Appendix 7 – Ground Investigation and Contamination Survey

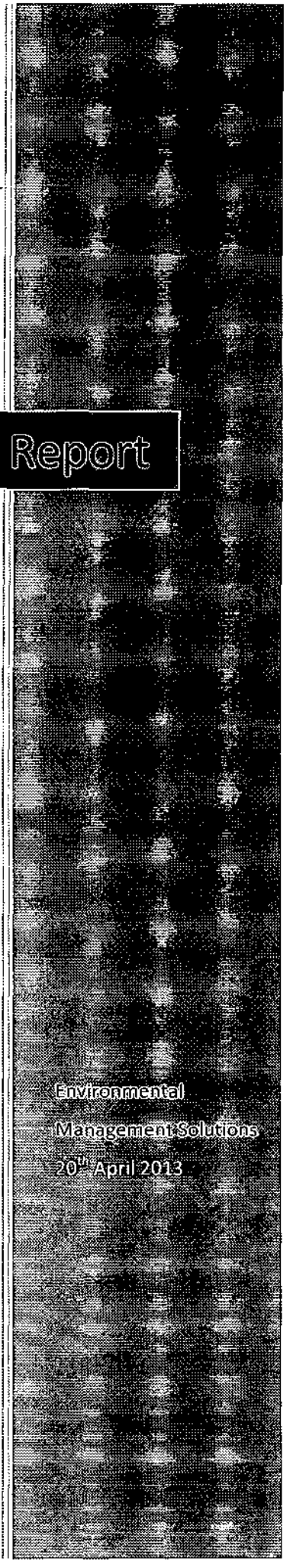
ENVIRONMENTAL
MANAGEMENT SOLUTIONS

Phase Two Intrusive Ground Investigation Report

Kingspan

Proposed Anaerobic Digester
The Airfield
Shobdon
Herefordshire
HR6 9NR

EMS3848b



Kingspan

Proposed Anaerobic Digester at The Airfield, Shobdon, Herefordshire, HR6 9NR

Phase 2 Intrusive Ground Investigation Report

Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Signed
1	0	Report EMS3848b	20/04/2013	[redacted]

James Woodier

Contents

1. Introduction

Environmental Management Solutions Limited (EMS) have been instructed by E & J Solutions Limited (of Craven Grain Storage, The Airfield, Shobdon, Herefordshire, HR6 9NR on behalf of Kingspan, The Ai rfield, Shobdon, Herefordshire, HR6 9NR to undertake an intrusive soil contamination investigation for their proposed anaerobic digester at The Airfield, Shobdon, Herefordshire, HR6 9NR.

The proposed location of the anaerobic digester is centred on National Grid Reference 339090 260020. Site location plans are included within Appendix A of this report.

A phase one desk study has previously been undertaken for the site. This is discussed in Section 3.1.

This investigation has been undertaken to provide information on the contamination status of the site.

2. Objectives of the Investigation

2.1 Objectives of the Investigation

The objectives of this intrusive investigation were:

- to characterise the site in terms of contamination status and further refine the conceptual model of the site to identify plausible pollutant linkages;
- to establish whether or not there are potentially unacceptable risks associated with soil and groundwater contamination; and
- to provide a phase 2 ground investigation report to be submitted to the relevant planning authorities in partial fulfilment of planning conditions.

2.2 Scope of Work

The scope of work was developed in general accordance with the Environment Agency and Department for Environment Food and Rural Affairs (DEFRA) document *'Model Procedures for the Management of Land Contamination'* Contaminated Land Report (CLR) 11, dated 2004.

2.3 Management Limitations

- This report has been prepared under the express instructions and solely for the use of the Client and for the Client's agents.
- The findings of this report represent the professional opinion of experienced contaminated land consultants. EMS does not provide legal advice and the advice of lawyers may also be required.
- All work carried out in preparing this report has utilised and is based upon EMS current professional knowledge and understanding of current relevant UK standards and codes, technology and legislation. Changes in this legislation and guidance may occur at any time in the future and cause any conclusions to become inappropriate or incorrect. EMS does not accept responsibility for advising the Client or other interested parties of the facts or implications of any such changes.
- The report is limited to the boundaries identified by the Client on this site and confirmed within this report.
- The extent of this investigation was designed in-line with the Client's budget which is considered suitable and not limiting.
- This report represents the conditions and findings on the dates of the investigation. Over time, site conditions may alter.
- It is recommended that this report is passed to statutory bodies for their comment as soon as is possible. Such statutory bodies may disagree with the conclusions/recommendations of EMS or provide further information useful to the proposed development.

