkover survey was carried out, as recorded in Appendix A, with photographs from the site presented in Appendix B. In summary, the area under investigation comprised a disused chicken shed which was built with half block walls and the remaining portion in timber. The entire site was covered with hardstandings, comprising concrete slabs. Chicken waste was noted in the base of the chicken house, however, this was to be removed and does not pose a significant risk of contamination.

The walkover survey did not identify any areas of particular concern regarding the geotechnical condition of the site. No trees or significant evidence of underground structures, ground instability, subsidence, wet areas, significant earthworks, etc, were noted.

The walkover survey did not identify any areas of particular concern regarding the geo-environmental condition of the site. No significant evidence of tanks, chemical storage, staining or sheens, built up ground, contaminative land uses etc., were noted.

3.3 Historical Land Use Data

Various historical records were reviewed in order to assess potential historical land uses and activities that may impact on ground conditions at the site.

A set of historical ordnance survey maps was obtained from Envirocheck, and a copy is presented in Appendix C. The following key features were noted:

- The earliest map dated 1875 showed the site comprised a portion of a large open field.
- The 1993 map showed the site to be developed with an area of hardstanding, which could have been used as a trackway for vehicles, leading into the field. This most recent map differed from the present day, suggesting that the chicken house was developed after the publication of the 1993 map.
- On the most recent map, a tank was noted immediately to the east of the chicken house, however this was not noted during the site walkover.
- Off site, a clay pit was located ~80m to the northwest of the site, which was later marked as a pond on the 1957 map. Two further ponds were noted ~50m and 70m to the northeast of the site.
- The historical map set included an aerial photograph dated 1999. The imagery showed a large rectangular building filling the majority of the site, located in the northeast portion of an open field, however the quality of the imagery was not sufficient to discern any land use features on site.

Recent aerial photography covering the site was examined using Google Earth Pro. The imagery identified a tank to the east of the chicken shed. This was first clearly visible in the imagery dated

2005, however, it could have been present prior to this. No evidence of a tank was noted during the site walkover, suggesting it was removed since the publication of the most recent imagery dated August 2020 and the present day.

A brief internet search was carried out, which did not immediately reveal any further relevant land use information, other than the poultry farm both on and surrounding the site.

3.4 Ground Conditions

A preliminary ground model was derived for the site based on a combination of various sources including published maps, borehole records, previous investigations, and the site history. In summary, the following potential ground model was identified:

Strata	Approximate Depth (mbgl)	Summary Description
Made Ground	<1.00m	The site has been used as a yard for several years and there is a potential for construction and demolition wastes, imported fill materials, and zones of disturbed ground, to exist.
Horsham Stone Member	1.00-2.00m*	Calcareous, generally fine-grained, micaceous sandstone which is pale grey to greenish/olive grey in colour.
Weald Clay Formation	To depth	Dark grey, thinly bedded mudstones, siltstones, fine to medium-grained sandstones, shelly limestones, and clay ironstones.

*The site lies on the edge of the Horsham Stone Member, overlying the Weald Clay. Therefore, if present, the Horsham Stone Member will only be approximately 1.00-2.00m thick.

In addition, groundwater was anticipated, as follows:

- Perched water – in granular soils upon cohesive soil, for example within the Horsham Stone Member, overlying the Weald Clay.
- Groundwater could also be present within granular pockets of the Weald Clay Formation.

The desk study included searches of geological hazards. None of the hazards were rated as moderate or above, considered the screening threshold for further investigation.

A search of various databases for coal mining, mining, brine compensation, and natural cavities was carried-out. No relevant features were identified, mapping suggested it was highly unlikely that the site lay within a Non-Coal Mining Area of Great Britain.

3.5 Environmental Setting

The site lies in the following groundwater setting:

- Superficial aquifer: None - No superficial strata were classified.

- Bedrock aquifer: The Horsham Stone Member was classified as a Secondary A - 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.
- Bedrock aquifer: The Weald Clay Formation was classified as an Unproductive Strata - Low permeability strata that have negligible significance for water supply or river base flow.
- Source protection zone: None - no groundwater Source Protection Zones were identified on site or in the vicinity.
- Flooding from Rivers and Sea: Zone 1 Low Probability - Land having a less than 1 in 1,000 annual probability of river or sea flooding.
- Surface water flooding on site: Very low risk - each year this area has a chance of flooding of less than 0.1%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.
- Groundwater flooding on site: No immediate risk.
- The site lies within a Nitrate Vulnerable Zone.

