

# Contaminated Land Risk Assessment

The Old Pump House, Wakefield Road, Lepton

**Reference** : 20032-R-002-V02

**Date** : 13 April 2021

**SOIL AND  
STRUCTURES**

# Contaminated Land Risk Assessment

The Old Pump House, Wakefield Road, Lepton

**SOIL <sup>AND</sup>  
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## Report Status

|                       |       |
|-----------------------|-------|
| <b>Project Number</b> | 20032 |
| <b>Report Number</b>  | 002   |

|                 |                                     |
|-----------------|-------------------------------------|
| <b>Revision</b> | V01 – Issue for planning submission |
|                 | V02 – Updated development plan      |

|                    |                     |
|--------------------|---------------------|
| <b>Date Issued</b> | 11 March 2021 (V01) |
|                    | 13 April 2021 (V02) |

## Report Author and Authoriser

| <b>Author</b>                                                    | <b>Signature</b>        |
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| <b>Authorised</b>                                                | <b>Signature</b>                 |
|------------------------------------------------------------------|----------------------------------|
| Russell Bowman<br>Director<br>BSc (Hons) MSc CEng CWEM<br>MCIWEM | <i>Redacted</i><br>13 April 2021 |

## Executive Summary

In conclusion, the Contaminated Land Risk Assessment finds that;

- > Residual risks are identified in relation to the proposed development for which further assessment and/or mitigation is recommended.

Recommended follow-on work includes:

1. **Review of risk register (contaminated land)** presented in this report;
2. **Submission of the Contaminated Land Risk Assessment** to the local planning authority and the project design team;
3. **Ground investigation** to; (a) develop the ground model for the Site, (b) inform the engineering design, (c) investigate the condition of soils and, and (d) geotechnical classification and environmental screening of the various materials originating from the ground to confirm suitability for retention/re-use and, where necessary, waste classification.
4. **Mitigation** works may be required as part of the development works. These may include, but not be limited to, segregation of possible Made Ground soils from topsoil and possible requirement for basic clean capping to soft landscaping areas (if and where residual Made Ground is present and found to be 'unsuitable' for use within soft landscaping areas).

The provision of basic ground gas protection measures is recommended on a precautionary basis within the Coal Mining Risk Assessment (presented under separate cover).

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## Appointment

Soil and Structures Ltd were instructed by Stone Developments Ltd on behalf of Kingscrown Developments Ltd (the Client) in February 2021 to prepare a Contaminated Land Risk Assessment (this Report) for a parcel of land off Wakefield Road, Lepton (the Site). The Report has been commissioned in support of a residential development.

## Scope and Context

The Contaminated Land Risk Assessment offers advice in relation to contaminated land hazards specifically. The Report includes an assessment of the potential risk these hazards may present to the proposed development.

The legal context of this advice relates to an assessment of:

- i) **Potential contaminated land hazards that may affect the development** that is governed by health and safety law (various acts and regulations); and,
- ii) **The suitability of the Site for its proposed end use** that is rooted within national planning policy guidance (the National Planning Policy Framework) that is governed by planning law (various acts). The assessment of 'suitability' relates specifically to the hazards of contamination, pollution and ground gases.

For further information on the context and scope please refer to the Annex.

## References

The Contaminated Land Risk Assessment has been written with reference to various sources of information. These are either appended or listed within Section 5.0 and referenced directly throughout this report in brackets, e.g. **(R1)**.

# Contaminated Land Risk Assessment

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## SOIL AND STRUCTURES

### 1.0 Introduction

#### 1.1 The Site

**Location and size:** The Site comprises an irregular shaped parcel of land approximately 0.05 Ha in size located at the end of an access driveway off Wakefield Road (A642), Huddersfield (Figure 1).

**Access:** The Site is accessed on foot or by car off Wakefield Road (A642).

**Topography:** The surface topography of the Site rises gently from the west to east from circa 185 to 190 mAOD (topographical survey appended) with a pronounced gulley or small valley on the western edge of the Site that drops-off towards the north-west. Locally to the site the topography continues this trend rising from the west to east with the onsite valley feature part of a larger drainage feature that originates around 300 m south-east of the Site and continues in the north-westerly aligned direction through the Site.

**Existing structures:** The Site is occupied by a cattery with various other associated structures present across the Site as illustrated in Figure 1.

**Existing reports:** A Coal Mining Risk Assessment (Soil and Structures Ltd document ref. 20032-R-001-V02) has been prepared by for the Site and the proposed development and is presented under separate cover.



**Figure 1:** Site location plan

- > Extract from 'Areas Plan' (copy appended)
- > Site approximately centred on NGR 421018 415345

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### 1.2 The Development

Development proposals include for the demolition of the existing structures followed by the construction of two detached dwellings (Figure 2).

**An appreciation of the construction processes is essential for development-focused risk assessments given the groundworks stand to significantly alter the risk rating, e.g. mine shafts being encroached upon.**

To enable this development, the following groundworks are likely to be required, N.B. listing is outline only and not exhaustive.

- > **Demolition:** Removal of existing structures and associated infrastructure.
- > **Preparation:** Site clearance across the proposed development area.
- > **Utility Excavations:** Excavation of any drainage and other utility alignments.
- > **Foundations:** Construction of sub-structures (foundations) followed by super-structures.
- > **Surfacing:** Formation of hard and soft-landscaping areas.

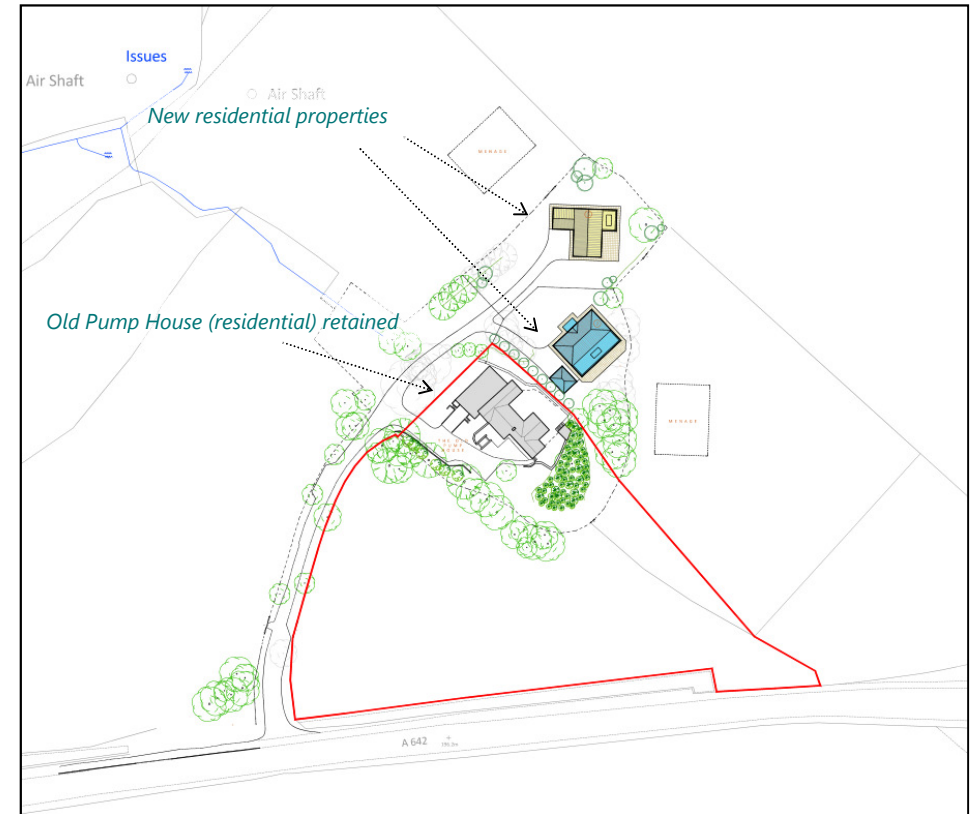


**Figure 2:** Development plan extract

> Extract from 'Site Plan as Proposed' (copy appended)

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### 2.0 Site Characterisation

#### 2.1 History

The Site has been subject to a three recorded uses since 1850s (the date of the earliest available ordnance survey mapping available from various online sources):

- > **The first phase:** occurred between the 1850s until the 1900s when the Site was in use as open fields. A 'well' was recorded at the head of the small valley feature. A number of mine entries 'air shafts' are recorded at least 75 m north-west of the Site.

Potential sources of harmful material: Through this phase of use no sources of potentially harmful material are identified on Site.