3. Land Use and Setting

3.1 Previous Investigation Reports

Desk Study

EMS has previously issued a desk study report for the site. The desk study report (reference EMS3848a) was issued on 19th March 2013. It is recommended that the desk study report is read in conjunction with this intrusive ground investigation report.

The desk study investigation included a site walkover, study of historical maps and study of environmental database information.

Published geological information suggests the site to be underlain by Glaciofluvial Deposits comprising sand and gravel. The Glaciofluvial Deposits are underlain by the Raglan Mudstone Formation of Silurian age. Both the superficial deposits (Glaciofluvial Deposits) and the solid deposits (Raglan Mudstone Formation) underlying the site are classified as Secondary-A-Aquifers.

The site is not within an area where radon protection measures are required in the construction of new buildings.

There are six water abstractions recorded within 500 m of the site. These all relate to abstraction of water from boreholes at distances between 245 m and 249 m to the north, at Torvale Industrial Estate. The listed uses for the water are general agriculture (spray irrigation), petrochemicals-general use (at the Kingspan Plant and at Stadium Limited). The closest listed abstraction for possible drinking water use is listed 960 m south-west of the site (general farming and domestic use). The site is not within a Source Protection Zone.

The nearest recorded surface water body to the site is a stream which runs along the northern site boundary and is culverted beneath the Kingspan plant before becoming the Pinsley Brook.

The site formerly comprised part of an airfield and housed ten small buildings/sheds which were demolished. It is understood that material relating to the demolition of these sheds is contained within the soil bund along the western site boundary. This exact nature of the material within this bund is unknown so it is considered a potential source of contaminants including asbestos. In addition ground at the site could have been contaminated by the former use of the site as an airfield.

No landfills have been identified in the vicinity of the site. It is not anticipated that a substantial thickness of Made Ground is present beneath the site although this is yet to be confirmed. Potential sources of ground gas at the site are therefore considered limited.

In order to confirm the contamination status of the site it was recommended that a series of machine excavated trial pits was put down at the site to allow inspection of the soils, and sampling for subsequent laboratory testing. As well as covering the site as a whole, it was recommended that the trial pits should particularly target the following areas:

- The area occupied by the former buildings.
- The area close to the site entrance where the presence of Made Ground is suspected.
- The earth bund in the west of the site.

3.2 Future Land Use

The construction of an anaerobic digester complex is proposed at the site. This industrial complex will comprise a large building in the south of the site and a number of tanks and smaller buildings in the north of the site. It is understood that the vast majority of the site surface will be covered by buildings, concrete slabs, or bituminous surfaced access roads.

4. Site Investigation and Observations

4.1 Investigation Strategy

The site was investigated by means of a series of sixteen machine excavated trial pits. As well as giving a good spread of information across the site, the positions of the trial pits were selected to target potential areas of concern identified by the desk study: TP01 and TP02 were excavated in the area of Made Ground near the site entrance; TP03, TP04 and TP05 were excavated in the area of the former huts and sheds; and TP11, TP12, TP13, TP14, TP15 and TP16 were excavated in the soil bund along the western site boundary.

The locations of the trial pits are indicated on the exploratory hole location plan included as Appendix B.

4.2 Investigation Methodology

Sixteen machine excavated trial pits were excavated at the site on 26th March 2013. The trial pits were excavated to depths of between 0.80 m (TP06) and 2.00 m (TP01).

The soils were logged in general accordance with British Standard BS5930:1999 by an experienced Geo-Environmental Engineer, with particular attention paid to signs of potential soil contamination (staining, odours and the nature of anthropogenic material).