3.6 Radon Gas

The requirement for Radon Protection Measures (RPM) has been assessed in accordance with BRE 211:2015. Public Health England and the BGS estimate the potential for radon and the requirement for Radon Protection Measures on site as follows:

- Radon probability: Not at risk - less than 1% of homes are estimated by PHE to exceed the threshold for Radon gas in residential dwellings.
- Radon Protection Measures (RPM): No Radon protection is required for new dwellings or extensions constructed at this location.

4.0 PRELIMINARY RISK ASSESSMENT (PRA)

4.1 General

A preliminary contaminated land risk assessment (PRA) has been prepared, based on the preliminary conceptual site model in section 4.0, to identify potential contamination risks following a source-pathway-receptor (SPR) approach, following established guidance and best practice.

4.2 Risk Assessment Framework

A qualitative estimate of the level of risk associated with the identified source-pathway-receptor linkages has been made. Each source, pathway and receptor in each linkage is given a rating from 0-5, and the overall rating for the linkage is expressed as a multiple of the three numbers.

Rating	Source	Pathway	Receptor	SPR Linkage
Unlikely	0	0	0	0
Very Low	1	1	1	1-3
Low	2	2	2	4-17
Moderate	3	3	3	18-48
High	4	4	4	49-100
Very high	5	5	5	100+

The scoring is based on professional judgement and qualitative assessment of various factors:

Source - Whether it is on-site or off-site, the distance from the site, the age and time period, the history and evolution, whether it has been redeveloped and when, the overall magnitude or extent, any existing data or observations. Sources are identified from the conceptual site model.

Pathway - Proximity and relationship to the associated receptor, frequency, the ground conditions, flow directions, migration pathways. Pathways may vary between each source and each receptor.

Receptor - Direct or indirect effects, human health or non-human receptor, age classes, exposure duration and frequency, types of activity, materials, existing evidence of harm, quality of the receptor and significance of any harm. This will depend on any existing or proposed site uses.

Potential sources and Receptors are identified first, before identifying whether any active realistic pathways exist between them.

The principle of primary and secondary sources has been adopted:

- A **primary source** for instance a leaking tank or drainage, industrial activity, buried fill materials, etc, identified as part of the desk study and site walkover.

- A **secondary source** environmental media (or phases) in which any resulting contamination may occur, being soils, ground gases, volatile vapours, and groundwater as described below:

Secondary source	Summary
Soil	Soils contaminated with materials such as ash, clinker, bitumen, refuse, wastes, asbestos, etc (Made Ground) or soils contaminated by discharges, spillage, drainage, run-off, migration etc of contaminants from diffuse or point sources.
Ground water	Mobile contaminants entering groundwater, being either perched water (impermeable horizons such as clays or buried structures) or as a water table (more persistent water bodies within productive strata).
Volatile vapours	Volatile or semi-volatile compounds generating vapours which exist in a gas phase and may be generated from soils, groundwater or directly from storage such as underground tanks.
Ground gases	Ground gases occurring from a variety of natural and man-made sources, principally from the decomposition of waste materials, organic matter, organic contaminants. Examples include landfill sites, alluvium, and mine workings etc.

4.3 Identified Potential Sources

The following potential primary sources of contamination were identified:

Primary sources	Soils	Ground Water	Vapours	Ground Gases
Made Ground <1m - widespread	Low	Very Low	Unlikely	Unlikely
Chicken houses	Low	Low	Very Low	Unlikely
Agricultural land	Low	Low	Very Low	Unlikely
OVERALL RATING	Low	Low	Very low	Unlikely

Made Ground may be present on site beneath concrete bases as it has been used as a yard area and trackway since 1993. These materials may contain a wide range of potential contaminants including metals, non-metals, and organic contaminants. However, given the site history and the nature of the site, the composition of the Made Ground is not expected to be particularly onerous. The depth and composition of Made Ground was not expected to be sufficient to be a significant source of ground gases.