- > **The second phase:** occurred between the 1900s until around the 1960s when the Site was in use as a pumping station (Flockton & Whitley Upper U. D. Councils Water Works) where a 'tank' was recorded on Site.

Potential sources of harmful material: The 'tank' recorded on Site is considered likely to be a balancing tank for water supply with the pump itself likely powered by a coal fired steam engine given its age. Through this phase of use the engines would have generated a continuous (whilst in operation) supply of ash deposits. Ash was commonly used as a building material and therefore may have been exported off Site however, the local abundance at the time (from various industries using coal), may have resulted in the ash being deposited on Site.

If deposited on Site, the ash will likely contain elevated concentrations of toxic inorganic compounds, e.g. arsenic and lead based compounds as well

as polycyclic aromatic hydrocarbons (PAHs; with varying toxicity profiles) resulting from incomplete combustion.

- > **The third phase:** occurred between the 1960s and the present day when the Site was in use as a cattery (Figure 1).

Potential sources of harmful material: Through this phase of use no specific sources of potentially harmful material are identified on Site.

The surrounding area is characterised by historical land uses consistent with agricultural land use within the coalfield region of the industrialised north of England. Locally to the Site, the villages of Lepton (west) and Grange Moor (east) are present with a history of coal mining, small industrial works and agriculture.

#### 2.2 Geology

Exploratory hole records are not available for the Site or local area. Available geological records indicating a lack of superficial deposits with weathered bedrock likely at shallow depths below the surface. Three main materials are therefore expected on Site:

**Topsoil** deposits in undeveloped areas of the Site.

**Made Ground** deposits likely isolated in nature and comprising either discarded building materials or ash from the former pump house.

**Bedrock** deposits across the entire Site are Pennine Lower Coal Measures characterised by '*sandstone interbedded with mudstone and siltstone with subordinate seatearth, ironstone, marine bands and coal*'. Locally to the Site these are recorded dipping at a very shallow angle (~3 degrees) in a generalised north-easterly to easterly direction.

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### 2.2 Hydrogeology & Hydrology

A water catchment is divided into two main ground-based elements; its hydrogeology (groundwater) and hydrology (surface water). The hydrogeological regime is primarily governed by the geology and the hydrological regime by the topography and surface cover. For any given site, these regimes are likely to be influenced by both on-site and off-site factors, i.e. site hydrogeology being controlled by regional (off-site) hydrogeology.

The Site's hydrogeological regime is influenced by the presence of generally low permeability superficial soils that will likely be transporting and storing limited volumes of water. Given these soils are expected to be both laterally and vertically variable, the permeability of the soils are also expected to be low / poor overall but variable with relatively high rates in sand and gravel pockets / lenses. A well is recorded on Site that is understood to be unfilled (accessible).

The Site's hydrological regime is influenced by the general north-westerly fall in topography resulting in a tendency for either surface water run-off or shallow surface infiltration to migrate this direction (towards the valley/watercourse).

### 2.3 Environmental Setting

The environmental setting relates to land designations either on-site or within the surrounding area that have the potential to influence or present a risk to the proposed development.

Landfills (historic and active) are not recorded within 250 m of the Site, the distance across which viable pathways for gas migration are more likely to be viable. **(R6)**

Historic in-filled land, e.g. ponds and quarries is not evidenced on available historical mapping within 250 m of Site. One 'well' is recorded on Site and two others within 100 m of the Site to the south-east.

Historic industrial sites are not recorded within 100 m of the Site.

Protected areas, e.g. Green Belt are associated with the Site which falls within the Green Belt. **(R7)**

Radon is emitted from naturally sources within a range of geologies. The Public Health England data indicates there is a 1-3 % chance the Site is that the Site is above the Action Level of 200 Bq m<sup>-3</sup>. This translates to overall low potential of the Site being affected by radon that would not trigger the specific requirement for radon protection to be incorporated within the proposed developments. **(R8)**

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## 3.0 Hazard Screen and Preliminary Risk Assessment

The **Hazard Screen (Table 1 and 2)** is first stage of risk management; establishing whether a hazard exists (that could present a risk). For the Contaminated Land Risk Assessment these relate to historical hazards, further detail on which is presented in the enclosed Annex.

**Preliminary Risk Assessment (Table 3)** is the second stage of risk management; establishing if the risk presented by the identified hazard is acceptable or not and, if not, what action is required to either further assess or reduce this risk. This assessment adopts the risk ratings and classifications of CIRIA C552 (**R5**). Referencing 'background threat' (Annex) as part of the process is intended to support transparency; offering further detail on the hazards as well as an indication of the relative threats they pose in the UK.

Figure 3 illustrates the sequential stages of risk management, a process modelled on that outlined within Land Contamination Risk Management (**R1**).

**Lines of evidence** are used across both stages to inform the assessment. These lines of evidence relate to both the Site itself, the inherent hazards in the ground, and also the proposed development. For example, chemically unsuitable material may be present on a Site but if hardstanding is proposed across the area this material is present then, whilst a hazard, the risk is likely low.

**Unexpected encounters** can arise even where lines of evidence indicate a hazard is not present. Where recommended, intrusive investigation should reduce the likelihood of such occurrences but the appointed Contractor is advised to have in place response plans. Outline advice on these is given in the following tables.

The following tables are intended to serve as a **risk register (contaminated land)** and to inform Construction Phase Plans for follow-on works.

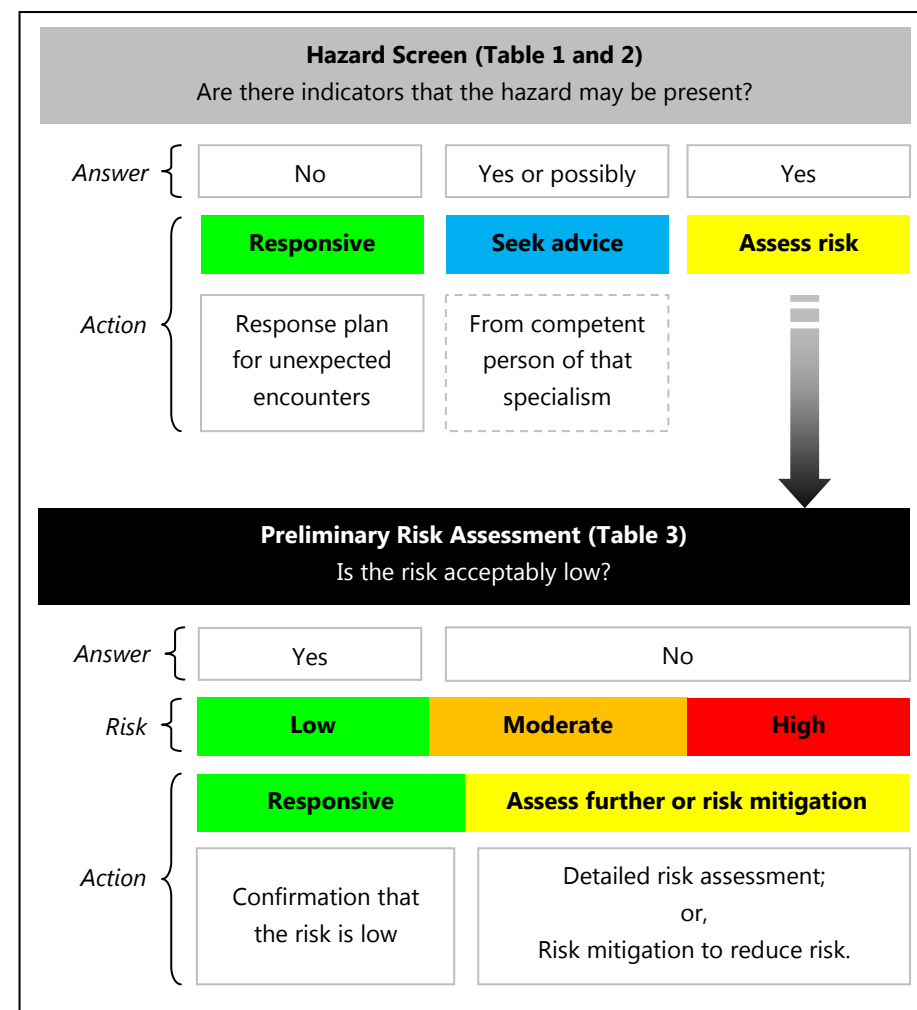


**Figure 3:** Decision making flowchart for risk management

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**Table 1: Hazard Screen**

|                           | Indicators? | Commentary                                                                                              | Action        |
|---------------------------|-------------|---------------------------------------------------------------------------------------------------------|---------------|
| <b>Historical Hazards</b> |             |                                                                                                         |               |
| Contamination (on-site)   | Yes         | Evidence of potentially contaminative former uses on Site.                                              | > Assess risk |
| Contamination (off-site)  | No          | Potentially contaminative land uses not evidenced locally with a potential (proximity) to impact Site.  | > Responsive  |
| Pollution (waters)        | No          | No specific sources of potential groundwater pollution recorded on Site.                                | > Responsive  |
| Ground gas (non-mining)   | No          | No landfills (historic or active) recorded within 250 m of Site.                                        | > Responsive  |
| Mining (incl. mine gas)   | Yes         | Refer to <i>Coal Mining Risk Assessment</i> presented under separate cover (ref. 20032-R-001-V01)       | > Assess risk |
| Sub-surface structures    | No          | No tunnels expected on Site however a 'well' is recorded on Site.                                       | > Responsive  |
| Unexploded ordnance       | No          | No evidence of military land use or evidence of historical bombing, e.g. ruins, on or adjacent to Site. | > Responsive  |
| Radon                     | No          | The Site lies within an area with between 1-3% chance of being above the radon Action Level.            | > Responsive  |