Environmental samples (plastic tub, amber jar and small amber jar) were taken as appropriate by the EMS Geo-Environmental Engineer for subsequent laboratory contamination testing. Further plastic tub samples were taken within the natural soils for sulphate testing purposes.

On completion of logging and sampling, the trial pits were backfilled with compacted soil arisings.

Details of the soils encountered, samples taken, and groundwater entries are recorded on the trial pit logs (Appendix C). Photographs of the trial pits are presented as Appendix D.

4.3 Collection, Preservation and Transport of Contamination Samples

EMS soil contamination sampling methodology determines that samples are taken from the trial pits and placed in glass jars and vials for storage. Jars and vials are stored within a cool box at the first possible opportunity to ensure sample preservation. Containers for volatile analysis were filled so that minimal air space remained prior to sealing. This, in combination with a low storage temperature, reduces the likelihood for volatile compounds, that may have been present within the sample, to volatilise to the headspace prior to analysis.

After brief temporary storage within EMS's sample refrigeration unit samples selected for laboratory analysis are transported in cool boxes via an overnight courier company. On-site inspection for below ground asbestos debris is undertaken as standard at the time of investigation, and soil/debris samples taken if deemed necessary.

The contamination testing was undertaken in line with an initial agreed budget. Samples were chosen for laboratory analysis based upon visual observations. Disposable nitrile gloves were worn and changed between each sample taken to prevent cross contamination.

The samples were analysed by Envirolab, Units 7-8 Sandpits Business Park, Mottram Road, Hyde, Cheshire, SK14 3AR. Envirolab are a UKAS accredited laboratory (UKAS number 1247) and part of the Monitoring Certification Scheme (MCERTS). A suite of tests, as listed in the table below, were requested to be undertaken on the samples submitted for analysis.

Testing was undertaken in accordance with in-house test methods. The full list of determinands screened for during these tests is listed on the test certificates included within Appendix E of this report.

4.4 Analytical Strategy – Contamination Testing

Representative soil samples from the trial pits were collected and analysed for contaminants selected based on the findings of the desk study. Analysis for these contaminants will give an initial determination of the level and distribution of contamination within soil beneath the site. Samples were also tested to determine the concentrations of sulphates in the soil (both naturally occurring and anthropogenic) for assessment of the risk posed to buried concrete. The samples were submitted for analysis for the following compounds:

Trial Pit	Depth (m)	Testing suite
TP02	0.40	pH, water soluble sulphate, total sulphate and total sulphur.
TP02	1.00	pH, water soluble sulphate, total sulphate and total sulphur.
TP03	0.10	Heavy metals, pH, water soluble sulphate, total sulphate, total sulphur, total cyanide, phenols, organic matter, banded TPH, speciated PAH and asbestos.
TP05	0.20	Heavy metals, pH, water soluble sulphate, total sulphate, total sulphur, total cyanide, phenols, organic matter, banded TPH, speciated PAH and asbestos.
TP11	0.70	Heavy metals, pH, water soluble sulphate, total sulphate, total sulphur, total cyanide, phenols, organic matter, banded TPH, speciated PAH and asbestos.
TP12	1.00	Heavy metals, pH, water soluble sulphate, total sulphate, total sulphur, total cyanide, phenols, organic matter, banded TPH, speciated PAH and asbestos.
TP13	0.50	Heavy metals, pH, water soluble sulphate, total sulphate, total sulphur, total cyanide, phenols, organic matter, banded TPH, speciated PAH and asbestos.

Trial Pit	Depth (m)	Testing suite
TP14	1.00	Heavy metals, pH, water soluble sulphate, total sulphate, total sulphur, total cyanide, phenols, organic matter, banded TPH, speciated PAH and asbestos.
TP15	0.80	Heavy metals, pH, water soluble sulphate, total sulphate, total sulphur, total cyanide, phenols, organic matter, banded TPH, speciated PAH and asbestos.
TP16	0.50	Heavy metals, pH, water soluble sulphate, total sulphate, total sulphur, total cyanide, phenols, organic matter, banded TPH, speciated PAH and asbestos.