The presence of chicken houses could be a potentially contaminative activity. Significant portions of animal wastes are associated with this; however, these do not pose an immediate contamination risk provided it is thoroughly cleared. Large tanks adjacent to the chicken houses may be point sources of potential contamination. Contaminants include organic compounds. No significant staining on the concrete hardstanding was noted during the site walkover, the tanks looked relatively modern in previous photographs and had been removed recently.

Agricultural Premises may have been used for contaminative activities including the use of persistent pesticides such as DDT, the application of sewage sludge or animal wastes, use of fuels and maintenance of vehicles, heating and lighting may also have been generated, for example, using diesel generators and/or paraffin heaters. Overall, the scale of activity was moderate. The period of land use was prolonged, and the activity ceased recently.

No other potential sources of contamination were identified on site, for example, no landfill sites were identified on site or in the vicinity, and no significant naturally occurring sources of ground gases were identified.

4.4 Potential Receptors

The following potential receptors associated with the site and the proposed development have been considered in this report:

- End Users - occupants of the proposed redevelopment. The proposed development comprised residential houses with private gardens.
- Adjacent Land - Sensitive land uses identified locally. the site was surrounded by open fields, residential dwellings, and disused agricultural premises.
- Soft Landscaping - Areas of planting including lawns, shrubs, trees, etc. New private garden areas were to be formed from existing hard landscaped areas.
- Structural Concrete - new foundations etc. cast into the ground. It was understood that no new foundations were to be constructed. It was understood that the existing outer building, including the floor slab and block wall were to be retained, and new walls and floors were to be constructed within the existing building.
- Water Supply Pipework – water supplies may become tainted when mains are laid in contaminated ground. New potable water mains are to be laid.
- Groundwater - Water below ground in permeable strata. The site overlies strata classified as Secondary A Aquifer and is a potential resource for potable or commercial abstractions.
- Surface Water - Surface water in lakes and rivers etc. Ponds were identified to the north of the site, two to the northeast and one to the northwest.

4.5 Receptors Excluded

The following potential receptors were excluded from the assessment as they are covered by other legislative controls and are outside the remit of this report.

- Ecological receptors such as statutory protected species or wildlife areas. An assessment of such risks was outside the scope of this report.
- Site workers such as those involved in construction work or future maintenance. Any risks posed to site workers would be controlled through Health & Safety legislation, including the CDM and COSHH regulations etc.

4.6 SPR Linkages and Risk Ratings

The source-pathway-receptor linkages identified are summarised below:

Soils	Pathways	Rating	Receptor	Rating	Overall Rating
Low	Dermal contact with soil and soil-borne dust	High	End Users	High	**Moderate**
Low	Ingestion of soil and soil-borne dust	High	End Users	High	**Moderate**
Low	Inhalation of soil-borne dust	High	End Users	High	**Moderate**
Low	Consumption of homegrown produce	High	End Users	High	**Moderate**
Low	Inhalation of soil-borne dust	Low	Adjacent Land	Very Low	**Low**
Low	Plant uptake, phytotoxic effects	Low	Planting	Low	**Low**
Low	Chemical attack	Low	Concrete	Unlikely	**Unlikely**
Low	Chemical attack	Low	Pipework	Low	**Low**
Low	Leaching-out, migration to water table	Very Low	Groundwater	Very Low	**Very low**
Low	Leaching-out, migration to water bodies	Low	Surface Water	Low	**Low**

Ground water	Pathways	Rating	Receptor	Rating	Overall Rating
Low	Direct contact	Unlikely	End Users	High	**Unlikely**
Low	Direct contact	Unlikely	Adjacent Land	Very Low	**Unlikely**
Low	Plant uptake, phytotoxic effects	Very Low	Planting	Low	**Low**
Low	Chemical attack	Very Low	Concrete	Unlikely	**Unlikely**
Low	Chemical attack	Very Low	Pipework	Low	**Low**
Low	Migration to Controlled Water receptor	Unlikely	Groundwater	Very Low	**Unlikely**
Low	Lateral migration to water bodies	Very Low	Surface Water	Low	**Low**

Vapours	Pathways	Rating	Receptor	Rating	Overall Rating
Very low	Inhalation, ignition	Very Low	End Users	High	**Low**
Very low	Inhalation, ignition	Unlikely	Adjacent Land	Very Low	**Unlikely**
Very low	Root asphyxiation, phytotoxic effects	Very Low	Planting	Low	**Very low**
Very low	Not a significant hazard	-	Concrete	Unlikely	**Unlikely**
Very low	Chemical attack	Very Low	Pipework	Low	**Very low**
Very low	Not a significant hazard	-	Groundwater	Very Low	**Unlikely**
Very low	Not a significant hazard	-	Surface Water	Low	**Unlikely**