**Table 2: Hazard Screen - Action Summary**

|                           | Action      | Outline detail of action N.B. responsibility will rest with the Contractor for the implementation of any responsive action        |
|---------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <b>Historical Hazards</b> |             |                                                                                                                                   |
| Contamination (on-site)   | Assess risk | Refer to Table 3                                                                                                                  |
| Contamination (off-site)  | Responsive  | Notify Engineer if any evidence of <b>gross-contamination</b> is observed in the ground or on any groundwater encountered.        |
| Pollution (waters)        | Responsive  | Notify Engineer if any evidence of <b>gross-contamination</b> is observed in the ground or on any groundwater encountered.        |
| Ground gas (non-mining)   | Responsive  | Notify Engineer if any evidence of <b>bubbling groundwater or odour</b> is noted in the ground or on any groundwater encountered. |
| Mining (incl. mine gas)   | Assess risk | Refer to <b>Coal Mining Risk Assessment</b> presented under separate cover (ref. 20032-R-001-V01)                                 |
| Sub-surface structures    | Responsive  | Notify Engineer if any <b>sub-surface structures</b> are encountered in the ground.                                               |
| Unexploded ordnance       | Responsive  | Notify Engineer if any <b>unexpected metal or glass bottled objects</b> are encountered in the ground.                            |
| Radon                     | Responsive  | The requirement for radon protection within the proposed properties would not be triggered at this level.                         |

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**Table 3:** Preliminary Risk Assessment, continued

| Background Threat       |                 | Consequence                                                                                                                                                                                                                                                       | Likelihood                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Risk                         | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Historical Risks</b> |                 |                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Contamination (on site) | <b>Moderate</b> | <p><b>Medium</b><br/>Chronic (long term) health effects of harmful material ('source') on residents and visitors</p> <p>&gt; ('receptors') from long or short term exposure respectively via various 'pathways' e.g. direct contact, ingestion or inhalation.</p> | <p><b>Low</b></p> <p>Based on available lines of evidence including; the former use the Site as a pumping station, the potential for harmful material, e.g. coal ash, to be present beneath proposed soft landscaping areas is considered a <b>low likelihood</b>. The potential for more recently placed harmful material to be present across the general Site area is considered <b>unlikely</b>.</p> <p>Contaminants of concern include: asbestos containing material (ACM) and asbestos containing soils (ACSs); and, coal ash. The former arising from out-buildings and the latter potentially arising from historic use of the Site as a pumping station (water).</p> <p>If and where potentially harmful is present within the Site's shallow soils there exists the potential for this material (the 'source') to present a risk to human health (the 'receptor') via various possible 'pathways' detailed in the following section of this table.</p> <p>It is also noted that following site clearance, a shallow surface scrape may reveal/remove most of the potentially harmful material and that overall, the Site is not considered to represent a major source of potential contamination.</p> <p>Particular attention should be given to the segregation of topsoil from any other materials present in the ground as the topsoil is likely to be a suitable for re-use (subject to confirmatory testing).</p> | <b>Low to Moderate / Low</b> | <p><b>Further assessment</b></p> <p>Adequate investigation and testing of Made Ground materials encountered with specific attention given to soft landscaping areas and former building positions.</p> <p><b>Mitigation</b> Suitable management of potentially harmful material encountered during groundworks (including ground investigation).</p> <p>Whilst considered unlikely, if and where residual Made Ground deposits are present in soft landscaping areas and deemed 'unsuitable', there would be a requirement for a clean capping.</p> |

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**Table 3:** Preliminary Risk Assessment, continued

| Background Threat                  |          | Consequence        | Likelihood                                         |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Risk | Action                                                               |
|------------------------------------|----------|--------------------|----------------------------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------|
| Historical Risks                   |          |                    |                                                    |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |
| Contamination (on site), continued | Moderate | Medium<br>As above | Potential Pollutant Linkages (PPL)                 |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Low  | Further assessment<br><br>As above<br><br>Mitigation<br><br>As above |
|                                    |          |                    | Source                                             | Pathway              | Likelihood of PPL being completed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                                                                      |
|                                    |          |                    | Made Ground (general)                              | Inhalation (fibres)  | Private gardens are planned within the development for which all potential pathways apply, e.g. residents may track-back soil dust from gardens to indoor spaces or ingest soil residue on home-grown produce.<br><br>At this stage, it is considered unlikely that the quality of soils across proposed soft landscaping will result in harm via the various pathways listed, i.e. the existing shallow soil quality is anticipated to meet quality criteria for 'residential with home-grown produce'.<br><br>The potential for off-site receptors to be impacted is considered unlikely. |      |                                                                      |
|                                    |          |                    |                                                    | Inhalation (dust)    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |
|                                    |          |                    |                                                    | Inhalation (vapours) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |
|                                    |          |                    |                                                    | Ingestion            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |
|                                    |          |                    |                                                    | Dermal contact       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |
|                                    |          |                    |                                                    | Track-back dust      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |
|                                    |          |                    | Made Ground (former coal ash from pumping station) | Inhalation (fibres)  | The former pumping station is considered likely to have employed coal fired engines that would have generated ash as a by-product. There is also the potential for localised oils/grease to be present but overall these are considered to present very limited potential sources of contamination.<br><br>At this stage, it is considered a low likelihood that the quality of soils across proposed soft landscaping will result in harm via the various pathways listed.                                                                                                                 |      |                                                                      |
|                                    |          |                    |                                                    | Inhalation (dust)    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |
|                                    |          |                    |                                                    | Inhalation (vapours) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |
|                                    |          |                    |                                                    | Ingestion            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |
| Dermal contact                     |          |                    |                                                    |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |
| Track-back dust                    |          |                    |                                                    |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                      |

# Contaminated Land Risk Assessment

The Old Pump House, Wakefield Road, Lepton

## 3.0 Conclusion and Recommendations

Based on the available information the Site is considered to be generally well-characterised (within the scope of this reporting).

Ground Investigation is recommended to help remove uncertainty in the ground and address specific objectives detailed hereafter.

In conclusion, the Desk Study finds that;

- > Residual risks (Table 3) are identified in relation to the proposed development for which further assessment and/or mitigation is recommended.
- > Basic risk mitigation / remediation may be required in the form of clean capping to soft landscaping areas (if and where any unsuitable Made Ground is present) or localised removal of unsuitable material.  
  
Segregation of any Made Ground deposits from potentially re-usable topsoil deposits should be a central objective of any earthworks.
- > For soft landscaping imported clean soils are unlikely to be required due to likely presence of suitable soils on Site (topsoil). Confirmation testing in line with local guidance is recommended to confirm topsoil suitability.

Recommended follow-on work includes:

1. [Review of risk register \(contaminated land\)](#) presented in this report;
2. [Cross-referencing](#) the recommendations made within the Coal Mining Risk Assessment;
3. [Submission of the Contaminated Land Risk Assessment](#) to the local planning authority and the project design team;

4. [Ground investigation](#) to; (a) develop the ground model for the Site, (b) inform the engineering design, (c) investigate the condition of soils and, and (d) geotechnical classification and environmental screening of the various materials originating from the ground to confirm suitability for retention/re-use and, where necessary, waste classification.
5. [Mitigation](#) works may be required as part of the development works. In outline these will likely include, but not be limited to, segregation of possible Made Ground soils from topsoil and possible requirement for basic clean capping to soft landscaping areas.  
  