5. Investigation Findings

5.1 Ground Conditions

Made Ground

Made Ground was present in four of the ten trial pits within the main site area (TP01, TP02, TP03 and TP05) and in all six pits in the bund on the western site boundary (TP11 to TP16).

The Made Ground observed in the main site area comprised topsoil with brick (TP01) and slightly organic slightly sandy slightly gravelly clay in TP02, TP03 and TP04. The gravel content in this soil included stone, concrete and brick. The maximum thickness of Made Ground identified in the main site area was 0.50 m (TP05). The remaining three trial pits recorded a maximum thickness of 0.20 m of Made Ground.

Trial pits TP11 to TP16 investigated the soil bund on the western site boundary. These trial pits identified variable materials including:

- Brown clayey sandy sandstone gravel (locally derived natural material) with occasional concrete cobbles and bricks.
- Brown and grey clayey very sandy sandstone, concrete and crushed rock gravel.
- Topsoil.
- Brown organic slightly gravelly clay. Gravel including brick, concrete and sandstone.

Of note, no visual or olfactory evidence of hydrocarbon contamination was noted in any of the trial pits. Additionally no suspected asbestos containing materials were observed.

Topsoil

Clay based topsoil was present in TP04, TP06, TP07, TP08, TP09 and TP10. The thickness of topsoil observed ranged from 0.15 m to 0.30 m and was typically 0.20 m.

Glaciofluvial Deposits

Strata considered to represent the Glaciofluvial Deposits was encountered directly beneath the Made Ground or topsoil within trial pits TP01 to TP11. Trial pits TP12 to TP16 did not penetrate the base of the soil bund to reach the underlying natural materials.

The Glaciofluvial Deposits observed comprised an upper layer of firm sandy clay, which extended to a depth of between 0.55 m (TP02) and 1.20 m (TP05). The clay layer was underlain by brown clayey sandy gravel with some cobbles. This gravel layer was present at the base of all ten trial pits in the main site area (maximum depth 2.00 m).

5.2 Groundwater Occurrence

Groundwater was encountered at depths between 0.90 m and 1.70 m. Groundwater entries were generally slow so it is anticipated that groundwater would have entered the majority of the trial pits put down at the site if they had been left open for an extended period of time. The majority of the trial pits were backfilled with arisings immediately on completion, for safety purposes.

5.3 Laboratory Analysis Results

The results of the laboratory soil contamination tests are presented in Appendix E.

6. Soil Contamination Assessment

6.1 Selection of Generic Assessment Criteria

Risk assessment of a site is undertaken via the source-pathway-receptor linkage concept. Thus, for a risk to exist, a source of contamination capable of causing harm to a receptor (such as groundwater or humans) has to be present on the site in association with a pathway which facilitates exposure. The Environment Agency has developed guidelines to risk assessment of human exposure to contaminated sites; this recommends the use of a tiered approach with an initial generic comparison against Soil Guideline Values (SGV's) being the first step to site human health risk assessment. The primary purpose of the SGV's is to provide 'intervention values' for the assessment of risk in relation to land contamination.

Due to the number of potential contaminants which may occur on brownfield sites, SGV's for many contaminants are still in development and have yet to be published by the government. Therefore, where SGV values are not available, the widely accepted Soil Screening Values (SSV's) developed as part of the Atkins ATRISK program have been used. These values have been developed utilising peer reviewed literature within the guidelines presented in the Environment Agency contaminated land guidance documentation CLR7 to CLR10. The values have been updated utilizing the 2008 new guidance (SC050021/SR3 (the CLEA report) and SC050021/SR2 (the TOX report).

The development of the site as an anaerobic digester complex is proposed. The SGV's and SSV's for a commercial land setting have therefore been utilised for comparison purposes.

Further screening values have been obtained from the Building Research Establishment (BRE) to allow preliminary assessment of the risk to buildings and structures on the site.

The risk to contractors from acute (short term) exposure has been initially assessed on a qualitative basis. The risk to controlled waters from concentrations of contaminants in soil samples taken as part of this preliminary investigation has also been assessed on a qualitative basis.

6.2 Human Health

General Substances

A table comparing the soil contamination results with the relevant SSV's has been included within Appendix E. None of the contaminants has been recorded in a concentration in excess of the relevant threshold criteria. These substances are therefore not considered to present a risk to future residents of the site.