Ground Gasses	Pathways	Rating	Receptor	Rating	Overall Rating
Unlikely	Inhalation, ignition	Very Low	End Users	High	**Unlikely**
Unlikely	Inhalation, ignition	Unlikely	Adjacent Land	Very Low	**Unlikely**
Unlikely	Root asphyxiation, phytotoxic effects	Very Low	Planting	Low	**Unlikely**
Unlikely	Not a significant hazard	-	Concrete	Unlikely	**Unlikely**
Unlikely	Not a significant hazard	-	Pipework	Low	**Unlikely**
Unlikely	Not a significant hazard	-	Groundwater	Very Low	**Unlikely**
Unlikely	Not a significant hazard	-	Surface Water	Low	**Unlikely**

4.7 Other Factors

The following other areas of possible concern were identified, but were outside the geo-environmental risk assessment:

Site workers	Site managers are responsible for the safety of persons in their employ under a variety of instruments including the CDM regulations and Health & Safety at Work Act. In terms of working on contaminated sites, guidance can be sought from the CIRIA publication entitled "A Guide for Safe Working on Contaminated Sites". Any work in confined spaces confined spaces should only be carried out following appropriate risk assessment. Detailed risk assessment for workers is outside the scope of this report.
Bird droppings (guano)	Dry bird droppings such as those from pigeons, if disturbed, can become a hazardous airborne dust that can cause a severe respiratory illness. Exposure to bird droppings and nesting materials under ideal conditions can result in a number of diseases including histoplasmosis, Newcastle disease, cryptococcosis, pseudotuberculosis and other avian transmitted diseases. If work is to be carried out in an area where pigeons have been nesting or congregating, the area must be thoroughly decontaminated.

5.0 CONCLUSIONS

5.1 Summary

Overall, the Preliminary Risk Assessment identified the following:

- Potential soil contamination from the presence of Made Ground, the previous storage tank on site, and agricultural land uses surrounding the site.
- Potential contamination of groundwater from the presence of Made Ground, the previous storage tank on site, and agricultural land uses surrounding the site.
- Potential vapour contamination from the previous storage tank on site, and agricultural land uses surrounding the site.

The Preliminary Risk Assessment did not identify any sources of ground gas contamination.

The findings of the Preliminary Risk Assessment identified potential risks to End Users, Adjacent Land Users, Soft Landscaping, Building Materials and Controlled Waters.

A site investigation will be required in due course to assess the risks and the extent of the remediation required; this is detailed in section 5.3.

5.2 Remediation Requirements

Given the reasonable best-case scenario, no remediation will be required.

The reasonable worst-case scenario will include some, or all, of the following:

- Provision of up to 600mm clean capping in the proposed garden areas.
- Removal of soils containing TPHs at the tank location.
- Provision of a VOC membrane into the floor slab of the proposed dwelling.
- Protection of the water supply in the form of aluminium barrier pipework.

At this stage it is unlikely that any direct groundwater remediation will be required.

None of the above are unreasonable or prohibitive and the site can be readily and safely developed for residential use.

5.3 Recommendations for Phase II Site Investigation

It would be necessary in due course to undertake basic ground investigation works, which may include:

- Shallow trial pits, to assess the composition and depth of any Made Ground and any field evidence of contamination into the underlying soils.
- Selected samples (including materials bearing field evidence of contamination) should be sent for laboratory analysis. The main analytical suite is identified below.

- A number of boreholes should be extended down into the water table and to the base of the aquifer to install standpipes and in turn enable groundwater quality to be sampled and tested for a similar analytical suite.
- Soil samples should be screened for vapours using a Photoionisation Detector (PID).
- Positions should be located in areas of concern. For example, targeted to specific points of potential contamination such as tanks, and in receptor sensitive locations such as in proposed garden areas and below the footprint dwellings.