The provision of basic ground gas protection measures is recommended on a precautionary basis within the Coal Mining Risk Assessment (presented under separate cover).

### 3.1 Outline Scope of Works for Ground Investigation

A ground investigation is recommended for various reasons detailed in Section 4.0 (Bullet Point 3).

[When to investigate](#): Given the current density of structures present across the Site (Figure 1) it is recommended that the ground investigation is conducted either at the end of or after the demolition works.

The practicalities and cost of conducting the investigation at the end of the demolition works may be favourable with the availability of plant and the ability to assess the Site condition more readily through inspection of demolition works and any reduced level surfaces.

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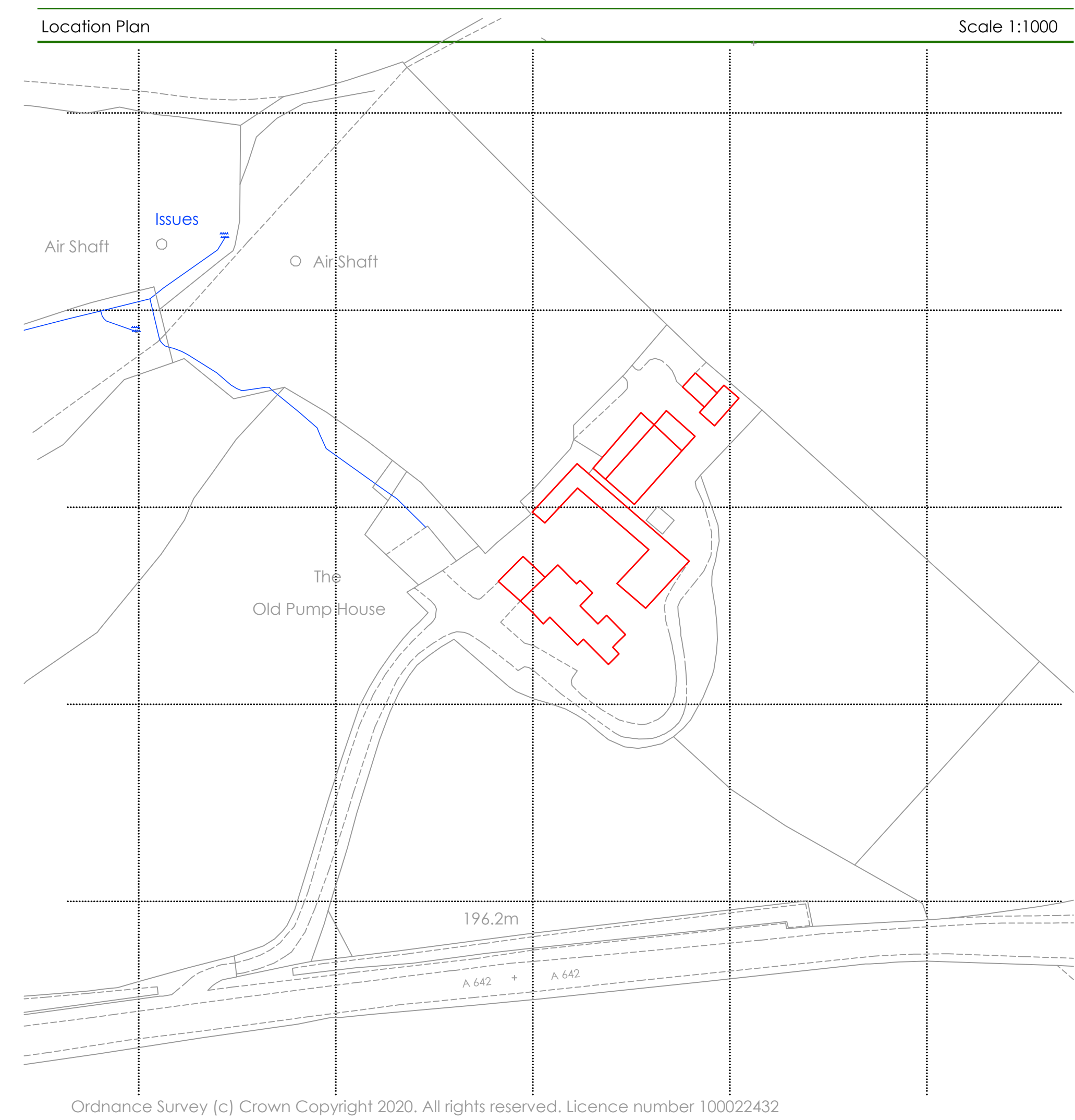
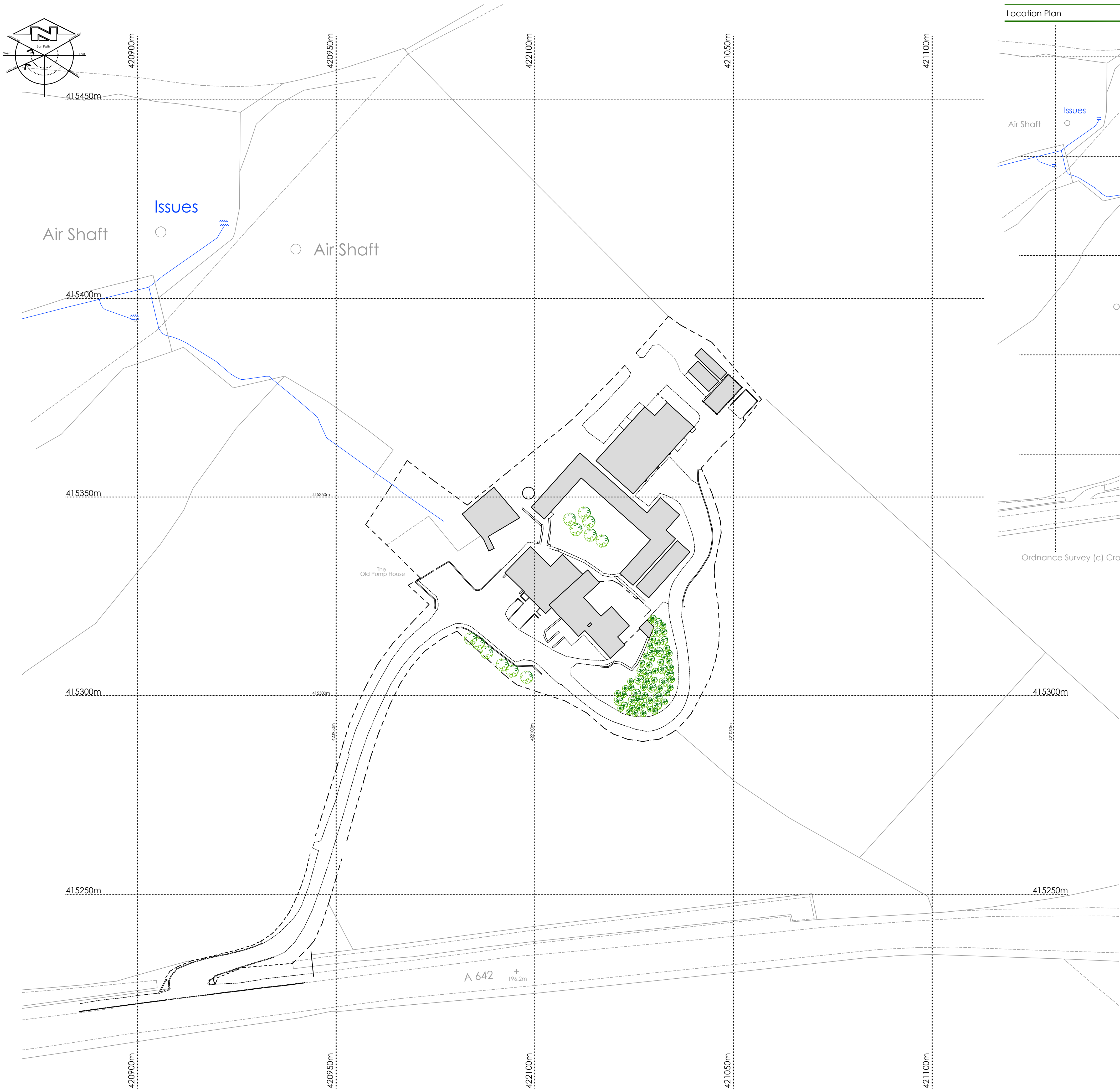
**What scope of works:** The final design or scope of works for the ground investigation should be confirmed with the project engineer(s) however should be in general accordance with relevant standards and codes of practice (**R2** and **R3**). The ground investigation is likely to include, but not be limited to:

- Machine excavated trial pits for: ground profiling; in-situ testing, e.g. infiltration; soil logging; and, sample recovery;
- Geotechnical sampling and testing of soils and rocks within which sub-structures may be formed; and,
- Environmental sampling and testing of potentially harmful soils or rocks where visually or olfactory evidence of harmful material is noted, e.g. ashy or stained soils. The testing suite will be subject to the material encountered but is likely to include a broad suite of inorganic and organic chemical species with reference to the potential 'sources' detailed in Section 2.1 and Table 3.