Petroleum Hydrocarbons

As no visual or olfactory evidence of hydrocarbon contamination was observed within soils at the site a banded TPH speciation was obtained instead of a full aromatic/aliphatic speciation. This speciation is presented in the following table:

Sample	TPH C6-C10	TPH C10-C25	TPH C25-C40
TP03 at 0.10 m	<10 mg/kg	<10 mg/kg	<10 mg/kg
TP05 at 0.20 m	<10 mg/kg	<10 mg/kg	<10 mg/kg
TP11 at 0.70 m	<10 mg/kg	<10 mg/kg	<10 mg/kg
TP12 at 1.00 m	<10 mg/kg	<10 mg/kg	<10 mg/kg
TP13 at 0.50 m	<10 mg/kg	<10 mg/kg	<10 mg/kg
TP14 at 1.00 m	<10 mg/kg	<10 mg/kg	<10 mg/kg
TP15 at 0.80 m	<10 mg/kg	<10 mg/kg	<10 mg/kg
TP16 at 0.50 m	<10 mg/kg	<10 mg/kg	14 mg/kg

These results have been compared with the worst case ATRISK SSV's (commercial land use, 1% soil organic matter) for these carbon chain lengths. The worst cases (lowest SSV's) are aromatic C16 to C21 and aromatic C21 to C35. The SSV's for both fractions are 28,400 mg/kg. As a result, the TPH concentrations recorded are not considered to present a risk to end users of the site.

6.3 Human Health – Construction Workers

As discussed above no threats to human health have been identified by the contamination testing. The risk level presented to construction workers in contact with soils at the site is considered to be low. Standard good practice including wearing gloves when handling soil, washing hands before eating, drinking or smoking and suppression of dust is still recommended.

6.4 Buried Concrete

Total sulphur, total sulphate, water soluble sulphate and pH results for soil samples from the site have been compared with the recommendations outlined within BRE Special Digest 1: 2005 (concrete in aggressive ground).

On the basis of the test results obtained it is considered appropriate to adopt a Design Sulphate classification of DS-1, together with an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-1.

6.5 Underground Services

It is recommended that this report is passed to service providers to allow appropriate pipe/cable materials to be selected.

6.6 Undiscovered Contamination

Should any hitherto undiscovered contamination be encountered during construction works, the Geo-Environmental Engineer should be informed immediately so that appropriate measures can be taken.

6.7 Ground Gas Assessment

A ground gas risk assessment was presented within the desk study report. This assessment has been reviewed based on the findings of the intrusive investigation. An updated assessment is presented in the following table:

Source	Pollutant	Receptors	Pathway	Hazard Severity	Likelihood	Risk
General Made Ground beneath the site	CO_2 Possibly methane if extensive organic material present	Human health and structures	Migration, volatilisation into indoor and outdoor air space and accumulation. Ground gas release from Made Ground tends to lack driving force.	Effect on human health (severe) Effect on structures (severe)	LOW. A maximum thickness of 0.50 m of Made Ground has been identified by the intrusive investigation.	Likely LOW
Natural soils	Radon	Human health	Migration, volatilisation into indoor and outdoor air space and accumulation.	Effect on human health (severe)	LOW – the site is not in a radon affected area.	LOW – no radon protection measures are required.

6.8 Controlled Waters

Both the Glaciofluval Deposits and the underlying Raglan Mudstone Formation are classified as Secondary-A Aquifers. There are six water abstractions recorded within 500 m of the site. These all relate to abstraction of water from boreholes at distances between 245 m and 249 m to the north, at Torvale Industrial Estate. The listed uses for the water are general agriculture (spray irrigation), petrochemicals-general use (at the Kingspan Plant and at Stadium Limited). The closest listed abstraction for possible drinking water use is listed 960 m south-west of the site (general farming and domestic use). The site is not within a Source Protection Zone.

The nearest recorded surface water body to the site is a stream which runs along the northern site boundary and becomes the Pinsley Brook.

Given the low levels of soil contaminants recorded at the site the level of risk posed by the site to controlled waters is considered to be low.