The analytical suite, based on the known site history and walkover survey, should include:

- General parameters: Acidity (pH), fraction of organic carbon.
- A selection of shallow samples should be screened for pesticides and herbicides.
- Metals: Arsenic, Cadmium, Chromium (total), Lead, Mercury, Selenium, Boron, Copper, Nickel and Zinc.
- Non-metals: water soluble Sulphate, Sulphide, total Cyanide
- Organic compounds: Speciated PAHs.
- Optional organic compounds: TPH, BTEX, VOCs and SVOCs, where positive PID readings are detected.
- Visual asbestos screening of all Made Ground samples. Where possible asbestos fibres or ACMs are identified, these should be examined under a microscope to determine type.

Further positions may be required, additional samples analysed or additional determinands added to the analysis, as appropriate, based on any field evidence of possible contamination encountered.

In addition, the requirement for Waste Acceptance Criteria (WAC) testing should be considered to categorise soils in terms of disposal.

It would be prudent to confirm the scope of ground investigation works with the Local Authority and other stakeholders before carrying out these works.

REPORT CONDITIONS

The Client

This report may also be used only by the client named in section 1 and their appointed project team for the purpose of design, obtaining planning, building regulations approval, and in connection with finance. This report must not be used by any other persons or for other purposes without express written agreement of Land Science.

General

Land Science takes all reasonable professional care in preparation of this report, using current standards and industry practice. However, the evaluation of ground conditions depends on an interpretation and extrapolation of the conditions revealed by a limited data set. The level of risk is related to the extent of investigation and no site is ever free of risk. The client should understand their risks and liabilities. We accept no liability whatsoever in respect of:

- The scope, extent or design of an investigation.
- Any conditions not directly revealed by the investigation.
- Published standards or methodologies used or adopted in this report.
- The opinion of any other party including any regulator, authority or stakeholder.
- Any dispute, claim or consequential loss arising from any findings of this report.
- Third party information and data.

This report relates solely to ground-related matters as set out in the objectives and makes no representation on other matters such as ecology, arboriculture, invasive plant species, the condition of buildings and structures, hazardous building materials such as insulation or asbestos, the locations of boundaries, unexploded ordnance, and or planning constraints etc. Further reports should be commissioned in this respect as appropriate.

Regulators and Approvals

This (and any other) report should be submitted to relevant authorities for their own assessments and to provide their approval or comments accordingly. This should be in good time before commencing on site in case additional work is to be carried out.

Standards, technical guidance and regulatory positions change over time and which may therefore affect the findings and recommendations made in this report; this should be verified by the client prior to any critical project milestones. Where this information is used in design, the designer should verify that the information is appropriate and has been used correctly.

Variations with time

The report relates to conditions revealed at the time of the investigation and any monitoring visits. Some parameters may vary over time or seasonally; groundwater levels, ground gas compositions, or concentrations of contaminants are particularly variable in this respect. Further monitoring or verification should be considered as appropriate.

GLOSSARY OF TERMS

ACM	Asbestos Containing Material
BGS	British Geological Survey
BRE	Building Research Establishment
BS	British Standard
C4SL	Category 4 Screening Level
CBR	California Bearing Ratio
CDM	Construction Design and Management regulations
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
CLEA	Contaminated Land Exposure Assessment model
CSM	Conceptual Site Model
EA	Environment Agency
EQS	Environmental Quality Standards
FOC	Fraction of Organic Carbon
GAC	Generic Assessment Criterion
GQRA	Generic Quantitative Risk Assessment
mbgl	Meters Below Ground Level
NHBC	National House Building Council
mOD	Metres above Ordnance Datum
PAH's	Polycyclic Aromatic Hydrocarbons
PHE	Public Health England
PID	Photo-Ionisation Detector
PQRA	Preliminary Quantitative Risk Assessment
PSD	Particle Size Distribution Test
RMS	Remediation Method Statement
S4UL	Suitable for Use Level
SOM	Soil Organic Matter
SPZ	Source Protection Zone
SPT	Standard Penetration Test
SSSI	Sites of Special Scientific Interest
ST-WEL	Short Term Workplace Exposure Limit
SVOC's	Semi-Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
TRRL / TRL	Transport Road Research Laboratory
TWA-WEL	Time Weighted Average Workplace Exposure Limit
UK HBF	United Kingdom House Building Federation
VOC's	Volatile Organic Compounds
WAC	Waste Acceptance Criteria