Based on the recorded geology (Section 2.2) the use of boreholes for deeper soil and rock profiling may not be necessary but should be subject to the engineer's discretion as well as in response to any revealed ground conditions.

### 4.0 References

- R1:** Environment Agency Land Contamination Risk Management (LCRM) (2020)
- R2:** Investigation of potentially contaminated sites. Code of practice. BS10175:2011+A2 (2017)
- R3:** Code of practice for site investigations. BS 5930 (2015)
- R4:** Environment Protection Act 1990: Part 2A (2012)
- R5:** C552 Contaminated land risk assessment - a guide to good practice (2001)
- R6:** Environment Agency data publisher  
<https://ckan.publishing.service.gov.uk/publisher/environment-agency> (accessed 08 March 2021)
- R7:** MAGIC maps <https://magic.defra.gov.uk/MagicMap.aspx> (accessed 08 March 2021).
- R8:** BRE Special Digest 1 (2005) Concrete in aggressive ground. 3rd edition.
- R9:** PHE Radon Mapping <https://www.ukradon.org/information/ukmaps> (accessed 08 March 2021).
- Opensource historical mapping archives have been reviewed to establish the Site's historical phases of use.



Building areas calculated using OS data - No surveying/measuring involved

| Rev   | Description                 |          |      | By   | Date     |
|-------|-----------------------------|----------|------|------|----------|
| A     | Topographical Survey        |          |      | HSL  | 21.11.20 |
| B     | Survey extended to entrance |          |      | HSL  | 11.12.20 |
| Surv. | Drawn                       | Date     | Chkd | Date |          |
| NH    | NH                          | 25.07.20 |      |      |          |

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Topographical Building & Site Surveys - CAD Services

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Title. Areas Plan  
Site. The Old Pump House  
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Huddersfield  
HD8 0LY

COMPUTER GENERATED DRAWING - DO NOT ALTER

Dwg No. Stone\_04\_Lepton

Sheet No. 1

| SCALE | 1/500 | REV. | B |
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Revisions



Client

Stone Developments (UK) Ltd

Project

The Old Pump House,  
Wakefield Road, Lepton  
HUDDERSFIELD, HD8 0LY

Drawing title

Site Plan as Proposed

CONCEPT DRAWING

Scale @ A1

1:500

Date

March '21

Drawing no

21-1142/(SK)01

Drawn by

CG

App'd

-

Rev

-

## Context and Scope of the Contaminated Land Risk Assessment

## Context

The purpose of site investigation is to reduce uncertainty in the ground.

For all site investigations the [legal imperative for reducing uncertainty](#) is primarily governed by health and safety law; identifying hazards and, where present, limiting their potential for harm. In addition, the reduction of uncertainty also applies to: various environmental laws (relating to the prevention of pollution and harm); as well as, the commercial risk of potential abnormal groundwork costs.

Current [UK planning policy](#), the National Planning Policy Framework (NPPF)<sup>1</sup>, makes reference to the need to ensure that *'a site is suitable for its proposed use taking into account of ground conditions and any risks arising from land instability and contamination'* (Paragraph 178). The NPPF also makes reference to the need to adopt Mineral Safeguarding Areas (Paragraph 204).

In practice, this policy is implemented through planning conditions. Where applied, these conditions compel the developer to demonstrate the site is ['suitable for its proposed use'](#) with respect to contamination and, in former mining areas, with respect to stability. Within Mineral Safeguarding Areas, planning conditions may also compel the developer to evaluate the viability of prior-extraction of a mineral before a development 'sterilises' the ground.

Warranty providers may also impose conditions on the development.

The assessment of other ground-related hazards, e.g. slope stability or collapsible soils, is typically not conditioned (unless a specific hazard locally) but rather an inherent part of the engineering design.

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<sup>1</sup> [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/810197/NPPF\\_Feb\\_2019\\_revised.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf)

## Scope

The first stage of 'site investigation' is invariably a desk-based exercise, commonly referred to as the Desk Study. Given the planning imperative is contaminated land focused; this desk-based reporting can be focused on contaminated land related hazards; the Contaminated Land Risk Assessment. With this approach being specific to contaminated land hazards, it is naturally a shorter document compared to a full Desk Study (all hazards).

The [assessment of risk](#) is guided by a series of international standards including ISO 31000:2018<sup>2</sup> 'Risk Management – Guidelines'. The Contaminated Land Risk Assessment is developed with reference to this guidance and other additional UK and sector-specific guidance that includes; the Construction (Design and Management) Regulations (2015)<sup>3</sup> and, the Environment Agency's 'Land Contamination Risk Management (LCRM)'<sup>4</sup>.

The [value of a Contaminated Land Risk Assessment](#) is in the early identification and assessment of contaminated land related hazards in the ground, the relation of these hazards to the proposed development and commentary on the likely risks these hazards may pose as well as potential risk mitigation options.

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<sup>2</sup> <https://www.iso.org/iso-31000-risk-management.html>

<sup>3</sup> <http://www.hse.gov.uk/construction/cdm/2015/index.htm>

<sup>4</sup> <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

## Annex

### Context and Scope of the Contaminated Land Risk Assessment

## SOIL AND STRUCTURES

Whilst factual advice is offered with respect to the following areas the following exclusions apply to the Contaminated Land Risk Assessment:

- > The **flood risk setting of the Site**, this Report does not constitute a flood risk assessment and the advice of a suitably qualified civil engineer or flood risk assessor should be sought to confirm the risk rating and requirement, if any, for mitigation.
- > The **condition of the existing structure** and associated infrastructure, e.g. utilities, to inform risk assessments, this Report does not constitute a building or structural survey. The advice of a RICS qualified surveyor or suitably qualified structural engineer should be sought if and where a survey or change in loading, e.g. new fixed plant, is required.
- > The **possible presence of non-native invasive species** and **protected species**, this Report does not constitute an ecological survey. The advice of a suitably qualified ecologist should be sought if and where a survey is required.
- > The **possible presence of archaeological features**, this report does not constitute an archaeological survey. The advice of a suitably qualified archaeologist should be sought if and where a survey is required.

Risk is rated with respect to the routine detailed within *CIRIA C552 – Contaminated Land Risk Assessment; a guide to good practice (2001)*.

The following tables are adapted from CIRIA C552 and serve as the routine by which risk is assessed within the Report and the corresponding definitions of the different classifications.

Risk is assessed with respect to the condition of the Site at the point of issue that can therefore be subject to change over time.

|            |                 | Consequence         |                     |                     |                     |
|------------|-----------------|---------------------|---------------------|---------------------|---------------------|
|            |                 | Severe              | Medium              | Mild                | Minor               |
| Likelihood | High Likelihood | Very High Risk      | High Risk           | Moderate Risk       | Moderate / Low Risk |
|            | Likely          | High Risk           | Moderate Risk       | Moderate / Low Risk | Low Risk            |
|            | Low Likelihood  | Moderate Risk       | Moderate / Low Risk | Low Risk            | Very Low Risk       |
|            | Unlikely        | Moderate / Low Risk | Low Risk            | Very Low Risk       | Very Low Risk       |

| Very High | <ul style="list-style-type: none"> <li>There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening.</li> <li>This risk, if realised, is likely to result in a substantial liability.</li> <li>Urgent investigation (if not already undertaken) and risk mitigation is likely to be required.</li> </ul>                                                           |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High      | <ul style="list-style-type: none"> <li>Harm is likely to arise to a designated receptor from an identified hazard.</li> <li>Realisation of the risk is likely to present a substantial liability.</li> <li>Urgent investigation (if not already undertaken) is required and risk mitigation may be necessary in the short term and is likely to be required over the longer term.</li> </ul>                                                                                                              |
| Moderate  | <ul style="list-style-type: none"> <li>It is possible that harm could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that such harm would be severe, or if any harm were to occur, it is more likely that the harm would be relatively mild.</li> <li>Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some and risk mitigation may be necessary in the longer term.</li> </ul> |
| Low       | It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would be mild at worst.                                                                                                                                                                                                                                                                                                                                            |
| Very Low  | There is a low probability that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.                                                                                                                                                                                                                                                                                                                                                                   |

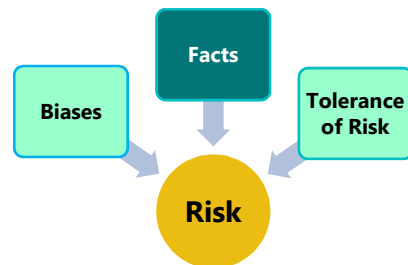
## Background Threat and Risk

This annex offers further reading and background information relating to the referencing of 'background threat' within the risk assessment process.