6.9 Waste Recommendations

Soil contamination test results are included as Appendix E. This ground investigation report should be used to assist appropriate classification of soils for disposal at landfill. If materials are to be re-used on site, this must be undertaken in accordance with all current waste and re-use (WRAP) guidance.

6.10 Updated Conceptual Model

A conceptual model was presented within the desk study report. This assessment has been reviewed based on the findings of the intrusive investigation. An updated assessment is presented in the following table:

Contaminant	Pathway	Receptor	Risk
Heavy metals and inorganics within upper strata; principally Made Ground	Direct contact, dust inhalation and ingestion of soil	Future site users	**Low** for future site users. No soil contamination has been identified by the intrusive investigation. The presence of floor slabs or hardstanding across the majority of the site area will limit the potential pathways.
Heavy metals and inorganics within upper strata; principally Made Ground	Direct contact, inhalation and ingestion of soil	Construction workers	**Low** for construction workers. No soil contamination has been identified by the intrusive investigation. Standard 'good site practices' should still be used (eg PPE, separate eating/drinking areas/provision of washing facilities and suppression of dust).
Heavy metals and inorganics within upper strata; principally Made Ground	Direct contact	Structures and services.	**Low** – No soil contamination has been identified by the intrusive investigation.
Heavy metals and inorganics within upper strata; principally Made Ground	Horizontal and vertical migration	Underlying aquifers	**Low** – The site is underlain by a Secondary-A-Aquifer. No soil contamination has been identified by the intrusive investigation.
Heavy metals and inorganics within upper strata, principally Made Ground	Horizontal and vertical migration	Nearest surface water body	**Low** – The nearest surface water body is a stream very close to the site. The presence of floor slabs and hardstanding across the majority of the site will reduce the potential for rainwater to percolate through the soils, causing leaching of any contaminants. No soil contamination has been identified by the intrusive investigation.

Contaminant	Pathway	Receptor	Risk
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Direct contact, dust inhalation and ingestion	Future site users	**Low** for future site users. No soil contamination has been identified by the intrusive investigation. The presence of floor slabs or hardstanding across the majority of the site will limit the potential pathways.
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Direct contact, inhalation and ingestion	Construction workers	**Low** for construction workers. No soil contamination has been identified by the intrusive investigation. Standard 'good site practices' should still be used (eg PPE, separate eating/drinking areas/provision of washing facilities and suppression of dust).
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Direct contact	Structures and services.	**Low** No soil contamination has been identified by the intrusive investigation.
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Volatile inhalation	Future site users	**Low** No soil contamination has been identified by the intrusive investigation.
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Horizontal and vertical migration	Underlying aquifers	**Low** – The site is underlain by Secondary-A-Aquifers. No soil contamination has been identified by the intrusive investigation. The presence of floor slabs and hardstanding across the majority of the site will reduce the potential for rainwater to percolate through the soils, causing leaching of any contaminants.

Contaminant	Pathway	Receptor	Risk
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Horizontal and vertical migration	Nearest surface water body	**Low** – The nearest surface water body is a stream very close to the site. No soil contamination has been identified by the intrusive investigation. The presence of floor slabs and hardstanding across the majority of the site will reduce the potential for rainwater to percolate through the soils, causing leaching of any contaminants.
Sulphates from Made Ground and natural carboniferous soils beneath site	Direct contact	Concrete structures and water pipes	**Low** – A concrete classification of DS-1, AC-1 is considered appropriate.
Asbestos if present within Made Ground beneath site	Inhalation of fibres	Future site users	**Low** for future site users. No asbestos has been identified at the site.
Asbestos if present within Made Ground beneath site	Inhalation of fibres	Construction workers	**Low** for construction workers. No asbestos has been identified at the site.
Aggressive pH from Made Ground beneath site	Direct contact	Concrete structures and water pipes	**Low** – pH levels fall within acceptable limits.

Appendices

a) **Site Plans**

b) **Exploratory Hole Location Plan**

c) **Trial Pit Logs**

d) **Trial Pit Photographs**

e) **Laboratory Test Results – Contamination**