The ratings presented herein **do not** reflect site-specific risk.

### Introduction

Risk is an inherent part of all decisions and everyone has an appreciation of risk. How risk is assessed by both individuals and organisations is guided by three main influences; facts, biases and tolerance of risk.



Acknowledgement of this interplay is important given that, as well as informing the assessment; it also informs the response to risk – the practical outcome of the theoretical process. To support greater ownership of the assessment and any recommended actions, risk assessments should therefore aim to be; clear, proportionate and transparent (evidence-based).

### Risk Assessment Influences

**Biases:** There are many types of biases that affect decisions or judgements including: i) *commercial bias*; does a given risk rating confer commercial opportunities or benefits on the person undertaking the assessment?; or, ii) *confirmation bias*; has the assessor not encountered any problems in similar scenarios and therefore generalised or under-assessed the risk rating.

**Facts:** The most important and ideally, guiding factor for the assessment of risk. Facts need to be evidenced and assessed by a competent person<sup>1</sup>.

**Tolerance of Risk<sup>2</sup>:** Is informed by both societal and individual factors. Societal factors may include: is the hazard acceptable at all, e.g. locating nuclear power stations within urban areas; or, balancing scientific and technological advances with possible burdens to society and the economy. An example of this for land contamination is the reduction of 'excess lifetime cancer risk (ELCR)' as part of generic assessment criteria for soil testing (society accepting more risk). Individual factors may include: how a given risk affects them, their family and their values; or, accepting a higher risk for a greater reward.

### Background Threat

Referencing 'background threat' as part of the Risk Assessment is intended to offer further detail on the hazards as well as an indication of the relative threats they pose. This aims to support; clarity, transparency and proportionality and help the reader better contextualise the risk and thus take greater ownership of it and any recommended action. Proportionality is central to effective risk management. Being over protective erodes the value of the process and adds unnecessary cost; being under protective exposes people and places to real risk.

Within the following tables, details on plausible routes or 'exposure pathways' by which a hazard may result in harm or other outcomes are detailed together with commentary on the assigned 'background threat' levels. The rating of 'background threat' is traffic-lighted between; high, moderate and low, with the nuances of the rating drawn more fully out within the commentary provided.

<sup>1</sup> <http://www.legislation.gov.uk/ukxi/2015/51/contents>

<sup>2</sup> <http://www.hse.gov.uk/risk/theory/r2p2.pdf>

| Background threat                                                                                                                          | Exposure pathway | Rationale for assigned level of threat<br>(Incident data, public perception and general commentary on harm and other impacts)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geological Risks</b>                                                                                                                    |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Collapsible soils <sup>3</sup><br><br><i>Deposits that can collapse when saturated or loaded. Generally isolated to South-East England</i> | <b>High</b>      | <p>Incident data for harm and other impacts is not readily available however, collapsible soils are widely distributed within the UK and the rapidly developing nature of the hazard means that the threat does carry immediacy. Public perception of the threat 'collapsible soils' pose is likely varied given its technical nature.</p> <p><b>Harm:</b> With links to excavation collapses which account for a high proportion of year-on-year fatal and non-fatal injuries within the construction sector<sup>4</sup>, the threat of harm is considered <b>high</b>.</p> <p><b>Other impacts:</b> With potentially large time and cost implications (on a site-by-site basis) for responding reactively to the adverse affects of collapsible soils the threat of other impacts is also considered <b>high</b>.</p>                                                                                                       |
| Compressible soils <sup>5</sup><br><br><i>Deposits that are very soft or degradable.</i>                                                   | <b>Moderate</b>  | <p>Incident data for harm and other impacts is not readily available. The slowly developing nature of the hazard means that the threat does not carry immediacy. However, with compressible soil's links to subsidence, one of the most damaging geo-hazards in the UK<sup>6</sup> that is on the rise largely due to the influence of clay soils<sup>7</sup> and, with their extensive distribution across the UK, other impacts are significant. Public perception of the threat 'compressible soils' pose is likely varied given its technical nature.</p> <p><b>Harm:</b> The slowly developing nature of the hazard means the threat of harm is considered <b>low</b>.</p> <p><b>Other impacts:</b> With potentially moderate time and cost implications (on a site-by-site basis) for responding reactively to the adverse affects of compressible soils the threat of other impacts is considered <b>moderate</b>.</p> |

<sup>3</sup> <https://www.bgs.ac.uk/products/geosure/collapsiblePHI.html>

<sup>4</sup> <http://www.hse.gov.uk/statistics/tables/index.htm#riddor>

<sup>5</sup> <https://www.bgs.ac.uk/products/geosure/compressiblePHI.html>

<sup>6</sup> [https://www.bgs.ac.uk/research/engineeringGeology/shallowGeohazardsAndRisks/shrinking\\_and\\_swelling\\_clays.html](https://www.bgs.ac.uk/research/engineeringGeology/shallowGeohazardsAndRisks/shrinking_and_swelling_clays.html)

<sup>7</sup> <https://www.crawco.com/assets/uploads/docs/Crawford-Subsidence-The-Silent-Surge-vFinal.pdf>

| Background threat                                                                                                                              | Exposure pathway | Rationale for assigned level of threat<br>(Incident data, public perception and general commentary on harm and other impacts)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geological Risks, continued</b>                                                                                                             |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Ground dissolution <sup>8</sup><br><i>Soluble rocks.</i>                                                                                       | <b>Moderate</b>  | <p>Incident data for harm and other impacts is not readily available. The rapidly developing nature of the hazard (sinkholes) means that the threat does carry immediacy. Ground dissolution is a geology/region specific hazard and therefore threat levels vary across the UK. The frequency with which incidents take place is likely to be relatively constant with possible increases due to extreme weather events and probable increases due to urban sprawl into ground dissolution prone areas, making incidents more likely. Public perception of the threat 'sinkholes' pose is likely to be relatively high.</p> <p><b>Harm:</b> falls into open or partially open dissolution features.</p> <p><b>Other impacts:</b> time-delays and damage to plant, structures and sub-structures.</p> <p><b>Harm:</b> The rapidly developing nature of the hazard but lack of evidence of fatalities or injuries attributed to sinkholes means the threat of harm is considered <b>moderate</b>.</p> <p><b>Other impacts:</b> With potentially moderate time and cost implications (on a site-by-site basis) for responding reactively to the adverse affects of ground dissolution albeit likely on a small scale (sinkholes are likely to be localised) the threat of other impacts is considered <b>moderate</b>.</p> |
| Running sand <sup>9</sup><br><i>Loosely packed sand that can become fluid or 'run' when wet and support is withdrawn, e.g. when excavated.</i> | <b>Low</b>       | <p>Incident data for harm and other impacts is not readily available however, fine-grained / saturated sands are widely distributed within the UK and the very rapidly developing nature of the hazard means that the threat does carry immediacy. Public perception of the threat 'running sand' poses is likely varied given its technical nature.</p> <p><b>Harm:</b> burial and crushing.</p> <p><b>Other impacts:</b> time-delays and damage to plant.</p> <p><b>Harm:</b> Whilst linked to excavation stability, the very rapid onset of this hazard means it is more likely to be observed before the threat can develop, the threat of harm is therefore considered <b>low</b>.</p> <p><b>Other impacts:</b> Time and cost implications (on a site-by-site basis) for responding reactively to the adverse affects of running sands, if managed well, are likely to be limited and therefore the threat of other impacts is considered <b>low</b>.</p>                                                                                                                                                                                                                                                                                                                                                           |

<sup>8</sup> <https://www.bgs.ac.uk/products/geosure/solublePHI.html>

<sup>9</sup> [https://www.bgs.ac.uk/products/geosure/running\\_sandPHI.html](https://www.bgs.ac.uk/products/geosure/running_sandPHI.html)

| Background threat                                                                                                                                                                      | Exposure pathway       | Rationale for assigned level of threat<br>(Incident data, public perception and general commentary on harm and other impacts)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geological Risks, continued</b>                                                                                                                                                     |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <p>Sensitive clays<sup>10</sup></p> <p><i>Fine grained (clay) soils that can shrink and swell when wetted or dried respectively.</i></p>                                               | <p><b>Moderate</b></p> | <p><b>Harm:</b> none that are directly linked or obviously plausible.</p> <p><b>Other impacts:</b> damage to structures and sub-structures.</p> <p>Incident data for harm and other impacts is not readily available. The slowly developing nature of the hazard means that the threat does not carry immediacy. However, with sensitive clays direct links to subsidence, one of the most damaging geo-hazards in the UK<sup>11</sup> that is on the rise and, with their extensive distribution across the UK, other impacts are significant. Public perception of the threat 'subsidence' poses is likely to be relatively high.</p> <p><b>Harm:</b> The slowly developing nature of the hazard means the threat of harm is considered <b>low</b>.</p> <p><b>Other impacts:</b> With potentially moderate time and cost implications for responding reactively to the adverse affects of sensitive clays the threat of other impacts is considered <b>moderate</b>.</p>                                                                                  |
| <p>Slope instability<sup>12</sup></p> <p><i>Falls, topples, slides or flows of soils or rocks generally due to gravity but controlled by various other factors, e.g. drainage.</i></p> | <p><b>High</b></p>     | <p><b>Harm:</b> falls from height, burial and crushing.</p> <p><b>Other impacts:</b> time delays and damage to plant, structures and sub-structures.</p> <p>Aggregated incident data for harm and other impacts is not readily available however there are relatively frequent case-studies of landslips taking place<sup>1314</sup> with some nationally significant incidents<sup>15</sup> resulting in significant changes to assessment and design. The slow to very rapidly developing nature of the hazard means that the threat does carry immediacy. Slope instability can occur anywhere throughout the UK. Public perception of the threat 'landslides' pose is likely to be relatively high.</p> <p><b>Harm:</b> The potentially very rapidly developing nature of the hazard means the threat of harm is considered <b>high</b>.</p> <p><b>Other impacts:</b> With potentially high time and cost implications for responding reactively to the adverse affects of slope instability the threat of other impacts is considered <b>high</b>.</p> |

<sup>10</sup> [https://www.bgs.ac.uk/products/geosure/shrink\\_SwellPHI.html](https://www.bgs.ac.uk/products/geosure/shrink_SwellPHI.html)

<sup>11</sup> [https://www.bgs.ac.uk/research/engineeringGeology/shallowGeohazardsAndRisks/shrinking\\_and\\_swelling\\_clays.html](https://www.bgs.ac.uk/research/engineeringGeology/shallowGeohazardsAndRisks/shrinking_and_swelling_clays.html)

<sup>12</sup> <https://www.bgs.ac.uk/products/geosure/landslidesPHI.html>

<sup>13</sup> <https://www.bgs.ac.uk/research/engineeringGeology/shallowGeohazardsAndRisks/landslides/home.html>

<sup>14</sup> <https://www.bgs.ac.uk/landslides/casestudies.html>

<sup>15</sup> <https://www.bgs.ac.uk/research/engineeringGeology/shallowGeohazardsAndRisks/landslides/aberfan.html>

| Background threat                                                                                                                                                                   | Exposure pathway | Rationale for assigned level of threat<br>(Incident data, public perception and general commentary on harm and other impacts)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geological Risks, continued</b>                                                                                                                                                  |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p>Natural ground gas<sup>16</sup></p> <p><i>Methane and carbon dioxide primarily (though can include other gases) given off as part of natural bio-geo-chemical processes.</i></p> | Moderate         | <p>Aggregated incident data for harm and other impacts is not readily available however nationally significant incidents have taken place<sup>17</sup> with the threat carrying an immediacy. However, the frequency with which this hazard manifests is considered to be low. Public perception of the threat 'natural ground gases' pose is likely varied given its technical nature.</p> <p><b>Harm:</b> The rapidly developing nature of the hazard means the threat of harm is considered high however the low frequency of incidents reduces this to <b>moderate</b>.</p> <p><b>Other impacts:</b> With potentially high cost implications for responding reactively to the adverse affects of natural ground gas the threat of other impacts is considered high however the low frequency of incidents reduces this to <b>moderate</b>.</p>                                                                                                                                                                                                                                      |
| <p>Radon<sup>18</sup></p> <p><i>Naturally occurring radioactive gas that is emitted from soils and rocks to varying degrees (depending on their composition) .</i></p>              | High             | <p>Incident data for harm is readily available<sup>19</sup> with radon being a significant contributory factor to lung cancer deaths across affected areas of the UK and with a risk of death that is the same order of magnitude as all deaths within the construction sector<sup>20</sup>. The slowly developing nature of the hazard means that the threat does not carry immediacy however the radioactive nature of the hazard does. Radon can occur anywhere throughout the UK but affects certain geological areas more so than others. Public perception of the threat 'radon' pose is likely low despite the high background threat.</p> <p><b>Harm:</b> The slowly developing but significantly hazardous nature of the hazard means the threat of harm is considered <b>high</b>.</p> <p><b>Other impacts:</b> The cost of mitigation is low if the risk is unacceptable and addressed proactively whereas responding reactively will incur moderate costs (retrospective fitting of protection). Overall however, the threat of other impacts is considered <b>low</b>.</p> |

<sup>16</sup> <https://www.bgs.ac.uk/products/geohazards/methane.html>

<sup>17</sup> <http://www.hse.gov.uk/comah/sragtech/caseabbeystead84.htm>

<sup>18</sup> <http://www.ukradon.org.uk/>

<sup>19</sup> <https://www.ukradon.org/information/risks>

<sup>20</sup> <http://www.hse.gov.uk/risk/theory/r2p2.pdf>

| Background threat                                                                                                                                                                                                                                   | Exposure pathway                                                                                                                                                  | Rationale for assigned level of threat<br>(Incident data, public perception and general commentary on harm and other impacts)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geological Risks, continued</b>                                                                                                                                                                                                                  |                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <p>Aggressive geology<sup>21</sup></p> <p><i>Primarily concerned with acidic conditions arising from sulphate compounds in the ground with the potential to degrade buried concrete. Can include other conditions, e.g. saline or solvents.</i></p> | <p><b>Low</b></p> <p><b>Harm:</b> none that are directly linked or obviously plausible.</p> <p><b>Other impacts:</b> damage to structures and sub-structures.</p> | <p>Incident data for harm and other impacts is not readily available. The slowly developing nature of the hazard means that the threat does not carry immediacy. However, when aggressive geologies are present, damage to buried concrete can be severe<sup>21</sup>. Aggressive geology is typically, though not always, linked to sulphide bearing geologies that results in the hazard being geology/region specific and therefore threat levels vary across the UK. Public perception of the threat 'aggressive geology' pose is likely low given its technical nature.</p> <p><b>Harm:</b> The slowly developing nature of the hazard means the threat of harm is considered <b>low</b>.</p> <p><b>Other impacts:</b> With potentially high cost implications for responding reactively to the adverse affects of aggressive geology the threat of other impacts is considered high however, on a site-by-site basis, the low frequency of incidents and ease of management reduces this to <b>low</b>.</p> |

**Hydrogeological and hydrogeological risks**

**All flood risk carries high background threats.** It is recommended that the advice of a suitably qualified competent person is sought for more information.

<sup>21</sup> <https://www.bgs.ac.uk/research/environmentalModelling/GeoProperties/SulphatesSulphides.html>

| Background threat                                                                                                                                                                                                                                      | Exposure pathway                                                                                                                                                                                                                                                                                                                   | Rationale for assigned level of threat<br>(Incident data, public perception and general commentary on harm and other impacts)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Historical Risks</b>                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p>Contamination (on-site and off-site)</p> <p><i>N.B. within the sub-surface environment there is invariably interplay between soil (contamination) and water (pollution) systems with these two risks commonly interacting with one another.</i></p> | <p><b>Moderate</b></p> <p><b>Harm:</b> dermal contact with, or ingestion and inhalation of dust or vapours of, harmful material by either workers during construction or end users of the site (various depending on development).</p> <p><b>Other impacts:</b> time-delays, damage to structures, sub-structures and ecology.</p> | <p>Aggregated incident data for harm and other effects is not readily available although the Environment Agency's enforcement register does offer an indication<sup>22</sup>. Case law also exists that directly relates contaminated land (airborne dust) to harm<sup>23</sup> as well as other impacts<sup>24,25</sup>. Harm is time-dependent; acute (short term) or chronic (long term). Acute risks for workers are generally informed by well-developed science of exposure limits for short and long term conditions<sup>26</sup>. Acute risks for end users are less well understood but an area of ongoing research<sup>27</sup>. Chronic risks are better understood and supported by established research including that undertaken by central government<sup>28</sup>. Public perception of the threat 'contamination' poses is likely varied given its technical nature.</p> <p>Contamination can occur in any location however former industrial land or waste depositories naturally carry a higher threat with increased volumes of potentially harmful material. Naturally geologies can also contain harmful material however these generally contribute to 'normal background concentrations' that local populations are exposed to.</p> <p><b>Harm (acute risk):</b> For acute risk, the rapidly development nature of the hazard means the threat of harm is high however, the low frequency of incidents reduces this to <b>moderate</b>.</p> <p><b>Harm (chronic risk):</b> For chronic risk an assessment of 'threat' is difficult not least as the threat can vary highly within a site itself. In general however, the slowly developing nature of the hazard means the threat of harm is lower than acute risk but not low. Whilst the frequency of chronic risk incidents resulting in harm is low in the UK, the potential for harm raises this to <b>moderate</b>.</p> <p><b>Other impacts:</b> With potentially high cost implications for responding reactively to the adverse affects of contamination the threat of other impacts is considered <b>moderate</b>.</p> |

<sup>22</sup> <https://environment.data.gov.uk/public-register/view/search-enforcement-action> e.g. Groundwater Regulations, Environmental Protection Act 1990, Environment Act 1995

<sup>23</sup> <http://www.environmentlaw.org.uk/rte.asp?id=266>

<sup>24</sup> <https://www.freeths.co.uk/2017/01/13/case-law-update-contaminated-land-liabilities/>

<sup>25</sup> <http://www.environmentlaw.org.uk/rte.asp?id=228>

<sup>26</sup> <http://www.hse.gov.uk/coshh/basics/exposurelimits.htm>

<sup>27</sup> <https://sobra.org.uk/about-us/sub-groups/>

<sup>28</sup> <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18341>

| Background threat                                                                                                                                                                                                                    | Exposure pathway                                                                                                                                                                                        | Rationale for assigned level of threat<br>(Incident data, public perception and general commentary on harm and other impacts)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| <b>Historical Risks, continued</b>                                                                                                                                                                                                   |                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <p>Pollution (waters)</p> <p><i>N.B. within the sub-surface environment there is invariably interplay between soil (contamination) and water (pollution) systems with these two risks commonly interacting with one another.</i></p> | <p><b>High</b></p> <p><b>Harm:</b> pollution of sensitive water bodies, e.g. Controlled Waters<sup>29</sup> with potential for harm to water users.</p> <p><b>Other impacts:</b> damage to ecology.</p> | <p>Aggregated incident data for harm and other effects is readily available that directly relates pollution to harm<sup>30</sup> with other impacts also reported<sup>31</sup> however discerning where this harm arises from historic, unused sources such as those more commonly encountered on land development is difficult. Harm varies according to the nature of the incident, e.g. a recent spillage of a large volume of potential pollutants versus an ongoing seepage of an unknown volume of potential pollutants. For land development, it is commonly seepages that are encountered. These seepages can be from either; a single point-source, e.g. an old storage tank, or diffuse source, e.g. a large area of soils leaching pollutants, e.g. a landfill. Public perception of the threat 'pollution' poses is likely to be relatively high.</p> <p><b>Harm:</b> The slowly developing nature of the hazard but potentially large impacts means the threat of harm is considered moderate however, the relatively high frequency with which these incidents take place result in the threat being considered <b>high</b>.</p> <p><b>Other impacts:</b> With potentially high cost implications for responding reactively to the adverse affects of pollution the threat of other impacts is considered <b>high</b>.</p> |

<sup>29</sup> <https://www.legislation.gov.uk/ukpga/1991/57/section/104>

<sup>30</sup> <https://environment.data.gov.uk/public-register/view/search-enforcement-action> e.g. Groundwater Regulations, Environmental Protection Act 1990, Environment Act 1995

<sup>31</sup> <https://www.bbc.co.uk/news/uk-england-devon-49242485>

| Background threat                                                                                                                                                     | Exposure pathway | Rationale for assigned level of threat<br>(Incident data, public perception and general commentary on harm and other impacts)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Historical Risks, continued</b>                                                                                                                                    |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Mining risks are varied and can carry high background threats.</b> It is recommended that the Coal Mining Risk Assessment, if required for the site, is consulted. |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Landfill gas                                                                                                                                                          | <b>Moderate</b>  | <p>Aggregated incident data for harm and other impacts is not readily available however nationally significant incidents have taken place<sup>323334</sup> with the threat carrying immediacy. However, the frequency with which this hazard manifests is considered low. Public perception of the threat 'landfill gas' poses is likely varied given its technical nature.</p> <p><b>Harm:</b> The rapidly developing nature of the hazard means the threat of harm is considered high however the low frequency of incidents reduces this to <b>moderate</b>.</p> <p><b>Other impacts:</b> With potentially high cost implications for responding reactively to the adverse affects of landfill gases the threat of other impacts may be considered high however the low frequency of incidents reduces this to <b>moderate</b>.</p>                                                                                                          |
| Sub-surface structures<br><br><i>i.e. tunnels, basements and cellars and not mine shafts or underground mine workings</i>                                             | <b>Moderate</b>  | <p>Incident data for harm and other impacts is not readily available. The rapidly developing nature of the hazard (surface collapses) means that the threat does carry immediacy. The frequency with which incidents take place is likely to be relatively constant. Public perception of the threat 'old basements' pose is likely to be relatively high and linked to 'sinkholes'.</p> <p><b>Harm:</b> With links to excavation collapses which account for a high proportion of year-on-year fatal and non-fatal injuries within the construction sector<sup>35</sup>, the threat of harm may be considered high however, the ease of management reduces this to <b>moderate</b>.</p> <p><b>Other impacts:</b> With potentially moderate time and cost implications (on a site-by-site basis) for responding reactively to the adverse affects of sub-surface structures the threat of other impacts is also considered <b>moderate</b>.</p> |

<sup>32</sup> <http://users.ox.ac.uk/~ayoung/LF/cwm039b.pdf>

<sup>33</sup> CIRIA document ref. "Assessing risks posed by hazardous ground gases to buildings (revised)" (C665) – Loscoe case study

<sup>34</sup> <https://inews-co-uk.cdn.ampproject.org/c/s/inews.co.uk/news/uk/council-houses-torn-down-burning-coal-seam-carbon-monoxide-derbyshire-826029?amp>

<sup>35</sup> <http://www.hse.gov.uk/statistics/tables/index.htm#riddor>

| Background threat                                                                                                                                                             | Exposure pathway | Rationale for assigned level of threat<br>(Incident data, public perception and general commentary on harm and other impacts)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Historical Risks, continued</b>                                                                                                                                            |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Unexploded ordnance                                                                                                                                                           | <b>Moderate</b>  | <p>Aggregated incident data for harm and other impacts is not readily available however incidents are well reported in national and regional news as well as on enthusiast websites<sup>36</sup> with the threat carrying immediacy. No deaths are directly attributed to unexploded ordnance since 1949. The frequency with which this hazard manifests varies across land used for military purposes and land used for military purposes but possibly bombed, with the former being likely and the latter a low likelihood. Public perception of the threat 'unexploded ordnance' poses is likely to be relatively high due compared to a lower background threat.</p> <p><b>Harm:</b> explosion damage (direct or indirect; on site and off site).</p> <p><b>Other impacts:</b> time delays and damage to plant, structures and sub-structures.</p> <p><b>Harm:</b> The rapidly development nature of the hazard means the threat of harm is high however, the low frequency of incidents on land not used for military purposes reduces this to <b>moderate</b>.</p> <p><b>Other impacts:</b> With potentially high cost implications for responding reactively to the adverse affects of aggressive geology the threat of other impacts is considered high however, on a site-by-site basis, the low frequency of incidents reduces this to <b>moderate</b>.</p> |
| <b>Archaeological interests can carry high background threats.</b> It is recommended that the advice of a suitably qualified competent person is sought for more information. |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Utilities can carry high background threats.</b> It is recommended that the advice of a suitably qualified competent person is sought for more information.                |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Ecological Risks</b>                                                                                                                                                       |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Ecological risk can carry high background threats.</b> It is recommended that the advice of a suitably qualified competent person is sought for more information.          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

<sup>36</sup> <http://bombfuzecollectorsnet.com/page14.htm>